I

SEVENTH FRAMEWORK PROGRAMME
Capacities Specific Programme
Research Infrastructures

Grant agreement for: Integrating Activity – Combination of Collaborative Project and Co-ordination and Support Action

Annex I – "Description of Work"

Project acronym: OPTICON
Project full title: Optical Infrared Co-ordination Network for Astronomy
Grant agreement no: 226604

Date of preparation of Annex I: 22 February 2009
Date of approval of Annex I by Commission: 04 May 2009

The Optical Infrared Co-ordination Network for astronomy brings together all the national and international agencies and organisations which fund, support, develop and operate Europe's facilities for optical and infrared astronomy, both night-time – classical astronomy – and day-time – solar astronomy. OPTICON provides a framework allowing joint actions to improve the quality of Europe's infrastructures, to train new astronomers, especially those from Central Europe, in modern new research methods, to develop innovative technologies to enhance research quality, to plan for future developments, and to work towards a strategic plan for Europe's future research infrastructures.

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A1:
Our project

Project Number [1]	226604	Project Acronym [2]	OPTICON

ONE FORM PER PROJECT

GENERAL INFORMATION			
Project title [3]	Optical Infrared Coordination Network for Astronomy		
Starting date [4]	01/01/2009		
Duration in months [5]	48		
Call (part) identifier [6]	FP7-INFRASTRUCTURES-2008-1		
Activity code(s) most relevant to your topic [7]	INFRA-2008-1.1.1: Bottom-up approach: Integrating Activities in all scientific and technological fields		
Free keywords [8]		astronomy, european coordination, strategic planning, community development, technology development, research excellence	

Abstract [9] (max. 2000 char.)

The Optical Infrared Coordination Network for astronomy brings together all the national and international agencies and organisations which fund, support, develop and operate Europe's facilities for optical and infrared astronomy, both night-time - callsical astronomy- and daytime - solar astronomy. Opticon provides a framework allowing joint action to improve the quality of Europe's infrastructures, to train new astronomers, especially those from Central Europe, in modern new research methods, to develop innovative technologies to enhance research quality, to plan for future developments, and to work towards a strategic plan for Europe's future research infrastructures.

List of Beneficiaries

Beneficiary Number	Beneficiary name	Beneficiary short name	Country	Date enter project	Date exit project
1	The Chancellor, Masters and Scholars of the University of Cambridge	UCAM	United Kingdom	01/01/2009	31/12/2012
2	European Southern Observatory	ESO	Germany	01/01/2009	31/12/2012
3	Centre National de la Recherche Scientifique	CNRS	France	01/01/2009	31/12/2012
4	Istituto Nazionale di Astrofisica	INAF	Italy	01/01/2009	31/12/2012
5	Max Planck Gesellschaft	MaxPlanck	Germany	01/01/2009	31/12/2012
6	The Science and Technology Facilities Council	STFC	United Kingdom	01/01/2009	31/12/2012
7	Instituto de Astrofisica de Canarias	IAC	Spain	01/01/2009	31/12/2012
8	Kiepenheuer-Institut fur Sonnephysik	KIS	Germany	01/01/2009	31/12/2012
9	The Royal Swedish Academy of Sciences	RSAS	Sweden	01/01/2009	31/12/2012
10	Anglo-Australian Telescope Board	AAO	Australia	01/01/2009	31/12/2012
11	Nordic Optical Telescope Scientific Association	NOTSA	Denmark	01/01/2009	31/12/2012
12	THEMIS S.L.	THEMIS	Spain	01/01/2009	31/12/2012
13	National Observatory of Athens	NOAthens	Greece	01/01/2009	31/12/2012
14	Liverpool John Moores University	LIVJM	United Kingdom	01/01/2009	31/12/2012
15	Office National d'Etudes et de Recherches Aerospatiales	ONERA	France	01/01/2009	31/12/2012
16	Centre Suisse d'Electronique et de Microtechnique SA	CSEM	Switzerland	01/01/2009	31/12/2012
17	Universiteit Utrecht on behalf of Nederlandse Onderzoekschool Voor Astronomie (NOVA)	NOVA	The Netherlands	01/01/2009	31/12/2012
18	Faculdade de Engenharia da Universidade do Porto	FEUP	Portugal	01/01/2009	31/12/2012
19	Politecnico di Milano	POLIMI	Italy	01/01/2009	31/12/2012
20	University of Durham	UDUR	United Kingdom	01/01/2009	31/12/2012
21	National University of Ireland, Galway	NUIG	Ireland	01/01/2009	31/12/2012
22	Stichting Astronomisch Onderzoek in Nederland (ASTRON)	ASTRON	The Netherlands	01/01/2009	31/12/2012

A3.2:
What it costs

Project Number 1	226604	Project Acronym 2	OPTICON

One Form per Project

Participant number in this project 9	Participant short name	Estimated eligible costs (whole duration of the project)						Total receipts	Requested EC contribution
		RTD (A)	Coordination (B)	Support (C)	Management (D)	Other (E)	Total A+B+C+D+E		
1	UCAM	0.00	564,545.60	0.00	564,437.20	0.00	1,128,982.80	0.00	755,670.14
2	ESO	3,144,000.00	33,644.40	89,717.04	0.00	0.00	3,267,361.44	0.00	2,477,716.63
3	CNRS	1,105,334.40	373,832.00	279,668.50	0.00	0.00	1,758,834.90	0.00	1,358,668.50
4	INAF	341,334.40	0.00	174,711.60	0.00	0.00	516,046.00	0.00	430,711.60
5	MaxPlanck	606,666.00	0.00	319,820.76	0.00	0.00	926,486.76	0.00	624,820.76
6	STFC	281,775.51	700,654.32	263,387.88	755,327.98	0.00	2,001,145.69	0.00	1,492,955.18
7	IAC	93,332.80	0.00	47,922.84	0.00	0.00	141,255.64	0.00	117,922.44
8	KIS	177,333.34	149,532.80	44,137.80	0.00	0.00	371,003.94	0.00	277,137.80
9	RSAS	0.00	0.00	103,874.40	0.00	0.00	103,874.40	0.00	103,874.40
10	AAO	160,000.00	0.00	271,451.25	0.00	0.00	431,451.25	0.00	391,451.25
11	NOTSA	0.00	0.00	121,590.00	0.00	0.00	121,590.00	0.00	121,590.00
12	THEMIS	0.00	0.00	45,269.28	0.00	0.00	45,269.28	0.00	45,269.28
13	NOATHENS	0.00	0.00	45,269.28	0.00	0.00	45,269.28	0.00	45,269.28
14	LJMU	0.00	0.00	56,851.20	0.00	0.00	56,851.20	0.00	56,851.20
15	ONERA	513,333.40	0.00	0.00	0.00	0.00	513,333.40	0.00	385,000.00
16	CSEM	166,666.00	0.00	0.00	0.00	0.00	166,666.00	0.00	124,999.50
17	UU-NOVA	317,333.33	61,682.40	47,092.50	0.00	0.00	426,108.23	0.00	340,092.50
21	FEUP	13,332.80	239,252.80	0.00	0.00	0.00	252,585.60	0.00	169,999.60

A3.2:
What it costs

Participant number in this project »	Participant short name	Estimated eligible costs (whole duration of the project)						Total receipts	Requested EC contribution
		RTD (A)	Coordination (B)	Support (C)	Management (D)	Other (E)	Total A+B+C+D+E		
26	POLIMI	80,000.00	0.00	0.00	0.00	0.00	80,000.00	0.00	60,000.00
27	UDUR	541,333.33	0.00	0.00	0.00	0.00	541,333.33	0.00	406,000.00
28	NUIG	0.00	170,467.20	0.00	0.00	0.00	170,467.20	0.00	113,999.94
30	ASTRON	0.00	156,074.86	0.00	0.00	0.00	156,074.86	0.00	100,000.00
TOTAL		7,541,775.31	2,449,686.38	1,910,764.33	1,319,765.18	0.00	13,221,991.20	0.00	10,000,000.00

B1. Concept and objectives, progress beyond state-of-the-art, S/T methodology and work plan

B1.1 Concept and Project Objectives

The OPTICON consortium exists to deliver a simple yet challenging set of strategic objectives.

- Structuring the European astronomical community by ensuring astronomers are able to carry out state of the art research on state of the art facilities.
- Developing European astronomy by allowing astronomical communities to develop scientific plans for their own future facilities.
- Strengthening European astronomy by delivering technology research and development, helping ensure extant and future astronomical research facilities are state of the art.

The required consortium membership to attain those goals defines the OPTICON partnership. The OPTICON consortium membership is composed of all the national and international organisations which (wholly or in-part) own and operate Europe's medium-sized modern optical-infrared astronomical observatories, and several major Institutes and organisations which develop and build innovative instrumentation – hardware and software – for those observatories and telescopes. All modern mid-sized telescopes are involved, both night-time and Solar.

B1.2 Progress beyond the state-of-the-art

Much astronomy research utilises mid-sized telescopes. Europe owns or shares a significant number of such telescopes, on sites round the world. Most were built as national facilities in the days before international cooperation and many are in need of significant investment to modernise their instrumentation, given recent extremely rapid technological advances in opto-mechanical systems. The newest telescopes are extremely large and expensive, driving proposals to rationalise the extant mid-sized facilities, allowing more focussed expenditure on a complementary group of fewer, specialised and fully modernised telescopes. If implemented properly, this will deliver even more high-quality science even more cost-effectively than the startling recent discoveries show is happening today. In parallel, to enlarge the astronomy community in Europe, and for fairness, all wish to integrate the astronomical communities of southern and central Europe fully into cutting-edge research on the best facilities.

This set of challenges drives a set of requirements. First, the newer astronomy communities must be trained, and given practical access, to the best research facilities. Second, those facilities need to be upgraded, and specialised. Third, the whole community needs to have the opportunity to operate *as a community*, and so to contribute ideas to these future developments. These three requirements are the drivers for, respectively, the OPTICON Access and Training programme, the OPTICON RTD programme, and the OPTICON networking programme.

B1.2.1 Networking

Most international collaboration in astronomy is based on subject-specific research programmes, or around use of major funded projects and facilities. There is no natural way for communities which are developing new techniques and facilities, or which are relatively small and physically dispersed, to operate. OPTICON networking activities meet that need through two forward-looking programmes: Europe of the Future: Science, and Europe of the Future: Technologies. The science networks allow community definition of the science cases for next generation facilities, ensuring involvement of the widest possible community in each case. The science activity supports activity in science case development for the European Extremely Large Telescope and applications of the extremely new technique of high time resolution astrophysics. These activities work, as part of relevant projects, to deliver science cases to support and define these future projects. The technology networks act similarly with those communities planning for future applications of new technologies currently outside astronomy and for global programmes in software standards. Both of these underpin next generation infrastructure definition and development. OPTICON also supports two subject-based networks, in Solar astronomy and in Interferometry. The goal here is to foster a culture of cooperation and integration between participants in these geographically dispersed communities.

B1.2.2 Transnational Access

Transnational access via the EC in optical-IR astronomy began in FP5, and proved both successful and wildly over-subscribed. The critical component is that this programme brings together all Europe's mid-sized telescopes into a coherent programme. In light of the strategic development ambitions noted above, the very existence of this collaboration is a critical step towards coordinated future planning and development.

On that basis we have developed an expanded programme, with substantial expenditure in simplifying technical aspects of observing proposal preparation, and with increased training support, focussed on new and currently isolated users. Uniquely in global astronomy, we will implement a central trans-national multi-observatory peer-review process, in order to ensure high-quality peer review, together with sensitive treatment of all proposals, and to provide positive feedback where needed, with this feedback informing the training programme.

The third step is to enhance the best of these mid-sized facilities with the best instrumentation. That is the goal of the RTD activities.

B1.2.3 Joint Research Activities

Comparison of the remarkable images widely available from the Hubble Space Telescope with those from the ground illustrates immediately the critical importance of spatial resolution for astronomical research. Decades of research have developed systems, using adaptive optics, which can very substantially improve delivered image quality in a telescope, by correcting for atmospheric image blurring. This process effectively makes ground-based mid-sized telescopes as powerful as much larger telescopes, extending their lifetimes and research quality. The technology is complex, expensive, and at the limits of deliverable performance. It also has implications for instrumentation, since higher image quality demands more sophisticated, higher-performance, instrumentation. It also drives detector technology and laser technology, since both limit control system performance. It is this set of complementary technology challenges which make up the OPTICON RTD activities. Each is described more fully below.

Overall however, WP1 and WP2 will deliver improved lasers, improved fast sensitive detectors, improved adaptive optics opto-mechanical systems, improved control algorithms, and test-beds for on-sky prototype performance verification. Other WP will prototype new materials for instrumentation, ranging from photonics to holograms, and will consider innovative means to incorporate these new components into new styles of high-efficiency, compact instruments, minimising cost while maximising efficiency. WP4 will develop new and improved algorithms and practical instrumentation control systems and will investigate new kinds of innovative instrumental devices. This will allow astronomers to approach the fundamental limits of high angular resolution observations by optical long baseline interferometry, developing this technologically promising method into a real astronomical research programme.

B1.3 Scientific and Technical methodology and associated work plan

B1.3.1 Overall strategy and general description

The overall strategy for the suite of OPTICON activities has been designed to deliver the top-level OPTICON ambitions.

Specifically, detailed analysis of the outcomes of current access to national and international facilities (telescopes) made clear that a target group, astronomers in central and southern Europe, today preferentially use older, smaller and less well-equipped facilities. Yet the agencies which fund telescopes have a need to localise support away from the present heterogeneous suite of telescopes onto the smaller subset of the most modern facilities, operating as a balanced set of specialist facilities. Clearly, before that can be implemented, the users of smaller facilities need to migrate to higher-quality facilities. This defines, motivates and informs the training programme. Similarly, it defines the strategic planning role, which will define that future set of optimal facilities. Presuming that successful implementation, the selected facilities must be provided with a complementary suite of state of the art facilities and instrumentation. Previous strategic analyses identified adaptive optics, using Laser Guide Stars, and supported by fast low-noise detectors, as the most important structural step for all facilities in delivering modern systems. Hence the majority focus in OPTICON's RTD programme. Two WP focus specifically on Adaptive Optics, three others on development of next generation instruments, utilising state of the art new technologies, which can match the image quality to be delivered by adaptive optics at high efficiency, and affordable mass, complexity and component cost.

Very high spatial resolution astronomy is the other branch of the strategic future path for ground-based astronomy. That is delivered by interferometry. Interferometry has the same detector requirements as does adaptive optics, and its demands on fast high-precision opto-mechanical control systems are similar to those of modern instruments. Thus the other WP is naturally interferometry, completing the synergy. Of course, future facilities will utilise the learning and prototyping needed for extant facilities. Retaining that link to technical demands for the next generation facilities ensures maximal long term value for the present investments. Future use of planned facilities, and future new concepts as yet unplanned, need to start from ideas from the scientific community, and must remain fully integrated with that community to retain relevance and focus. It is this link to future facilities which several OPTICON networks supply. The remaining networks allow communities to plan shorter term enhancements to extant or near-term facilities and requirements, and deliver, with the agencies, the strategic plan for the development of extant facilities.

B1.3.2 Timing of Work Packages and their components

All twelve top-level Work Packages continue through the 4-year programme. A top level Gantt chart is therefore inappropriate.

Table 1.3.3: Work Package List/ Overview

Work package	Work package title	Type of activity	Lead beneficiary Number	Person months	Start month	End month
WP1	Adaptive Optics Systems: seeing beyond atmospheric limits.	RTD	2	259.2	1	48
WP2	Fast Detectors for Laser Guide Star Adaptive Optics	RTD	3	138	1	48
WP3	Astrophotonics	RTD	20	40	1	48
WP4	High Angular Resolution by Interferometry: Reaching for the fundamental limits	RTD	3	42	1	48
WP5	Smart Instrument Technologies	RTD	6	55.5	1	48
WP6	New Materials and Processes for Astronomical Instrumentation	RTD	4	57	1	48
WP7	Trans-national access	SUPP	6	n/a	1	48
WP8	Management	MGT	1	108	1	48
WP9	Europe of the Future: Technologies	COORD	6,2	25	1	48
WP10	Europe of the Future: Science	COORD	6, 21	59	1	48
WP11	Enhancing the community - Strengthening Skills	COORD	3, 18	5	1	48
WP12	Enhancing the community – Optimising Science Access	COORD	6, 8	119	1	48
	TOTAL			907.7		

Table 1.3.4 (1): List of Deliverables

Del no.	Deliverable name	WP no.	Lead beneficiary	Estimated indicative person-months	Dissemination level	Delive date
1.2.1	CANARY on-sky test report	1.2	UDUR	24	PP	48
1.3.1	Coronagraphic phase diversity final test report	1.3	ONERA	2	PP	36
1.3.2	Post focal plane wavefront sensor final test report	1.3	CNRS-INSU-LAOG	6	PP	30
1.3.3	Optimized real time algorithms for (SPHERE) final test report	1.3	ONERA	1	PP	30
1.4.1	LBT Laser Guide Star Ground Layer AO Final Design report	1.4	MPE	37.4	PP	42
1.6.1	Laser pre-production unit delivery & test report	1.6	ESO	1.2	CO	48
2.5.1	LGS detector test report at Optical wavelengths	2.5	ESO	8	PP	46
3.3.1	PCF Final Report	3.3	UDUR	0.5	PU	30
3.3.2	IRW Final Report	3.3	UDUR	0.5	PU	30
4.3.1	Test reports of co-phaser and fringe tracking performance	4.3	ESO/CNRS	20	PP	36
5.2.5	Test Report: Prototype Aspheric Mirror	5.2	CNRS	3	RE	40
5.3.1	Cryogenic smart structures analysis, design and manufacturing report	5.3	NOVA	1	PU	40
6.4	Study Report and possible Prototypes	6.4	INAF	2.2	PP	12
8.1	First EC Report	8	UCAM	12	PP	14
8.2	Second EC Report	8	UCAM	12	PP	32
8.3	Third EC Report	8	UCAM	12	PP	50
8.4	Final EC Report	8	UCAM	12	PP	50
9.1.1	Revision of the Technology Roadmap	9.1	STFC	0.5	PP	13
10.1.1	Community E-ELT science meeting report	10.1	STFC	3	PU	13
10.2.1	International Conference	10.2	NUIG	2	PU	36
11.1.1.1	Observing school (Telescope)	11.1.1	CNRS	0(2)	PU	18
11.1.1.2	Observing school (Archives)	11.1.1	ESO	0(1)	PU	20
11.1.3.1	Awareness conference	11.1.3	UDUR	0(1)	PU	21

12.1.1	NORTHSTAR Package for Astronomical TAC	12.1	ASTRON	16	PU	24
12.1.2	Telescope Directors Meeting	12.1	STFC	2	PU	24
12.1.3	Final Report on Access Delivered	12.1	STFC	2	PU	48

Table 1.3.4 (2): Summary of Transnational access provision

rticipant umber	Organisation short name	Short name of infrastructure	Installation			Operator Country Code	Unit of access	Estimated Unit costs (€)	Min quantity of access to be provided	Access costs to be charged to the GA	Estimated number of users	Estimated number of projects
			number	short name	Estimated costs							
2	ESO	La Silla	1	ESO-3.6	45777	INO	Night	2543	18	44858	12	6
2	ESO	La Silla	2	ESO-NTT	45777	INO	Night	2543	18	44859	12	6
3	CNRS	CFHT	1	CFHT	116880	FR	Night	14610	8	109809	5	2
3	CNRS	OHP	1	OHP193	87840	FR	Night	1756	50	87840	14	6
3	CNRS	TBL	1	TBL	82019	FR	Night	2563	32	82019	9	4
4	INAF	TNG	1	TNG	180258	IT	Night	6933	26	174712	17	8
5	Max Planck	CAHA	1	CAHA 3.5m	161404	DE	Night	8966	18	157736	9	4
5	Max Planck	CAHA	2	CAHA 2.2m	94406	DE	Night	3371	28	94406	10	4
5	Max Planck	La Silla	3	MPG-2.2	67678	DE	Night	2707	25	67678	13	7
6	STFC	ING	1	WHT	143852	GB	Night	7992	18	140960	17	6
6	STFC	ING	2	INT	11404	GB	Night	1629	7	11404	2	1
6	STFC	UKIRT	1	UKIRT (hours)	111024	GB	Hour	881	126	111024	39	6
7	IAC	TCS	1	TCS	48592	ES	Night	2113	23	47923	14	4
8	KIS	VTT	1	VTT	45546	DE	Day	3503	13	44137	6	2
9	RSAS	SST	1	SST	104436	SE	Day	2748	38	103874	6	3
10	AAO	AAO	1	AAT	238931	AU	Night	8239	29	233878	10	10
10	AAO	AAO	2	UKST	37573	AU	Night	1503	25	37573	4	4
11	NOTSA	NOT	1	NOT	123538	DK	Night	3860	32	121590	33	6

12	THEMIS	THEMIS	1	THEMIS	47904	ES	Day	3992	12	45289	8	2
13	NOAthens	Helmos	1	Aristarchos	47184	GR	Night	1966	24	45269	16	8
14	LIVJM	LT	1	LT (hours)	57152	GB	Hour	376	152	56851	12	3
17	NOVA	DOT	1	DOT	47851	NL	Day	1495	32	47092	14	4

Work package	WP1				Start date			01-01-2009	
Work package title	Adaptive Optics Systems: seeing beyond atmospheric limits								
Activity type	RTD								
Participant number	2	3	4	8	5	27	15	6	17
Participant short name	ESO	CNRS	INAF	KIS	MPG	UDUR	ONERA	STFC	NOVA
Person-months	67.2	44.4	22.8	3.6	45.6	36	27.6	12	0

Objectives:

Adaptive optics technology, using both natural and laser guide stars, is the key technology for the next major advance in ground-based optical-IR astronomy. The primary goal of this set of activities is to design and develop Laser Guide Star Adaptive Optics systems for existing large telescopes (Large Binocular Telescope, Very Large Telescope, William Herschel Telescope), to upgrade extent Adaptive Optics systems for a Solar telescope (GREGOR) and to upgrade the Very Large Telescope Planet Finder instrument (SPHERE) to maintain its competitiveness in the period 2010-2012. In addition to their direct impact on European research quality, these programmes have long-term impact as pathfinders for the future 42 m European Extremely Large Telescope and for the 4 m European Solar Telescope.

The secondary objective of this Joint Research Activity is to develop Adaptive Optics key technologies required by the existing European Adaptive Optics Facilities. Critical technologies addressed are: Sodium laser sources at 589 nm for high signal to noise wavefront sensing, real time computer platforms (hardware and software) for both high order and flexible low order AO systems, optimum control algorithms for new Adaptive Optics concepts (multi-Object AO), calibration of large deformable mirrors and operation strategies for adaptive telescopes.

Description of work:

WP 1.1: Coordination: This work package will coordinate the RTD activities, prepare the key specifications for the other WPs, organise study and design reviews, prepare the EC reports and detailed work plans for the OPTICON management. Excellent communication between the Participants will be ensured by dedicated meetings and proper dissemination of documents.

- *AO-RTD General Meetings*: These meetings will involve the lead scientists from the participant institutions, and will occur approximately every 9 months. They will review progress, disseminate results to the whole activity, and plan for future research. Meetings will be held in the participant institutes so that scientific sessions will permit the local staff involved to give detailed reports and interact with the wider scientific community.
- *Design or Study Reviews*: Several important design or study reviews are included in the Work Plan. Design and Study reports will be distributed in advance to the reviewers to permit efficient evaluation of the work delivered by the participants or subcontractor. Minutes and Action lists will be prepared at the end of these reviews and will normally be made available through a dedicated WP1 web page.
- *Progress Meetings*: Progress Meetings will be decided on a case by case basis between the Participants and subcontractors to discuss specific WP progress. Minutes of the Progress Meetings will be made available through the WP1 dedicated web page.
- *Internet*: Documents will be circulated by electronic mail, thereby ensuring fast dispatching and easy archiving and access. A WP1 Web site with public and restricted access will be created by ESO (lead partner) to disseminate all documents produced by WP1.

WP1.2: Laser Guide Star Multi-Object Adaptive Optics system on the William Herschel Telescope:

The CANARY pathfinder for the 4.2m William Herschel Telescope is a European collaborative project comprising Durham University, CNRS-INSU-LESIA, ONERA, STFC-UKATC and CNRS-INSU.

This work package will provide the effort to develop Rayleigh laser power, laser guide star wavefront sensors, calibration, and Real Time Computer (RTC) capacity to support the phase C upgrade of CANARY. "Real time computer capacity" includes the work on the hardware and software extensions to the CANARY RTC used in previous phases, as well as optimized control algorithms and detailed adaptive tomography. All of these enhanced capacities will require detailed specification and design with appropriate reviews (and have related milestones and internal deliverables).

The final report will be a detailed evaluation of the technical implementation and performance of Laser Guide Stars multi-object adaptive optics - and how these issues scale with telescope diameter. We shall also produce a working multiple Laser Guide Star multi-object adaptive optics system, which may be used for the collaborative on-sky evaluation of future candidate technologies such as novel Laser Guide Star wavefront sensors.

Access to the William Herschel Telescope is also required to perform the on-sky experiments.

WP1.3: Very Large Telescope Planet Finder Upgrade:

In the frame of the Very Large Telescope 2nd generation instrumentation, ESO has launched the development of SPHERE (VLT Planet Finder), with a first light planned in 2011; equipped with an extreme adaptive optics system (SAXO), various coronagraphs, an infrared differential imaging camera (IRDIS), an infrared integral field spectrograph (IFS) and a visible differential polarimeter (ZIMPOL). Techniques to directly image exo-planets are a rapidly moving field. New ideas and possible upgrades have already been identified to further enhance the performance and the scientific competitiveness of SPHERE compared to similar instrument under development for the Gemini observatory in the US.

WP1.3, led by CNRS-INSU-LAOG in collaboration with ONERA and ESO, will develop and implement innovative methods to better control the quasi-static aberrations, which clearly remain one of the critical limitations in terms of ultimate detection capabilities in the current design and new Adaptive Optics real time algorithms. The two main tasks of this WP are:

- Design of post focal wavefront sensors: phase diversity algorithms to calibrate non common path aberrations with the coronagraphic device and on-line measurement of non common path aberrations using the post focal plane wavefront sensor.
- Optimization of real time algorithms for the adaptive optics system of SPHERE.

WP1.4: Laser Ground Layer Adaptive Optics System for the Large Binocular Telescope:

This WP will develop the design of a multi laser based Ground Layer Adaptive Optics for the 8m Large Binocular Telescope. This facility will make use of the existing deformable secondary mirror with 672 actuators and will offer wide field of view seeing improvement capability. This system should be able to provide a gain of a factor ≥1.5 in FWHM and ≥2 in energy concentration, while also improving telescope efficiency by enhancing operability above median seeing.

Max-Planck Institute for extraterrestrial Physics (MPE), PI of this WP together with Arcetri Astrophysical Observatory (INAF-OAA) and Max-Planck Institute for Astronomy (MPIA) will develop the design of this facility. The implementation of this upgrade (not part of the present WP) is planned to be pursued rapidly and should be able to deliver exquisite image quality and spectroscopy sensitivity with the existing LUCIFER instrument.

WP1.5: Solar Adaptive Optics:

The main objectives of the WP 1.5 is to improve the science capabilities and to upgrade the 1.5m GREGOR telescope located in Tenerife with a high order pupil-plane AO – already funded for MCAO but with low-order pupil-plane AO. Apart from the science improvement of this facility, the implementation of high order Multi Conjugate AOs on one Solar telescope operating at this site will provide important information about the expected performance of the EST which will be equipped with a similar AO system.

The Kiepenheuer-Institut für Sonnenphysik (KIS) will develop the high order AO system for the 1.5m GREGOR solar telescope and will investigate its MCAO performance using the existing low order deformable mirror in the reimaged telescope pupil. A test report will be produced.

WP1.6: Sodium Laser prototype for Adaptive Optics:

This work package will develop a sodium laser source at 589nm with equivalent power ranging from 15-25W with an optimized spectral format. It will demonstrate a fully functional laser Pre-Production Unit (PPU) or advanced prototype, potentially useful for the Very Large Telescope Adaptive Optics Facility.
The unit will be developed by the laser industry (either in Europe or in the US) under subcontract from ESO.
Following a Call for Tender with the usual ESO legal and management procedures for large European contracts, a first phase of preliminary design (fixed cost), possibly with component validations will be conducted. The proposed design will be validated by a board of experts in the field, with this board solicited and chaired by the ESO WP1 coordinator.
This design phase will be followed by a final design and the development of a laser PPU or advanced laser prototype. The latter will be extensively tested by the supplier before delivery to ESO.
ESO may decide to upgrade this laser pre-production unit or prototype to a final operation unit (not part of the JRA1 scope of work).

This work package is therefore divided into several tasks:

- Preparation of Laser Technical Specifications, Statement of Work & Call for Tender documentation
- Laser preliminary design
- Laser final design and development of laser pre-production unit or advanced prototype
- Testing and delivery of the laser pre-production unit or prototype (supplier)

WP1.7: European Real time platform for Adaptive Optics:

In the OPTICON-FP6 Joint Research Activities -1 (JRA-1) an advanced real time architecture for Adaptive Optics capable of handling 1500 channels at up to 1.5KHz frame-rate was studied. This architecture, called SPARTA, was successfully studied up to preliminary design and prototyped to demonstrate the performance of this platform.

The European Adaptive Optics community has expressed strong interest in a lightweight and more affordable version of this platform in order to serve both on sky experiments and small size adaptive optics systems. SPARTA-light is a project initiated by ESO such that it can serve research projects in advanced algorithms and adaptive optics concepts, with the potential to easily grow to a fully deployable system.

This work package, led by ESO in collaboration with University of Durham and ONERA, will procure software modules from industry for joint use in both SPARTA light and in the Real-Time Computer (RTC) for CANARY. These modules will consist of high-speed real-time control components and, where appropriate, their associated configuration and visualisation elements. Deliverables will be based on proven already available software, but will be selected, modularised, interfaced and documented according to specifications jointly derived by ESO (the SPARTA-light project) and the CANARY consortium (ONERA, LESIA, INSU, UDUR, STFC-UKATC). The intellectual property arrangement will also be jointly specified, and will make the source code available for free non-commercial re-use by the CANARY and SPARTA-light user base. Funds will be primarily held by ONERA who will subcontract the module development under the jointly agreed specification. UDUR will integrate the modules into an RTC system for CANARY, which will follow SPARTA-light specifications wherever possible. UDUR will agree the interface specifications with ESO, and the performance specifications and testing criteria for the integrated CANARY system with LESIA and ONERA

WP1.8: Optimal Control algorithms for wide field adaptive optics:

This work package will study optimal control for wide field Adaptive Optics, in particular for Multi Object Adaptive Optics. The outcome of this work package will be directly applied to the Natural and Laser Guide Star Multi Object Adaptive Optics System (CANARY) planned to be installed on the William Herschel Telescope. The results of the study will provide the requirements and algorithms to be implemented in the real time computer. This control algorithm will be validated in the laboratory.

This work package, led by ONERA with a subcontract to L2TI, is divided in three tasks:

- Study of the Control Strategy for Natural and Laser Guide Stars Multi Object Adaptive Optics
- Algorithms requirements for the real time computer
- Laboratory validation of the control algorithms

WP1.9: Calibration, control and operation of an adaptive telescope with LGS:

The Adaptive Optics Facility (AOF) is a project that will transform one telescope of the Very Large Telescope at the Paranal Observatory into an Adaptive Telescope. This Facility will be tested in the laboratories of ESO using a test bench called ASSIST (The Adaptive Secondary Setup and Instrument STimulator) before being assembled on the telescope.
WP 1.9 will:

- Calibrate a deformable secondary mirror based adaptive optics system
- Demonstrate operation and control of an adaptive telescope with laser guide stars

The first task will address the problem of estimating on-sky and pseudo synthetic interaction matrices and will demonstrate the possibility to identify and update online the control matrix.
The second task will study the interaction and control strategy of adaptive optics, active optics and telescope guiding; deformable mirror - wavefront sensor mis-registration management; laser guide star jitter and focus loop management; and mitigation of the effect coming from LGS spot size variation (minimization of the pseudo static aberration by a low bandwidth wavefront sensor and update of centroiding gains). The on-sky validation at the VLT of these methods is not part of the WP 1.9 scope of work.
This work package is led by ESO in collaboration with Leiden University (NOVA).

Deliverables

1.2.1: CANARY on-sky test report (48)
1.3.1: Coronagraphic phase diversity final test report (36)
1.3.2: Post focal plane wavefront sensor final test report (30)
1.3.3: Optimized real time algorithms for (SPHERE) final test report (30)
1.4.1: LBT Laser Guide Star Ground Layer AO Final Design report (42)
1.6.1: Laser pre-production unit delivery and test report (48)

Work package number	WP2		Start date or starting event		01/01/2009		
Work package title	Laser Guide Star Adaptive Optics detectors						
Activity type	RTD						
Participant number	3	3	3	2			
Participant short name	CNRS/LAOG	CNRS/INSU	CNRS/OHP	ESO			
Person-months per participant	26	86	20	6			

I Objectives

New fast detector developments are required to push the technologies into new and innovative directions for AO wavefront sensing and laser guide star (LGS) AO detectors.
WP2 will develop detectors for a low light level high speed optical WFS detector for AO applications that use LGS on existing facilities. Extended use of this detector with larger telescopes built in the future will be taken into account. This detector development is targeted towards Laser Assisted Ground Layer AO, Laser Tomography AO, Laser Assisted Multi-Conjugate AO (LA MCAO) and Laser Assisted Multi-Object AO (LA MOAO). WP2 is closely linked for this part of the activity to WP1. This link is illustrated by the responsibilities inside WP2: the leader of the WP2.2 (LGS detector development) is also the leader of WP1. This will ensure that the detector developed in this WP is well suited for future AO LGS systems.

II Description of work

To achieve the goals mentioned above, the following Work Packages (WP) will be undertaken:

WP2.1: Management of the WP:

CNRS/LAOG will coordinate the WP2 activity, prepare the key specifications for the other WPs, monitor the WPs, organize study and design reviews, prepare the regular reports and detailed work plans. A kick-off meeting (KO) will be held, followed by annual progress meetings. These meetings will provide progress reports and plans for remedial actions. A website with all the presentations made at these Progress Meetings will be produced and access will be given to all members of the WP2 activity and to the OPTICON management.

WP2.2: Laser Guide Star detector development:

WP 2.2 will develop a Scaled-Down Demonstrator (SDD) for LGS wavefront sensing. Technical specifications and a Statement of work will be prepared based on the Adaptive Optics requirements of future instruments. These requirements will be defined using existing simulation tools and will take into account technology maturity level. After a call for tender and short design phase, the Scaled-Down Demonstrator detector will be developed. This activity will be subcontracted (in Europe or in US) as it requires specialist skills and equipment. This procurement will follow ESO procurement rules.
Preliminary requirements for the SDD LGS detector are:

- About 300 x 300 pixels, scalable to the final format needed for LGS AO wavefront sensing.
- High frame rate: 700 Hz
- High peak quantum efficiency of > 90%
- Low read out noise of < 5e-/pixel (goal <1 e-/pixel) RMS

WP2.3: Test Controller design for LGS detectors:

WP 2.3 will design the camera readout system required to perform detailed performance test of the SDD laser guide star detector. The detector controller design will take into account the specific constraints of the LGS detector: high frame rates, CMOS or CCD technology, and low readout noise. Hybrid controllers might be considered for this design: ASICs might be used to control for example, multiplex a multiple outputs detector whereas a classical controller will be used to drive the clocks, bias and A/D converters. Some test beds addressing the critical points of the controller will be developed. The actual development of the final controller is not a deliverable.

WP2.4: Test setup design for LGS detector:

WP 2.4 will design the camera test setup required to perform detailed performance tests of the SDD laser guide star detector with the controller designed in WP2.3. This test setup will include a camera head embedding the proximity electronics, the detector package and the detector cooling system. The detector cooling will depend on the technology that will be used, Peltier coolers fully integrated inside a closed package could be a appropriate solution. The development of the final test setup is not a deliverable.

WP2.5: LGS detector characterisation:

WP2.5 will test the performance of the detector. The testing of the detector will be performed by the selected supplier under ESO supervision. A test report will be provided including read noise versus frame frequency, cosmetic tests, crosstalk between channels, smearing effect measurement, transfer efficiency.

Deliverables

2.5.1: LGS detector test report at Optical wavelengths

Work package number	WP3		Start date			01-01-2009
Work package title	Astrophotonics					
Activity type	RTD					
Participant number	20	3	10			
Participant short name	UDUR	CNRS	AAO			
Person-months	14	12	14			

Objectives: To exploit developments in photonic technology for astronomy

The AstroPhotonica Europa (APE) partnership was developed by the OPTICON Key Technologies Network under FP6. WP3 will implement a focussed programme to develop relevant photonic technologies; making maximum use of existing commercial developments and the synergy with our existing programmes to provide additional resources for a comprehensive programme.

Description of work.

WP3.1: Astronomical requirements

WP3.1 will define the requirements for new photonic instruments and subsystems via an assessment of new instrumental capabilities required in the medium term for astronomy. This will require a critical evaluation of the performance of future observatories, specifically their active and adaptive optics, and the instrumentation structural problems which may frustrate these goals. This may include: (i) definition of currently-important and projected science programmes; (ii) modelling representative science programmes to identify the required performance indicator, (making reasonable assumptions about the telescope system performance). From this flows the broad instrumental parameters required (spatial and spectral sampling, throughput, background suppression). (iii) From this WP3 will develop the superset of instrumental capabilities required. (iv) Finally, the WP will identify common requirements that span different application areas to produce a limited set of system requirements that will define a path-finder instrument currently envisaged as a miniaturised photonic spectrograph.

WP3.2 Photonic spectrograph testbench

WP3.2 will demonstrate that photonic dispersers can provide a miniature and highly cost effective alternative to conventional bulk optic spectrographs for multiplexed spectroscopy. There are two main development paths; Arrayed Waveguide Gratings (AWG) led by AAO and Lippmann interferometry led by LAOG. This will require: (i) Identification of suitable spectrograph parameters for the demonstration devices (interface to WP3.1); (ii) Definition of the required test and benchmarks; (iii) Construction of a test facility (partly from existing sources) at both the AAO and at LAOG; (iv) liaison with vendors and fabricators; (iv) modelling and design to optimise coupling with the input multimode light making use of theoretical work already done; (v) modelling and design to optimise coupling to the detector and defining the interface requirements (e.g. .curvature of the 1-D array required) in conjunction with fabricators; (vi) manufacture and testing of prototype devices; (vii) assessment of versatility and sensitivity to changes of spectrograph parameters; (viii) develop detector requirements and assess current technology for integration with detector in the future; (ix) assess technology readiness, large-scale manufacturability and unit costs. This work will proceed so that the two options can be directly compared.

WP3.3 Photonic technology assessment

WP3.3 will investigate properties of photonic devices for immediate or short-term application to existing instrument projects and as an input to instrument design underway at the time. This will concentrate on two main types of device: Photonic Crystal Fibres (PCF) and IR waveguides (IRW). The choice of device to be investigated will depend on the system requirements definition in WP3.1. This is a bottom-up approach designed specifically to exploit technology which is already available, provided it offers an astronomically-useful functionality.

The work will proceed in the following phases: (i) definition of candidate devices; (ii) modelling of performance for astronomical applications; (iii) experimental investigation and characterisation; (iv) critical review of suitability; (v) technology readiness review.

WP3.4 Coordination and reporting

Programme: Yearly progress meetings will be held and used to generate progress reports to OPTICON. At other times, contact will be maintained with all partners to allow the lead partner (UDUR) to provide programme direction in consultation with the activity leaders. The management will be aided by a management board consisting of the coordinator and task leaders.

Deliverables

3.3.1: PCF Final Report (30)
3.3.2: IRW Final Report (30)

Work package number	WP4		Start date		01-01-2009	
Work package title	High Angular Resolution by Interferometry: Enhancing the scientific output & Reaching the fundamental limits						
Activity type	Joint Research Activities						
Participant number	3	2	10	5	4	18	1
Participant short name	CNRS	ESO	ONERA	MPG	INAF	FEUP	UCAM
Person-months	15	10	0.4	10	0.2	2	0.1
Participant number	17						
Participant short name	NOVA						
Person-months	5						

Objectives

The recent successes of the network of institutes involved in the European Initiative for Interferometry confirm a worldwide leadership and powerful capabilities for this astrophysical field. The coordination of actions during FP6 led to a truly European interferometric community. Starting from 3 national expertise centres, a network of more than 20 institutes spread over 14 countries is now well established.

Description of Work

WP4.1: "Coordination and Management"

This WP will organise the reporting from the WP Leaders and the reporting to OPTICON. It will also organise communication with the European interferometric community and more generally outreach actions for disseminating Interferometry into Astronomy in general. WP 4 will be managed by a board composed of the three work package leaders. The board will be chaired by the lead partner of WP4. It will be responsible for the web pages of the JRA and the organization of regular telecons.

WP4.2: "Enhancing the scientific output of Interferometry"

In the near future, the installation of the PRIMA facility at ESO will enrich the current generation of VLTI instruments with off-axis phase referencing for imaging and astrometry. In parallel, three European consortia have already started studies for the second generation VLTI instrumentation. This WP will support these activities, especially with respect to the phase reference imaging mode. This will be done through a *phased approach* to progressively increase the capabilities of the array in this observing mode. This effort is motivated by access to faint object science and high precision astrometric measurements.

WP4.2.1 Evaluation of the Paranal Observatory's atmospheric parameters: This WP will assemble a complete picture of the current status of the atmospheric turbulence at Paranal, specifically on the properties of interest for interferometry (piston spectrum, turbulence structure and external scale). The work will include a synthesis of the different measurements already available in the scientific literature and ESO technical reports and the re-analysis of archive data (VINCI, MIDI, AMBER) from the point-of-view of atmosphere characterization. In addition, an extensive series of dedicated technical measurements will be obtained at Paranal. The study will serve as a fiducial point for the control loop design and daily operation of the VLTI fringe trackers, both with VLTI1 and VLTI2 instruments.

WP4.2.2 Assessment of the VLTI behavior for MIDI and AMBER operations with PRIMA.

This WP will assess the possibilities and limitations of the VLTI infrastructure for PRIMA operations, and therefore facilitate its first observations. The work programme will include the analysis of archival data from first generation instruments (VINCI, MIDI, AMBER) and of existing studies, together with additional in-situ measurements. In this process, a "clean-up" of the existing data processing software may be necessary to allow dual field data analysis. The conclusions of this study will also contribute to the preparation of the second generation of VLTI instrumentation that will be developed further in WP4.2.3.

WP4.2.3 Preparing the VLTI for its second generation instrumentation. Following the work done for WP4.2.2, this activity will prepare the installation of VLTI2 instruments through a targeted evaluation of the relevant environmental parameters, and the identification of corrective actions (if necessary). The programme will include a characterization of the VLTI tunnel seeing in the context of dual field, and the identification of methods to mitigate its effects. This will be done using the first generation instrumentation as soon as possible after PRIMA first fringes. In addition, the activity will also explore the first astrophysical applications of dual-field operation, in close interaction with the instrument teams.

WP4.3: "Contribution to the development of an optimum co-phaser for the VLTI"
This WP will reinforce the collaboration between the various European institutes and ESO for the development of co-phasing. This WP will be divided into the following phases:

WP 4.3.1 - Phase 1 – FINITO and PRIMA commissioning data analysis
This WP will undertake the systematic collection of fringe tracking (co-phasing) data during the commissioning phases of PRIMA and operation of FINITO on the VLTI and study the disturbances as observed during this commissioning. Analysis of these data will be made in view of the needs for the extension of the co-phasing to 4 telescopes and of the needs of the VLTI 2nd generation instruments. The final goal is to provide detailed specifications for the VLTI new co-phaser for 4 telescopes, based on the PRIMA and FINITO experience.

WP 4.3.2 - Phase 2 – Development of fringe detection and tracking algorithms
Based on the co-phaser specifications and preliminary design, this WP will develop optimum algorithms for phase detection, fringe tracking and data reduction. It will develop methods to reduce the impact of the disturbances (vibrations, tip-tilt and jitter) on the fringe tracking performance. It will carry out testing of these new ideas and algorithms on PRIMA and FINITO in Paranal.

WP 4.3.3 - Phase 3 – Integration and testing of the new co-phaser for the VLTI
This WP will integrate the co-phaser and a testbed simulating the environment and disturbances as measured in the VLTI during Phase 1. Intensive testing of the co-phaser behavior and of the fringe tracking algorithms (developed in Phase 2) on the testbed with the various kinds of disturbances and in conditions mimicking the operation of the VLTI 2nd generation instruments will be made.

Deliverables

4.3.1: Test reports of co-phaser and finge tracking performance (36)

Work package number	WP5			Start date		01-01-2009	
Work package title	Smart Instrument Technologies						
Activity type	RTD						
Participant number	6	17	3	16			
Participant short name	STFC	NOVA	CNRS	CSEM			
Person-months	16	22	12	5.5			

Objectives

Smart technologies and devices will be developed so that European astronomical instrument builders can meet the demands made by the science community for wider fields-of-view, higher spectral and spatial resolutions, wider bandwidths and simultaneous spectroscopy of multiple objects while fitting within demanding size-footprints, mass budgets and engineering tolerances.

Early in the programme the team will develop a novel instrument architecture that will be used to drive the requirements of these Smart Instrument building blocks and then use this to model operational and observing efficiency in the context of a practical instrument.

Description of Work

WP 5.1: Technical Management and System Analysis:

This WP will develop a concept instrument architecture based on an existing telescope such as the European Southern Observatory's (ESO) Very Large Telescopes (VLT) instrument suite. The instrument concept will be evaluated against existing instruments to assess the improvements in terms of performance, mass, volume and cost.

WP 5.2: Optical Components with Extreme Aspheric Surfaces:

This WP will develop the concept of a highly compact optical design that makes use of extreme aspheric surface optical components, which are primarily reflective. The main tasks to be carried out are to:

- Develop a plug-in design tool that can be used in conjunction with existing optical analysis software such as Zemax to design, optimise and analyse the performance of extreme aspheric surface optical components.
- Develop and evaluate the manufacturing processes (including stress polishing) required to manufacture these extreme aspheric optical surfaces.
- Design and manufacture an optical component demonstrator with extreme aspheric surfaces (in the context of an astronomical instrument for wide field spectroscopy) making use of the processes developed in this and WP 5.3.
- Devise methods to differentiate between low and mid/high order deformations, e.g. combining passive low/mid order deformations and high order active deformations
- Laboratory characterisation of the extreme surface optical component.
- Define the optical requirements of the demonstrator's extreme surface optical components and feed the results back to WP 5.1 in the form of performance specifications.

WP 5.3: Smart Micro Actuation Devices and Cryogenic Structures:
Devices and technologies that work well at room temperatures (e.g. from 253-330K) typically will not work at the cryogenic temperatures needed for IR Instruments (typically 140K). As such it is important to adapt these for cryogenic operation. This WP will investigate the combination of piezo actuators, miniature motors and miniature optical devices to produce a number of building blocks that can be used in, for example: a moderate speed, low density wavefront compensator to correct for instrument deformation, and thus actively control the stiffness of a structure over a large dynamic range. For actuation the consortium will concentrate on piezo and similar techniques. Piezo technology is now a mature technology at room temperatures and has the potential to be adapted to operate at cryogenic temperatures. Position sensing together with optical and dimensional metrology all form part of maintaining control of a structure which is actively controlled. This WP will evaluate optical and dimensional metrology systems used in the growing application of Smart Structures in the aerospace, defence and civil engineering industries including CCD/CMOS cameras and interferometers, strain gauges and additional sensors such as inclinometers. This WP will Investigate the application of cryogenically cooled extension sensing actuators to maintain open loop nanometre position accuracy for instrumentation applications. In particular investigation will be undertaken into the bonding of piezo-devices to Zerodur and silicon carbide using silicate bonding. The intention is to consider broader applications where precise positional control could extend the capabilities of the instrument.
Deliverables 5.2.5: Test report – Prototype Aspheric Mirror (40) 5.3.1: Cryogenic smart structures analysis, design and manufacturing report (40)

Work package number	WP6		Start date or starting event		01.01.2009	
Work package title	New Materials And Processes for Astronomical Instrumentation					
Activity type	RTD					
Participant number	4	7	19			
Participant short name	INAF	IAC	POLIMI			
Person-months per participant	23	17	17			

Objectives:
Identification of new technologies and new materials of potential astronomical application is a very major continuing requirement in astronomy. This WP focuses on new types of optically-active materials of potential astronomical application, moving beyond glass and steel, to organic, photosensitive and polymer materials. The objective is both to identify and characterise those new materials of most practical promise, and also to prove the viability of laboratory and industrial scale processes which are essential to turn their promise into practical technologies.

Description of work

WP6.1 : Management

WP6.1 will be coordinated by INAF-Osservatorio Astronomico di Brera. It will oversee, manage and assess the progress of WP6. It will coordinate the dissemination of the results of the research carried out in the WP to the whole OPTICON community. The WP-office at Brera Observatory will include a Project Secretary. She/He will follow the outsourcing contracts and the accounting and financial reporting, as well as any other WP related administration business.

WP6.2: Novel Volume Phase Holographic Grating-based devices (VPHG)

Many possible areas of application of traditional VPHG devices to improving astronomical instrumentation are still largely unexplored. This WP will investigate novel configurations potentially of use to future astronomical instrumentation. This includes but is not limited to

- **Slanted Fringes Devices.** These devices are currently under study as cross-dispersers in high resolution spectrographs, exploiting the use of anamorphic configurations.
- **Multi-order devices and Echellettes**. Presently available VPHG devices have been optimized to provide maximum efficiency in a single diffraction order, e.g. the first order. It is however possible to optimize their efficiency in more than one order, and theoretically, also at high orders. Multi-order devices, especially if they can be designed and built to operate in the high-order high-resolution regime, would be a real breakthrough alternative to the low-efficiency reflective gratings (echelles) which are currently used in cross-dispersed high resolution spectrographs.
- **Piled devices.** VPHG devices can be stacked one upon the other. In order to be stacked VPHGs must be optimized for the desired diffraction order and also for the

0th order that passes to the following stack. This process has been tested in only a few specific cases so far. If it can be generalized it enable a range of technological opportunities, with multiple interesting possibilities for wide application in astronomical instrumentation.

WP6.3 Photochromic and Photosensitive Materials and associated devices .

This WP will investigate some material-related and process-related issues potentially of use in future astronomical instrumentation. This includes but is not limited to:

- **DCG Replacement.** The photosensitive layer used in traditional VPHG device manufacturing is Dichromated Gelatine (DCG). This material requires sophisticated techniques to be coated on the substrate and complex chemical post-processing after exposure in the Holograph. Possible DCG replacements will be researched in the area of photosensitive materials with equal or better performances but an easier or more reliable processing.
- **Photochromic Based Devices.** Photochromic polymers have an area of application larger than their current use as gratings and multi-object spectrograph masks. A homogeneus concentration of photochromic polymer in a solid matrix would allow realization of re-writeable gradient index lenses and waveguides. This WP will carry out a first theoretical assessment of feasibility and possible performance impact. Where feasible, a first set of engineering grade prototypes will be produced and characterized.

WP6.4 New Materials and processes for fabrication of reflective and refractive optics.

This WP will investigate some material-related and process-related issues potentially of use in future astronomical instrumentation. For each area listed below a theoretical assessment of feasibility and the possible performance impact will be assessed. In some cases, where feasible, a first set of engineering grade prototypes will be produced and characterized. Following the Characterization, where appropriate a second set of prototypes will be produced and characterized.

- **Polymer lenses and mirrors.**
- **Complex shape optical devices**
- **Auto-mounted optics**

Deliverables

6.4: Study Report and possible prototypes (12)

Work package number	WP7		Start date			01-01-2009	
Work package title	TRANS-NATIONAL ACCESS						
Activity type	SUPP						
Participant number	2	3	4	5	6	7	8
Participant short name	ESO	CNRS	INAF	Max Planck	STFC	IAC	KIS
Person-months per participant	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Participant number, contd.	9	10	11	12	13	14	17
Participant short name, contd.	RSAS	AAO	NOTSA	THEMIS	NOAthens	LIVJM	NOVA
Person-months per participant, contd.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Common Description of work for all Participants

Implementation of this FP7 access programme builds on the experience of OPTICON FP6, which was the largest ever coordinated access project in European optical-infra-red astronomy. We have reviewed in detail the successes and limitations of that programme, in a process involving both its beneficiaries and those of the target group – central and southern Europe - who did not benefit. On that basis we have developed a programme, with expenditure in simplifying technical aspects of proposal preparation, and with increased training support, focussed on new and currently isolated users. Uniquely in global astronomy, the WP will implement a central trans-national multi-observatory peer-review process, in order to ensure high-quality peer review, together with sensitive treatment of all proposals, to ensure projects are allocated to the highest quality appropriate technical facility. It will provide positive feedback where needed, with this feedback informing the training programme.

As a complementary step, OPTICON will work with the strategic planning ERANET AstroNet to develop a strategic plan for the future viability and excellence of the infrastructures. Europe has many mid-sized telescopes, largely for historical reasons. This dilutes funding, and disperses users. .A rationalisation, ensuring that the subset of the highest technical quality telescopes, equipped with a complementary suite of state of the art instruments, are funded fully, is both desirable and necessary. A preliminary step is to migrate under-resourced users onto the best facilities. The access and training work (WP7 and WP12) addresses that. The other step is to develop a rational and viable optimisation strategy, taking into account the needs of funding agencies and the whole (potential) user community. OPTICON will work with AstroNet to deliver that vision as a reality.

Both these actions are described in detail in WP12.

<u>Modality of access under this contract, Outreach to new users, review procedure:</u>

Our innovative allocation process and training programme is described fully under WP12.

Description of the infrastructure
Name of the infrastructure: La Silla Observatory
Location (town, country): La Higuera, Chile
Web site address: www.eso.org
Legal name of organisation operating the infrastructure: ESO
Location of organisation (town, country): Garching, Germany
Annual operating costs (excl. investment costs) of the infrastructure (€):1373000

Description of the infrastructure:

The La Silla observatory, located at the southern edge of the Atacama desert about 650km north of Santiago de Chile, is one of the prime sites for the observation of the Southern Skies. ESO operates two 4m-class telescopes on the site, and hosts a number of smaller telescopes owned and operated by institutes from various European countries. The 2.2m Max Plank telescope is also offered to ESO visitors for 20% of the time, but access to this telescope will be via the Max Planck Society (Participant No. 5).

The 3.6m and NTT telescopes are operated 365 nights per year, but only for about 320 of those is the telescope available to visitors. The rest of the time is reserved for maintenance, installation of new instruments, observatory programmes. A team of scientists, engineers, technicians, and service-staff provide full scientific, technical, and logistics support to visiting astronomers.

The 3.6m is equipped with HARPS – the High-Accuracy Radial Velocity Planet Surveyor - the world's most precise instrument to search for extra-solar planets using the radial velocity technique, and to study stellar seismology. HARPS is the only instrument in the world that systematically delivers radial velocities with a long-term precision under 1m/s and therefore places European astronomy in a unique position to find earth-like planets which can then be characterized by larger telescopes.

The NTT is equipped with two general purpose state of the art imaging spectrographs in the optical (EFOSC2) and near-IR (SOFI) wavelengths. Coupled to the superb optics of the telescope, and the excellent seeing of La Silla, these instruments provide OPTICON/Access observers with a unique access to the southern skies. In addition to imaging and spectroscopy a 10 arc-min field of view, EFOSC2 offers multi-object spectroscopy (MOS), linear and circular polarimetry, and coronography.

In the course of 2010, SOFI will be decommissioned leaving open a focal station for visitor instruments which may be made available to OPTICON Access PI's through special agreements.

Description of work

Support offered under this contract:

La Silla observatory offers full support through all steps of the preparation and execution of scientific proposals. Service Mode observations are not supported under the OPTICON Access programme, but the observatory provides comprehensive scientific and technical support during visitor mode observations. All proposals to La Silla (including OPTICON Access) are expected to ask for a minimum of 3 observing nights. Much longer runs will be supported and encouraged. This will provide OPTICON Access PI's with a unique opportunity to conduct ambitious long-term programmes with unique state of the art instrumentation.

Description of the Infrastructure
Name of the infrastructure: CFHT (Canada-France-Hawaii Telescope)
Location (town, country): Kamuela, Hawaii, USA
Web site address: www.cfht.hawaii.edu
Legal name of organisation operating the infrastructure: Canada-France-Hawaii Telescope Corporation
Location of organisation (town, country): Kamuela, Hawaii, USA
Annual operating costs (excl. investment costs) of the infrastructure (€): 5.4M (at 1€=1.4US$)

Description of the infrastructure:

The Canada-France-Hawaii Telescope is an international facility located at the summit of Mauna Kea, a 4200-m high dormant volcano in the middle of the Pacific. Operated by the French Agency Institut National des Sciences de l'Univers (INSU) for the Centre National de la Recherche Scientifique (CNRS). In spite of its modest size (3.6-m diameter), CFHT is at the forefront of today's astronomy, thanks to its unique and powerful instrumentation. With 50 employees operating and maintaining the facility, CFHT operates 100% in service observing mode. CFHT provides pre-processed data to its users, who in return are extremely productive scientifically due to the quality of the data delivered. CFHT is well ahead in the community of medium-size telescopes in term of publications and impact factor.

Three instruments are mainly used at CFHT:

- MegaCam is the largest CCD camera presently in operation on a telescope (340MPixels), with a 1-square degree field of view (2x2 full moon). This instrument delivers images of superb quality over the whole visible spectrum, including the near-UV.
- WIRCam, with a mosaic of four infrared detectors of 4Mpixels each, is equivalent in size to the largest near-infrared cameras available in the world. This instrument is an excellent complement to MegaCam, with a good compromise between field size (20'x20') and image resolution (0.3"/pixel).
- ESPaDOnS is a spectropolarimeter covering the whole visible spectrum with a spectral resolution of 70,000 and allowing the measurements of all the linear and circular polarisation for all the lines available in the spectra observed. This data gives access to the magnetic fields of stars up to magnitude 15.

Services currently offered by the infrastructure:

CFHT observing time is offered in service observing mode all year long, with tools for observation submission provided to the users. Data are pre-processed by the observatory and accessible in a ready-to-use format through the Internet.

Description of work

Support offered under this contract:

PIs submit their proposals through an on-line tool. Once they are awarded time, they submit their request for observation in a Phase-II process that is offered by CFHT, with assistance given by the observatory staff astronomers when needed. The observations are later carried out by the CFHT staff so that the observing conditions match those requested by PIs, who can follow the progress of their programme on line.

Data are then pre-processed at the observatory and checked by staff astronomers, before being made available with a set of ancillary data to the PIs through the Internet.

Description of the Infrastructure
Name of the infrastructure: Observatoire de Haute-Provence, 193cm télescope
Location (town, country): Saint Michel l'Observatoire, France
Web site address: www.obs-hp.fr
Legal name of organisation operating the infrastructure: CNRS
Location of organisation (town, country): Paris, France
Annual operating costs (excl. investment costs) of the infrastructure (€):2800000€

Description of the infrastructure:

The Observatoire de Haute Provence 193cm telescope (OHP193) is located at St Michel l'Observatoire in Southern France. It is operated by the Institut National des Science de l'Univers (INSU) for the Centre National de la Recherche Scientifique.
The OHP 193cm is equipped with one of the world's most stable echelle spectrographs, SOPHIE, with a resolution of 70000, and an accuracy of 2m/s for radial velocity. Data reduction is fully automated with SOPHIE and the result is available both on DVDs and over the internet as spectra and radial velocity curves. The other instrument is CARELEC a low-medium resolution spectrograph for faint objects (5000). OHP can also accommodate visitor instruments.
SOPHIE, a correlation spectrograph, is unique in the Northern hemisphere. It is heavily used for the detection and study of extrasolar planets, and is able to accommodate long term searches. Among its recent success are the confirmation of several superwasp planets, the follow-up of COROT candidates, and the spectroscopy of a planetary transit. SOPHIE is also heavily used for stellar studies. More recently SOPHIE has been used for asteroseismology, and has discovered the oscillations of 51Peg.
CARELEC is a long slit spectrograph and is used for stellar studies, high energy sources, and extragalactic sources as AGNs.
The Observatory is now making a major effort to refurbish the 193cm, making it semi-automated, enhancing its throughput and performances. These efforts will be completed in 2008. For the future we are planning a new bonnette featuring some adaptative optics and better instrument management. With the new bonnette we hope to reach an accuracy in the range 20-50cm/s for SOPHIE.

Services currently offered by the infrastructure. .

The OHP193 is used all the year around, and time is allocated on a semestrial basis. We have now implemented a service mode, which will be facilitated when the upgrade will be completed by the end of 2008.

Description of work

Support offered under this contract:

The service offered by OHP193 is a complete support at all stages of the observing process from proposal management, handled by a centralized proposal software installed under FP6 OPTICON Access Programme; NorthStar, to archiving of the data. Since 2007A, a service mode is offered where observations are performed by service observers under prior guidance of the Principal Investigators. Scheduling will gradually evolve from a static scheduling to a full dynamical scheduling from 2008 to 2012. OHP193 services include observations, data reduction with a state-of-the-art pipeline, quality control and release at the end of each night. WWW Interfaces are being developed to allow astronomers a full control on their programme observations.

Description of the Infrastructure
Name of the infrastructure: TELESCOPE BERNARD LYOT
Location (town, country): PIC DU MIDI DE BIGORRE, FRANCE
Web site address: www.tbl.bagn.obs-mip.fr
Legal name of organisation operating the infrastructure: Centre National de la Recherche Scientifique (CNRS)
Location of organisation (town, country): Paris, FRANCE
Annual operating costs (excl. investment costs) of the infrastructure (€): 615140

Description of the infrastructure:

The Telescope Bernard Lyot (TBL) is a 2.13-m telecope operated by the French Agency Institut National des Sciences de l'Univers (INSU) for the Centre National de la Recherche Scientifique (CNRS) and the Observatoire Midi-Pyrénées for the Université de Toulouse. TBL located in the French Pyrenees Moutains at the summit of Pic du Midi de Bigorre (2877m), reknowned for its image quality and sky darkness.
TBL is supported by a team of 15 technicians and engineers working all year round. TBL has a unique instrument: Narval, an echelle spectropolarimeter yielding a resolution of 65000/80000 in the range 370-1000nm, optimized for measurement of QUV stokes parameters in spectral absorption lines. TBL/Narval is the only telescope in the world to provide long term follow-up capabilities of stellar magnetic fields. Associated with the CFHT/ESPaDoNS instrument in addition TBL/Narval allows observers to make continuous follow-ups of dedicated objects.

Services currently offered by the infrastructure:

The telescope is offered to the French community, to third countries under one-to-one agreements and to the European community as part of the OPTICON Access Programme.

Description of work

Support offered under this contract:
TBL/Narval offers complete support at all stages of the observing process from proposal management, handled by a centralized proposal software installed under FP6 OPTICON Access Programme; NorthStar, to archival of the data. Starting 2008A, a service mode will be offered where observations will be performed by service observers under prior guidance of the Principal Investigators. Scheduling will gradually evolve from a static scheduling to a full dynamical scheduling from 2008 to 2012.
The process started in 2007 has already proven to be both scientifically rewarding with pioneering discoveries published soon after the observations, and very successful among observers with a pressure of ca. 3 in all TBL/Narval call for proposals.
TBL/Narval services include observations, data reduction with a state-of-the-art pipeline, quality control and release at the end of each night. WWW Interfaces are being developed to allow astronomers a full control of their programme.

Description of the Infrastructure
Name of the infrastructure: Telescopio Nazionale Galileo (TNG)
Location (town, country): Observatorio del Roque de Los Muchachos, La Palma, Spain
Web site address: http://www.tng.iac.es
Legal name of organisation operating the infrastructure: Istituto Nazionale di Astrofisica (INAF)
Location of organisation (town, country): Rome, Italy
Annual operating costs (excl. investment costs) of the infrastructure (€): 1,976,134

Description of the infrastructure:

The 3.58m TNG telescope is located at the Roque de Los Muchachos Observatory in La Palma (Spain). It is dedicated to astrophysical observations at visual and near infrared wavelengths and offers a remarkably complete set of instruments for imaging and spectroscopic observations. The main advantage of the TNG relative to other telescopes of the same class is that all the instruments are always on-line and quickly selectable by the users who may, therefore, organize their observations in a very flexible way.

TNG is a very popular, productive and successful facility. The oversubscription rate (i.e. the ratio between requested and available time) is, on average, a factor 2.5, with about 1/3 of the requests coming from international (i.e. non-Italian, non-Spanish) teams. The scientific production of TNG has been steadily increasing in the last 7 years. The publication rate is one of the largest for 4m class telescopes worldwide and corresponds to one refereed paper every 5 nights of useful observing time over the full life of the facility.
TNG has been part of the EU access programme since FP5 (ENO). It was one of the most successful and oversubscribed facilities in FP6 (OPTICON).

Services currently offered by the infrastructure:

The focal plane instruments of TNG which account for most of the scientific publications are

- DOLORES: a multi-mode imager/spectrometer at visual wavelengths with a field of view of 9'x9' and spectral resolving power from R=300 to R=7,000
- NICS: a multi-mode imager/spectrometer at infrared wavelengths (0.9-2.5 microns) with a field of view of 4.2'x4.2' and spectral resolving power from R=40 to R=2,500
- SARG: a high resolution (up to R=160,000) spectrograph at visual wavelengths

A fourth instrument, planned to become operational by 2009, is

- GIANO: a high resolution (R=50,000) IR spectrograph covering the 0.9-2.5 microns range in a single shot. It will be the first and only IR instrument worldwide combining wide spectral coverage and high resolution.

All the above instruments are permanently mounted, maintained and made available to all observers. TNG intends to offer this service throughout the whole period covered by the contract.

Description of work

Support offered under this contract:

TNG will provide all the maintenance work on telescope and instruments, as well as the calibration and quality-control operations necessary to achieve the best possible scientific outcome from the data.
Logistic, technical and scientific support will be made available to the visiting observers who will be also invited to give seminars and exchange information with the all the research staff of La Palma.

Description of the Infrastructure
Name of the infrastructure: Centro Astronomico Hispano Alemain
Location (town, country): Sierra de Los Filabres, Andelucia, Spain
Web site address: http://www.caha.es
Legal name of organisation operating the infrastructure: MAX PLANK GESELLSCHAFT
Location of organisation (town, country): c/ Jesus Durban Remon 2-2, 04004 Almeria, Spain
Annual operating costs (excl. investment costs) of the infrastructure (€): 14.5m

Description of the infrastructure:

Calar Alto Observatory is located in the Sierra de Los Filabres (Andalucía, Southern Spain) north of Almeria. It is operated jointly by the Max-Planck-Institut für Astronomie (MPIA) in Heidelberg and the Instituto de Astrofísica de Andalucía (CSIC) in Granada and its role is to provide world-class observing facilities to Spanish and German optical and infrared astronomers as well as to the international community. Calar Alto currently provides two telescopes with apertures of 2.2m, and 3.5m together with state-of-the-art instrumentation. Calar Alto Observatory is the largest astronomical observatory in continental Europe and has a staff of about 50, comprising technical staff, engineers, and PhD astronomers.

Calar Alto offers 12 instruments to its users, covering the optical and near-infrared wavelengths, both with imagers and spectrographs, both low and high-resolution. A popular instrument is the Integral Field Unit, PMAS.

Most of the observations (60%) are now carried by Calar Alto astronomers in Service Mode. Surveys, target of opportunity, and monitoring programmes are being implemented, together with normal programmes. A fast response Director Discretionary Time programme is currently in place.

Services currently offered by the infrastructure:
Calar Alto provides world-class observing facilities to Spanish and German optical and infrared astronomers as well as the international community. Observing time for both telescopes and their instruments is open to the entire community via a Call for Proposals. Time allocation follows strictly the recommendation of an international TAC and is solely based on scientific merit. Currently, about 20% of Calar Alto time goes to international proposals (proposals not from Spain nor Germany, OPTICON eligible or not).

Description of work

Support offered under this contract:
The support offered is the same as the support given to astronomers from member countries. i.e., full support at all stages of the observing process, from proposal management and handling to archival data (the latter starting end 2008). Data will be archived at the Spanish Virtual Observatory in Madrid, made VO compliant, and open to the community after a proprietary time. Instrument manuals and pipelines are available to users.

Description of the Infrastructure
Description of the infrastructure:
Name of the infrastructure: MPG 2.2m telescope, LaSilla, Chile
Location (town, country): ESO LaSilla Observatory, Chile
Web site address: http://www.mpia.de/Public/menu_q2.php?MPIA/ESO22/index.html
Legal name of organisation operating the infrastructure: Max-Planck Society, Germany
Location of organisation (town, country): Munich, Germany
Annual operating costs (excl. investment costs) of the infrastructure (€):625.000,00

Description of the infrastructure:

The MPG 2.2m telescope is a fork-mounted Ritchey-Chretien system with a free aperture of 2.2m. The telescope is located at the La Silla observatory of the European Southern Observatory in Chile.
(http://www.ls.eso.org/lasilla/sciops/2p2/E2p2M/tecnica220.html).
The telescope is equipped with three permanently installed state of the art instruments. The Wide Field Imager (WFI) is a focal reducer-type camera which is permanently mounted at the Cassegrain focus. With field of view of 34'x33', Nyquist sampled by 0.238" pixels exceeding any other La Silla instrument by a factor of 2. It offers excellent sensitivity from 350 nm to the near IR, with more than 40 filters simultaneously available.

FEROS is a state-of-the-art fibre-fed Échelle spectrograph. It covers the 360 – 920 nm wavelength range in one shot and provides a spectral resolution of about R = 50,000.

The third instrument at the telescope is GROND, an imaging instrument designed to investigate Gamma-Ray Burst Afterglows and other transients simultaneously in seven filter bands. Several dichroic beamsplitters feed light into three NIR channels and four visual channels, each equipped with its own detector. GROND became operational in 2007.

Services currently offered by the infrastructure:

The 2.2m telescope is presently run by the European Southern Observatory and is fully VLT compliant.

Description of work

Support offered under this contract:

International access to the 2.2m telescope on LaSilla via the ESO system will be significantly reduced by 2009. From April 2009 onwards, the telescope will be operated as a semi-national facility under an agreement with the MPG. MPG will control some 9 - 10 months per year and will have full authority in the distribution of that time. The availability to eligible users in the transnational access programme will thus greatly increase, and will include any astronomer not affiliated with a German institution. This is a significant change from the arrangements that existed in FP6. MPG will offer at least 25 nights to the programme. We will adopt the ESO rule and require each visiting astronomer to arrive on LaSilla 2 nights prior to the observations. Alternatively, we will offer the possibility to perform observations under the access programme in service mode, via MPIA-astronomers present at the telescope.

Description of the Infrastructure
Name of the infrastructure: Isaac Newton Group of Telescopes
Location (town, country): Santa Cruz de la Palma, Spain
Web site address: http://www.ing.iac.es/
Legal name of organisation operating the infrastructure: Science and Technology Facilities Council
Location of organisation (town, country): Swindon, United Kingdom
Annual operating costs (excl. investment costs) of the infrastructure (€): € 4.1M

Description of the infrastructure:

The Isaac Newton Group of Telescopes (ING) operates the 4.2-m William Herschel Telescope (WHT) and the 2.5-m Isaac Newton Telescope (INT), located at the Roque de los Muchachos Observatory at an altitude of 2400-m on the island of La Palma. Both telescopes are equipped with state-of-the-art instruments and allow a very wide range of scientific projects to be conducted.

The INT provides capability for wide-field optical imaging and intermediate resolution spectroscopy. This combination makes the telescope particularly suited for research in stars and stellar systems, as well as for nearby galaxies; it complements well the capability of other telescopes within the OPTICON framework.

Services currently offered by the infrastructure:

The telescopes are operated year-round in order to optimally profit from the excellent weather conditions on La Palma. Common-user instruments are freely available to all applicants. ING is well-equipped and set up to provide a high-quality service to its users. Scientists may also bring their own instrument, and observatory personnel will assist in the successful execution of these experiments. This service is rather unique and popular with university groups to fast-track scientific experiments.

The ING telescopes see a wide interest from astronomers around the world. The high oversubscription of telescope time implies that only the very best scientific projects are awarded time.

Description of work

Support offered under this contract:

The service offered by the ING under this contract is identical to that offered to our normal user community, including transport on site, accommodation, computing and network infrastructure, consumables, data reduction software, data archival facilities. For the scientific support the visiting astronomers are assisted by a team of support personnel, including astronomers, technical assistance on the night, a telescope operator on the WHT, and administrative support. The support team ensures that the instrumentation is set up and tested in order that the available observing time be used as efficiently as possible. ING also provides training and advice for those astronomers that are less familiar with the equipment. This makes the ING particularly suitable to reach out to new science communities in Europe. ING's infrastructure includes extensive web tools and documentation to plan observations prior to arrival at the observatory and during the observations, as well as the standard data reduction tools for on-line analysis of the scientific data.

Description of the infrastructure
Name of the infrastructure: United Kingdom Infrared Telescope (UKIRT)
Location (town, country): Mauna Kea, Hawaii, USA
Web site address: http://www.jach.hawaii.edu/UKIRT
Legal name of organisation operating the infrastructure: UK Science and Technology Facilities Council (STFC)
Location of organisation (town, country): Swindon, UK
Annual operating costs (excl. investment costs) of the infrastructure (€): 2871427 (FY 2008/09)

Description of the infrastructure:

The facility is located at an altitude of 4000m at the summit of Mauna Kea on the island of Hawaii, which is one of the best infrared observing sites in the world.

UKIRT has two mutually-exclusive modes of operation: Cassegrain and wide-field. In Cassegrain mode, imaging and spectroscopy are available over the range 1–5μm with the instruments UIST, UFTI and CGS4, all with polarimetric options. In wide-field mode, WFCAM is available. WFCAM is a revolutionary near-infrared (ZYJHK) camera.

The administrative base for the facility is the Joint Astronomy Centre (JAC) located at sea level in Hilo, Hawaii.

Services currently offered by the infrastructure:

The mission of UKIRT is to enable astronomical observations and to provide the resultant data products to its users. Sophisticated data reduction pipelines are provided for each instrument.

Description of Work

Support offered under this contract:

UKIRT operates a flexible-scheduling system. Approved projects are carried out in one of two modes:

- 'observer mode': A member of the user group visits the telescope for an observing run.
- 'service mode': The user group does not send an observer to the telescope, but the data are obtained by other observers over the course of the semester. Data are made available for download within 24 hours of the observations taking place.

Note on Implementation Plan

Unit of Access: Time is allocated on the telescope in units of hours and this is the adopted unit of access.

- For projects undertaken in service mode: the delivered access is the number of hours spent observing the project.

For projects undertaken in observer mode: the delivered access is the number of hours allocated to the project.

Description of the infrastructure
Name of the infrastructure: Telescopio Carlos Sánchez (TCS)
Location: Tenerife, Canary Islands, Spain
Web site address: http://www.iac.es/telescopes/ten.html
Legal name of organisation operating the infrastructure: Instituto de Astrofísica de Canarias
Location of organisation (town, country): C/ Vía Láctea s/n. 38200 – La Laguna. Tenerife, Spain
Annual operating costs (excl. investment costs) of the infrastructure (€): 338028 €

Description of the infrastructure:

Access is offered to the 1.52-m Telescopio Carlos Sánchez (TCS), installed at The Observatorio del Teide (OT), located in Izaña (Tenerife, Spain) at the altitude of 2,400m, upon a volcanic plain in the pre-park area of Teide National Park.
The telescope is owned and operated by the Instituto de Astrofísica de Canarias (IAC). The TCS is mainly devoted to night-time infrared observations, with an excellent image quality over a wide field of view.
The TCS' common user instrumentation includes two near infrared and one optical instrument. As a complement to these instruments, SCIDAR (SCIntillation Device And Ranging) is regularly set up to measure the intensity of the atmospheric turbulence and its dependency on altitude.

Services currently offered by the infrastructure:

Research teams presently have the opportunity twice a year to apply for time at the TCS through the Spanish Time Programme (CAT).

Description of work

Support offered under this contract:

All users receive all required technical support. Astronomy support, covering introduction, assistance and professional advice in the use of the equipment and for optimal execution of the research programme, and night-time support. Health and safety procedures and equipment to ensure a safe working environment, including trained first-aid staff, lone-worker alarm systems, on-call night guard, medical emergency room, and an ambulance. Office space is made available, in case a longer stay is required.

Description of the Infrastructure
Name of the infrastructure: German Solar Telescopes
Location (town, country): Mt Teide, Canary islands, Spain.
Web site address: http://www.kis.uni-freiburg.de
Legal name of organisation operating the infrastructure: Kiepenheuer-Institut fuer Sonnenphysik (KIS)
Location of organisation (town, country): Freiburg, Germany
Annual operating costs (excl. investment costs) of the infrastructure (€): 818580 Euro.

Description of the infrastructure:

The VTT is a classical solar telescope: two coelostat mirrors at the top feed the sunlight into the telescope. The primary mirror has a diameter of 70 cm and a focal length of 46 m. The VTT is one of only a few solar telescopes world-wide that have adaptive optics permanently installed.

The VTT is equipped with state-of-the-art instrumentation to perform imaging and spectropolarimetric measurements: Fast CCDs can be used for high cadence imaging. Sophisticated instruments include (a) POLIS, a spectropolarimeter for the iron line pair at 630.2 nm with simultaneous intensity profiles for Ca II H. (b) TIP, a spectropolarimeter for the near Infrared (up to 2 μm). (c) TESOS, a 2D spectrometer based on three Fabry-Perot-Interferometers achieving a spectral resolution of 250000. TESOS can also be used in a polarimetric mode to measure the magnetic field, and (d) the Echelle spectrograph, which allows to measure the line intensity profiles simultaneously in three different optical wavelength bands. Certain combinations of intruments allow for simultaneous muti-wavelength observations, in order to retrieve information from different layers of the solar atmosphere.

Services currently offered by the infrastructure:

The telescope is used for scientific observations from mid April through mid December. Typically 25 observing campaigns of 9 days each are carried out every year. The VTT service team prepares all campaigns by setting up the instruments and aligning them optically prior to the campaigns. A technical assistant accompanies each observation. Computing facilities at the VTT assure that preliminary data analysis can be performed on the recorded data at the site during the observations.

Description of work

Support offered under this contract:

For the OPTICON ACCESS programme we support the instruments: (a) POLIS, (b) TIP, (c) TESOS, and (d) the Echelle Spectrograph. Some of the instruments can be used in parallel for multi-wavelength observations, e.g., POLIS & TIP or TESOS & TIP.

The users are offered accomodation in the recidencia of the Observatorio del Teide. The VTT offers powerful on-site computing facilities including imaging processing software (e.g., IDL) and internet connection during the observing campaigns. The relevant instrumentation will be optically aligned and prepared to start observation. Typically, one support scientist and one technical assistant accompany each OPTICON campaign.

Description of the Infrastructure
Name of the infrastructure: Swedish 1-m Solar Telescope
Location (town, country): Observatorio del Roque de los Muchachos, La Palma, Spain
Web site address: www.solarphysics.kva.se
Legal name of organisation operating the infrastructure: Royal Swedish Academy of Sciences
Location of organisation (town, country): Stockholm, Sweden
Annual operating costs (excl. investment costs) of the infrastructure (€): 2748

Description of the infrastructure:

The SST is located on La Palma at an altitude of 2400 m in the Observatorio del Roque de los Muchachos. It is currently (2008) the largest solar telescope in Europe and the second largest in the world. Its main goal and asset is high spatial resolution. The SST reaches the 'dream-limit' of solar physics with diffraction-limited 0.1-arcsecond resolution in blue light. Recent progress in detector technology and image restorations has allowed also record-high temporal resolution (~1s) while maintaining spatial resolution.

The telescope has adaptive optics and tip-tilt correction integrated in the light path. The adaptive optics will be upgraded to higher order (about 90 modes) in 2010. An observer can choose between two main observing modes: spectroscopy or imaging. There are basic optical setups with possibilities for individual changes or additions. Instrumentation is as follows:

TRIPPEL A spectrograph with polarimetric capabilities. Three spectral regions can be observed simultaneously with supplemental slit-jaw imaging in several wavelengths.

Blue imaging (<500 nm) Four fast-readout 2k x 2k CCD cameras are used with interference filters for passbands of diagnostic interest, e.g. different positions in the Ca II H line.

Red imaging and polarimetry (>500 nm) A new state-of-the-art double Fabry-Pérot system is being installed during 2008. The new high-transmission and fast-tuning system is an imaging full-Stokes polarimeter that can scan spectral lines. Detectors are several 37-frames/s Sarnoff CCDs with very low readout noise.

Services currently offered by the infrastructure:

The observing season is from April to October. Observing runs typically last 10-15 days.

Description of work

Support offered under this contract:

Operations and instrumentation are well documented in an on-line manual. On-site support consists of a support astronomer and a student assistant who provide introduction to the instrumentation and problem solving when needed.

The large amount of data produced makes it imperative that the observer can inspect it and select what is good. Software tools to that end are provided.

Description of the Infrastructure

Name of the infrastructure: Anglo-Australian Telescope + United Kingdom Schmidt Telescope

Location (town, country): Siding Spring Observatory, Australia

Web site address: http://www.aao.gov.au

Legal name of organisation operating the infrastructure: Anglo-Australian Telescope Board

Location of organisation (town, country): Sydney, Australia

Annual operating costs (excl. investment costs) of the infrastructure (€): 5,699,400 (AAO)

Description of the infrastructure:

The Anglo-Australian Telescope (AAT), the largest optical/infrared telescope in Australia, has a 3.9m mirror on an equatorial mount, with prime, Cassegrain, and coudé foci. It is situated at Siding Spring Observatory, at an altitude of 1154m. The United Kingdom Schmidt telescope (UKST), also situated at Siding Spring Observatory, is a 1.2m Schmidt telescope that has been used for wide-field photographic surveys of the southern sky but is now used almost exclusively for multi-object fibre spectroscopy with the Six-degree Field (6dF) instrument.

Both the AAT and the UKST are operated by the Anglo-Australian Observatory, which has its headquarters in the Sydney suburb of Epping. Approximately a dozen astronomers provide observing support to visiting observers. A night assistant and technical support staff are always provided at the AAT, while UKST observations with 6dF are carried out both in service mode and by visiting observers.

Services currently offered by the infrastructure:

The common user instruments on the AAT are: (i) the AAOmega dual-beam optical spectrograph, fed by either the Two-degree Field (2dF) multi-fibre system, allowing simultaneous spectroscopy of up to 392 objects within a two-degree field, or by the SPIRAL integral-field unit with a 22" x 11" field of view; (ii) IRIS2, a 1–2.5 micron imager and spectrograph offering broad-band and narrow-band imaging over a 7.7' x 7.7' field, as well as R=2400 spectroscopy in long-slit or multi-object mode using multi-slit masks; and (iii) UCLES and UHRF, for high-resolution (R=50k–100k) and ultra-high resolution (R=300k–900k) optical échelle spectroscopy. Visitor instruments are also supported, as are Target of Opportunity override programmes using the currently mounted instrument.

Observing time on the UKST is available to User Groups, normally for large, long-term survey projects, and is allocated based on open, competitive calls for proposals. The sole instrument currently offered on the UKST is the 6dF multi-object fibre spectrograph, which can observe up to 150 objects simultaneously, using an off-telescope robotic fibre positioner to place fibres on interchangeable field-plates.

Description of work

Support offered under this contract:

Like other AAO observers, OPTICON users receive assistance with proposal preparation and submission to AATAC. Due to the complexity of the instrument, 2dF observers have an AAO staff astronomer provided for each scheduled night; users of other instruments receive training on their first night, and on-call support thereafter. Data reduction pipelines are provided for 2dF, 6dF, SPIRAL and IRIS2. Post-observing assistance with data reduction is also available.

Description of the Infrastructure
Name of the infrastructure: **Nordic Optical Telescope**
Location (town, country): Roque de los Muchachos Observatory, Garafia, La Palma, Spain
Web site address: http://www.not.iac.es
Legal name of organisation : Nordic Optical Telescope Scientific Association
Location of organisation (town, country): Lund, Sweden
Annual operating costs (excl. investment costs) of the infrastructure (€): 1.7 M€

Description of the infrastructure:

NOT is a 2.5m telescope at the world-class site of Roque de Los Muchachos Observatory, La Palma, Canary Islands. The NOT instrument suite includes direct imaging and low-resolution spectroscopy with a wide choice of filters, grisms, and polarimetric options in flexible combinations through the focal-reducer instruments ALFOSC (optical, 2Kx2K CCD) and NOTCam (near-IR, 1Kx1K Hawaii array). The 4Kx4K direct CCD camera MOSCA offers high UV sensitivity. The fibre-coupled, high-resolution optical spectrograph FIES (R = 60,000), located in a stabilised room off the telescope, can yield radial velocities with errors below 3 m/s, as needed to search for extrasolar planets.
The standby CCD imager StanCam and FIES are always ready for use for Target-of-Opportunity and synoptic projects on transient or variable targets. NOT's goal for ~2011 is a fixed set of instruments offering instant access to optical and near-IR imaging and low-resolution spectroscopy with polarimetric options, high-resolution optical spectroscopy with excellent radial-velocity performance, and a fast-readout ("Lucky") camera. Our operating procedures will be optimised to take full advantage of this flexibility.

Services currently offered by the infrastructure:

In addition to standard proposal submission, peer review, and scheduling procedures, NOT offers a 'fast-track' option by which small programmes can be submitted, approved, and executed within a short time. Service observing by staff is offered when the science goals require special scheduling. At the telescope, visiting scientists are given instructions in the use of the telescope and accompanied by staff at the beginning of their run. Quick-look pipeline processing is available for all instruments to allow immediate quality assessment by the observer. Observers under the OPTICON access programme receive exactly the same level of service as Nordic observers.

Description of work

Support offered under this contract:

The NOT will offer complete support for users, from proposal submission through the common OPTICON observing proposal interface to support at the observatory and data delivery at the end of the project, whether conducted on-site or by staff observers in remote mode. Complete up-to-date information on all instruments and facilities is maintained at the NOT web site. Staff are always available for consultations and may help with local travel arrangements.

Description of the Infrastructure
Name of the infrastructure: THEMIS solar telescope
Location (town, country): Tenerife, Canary Islands, Spain
Web site address: http://www.themis.iac.es
Legal name of organisation operating the infrastructure: THEMIS S.L.
Location of organisation (town, country): La Laguna, Tenerife, Spain
Annual operating costs (excl. investment costs) of the infrastructure (€): 914000 €

Description of the Infrastructure:

THEMIS is a joint operation of France (CNRS) and Italy's (CNR) national research agencies. It is located at Izana, altitude 2400m, within the Teide Observatory on the island of Tenerife (Canary islands, Spain). The installation was commissioned in 1999. A local technical staff of 11 works either at the telescope or at our base offices.

The THEMIS telescope is a 90 cm, f/16 aperture solar telescope, currently the world's third largest in operation. Its specialized design allows for very high-accuracy spectropolarimetry of the solar surface. Sunlight is polarized at fractional levels of intensity ranging from 10^{-2} (1%) to 10^{-6} (0.0001%), or even possibly weaker levels. Polarization conveys unique information on the magnetic fields acting at the solar surface and atmosphere, but also provides much other information on the physical state of the emitting atoms in conditions unobtainable in any terrestrial laboratory. Polarization is also a delicate physical property, quite easy to contaminate with spurious signals coming from the optical collectors. THEMIS has a dedicated "polarization-free" optical path to avoid such problems. This includes an alt-az telescope mount with an helium filled telescope tube, and a polarimeter located at the prime focus. A tip-tilt system was fitted to the telescope in 2006 to stabilize the solar image on the entrance slit of the spectrograph. The spectrograph itself is an f/70double spectrograph ($r=10^6$), and allows up to 10 simultaneous wavelengths to be detected at the output. Themis has several modern EMCCD and InGaAs CMOS cameras to detect the full range of wavelengths at high sampling rates. Thanks to its optical design, THEMIS delivers routine vector polarimetry analysis with an accuracy ranging from 10^{-3} to a few 10^{-6}, state-of-the art values not easily achievable in other telescopes.

The MDSP mode allows for multichannel subtractive double-pass spectro-imaging. The IPM IPM mode allows very narrow-band imaging with a universal birefringent filter followed by a Fabry-Perot interferometer. Imaging at the limit of diffraction has been considerably improved by the tip-tilt device.

The observing campaign lasts from mid-april to mid-November, providing about 250 days of observations (7 days/ week). A typical observation 'run' lasts 7 to 10 days and we programme 20 to 25 observing runs per campaign. Observations are normally technically prepared by local staff and performed by the visitors.

Description of work

Support offered under this contract:

The proposed instrumentation is: MTR, DPSM and imaging programmes.

During the run, the observer is backed up at all times by a technical assistant / telescope operator. A staff scientist is always physically present in the beginning to validate the setup and ensure that the scientific case can be achieved. A request for more scientific or technical support can be expressed at any time with a typical response time of 2 to 4 hours. We strongly support the data analysis using a dedicated set of online software that are available in the observing room and down loadable at the user's institution. Observers are encouraged to use them and trained to do so during the first few days of their run.

Description of the Infrastructure
Name of the infrastructure: Aristarchos Telescope Helmos Observatory (ATHO)
Location (town, country): 2.3 km Neraidorahi peak, Helmos mountain, Kalavryta Achaias, Peloponnese, GREECE
Web site address: http://www.astro.noa.gr/helmos
Legal name of organisation operating the infrastructure: National Observatory of Athens – Institute of Astronomy and Astrophysics
Location of organisation (town, country): P.O. Box 20048, GR-118 10, Thissio, Athens, GREECE
Annual operating costs (excl. investment costs) of the infrastructure (€): 609568

Description of the infrastructure:

The new 2.3m ARISTARCHOS optical telescope has been built by Carl Zeiss Jena utilizing new technologies and techniques arising mainly as a spin-off of the development of the new generation of 8-metre optical/IR telescopes. Its optical design is such as to offer a large imaging area (1.05 degrees).

The telescope dome and ancilliary buildings are located at the Neraidorahi peak of the 2.3 km mountain Helmos, Peloponnese, South Greece.

The telescope is equipped with a number of instruments covering all standard needs in imaging and spectroscopy. In particular, the following instruments are available for the guest observers from June 2008:

a. A back-illuminated 1kx1k CCD camera (SITeAB, liquid nitrogen cooling). The pixel size is 24 microns and thus the camera covers a 5 arcmin field-of-view on the sky.
b. A low dispersion spectrograph (1200 line mm^{-1} resulting in a scale of 3 Å/pixel). This covers the wavelength range of 4270 Å -7730 Å.

while two more instruments are soon going to be commissioned:

c. The Manchester echelle spectrograph (MES; $R=10^5$ for 30 micron pixel, 31.6 grooves/mm echelle grating, resolution ~6 km/s).
d. A moderate field-of-view back-illuminated 4kx4k camera (Fairchild Imaging CCD 486, Grade 1) with a pixel size of 15 microns (~10 armin field of view).

Services currently offered by the infrastructure:

A call for proposals was released for a first testing observing period 2008 A (June-July 2008). Once final commissioning is complete there will be 2 calls for proposals annually.

Description of work

Support offered under this contract:

Support Astronomers as well as Night Assistants and Technicians are available to assist the observer with the preparation of the observations as well as the acquisition of the data. Data are stored in high capacity data storages and can be retrieved by the observer at their home institution using standard internet protocols.

Description of the Infrastructure
Name of the infrastructure: Liverpool Telescope
Location (town, country): Observatorio del Roque de los Muchachos, La Palma, Spain.
Web site address: http://telescope.livjm.ac.uk/
Legal name of organisation operating the infrastructure: Liverpool John Moores University
Location of organisation (town, country): Liverpool, UK.
Annual operating costs (excl. investment costs) of the infrastructure (€): 903,197

Description of the infrastructure:

The Liverpool Telescope is a fully robotic 2m aperture optical and near infra-red telescope. It is the largest fully robotic telescope in the world, and offers unique rapid-response capabilities for optical studies of transient sources or follow-up of sources detected at other wavelengths. The instrumentation offered consists of two optical CCD cameras (one optimised for high time-resolution studies), an infra-red camera, an optical single-shot polarimeter and an optical, fibre-fed double-beam spectrograph.

Services currently offered by the infrastructure:

We offer the facility for repeated monitoring of astronomical objects at any frequency from minutes to months; target-of-opportunity observations of transient sources; moving solar system objects; sources which flare; or observations scheduled to be simultaneous with observations at other facilities (usually spacecraft). Such observations can be optical or infra-red imaging photometry; spectroscopy; or polarimetry.

Description of work

Support offered under this contract:

Successful applicants define their observations using web forms, an automatic scheduler optimises the sequence of all observations, and users are notified by email the day after any of their observations are carried out. They are then able to retrieve their data at their home institution using standard internet protocols. Observations for a project are not carried out in a single block, but at user-defined intervals, and they are available to the user as they are taken, and can be used to modify the programme as appropriate.

Support is via a dedicated web accessible electronic helpdesk and a support astronomer who can be contacted by email. Queries relating to specification of observations and data products are answered within one working day, and usually sooner. Observers do not travel to the LT, and support at the telescope is not applicable. Some users may instead visit the operating centre in Birkenhead, UK, for pre- or post-observation assistance by Observatory staff.

Description of the Infrastructure
Name of the infrastructure: DOT
Location (town, country): Roque de los Muchachos Observatory, La Palma, Spain
Web site address: http://dot.astro.uu.nl
Legal name of organisation operating the infrastructure: NOVA
Location of organisation (town, country): Utrecht, The Netherlands
Annual operating costs (excl. investment costs) of the infrastructure (€): 147.282.-

Description of the infrastructure:

The Dutch Open Telescope (DOT) is an innovative 45cm solar telescope, completely open, on an open 15m steel tower and uses wind to flush the telescope and its surroundings to minimize local atmospheric turbulence. It demonstrated successfully the open-telescope technology that now widely is used for the design of future instruments.
The DOT produces multi-wavelength tomographic images, operating at the wavelengths of Ca II H (396.8nm), G-band (430.5nm), blue continuum (432nm), red continuum (654nm) and H-alpha (656.3nm). Together they sample the solar regime from deep photosphere through low chromosphere into the high chromosphere.
The DOT is a source for high-resolution image sequences and the only source worldwide for routine high-resolution H-alpha image data of the sun.
DOT-data provides science input in themselves, but are also highly valuable as context tomography for smaller-field spectrometry and polarimetry at other telescopes, and when combined with coronal EUV imaging from space. The DOT is frequently used in multi-telescope campaigns with other telescopes (e.g. SST, VTT, THEMIS), rocket launches and spacecraft. The DOT and SST are neighbours with the DOT control room inside the SST building, sharing the same seeing and hence maximizing scientific output.

Services currently offered by the infrastructure:

Solar observing campaigns in general take place between mid April and mid December. They normally last for 2 weeks, which is considered as a minimum to give the observer a reasonable chance of good seeing conditions.
The DOT follows an open data policy, meaning that the processed observations are made available on the web and are available for scientific use to everybody. External users receive telescope time through peer-review time allocation. Allocation in multi-telescope campaigns is done in close collaboration with other telescopes.
In order to be able to process the enormous amount of data (up to several Terabyte per observing day) without huge delays, an on-site water-cooled computer farm is operational capable of keeping up with the processing of the average daily harvest of speckle data. The data is reduced during the night and available for the PI the next day. The processed data is stored on a high-volume data server that contains all data collected since the autumn of 1999. Integration into the Virtual Solar Observatory VSO is foreseen within the contract period.

Description of work

Support offered under this contract:

DOT will offer complete support at all stages of the observing process. Technical information about the instrumentation is available on the DOT web pages, where the DOT data archive is housed as well. Observers will be assisted by at least one DOT technician and astronomer on-site to introduce them and help with the observations and with data processing and archiving. There are adequate computer facilities.

WP7: Implementation Plan

Short name of installation	Unit of access	Estimated Unit cost (€)	Min quantity of access to be provided	Estimated number of users	Estimated number of days spent at the infrastructure	Estimated number of projects
ESO-3.6	Night	2543	18	12	22	6
ESO-NTT	Night	2543	18	12	22	6
CFHT	Night	14610	8	5	0	2
OHP193	Night	1756	50	14	55	6
TBL	Night	2563	32	9	37	4
TNG	Night	6933	26	17	30	8
CAHA 3.5m	Night	8966	18	9	24	4
CAHA 2.2m	Night	3371	28	10	36	4
MPG-2.2	Night	2707	25	13	36	7
WHT	Night	7992	18	17	24	6
INT	Night	1629	7	2	9	1
UKIRT (hours)	Hour	881	126	39	0	6
TCS	Night	2113	23	14	30	4
VTT	Day	3503	13	6	26	2
SST	Day	2748	38	6	56	3
AAT	Night	8239	28	10	32	10
UKST	Night	1503	25	4	10	4
NOT	Night	3860	32	33	40	6
THEMIS	Day	3992	11	8	14	2
Aristarchos	Night	1966	23	16	30	8
LT (hours)	Hour	376	151	12	0	3
DOT	Day	1495	32	14	36	4

Some infrastructures (eg CFHT, LT, UKIRT) operate in service mode, at such facilities the user is not physically present at the facility during the data taking.

The number of observers at classically scheduled telescopes may vary depending on the complexity of the observing plan, so the estimated number of person-days spent at the infrastructures is only indicative.

Work package number	WP8		Start date		1-1-2009	
Work package title	Management					
Activity type	MGT					
Participant number	1	6				
Participant short name	UCAM	STFC				
Person-months	60	48				

Objectives:

This WP will deliver effective and efficient project-wide management; ensure excellent communications within, and cohesion between, the many aspects of this large and complex project. Priority will be given to ensuring efficient financial control, ensuring that each activity is managed appropriately and ensuring that all milestones, deliverables, and EC reports are achieved to a high standard.

Description of work:

This activity will be carried out by these overlapping activities:

I The Management Board: Strategic decisions and oversight of the entire project will be made by a management board. It will meet approximately every 12-48 months. The board will meet at open 'general meetings' with closed sessions limited only to the most sensitive discussions. Board Meetings will involve key project personnel plus the lead scientists from the participant institutions with the aim of reviewing progress, disseminating results to the whole project and to other interested parties and planning for future activities. Meetings will be held in the participant institutes so that scientific sessions will permit the local staff involved to give detailed reports and interact with the Steering Committee. Observers for other EU activities (Radionet, AstroNet, Europlanet or their successors) will be invited to maximise inter disciplinary exchange.

II The Executive Committee: Day to day control will be invested in an executive committee comprised of representatives from major funding bodies and by representatives of smaller partners. It will meet every 6-24 months.

III The Project Office: The Project office will include the Project Coordinator, the Project Scientist, and senior PA support. The Project Scientist, assisted as necessary, will maintain oversight of all project activities, at monthly, quarterly or semi-annual level as appropriate. This involves attendance at WP meetings and web-site monitoring, with the aim of checking timeliness of deliverables and quality of milestones, providing an external review of management and activity performance.
The project office will be responsible for collecting, editing and collating all the financial and technical reporting information for the EC reports, in addition to supporting the Executive and Board meetings and reviews. The Project Scientist manages technical reporting, and continuing financial status review of the whole project. The Coordinator's PA manages all financial and administrative issues.

Deliverables:
8.1: First EC report (14)
8.2: Second EC report (32)
8.3: Third EC report (50)
8.4: Final EC report (50)

Milestone: Mid-Term Review (if implemented)

Work package number	WP9			Start date		01-01-2009	
Work package title	Europe of the Future: Technologies						
Activity type	COORD						
Participant number	6	17	4	3	2		
Participant short name	STFC	NOVA	INAF	CNRS	ESO		
Person-months per participant	5	3	8	8	1		

Objectives:

This WP combines two activities. The Key Technologies Network continues OPTICON's highly-successful (and now widely copied) FP6 planning activity, which maintains awareness of a wide range of technologies of potential value to astronomical instrumentation and telescopes, investing seed-corn effort into proving and testing the most promising. It also provides the forum where all the RTD programme leads share information and requirements. The Software Standards network is the European part of an international collaboration, which defines the standards required for the next generation of data processing software. This software, which makes up a major part of lifetime project costs, is the tool which captures and converts the data from the instruments on the telescopes into a form suitable for scientific use.

Description of work

WP 9.1 Key Technologies Network (KTN):
This will identify key technology needs relevant to the AstroNet Facility Roadmap, develop and regularly update the extant (FP6) dynamic Technology Roadmap, analyse technology developments in other sectors which provide opportunities for application in astronomy, identify spin-out opportunities for technologies developed for astronomy to be used in other research sectors and to improve the competitiveness of European industry, help build project consortia to develop those technologies and search out technology development funding. It will provide a forum to share information between the FP7 OPTICON RTD activities.
The network will be coordinated by a core working group based on the RTD PIs with additional co-opted members, with several members carrying on from the FP6 OPTICON KTN working group to ensure continuity. Specific working groups on individual technologies will draft in others with particular expertise where appropriate. The programme will be explicitly coordinated with the ESA technology programme and connected to the AstroNet Science Vision and Facility Roadmap.
The main KTN activity will be to run a series of workshops at host sites chosen from the OPTICON partner organisations. Activities will include:

- Project definition and consortium development: bringing together teams to develop future proposals for technology development.
- Technology Roadmapping: mapping AstroNet science goals onto technologies available and requiring development, and linking to implementation paths and funding sources.
- Key Technologies Workshops: to look into particular technology areas and investigate how European cooperation can help make significant advances, in particular: detectors, new optical materials, photonics devices, novel materials for cryogenic structures, and systems modelling. Explore linkages and opportunities between technology developments across the OPTICON FP7 programme and other relevant European collaborative programmes.

The KTN will assist the OPTICON Astrophotonics JRA in developing links with industrial and academic photonics groups throughout Europe, making use of European industrial networks such as the UK Photonics Knowledge Transfer Network. It will also develop a network of European organisations with capabilities and interests in cryogenic measurement of structural and optical properties of new materials, aimed at developing future funding proposals. Meeting costs will be minimised by holding them with OPTICON progress meetings and during international conferences.

WP 9.2 Software Standards

This WP will develop detailed software standards for an open, modular system for processing and analysis of astronomical data by end users. The work described will be shared on equal terms between a North American project lead by the US Virtual Observatory project NVO, and the OPTICON effort described for this Network.

A steering committee representing the OPTICON portion of the effort will be formed to plan and coordinate activities by the European partners. It will also provide scientific guidance. Likewise, activities within North America will be managed by NVO. An executive committee composed of senior members of the OPTICON and NVO projects will jointly plan and coordinate development across the two groups. The steering committee, with participation from the major organizations involved and the community, will oversee the work through regular reviews. It will plan and coordinate activities by the European partners, and provide scientific guidance to the project. ESO will lead this committee and provide its chair while the vice-chair will be selected from the Euro-VO community to ensure close coordination with these efforts. An executive group composed of senior members of the OPTICON and AVO projects will jointly plan and coordinate development across the two groups.

The developments of the software standards will be based on the work of the OPTICON FP6 Network 3.6 on 'Future Astronomical Software Environments' which defined high-level requirements, provided an architectural concept and outlined interface standards to be specified. The work will be shared between INAF and CNRS-OAMP following prescriptions by the steering committee. Several standards will be developed in close collaboration with IVOA and Euro-VO, such as for messaging and parameter passing. All standards proposed will be reviewed following IVOA procedures. A first draft version of the standards will be verified through prototypes.

To ensure usability and interoperability, a basic reference implementation will be produced when the final standards specifications have been issued. It will provide a minimum but functional system which can be evaluated by external users. Some real-world astronomical use cases, both in Python and C languages, will be developed to demonstrate scalability, usefulness and flexibility of the system. Basic recommendations on software engineering aspects such as code control, problem reporting and installation will be issued.

Deliverables

9.1.1: Revision of the Technology Roadmap (13)

Work package number	WP10		Start date			01-01-2009	
Work package title	Europe of the Future: Science						
Activity type	COORD						
Participant number	6	21					
Participant short name	STFC	NUIG					
Person-months per participant	51	8					

Objectives:

WP10 is a two-part network, supporting wide community involvement in defining the scientific goals of the next generation large facilities. WP10.1 supports the European Extremely Large Telescope science case development; WP10.2 supports the High Time Resolution Astrophysics community in contributing their expertise and interests to many projects.

Description of work

WP10.1 Science Case development for the European Extremely Large Telescope

The European Extremely Large Telescope (E-ELT) is a future, major new infrastructure that will revolutionise astronomy in Europe and will allow Europe to maintain is world-leading position in astronomical research. This WP will provide the essential networking infrastructure to continue science case development in the critical period leading up to construction of the telescope and instruments.

The next phases of the E-ELT Project

Development of the science case itself (and hence the scientific input to the Design Reference Mission planning process), was specifically excluded from the FP7 "E-ELT Preparatory Phase" programme. In this WP we will provide the essential community networking activity to achieve further science case development during the three year period beginning in early 2009. The WP will organise community E-ELT science meetings - one meeting will be held every other year. The meetings will be particularly important for maintaining dialogue between the E-ELT project, the instrument teams in the community and the base of future E-ELT users. This will require staff to coordinate the work, organise meetings and write/edit science case documents.

The WP will provide continued support of the ESO- OPTICON Science Working Group. This involves providing funds to cover travel for SWG members in the community to attend SWG meetings.

The WP will deliver a detailed science case document to support the proposal for E-ELT construction.

WP10.2 European Network for High Time Resolution Astrophysics

The E-ELT represents a specific challenge to the HTRA community. This WP will develop science cases and concepts for telescope and instrument design. In particular, it will concentrate on the science foundations of HTRA, and include the implications of E-ELT, detectors and the data aspects of HTRA. The latter will include data storage, streaming, curation and HTRA aspects of virtual observatories. The science foundations will include a

theoretical and observational analysis of various astronomical targets as well as the underlying fundamental physics of the radiation field at very short time scales, such as quantum correlation effects. The instrumentation work will include issues relating to controller electronics for existing and future fast read-out detector systems. This WP will form specialist working groups, considering the various scientific and technical challenges and their possible mitigations. These groups will work closely with WP2, which is concerned with development of fast detectors. The efforts of the working groups will be presented and discussed in a wider forum through workshops. The WP will hold two specialist workshops, bringing together the European HTRA scientific community. The programme will culminate with an international conference on HTRA, which will build on workshop outcomes, and will include relevant aspects of expected E-ELT performance and instrumentation plans, more general detector developments, and relevant data handling techniques.
Deliverables 10.1.1: Community E-ELT Science meeting report (13) 10.2.1: International Conference (36)

Work package number	WP11		Start date		01-01-2009	
Work package title	Enhancing community skills -- Strengthening Skills					
Activity type	COORD					
Participant number	3	2	5	20	18		
Participant short name	CNRS	ESO	MPG	UDUR	FEUP		
Person-months per participant	0(12)	0(2)	0(1)	0(2)	5		

Objectives The objectives of this WP are to teach the skills necessary to use state-of-the-art European astronomical infrastructures, to develop the user community regardless of nationality and to enable both established and new communities to participate fully in the use and development of the newest large scale facilities.

Description of work:

WP11.1 – Community Development: This WP will organise activities transferring knowledge from experienced astronomers familiar with forefront observatories to new users (young scientists, or scientists from the new member states). These activities include technical schools and workshops organised in leading institutes or observatories and short term exchanges of engineers or scientists. The activity will be managed by a Steering Committee comprising experienced people from leading institutes and observatories plus representatives from the "targeted" communities. It will work in coordination with the SREAC (Sub-Regional European Astronomical Committee, gathering all countries from South-Eastern Europe and their neighbours) and the EAS (European Astronomical Society), to ensure an appropriate communication with, and feedback from, the user community at large , and in particular from the new EU member states. The tasks are organised according to the primary objectives.

WP 11.1.1 Organisation of observing schools This WP addresses mainly the first objective: "to train young researchers in observing techniques and data reduction early in their careers". It will organise "Observing schools" hosted by observatories equipped with modern instrumentation where medium-size telescopes (1-2m) are used to conduct a genuine research programme. The training will be conducted in small groups (typically 4 students) under the supervision of an experienced astronomer. The process will include preparation of the observations, set-up of the instruments, observations, data reduction and presentation of the scientific results, all within a two week duration school. With the development of large databases and virtual observatories, and the increasing importance of multi-wavelength studies, specific training is also required to optimally extract, evaluate, and then exploit these data. This will be done by schools which simply replace newly obtained telescope data by archive data, all other organisational details being similar.

WP11.1.2 LaCaille exchange grants. The WP will develop a programme to fund short (up to one month) visits of engineers or scientists to leading institutes all over Europe, with emphasis on development of modern instrumentation or observing techniques. Announcements of opportunity will be periodic, selection made by a specific board, but with a time scale flexible enough to allow rapid response to emerging needs.

WP11.1.3 Organisation of "Awareness" conferences. The WP will organise workshops given by a small team of expert scientists and instrumentalists (assembled by OPTICON) at Universities or National Observatories. These events of a few days duration will address students ready to engage on a PhD programme, 3rd cycle young researchers or even more senior scientists gathered in a single place from all over a country or region.

They will present the top-level existing facilities in Astrophysics, their scientific capabilities, as well as the future facilities with their science cases, thus covering a broad range of subjects.

WP11.2 The European Interferometry Initiative

This activity will maximise community-wide involvement in the world's first common-user large telescope interferometer, ESO's VLTI, strengthening both scientific and technical involvement. The WP will include an exchange programme, three astrophysical working groups to define a European vision and strategy for interferometry in the ALMA/E-ELT era. The groups will review the specific areas to put 2nd generation VLTI instrumentation in context with available and planned facilities and instrumentation, exploiting synergies and complementarities. These groups will include experts from outside the extant consortia, in order to build an open and participative science vision for the near future of the VLTI.

WP11.2.1 Fizeau exchange grants

The WP will organise a programme of grants to fund one month exchanges (travel and accommodation) of PhD students, post-docs and established researchers in the field of optical interferometry across Europe. They will be announced twice a year and awarded by a selection board.

WP11.2.2 Circumstellar disks and planets working group this working group will address the science of Circumstellar disks and planets in the context described above.

WP11.2.3 AGNs and the galactic centre working group this working group will address the science of AGNs and the galactic centre in the context described above.

WP11.2.4 Science cases for a second generation facility

This third group will develop a long term science vision for optical interferometry in the E-ELT and ALMA era.

WP11.2.5 European Interferometry Initiative (EII) Meetings

The WP will organise meetings of the scientific council of the European Interferometric Initiative which joins representatives of Austria, Belgium, Czech Republic, France, Germany, Hungary, Italy, Israel, Netherlands, Poland, Portugal, Spain, Switzerland, United Kingdom, ESO and ESA in yearly meetings.

Deliverables

11.1.1.1: Observing school (Telescope) (18)
11.1.1.2: Observing school (Archives) (20)
11.1.3.1: Awareness conference (21)

Work package number	WP12		Start date		01-01-2009		
Work package title	Enhancing the community – Optimising Science Access						
Activity type	COORD						
Participant number	6	8	12	17	30		
Participant short name	STFC	KIS	Themis	NOVA	ASTRON		
Person-months	74	24	9	0.3	12		

Objectives

This WP has multiple objectives relating to the development of night time and day time (solar) astronomy. These include:

- Developing better-coordinated strategic planning and more cost-effective operation models for medium-sized telescopes within the framework of European astronomy.
- Supporting trans-national access to the OPTICON telescope network.
- Integrating our user communities effectively in the future development and use of European night-time astronomical and solar telescopes;
- Co-ordinating the development of the scientific programme, organisational framework, and operational concept for a large European Solar Telescope in cooperation with the European and wider international solar communities.

Description of work

WP 12.1 A Telescope Directors Forum. A forum of Directors of all the major European medium sized telescopes (night time and solar) will meet to develop actions of common interest to medium sized telescopes, both those in the TNA network, and those currently of lesser international competitiveness. It will work closely with the activities on training and integrating new communities (WP11) some of which will use facilities in the telescope network. The forum's objectives will be to achieve further bi-or multilateral co-operation inside and outside the OPTICON programme with regards to such things as observing time exchanges, sharing of software, access to expensive but seldom used facilities such as coating plants, and exchange of experience on major but infrequent system upgrades, such as control systems and instrument electronics. It will provide oversight of WP12.1.2, 12.1.3 and 12.1.4. It will commission groups, including representatives of telescopes not in the network, to investigate how best to enhance the programme to further benefit the whole community.

WP 12.1.2. A common observing time allocation process. The WP will develop a single time allocation process for all EU supported Trans-national Access time on European medium sized night time and solar telescopes. This pan-European time allocation process will provide a common standard of review for all observing proposals, and the opportunity to tune the outcomes to meet the strategic goals of closer integration and the delivery of new opportunities for smaller communities. To ensure high scientific quality, avoid duplication and encourage synergy, the Time Allocation Committee will invite representation from the national panels which will still allocate the bulk of the time of these facilities during the FP7 contract period. A parallel process will operate for the solar telescopes.

WP 12.1.3 Development of the NORTHSTAR common proposal tool. To ensure simplicity and efficiency of the allocation process, the common time allocation process will benefit from a common proposal system. Taking maximum advantage of software developed in FP6, this WP will build a versatile application that can support proposal submission and handling for all telescopes within the OPTICON network. This software will be designed to be exportable to any other European telescope wishing to adopt it. This activity will be led by ASTRON, who developed the Radionet 'NORTHSTAR' package under FP6.

WP 12.1.4 A trans-National Access Office. The WP will establish a small group charged with day to day support of the Trans-national access programme. The office will be responsible for all practical matters dealing with providing access to EC supported users and act as the primary interface with those users. It will also collect statistics, deliver reports on past results and provide advice on future planning. It will be based at the ING group of telescopes in La Palma, Spain, close to many of the telescopes in the network

WP 12.2 Planning for a viable future. European astronomy, through the ERANET AstroNet, is creating a strategic plan for the future development of astronomy facilities. This includes proposing a reorganisation of our current mid-sized facilities to improve efficiency and cost effectiveness, to identify, develop, and implement complementary approaches to delivery of the resources to satisfy the increasing needs of the widening European astronomical research community OPTICON and AstroNet are collaborating in this process, and will establish a joint review.

WP12.3 The European Association for Solar telescopes (EAST). European Solar astronomy is poised for a quantum leap in capabilities with plans for a large solar telescope included in the AstroNet science vision roadmap. This WP will establish groups which will address key objectives towards this goal. Membership of these workgroups will be recruited from within the EAST consortium as well as from other institutes in EAST member states. The Annual EAST General Assembly, the EC and Final reports and the management of the network activities will be led by KIS. Solar facility directors will participate in the Directors Forum and advise on the development of the NORTHSTAR proposal tool tuned for solar telescopes.

WP 12.3.1 will be responsible for the trans national access solar time allocation committee. This work group will be chaired by THEMIS and will consult through the TDF on NORTHSTAR development.

Deliverables

12.1.1: NORTHSTAR package for Astronomical TAC (24)
12.1.2: Telescope Directors' meeting (24)
12.1.3: Final report on Access delivered (48)

Table 1.3.6: Project Effort Form 1 – Indicative efforts per beneficiary per WP

Workpackage	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	WP10	WP11	WP12	TOTAL per beneficiary
UCAM				0				60					60
ESO	67.2	6		10			✓		1				84.2
CNRS	44.4	132	12	15	12		✓		8				223.4
INAF	22.8			0.2	0	23	✓		8				53.8
MaxPlanck	45.6			10			✓						55.6
STFC	12				16		✓	48	5	51		74	206
IAC						17	✓						17
KIS	3.6						✓					24	27.6
RSAS							✓						
AAO			14				✓						14
NOTSA							✓						
THEMIS							✓					9	9
NOAthens							✓						
LIVJM							✓						
ONERA	27.6			0.4									28
CSEM					5.5								5.5
NOVA				5	22		✓		3			0.1	30
FEUP				2							5		7
POLIMI						17							17
UDUR	36		14										50
NUIG							✓			8			8
ASTRON							✓					12	12
	259.2	138	40	42	55.5	57		108	25	59	5	119	907

Table 1.3.6: Project Effort Form 2 – Indicative efforts activity type per beneficiary

Project number (acronym): OPTICON

Activity type	UCAM	ESO	CNRS	INAF	MaxPlanck	STFC	IAC	KIS	RSAS	AAO	NOTSA	Total Activities
RTD												
WP1		67.2	44.4	22.8	45.6	12		3.6				195.6
WP2		6	132									138
WP3			12							14		26
WP4		10	15		10							35
WP5			12			16						28
WP6				23			17					40
TOTAL		83.2	215.4	45.8	55.6	28	17	3.6	0	14	0	462.6
COORD												
WP9		1	8	8		5						22
WP10						51						51
WP11												0
WP12						74		24				98
TOTAL	0	1	8	8	0	130	0	24	0	0	0	171
MGT												
WP8	60					48						108
TOTAL	60					48						108
SUPP												
TOTAL												
TOTAL BENEFICIARIES	60	84.2	223.4	53.8	55.6	206	17	27.6	0	14	0	741.6

CONTINUED ON NEXT PAGE

Activity type	THEMIS	NOAthens	LIVJM	ONERA	CSEM	NOVA	FEUP	POLIMI	UDUR	NUIG	ASTRON	Total Activities
RTD												
WP1				27.6					36			63.6
WP2												0
WP3						5			14			14
WP4				0.4		22	2					7
WP5					5.5							27.5
WP6								17				17
TOTAL	0	0	0	28	5.5	27	2	17	50	0	0	129.1
COORD												
WP9						3						3
WP10										8		8
WP11							5					5
WP12	9										12	21
TOTAL	9	0	0	0	0	3	5	0	0	8	12	37
MGT												
WP8												
TOTAL												
SUPP												
TOTAL												
TOTAL BENEFICIARIES	9	0	0	28	5.5	30	7	17	50	8	12	166.1

B1.3.7 Milestones

The RTD work packages include a significant number of internal technical reviews and assessments. There are no milestones on the scale of a whole work package. The Executive and Board implement annual progress reviews. Progress against internal milestones will be described in the EC reports. A possible EC Mid-Term Review is noted, should it be requested.

Tentative schedule of project review			
Review no.	Tentative timing, i.e. after month X = end of a reporting period	*Planned venue of review*	*Comments, if any*
1	After project month: 24	TBC	Mid-Term Review

B2 Implementation

B2.1 Management structure and procedures

Management structure: A multi-layer delegation-plus-monitoring process will be used. Each activity has a designated project manager, responsible for its day-to-day delivery to requirements and budget. All activities will be monitored regularly but non-invasively by a small central project office. Full annual appraisal of performance of projects and project office is provided by detailed review of the EC reporting documents, and financial status information, by an Executive Committee made up of the main national funding agencies plus wider community members. A Board with representatives from all participants, and the wider community, and with all Work Package leaders present, will receive regular project presentations from the WP leaders, ensuring full project-wide communications.

The origin of the OPTICON management structure is a system of best practice implemented by national funding agencies, and adapted to and adopted by the OPTICON FP6 activities. It has been successfully implemented in FP6.

OPTICON has as its senior body a management Board.

Management Board

Strategic decisions will be made by the OPTICON Board which will meet approximately every 12-48 months. The board will comprise a representative of every OPTICON partner, and other community representatives as the Board may wish to invite. All Work Package leaders are expected to attend Board meetings, to provide overview presentations of their WP activities, status, and progress to the whole consortium.

Executive Committee

A subsidiary body of the OPTICON Board, to be known as the OPTICON Executive Committee, will oversee the day-to-day implementation of the OPTICON programme. This will meet as required, typically once a year. The membership will comprise a representative of a subset of the national and international agencies, and such others as the Board may decide.

Management Team

The OPTICON Co-ordinator will appoint a management team (to be called the Project Office) led by a Project Scientist.

The project office will undertake the following tasks:

- Provide secretariat support for the OPTICON Board and the OPTICON Executive Committee – prepare and/or commission papers, reports, organise meetings; take minutes.
- Commission from the various elements of the OPTICON programme the reports, forward projections and other documentation required for EU reporting.
- Receive financial and progress reports from the various elements of the OPTICON programme.
- Assemble and collate the commissioned reports, and provide any covering or overview documentation for EU reporting and submit to the OPTICON Co-ordinator for approval and submission to the EU.
- Ensure that plans, schedules and forward projections for the various elements of the OPTICON programme are reviewed annually.
- Create and maintain the central OPTICON Web page and presence.
- Promote the activities of OPTICON in international forums.
- Receive reports for the Executive Committee from the Access Office, including the financial reports and reconciliation of expenditure against advances.

- Receive annually proposals and cost estimates outlining the planned programme of networking activities.
- Prepare for the Co-ordinator papers to the Executive Committee for decisions on which programmes and activities will be supported.
- Receive progress reports, financial reports and forward projections of activity and financial requirements from the Work Package leaders.
- Receive details (schedules and documentation) of progress from each Work Package.
- Attend Work Package meetings as appropriate.

Management of Individual Activities:
Each network and RTD activity has an identified leader. This individual is responsible for producing the main deliverables of that particular activity. This individual, or their delegates, is responsible for reporting on progress to the board and Executive Committee.

Work package Implementation: For all WPs, internal communication between the Participants will be ensured by dedicated meetings and proper dissemination of documents.

- ***General Meetings***: These meetings will involve the lead scientists from the participant institutions, and will occur every 9-12 months. Each will review progress, disseminate results to the whole project, and other interested parties from other OPTICON activities, and plan for future research. Meetings will be held in the participant institutes so that scientific sessions will permit the local staff involved to give detailed reports and interact with the Steering Committee. Representatives from related RTD and networking activities will be invited to attend.
- ***Progress Meetings***: Progress Meetings will be decided on a case by case basis between the Participants and subcontractors to discuss specific technical progress. Minutes of the Progress Meetings will be made available through a dedicated web page.
- ***Internet:*** Documents will be circulated by electronic mail. A dedicated Web site with public and restricted access will be created by the WP coordinator to disseminate all documents produced by the activity.
- ***Wider communications:*** regular overview progress reports to a full Board meeting which will be used to ensure project-wide communications.

B2.2 Beneficiaries

Partner 1: UCAM: Cambridge University, UK

Cambridge University is a large teaching and research University with a high international reputation. A central Research Services Division provides legal, funds management and transfer services, and financial management support as needed to support proposals and projects. This specific activity is based in the Institute of Astronomy (IoA), a large research and teaching Institute with a very high international reputation, and its own management support team. The relevant staff include the project Coordinator, Prof Gerry Gilmore, Professor of Experimental Philosophy, and Suzanne Howard, OPTICON PA. Both have experience in coordinating and managing OPTICON through FP6. Some technical work in interferometry (WP4) will be in Cambridge, involving an expert group from the Cavendish (Physics) Laboratory.

Partner 2: ESO: European Southern Observatory (international organisation)

ESO is the intergovernmental European Organisation for Astronomical Research in the Southern Hemisphere. On behalf of its fourteen member states ESO operates a suite of the world's most advanced ground-based astronomical telescopes located at the La Silla Paranal Observatory in the Atacama Desert in Chile. The ESO Headquarters are situated in Garching near Munich, Germany. ESO is supported by 13 member states: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Italy, the Netherlands, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

ESO is coordinating the construction of large infrastructures and instruments like the Very Large Telescope (VLT), the VLT interferometer, ALMA and is designing the future 42m European Extremely Large Telescope.

The Adaptive Optics Department (~20 researchers) within the Telescope System Division, leading the WP1a & 1b of the current contract and involved in the WP2, has developed and put in operation several adaptive optics systems over the last decade for the European astronomical community. The ESO Adaptive Optics Department has been involved or has led successfully several European programmes in the frame of FP4, FP5 and FP6: Training & Mobility of Researchers, Research & Training Network, OPTICON-JRA1 &2, Extremely Large Telescope Design Study and more recently has been asked to lead the E-ELT upgrade path work package of the E-ELT Preparatory Activity in the frame of FP7. The ESO Optical Detector Department (ODT) has developed several detector systems for astronomical instruments in operation in Chile as well as for Adaptive Optics. ODT has successfully followed up a fast readout, low noise detector development for Adaptive Optics in the frame of FP6 OPTICON JRA2. In the current contract, ODT is involved in the follow-up of a Laser Guide Star wavefront sensor detector for AO.

Partner 3: CNRS: Centre National de la Recherche Scientifique, France

CNRS is the French national research organisation, funded by the Ministry of Research. Among its many constituent laboratories and groups several play leading roles in OPTICON. These include Lyon, Nice, Grenoble, and Paris

CNRS/LAOG: The Laboratoire d'Astrophysique de Grenoble (LAOG) is a joint laboratory of CNRS and University Joseph Fourier. One of its main research areas is the study of stellar and planetary formation, through modelling, observations and instrument development. LAOG has developed over the past 15 years expertise in the fields of high contrast imaging, using adaptive optics and coronagraphy, stellar interferometry and infrared cameras (for both high contrast and wide field imaging).

CNRS LESIA (Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique) is a research laboratory (CNRS UMR 8109 located at Observatoire de Paris in Meudon) in the field of astronomy and astrophysics depending on 4 legal entities (CNRS, Observatoire de Paris, Université Paris 7 and Université Paris 6). LESIA is developing scientific instruments both for ground based telescopes and for Space missions. It has a long record of instruments in use for many years in the field of astronomy. The laboratory has 146 permanent staff members including 70 engineers and technicians.

The following third parties are linked to CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE (CNRS)

- OBSERVATOIRE DE PARIS
through the Joint Research Unit UMR 8109 (Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique))

- UNIVERSITÉ DE NICE SOPHIA ANTIPOLIS
through the Joint Research Unit UMR 6525 (Laboratoire Hippolyte Fizeau)

These *beneficiaries* may charge costs incurred by the above-mentioned third parties in carrying out the *project*, in accordance with the provisions of the *grant agreement*. These contributions shall not be considered as receipts of the *project*.
The third parties shall identify the costs to the *project* mutatis mutandis in accordance with the provisions of the *grant agreement*. The *beneficiary* shall provide to the *Commission*:

- an individual financial statement from each third party in the format specified in Form C. These costs shall not be included in the *beneficiary*'s Form C
- certificates on the financial statements and/or on the methodology from each third party in accordance with the relevant provisions of this *grant agreement*.
- a summary financial report consolidating the sum of the eligible costs borne by the third parties and the *beneficiary*, as stated in their individual financial statements, shall be appended to the *beneficiary*'s Form C.

When submitting reports the *consortium* shall identify work performed and resources deployed by each third party linking it to the corresponding *beneficiary*.

The eligibility of the third parties' costs charged by the *beneficiary* is subject to controls and audits of the third parties.

The *beneficiary* shall retain sole responsibility towards the *Community* and the other beneficiaries for the third parties linked to it. The *beneficiary* shall ensure that the third parties abide by the provisions of the *grant agreement*.

Partner 4: Istituto Nazionale di Astrofisica, Italy

INAF is the National Institute for research in astronomy in Italy. It coordinates and directly finances astronomical research for the whole non-university based community, therefore more than 90 per cent of the researchers in the field belong to INAF (570 scientists with a permanent position); furthermore, the large majority of University professors are associated to INAF.
All Italian astronomical facilities on the ground are built, maintained and run by INAF; among these are the 4 meter Galileo Telescope in Canary Islands, the twin 8 meters LBT Telescope in Arizona (25% share), the two 32 meters VLBI antennas in Sicily and Bologna, the 60 meters antenna being presently built in Sardinia (SRT). Several INAF institutes are activity leaders in OPTICON.
Brera Astronomical Observatory covers the field of Optics, mechanics, finite element analysis, system engineering and project management. Brera has specialised in the area of new materials and processes in optics for Astronomical Instrumentation.
The AO group of the Arcetri Observatory (OAA) has been active in the field of AO since 1994. In the period 1994-2007 the group undertook several national and international projects. The most important of those were the development of pyramid wavefront sensors and Adaptive secondary mirrors for the LBT telescope. The group is also involved in other experiments related to wavefront sensing like the High Order Test bench (HOT, FP6 OPTICON-JRA1) experiment and the Active Phasing Experiment (APE, FP6 E-ELT Design Study).

Partner 5: Max Planck Gesellschaft, Germany

Two laboratories of the MPG lead activities in FP7. These are MPIA and MPE. MPIA additionally manages telescopes in the Access programme.

MPIA is the Max-Planck Institute for Astronomy in Heidelberg which is an astronomical research institute with more than 200 staff. MPIA runs a vast instrumentation programme for the VLT, the LBT, and participates in two phase-A studies of the MIDIR and MICADO E-ELT instruments. It is a partner in the operation of the Calar Alto observatory, together with the IAA in Granada, and belongs to the LBTB consortium. Apart from instrumentation development for ground based observatories, MPIA participates in international consortia that provide instruments for Herschel, JWST, and other space missions.

MPE is the Max Planck Institut für extraterrestrische Physik in Garching, Germany which is an astronomical research institute with more than 400 employees. Scientific work is done in four major research areas that are supervised by one of the directors. MPE runs a vast instrumentation programme for the VLT, the LBT and belongs to the LBT consortium. To run advanced extraterrestrial physics and state-of-the-art experimental astrophysics, the institute continues to develop high-tech instrumentation in-house.

Partner 6: Science and Technology Facilities Council, UK

STFC is the UK national funding agency for astronomy, particle and nuclear physics. Its involvement in OPTICON includes several telescopes in the Access programme, and technical leadership roles in several WP, including hosting the OPTICON Project Scientist. These activities are all managed through the UKATC.

The UK Astronomy Technology Centre (UKATC) is the UK's National centre for the design and production of world leading astronomical telescopes, instruments and systems. Its customers include both space missions and the telescopes of the European Southern Observatory (Chile), the Gemini Observatory, the Isaac Newton Group of Telescopes (La Palma), the UK Infrared Telescope (Hawaii), the James Clerk Maxwell Telescope (Hawaii) and the upcoming ALMA telescopes (Chile). To meet the needs of these customers the UKATC employs a staff with specialist expertise including: systems engineering and project management; infrared/sub-mm optical design; cryogenics and low-temperature engineering; mechanism design and analysis; stiff structures with low vibration.

Partner 7: Instituto de Astrofisica de Canarias, Spain

The Instituto de Astrofísica de Canarias (IAC) is an internationalised Spanish research centre. It has two headquarters and two observatories set in an environment of excellent astronomical quality, both constituting the European Northern Observatory (ENO). The Instituto de Astrofísica is the main headquarters and normal workplace of the greater part of its staff. Here, astrophysical research and technical projects are developed. There is also a postgraduate school. The IAC also considers scientific outreach as one of its principal aims.

The IAC operates the European Northern Observatory at the Canary Islands where more than 60 international research institutions from 19 countries have installed and operate their telescopes.

Partner 8: Kiepenheuer-Institut fur Sonnephysik, Germany

The Kiepenheuer-Institut für Sonnenphysik (KIS), a member of the Leibniz association, is the largest German institute specialized in solar physics. It is located in Freiburg, Germany and has a staff of about 60 people. The KIS is a Foundation under Public Law of the State of Baden-Württemberg. The KIS offers regular courses in Astronomy and Astrophysics at the University of Freiburg.

The institute operates the German solar telescopes at the Observatorio del Teide, Tenerife, and leads the construction of the 1.5m solar telescope GREGOR. It participates in several international instrumentation projects for the ground and space. The scientific work of the KIS is dedicated to the physics of the Sun. The observational work is focused on but not limited to its telescopes on Tenerife. Data from space-borne and other ground-based telescopes are used as well. Theoretical work is focused to numerical calculations in the area of magneto-hydrodynamics of the outer layers of the Sun.

Partner 9: The Royal Swedish Academy of Sciences, Sweden
The Institute for Solar Physics (ISP) belongs to the Royal Swedish Academy of Sciences and operates the Swedish 1-m Solar Telescope (SST), which is part of the Access programme.

Partner 10: Anglo-Australian Telescope Board, Australia
The AAT Board (AATB) is an independent, bi-national authority funded by the United Kingdom and Australian Governments. The AATB owns the Anglo-Australian Observatory (AAO) and operates the Anglo-Australian Telescope (AAT) and the UK Schmidt Telescope (UKST), which are in the Access programme. The AAO has operated the AAT since 1974 and the UKST since 1988.

Partner 11: Nordic Optical Telescope Scientific Association, Denmark
The Nordic Optical Telescope (NOT) Scientific Association (NOTSA) was founded in 1984 to construct and operate a Nordic telescope for observations at optical and infrared wavelengths. The current Associates of NOTSA are the relevant Nordic country national funding agencies:

- Forskningsrådet for Natur og Univers (Denmark)
- Suomen Akatemia (Finland)
- Háskóli Íslands (Iceland)
- Norges forskningsråd (Norway)
- Vetenskapsrådet (Sweden)

The NOT telescope is part of the Access programme.

Partner 12: THEMIS S.L., Spain
THEMIS is a joint operation of France (CNRS) and Italy (CNR) national research agencies. It is located at Izana , 2400 m, within the Teide Observatory from the Instituto de Astrofisica de Canarias, on the island of Tenerife (Canary islands, Spain). The Themis telescope is in the Access programme.

Partner 13: National Observatory of Athens, Greece
NOA-IAA operates two Observatories; Helmos and Kryoneri Observatories where a 2.3m and a 1.2m telescope exists, respectively. At Helmos Observatory there is the 2.3m "Aristarchos" telescope which belongs to the OPTICON Access group of telescopes.

Partner 14: Liverpool John Moores University, UK
LJMU is a major university which operates the Liverpool Telescope, which is part of the Access programme.

Partner 15: Office National d'Etudes et de Recherches Aerospatiales, France
ONERA (Office National d'Etudes et Recherches Aérospatiales) is the French national aerospace research centre (1,500 scientists, engineers and technicians). ONERA Optics Department (DOTA) has more than twenty years of experience in Adaptive Optics with a successful record of AO projects: COME-ON+, ADONIS, NAOS and more currently SPHERE-SAXO. More recently, DOTA is involved in several AO system studies for the European E-ELT: 2.6-m large adaptive mirror, Multi Object AO based instrument (EAGLE), Multi-Conjugate AO module. Optimal control for Adaptive Optics has been a core activity of the DOTA and experimental demonstration has been performed in the FP6 JRA1 framework.

Partner 16 : Centre Suisse d'Electronique et de Microtechnique SA, Switzerland
Established in 1984, CSEM (Centre Suisse d'Electronique et de Microtechnique SA) is a private R&D centre specialising in microtechnology, nanotechnology, microelectronics, systems engineering and communications technologies. It provides its industry customers and partners with tailor-made, innovative product solutions based on its commercial and technological expertise, further expanded by the results of its applied research. Additionally, through the establishment of start-up businesses, it actively contributes to developing Switzerland as a centre of industry and commerce. To date,

CSEM has established a total of 25 new enterprises with more than 500 employees. More than 340 highly-qualified employees from the most varied scientific and technical fields work for CSEM in Neuchâtel, Zurich, Alpnach and Landquart. They represent more than 20 different nationalities and constitute the basis of the company's creativity, dynamism and innovation potential.

Partner 17 : Universiteit Utrecht on behalf of Nederlandse Onderzoekschool Voor Astronomie (NOVA), Netherlands

NOVA is a federation of the astronomical institutes at the universities of Amsterdam, Groningen, Leiden, Nijmegen and Utrecht, currently legally represented by the University of Utrecht. NOVA is one of the six national top research schools. NOVA's status and funding are secured by the Dutch Minister of Education, Culture and Science through at least 2013. NOVA astronomers have experience in the chain from scientific idea, instrument concept, design and construction to successful science data collection and analysis for instruments at international facilities on the ground and in space. Over the last seven years NOVA was prime NL contract partner for ESO on seven instrument projects for the VLT, the VLT Interferometer and ALMA, and for ESA on JWST-MIRI. The NOVA Optical Infrared Instrumentation Group hosted at ASTRON is the national expertise centre for optical-infrared astronomical instruments. Its expertise also includes working experience on systems aspects of astronomical instruments, opto-mechanical design, cryogenics and construction and testing of complex instruments.

The contractor Universiteit Utrecht represents also the following members of Opticon (referred to here as "member(s)") – Univeristy of Amsterdam (UvA) – University of Leiden – Groningen Unversity – University of Nijmegen.

Partner 18: Faculdade de Engenharia da Universidade do Porto, Portugal

The Faculty of Engineering of the University of Porto (FEUP) is the largest of the 14 faculties of the University of Porto, the largest university of Portugal. The faculty has 24 R&D/interface units ranging from chemistry to precision mechanics and biomechanics. The faculty has established collaborations with several international institutions, such as the European Space Agency (ESA), IBM, Microsoft and the European Organisation for Nuclear Research (CERN), as well as research universities such as the Massachusetts Institute of Technology (MIT), the University of Texas at Austin (UTA) and the Carnegie Mellon University (CMU).

Partner 19: Politecnico di Milano, Italy

The Politecnico di Milano was established in 1863. The Politecnico di Milano is now a science and technology university producing engineers, architects and industrial designers through a variety of innovative specialist courses, with great attention being devoted to all sides of education. The Politecnico di Milano has always been based on quality and innovation in teaching and research, resulting in a prolific relationship with the economic and manufacturing worlds through experimental research and the transfer of technology. During FP6 POLIMI played a major and highly successful part in new materials modeling and creation under Prof Zerbi.

Partner 20: University of Durham, UK

Durham is one of the UK's leading universities, with specific expertise in astronomical instrumentation through its Centre for Astronomical Instrumentation, housed in a large modern facility. CfAI has a long heritage in design and construction of innovative facility-class instruments: pioneered robot multifibre systems (with AAO); monolithic techniques for image-slicing integral field spectroscopy; first integral field spectroscopic facility on an 8/10m telescope; very experienced with multiple fibre systems. Recent instrument projects include GMOS (Gemini), FMOS (Subaru), KMOS (ESO-VLT) and NIRSpec-IFU (JWST). It is a major centre for Adaptive Optics (real-time systems, numerical modelling and laser beacons), recently adapting astronomical techniques to the life sciences; extensive publications on astronomical applications in photonics; partner with AAO on two Astrophotonics projects; extensive test and metrology facility and precision optics micro-optics facility.

Partner 21: National University of Ireland, Galway, Ireland

The National University of Ireland, Galway was established in 1845 and currently has over 15,000 students undertaking a range of taught programmes and research throughout its seven faculties and many Research Centres. The university currently manages over 70 EU projects and since 1999 NUI, Galway has won over €68.5m in research funding. The main task that is attributed to NUI, Galway is the principal investigator of the HTRA Network. NUI, Galway was a partner in the OPTICON FP6 project for the HTRA Network.

Partner 22: Stichting Astronomisch Onderzoek in Nederland (ASTRON), Netherlands

ASTRON is an institute of the Netherlands Organization for Scientific Research, NWO. The main goal of ASTRON is to enable discovery in astronomy by operating and developing state-of-the-art astronomical telescopes and instrumentation. Engineers and astronomers at ASTRON have an excellent international reputation for innovative technology development, and fundamental research in galactic and extra-galactic astronomy. The primary responsibility of ASTRON in OPTICON is delivery and support of the NorthStar common observing proposal software system, a major OPTICON initiative designed to ease access by inexperienced users to the Access programme.

B2. 3 Consortium as a whole

The OPTICON consortium includes all the national and international organisations which own and operate Europe's modern medium-sized optical-infrared astronomical observatories and telescopes and many of the major Institutes and organisations which develop and build innovative instrumentation – hardware and software – for those observatories. Every relevant organisation is a partner, and every partner has a critical role. To complement this, two specific high-tech industrial partners are included. There is a total of 22 members. OPTICON is however very much more than the sum of its parts. OPTICON has become an organisation which truly integrates the European astronomical community across national and wealth boundaries, across subject specialisations, and across technologies. Nearly 70 institutes and organisations applied for OPTICON FP7 membership, indicating the breadth of community awareness, interest, and support. In FP7 OPTICON has expanded its FP6 community primarily through support for the **European Association for Solar Telescopes (EAST),** a collaboration of all European Institutes involved in ground-based solar astronomy, created to ensure access of European solar astronomers to world-class high-resolution ground-based observing facilities.

The OPTICON consortium exists to deliver a simple yet challenging set of strategic objectives:

- Structuring the whole European astronomical community, by ensuring all astronomers are able to carry out state of the art research on state of the art facilities.
- Developing European astronomy, by allowing astronomical communities to develop scientific plans for their own future facilities, and agencies to plan for a viable future set of facilities.
- Strengthening European astronomy, by delivering cutting edge technology research and development, helping ensure astronomical research facilities are state of the art, and internationally leading in performance.

The required consortium membership to attain those goals defines the OPTICON partnership.

The consortium is inclusive. The challenging and comprehensive nature of OPTICON's RTD activities require participation by all the major Institutes involved in complementary aspects of the RTD. A successful RTD programme requires the large number of technologically active Institutes in OPTICON to achieve a critical mass.

The consortium is able to deliver an Access programme which is second to none world-wide, and which provides a basis to plan for and implement a viable long-term affordable set of telescopes and observatories. This is possible only if all the relevant funding agencies, and all the relevant telescope directors, and all the community who are motivated to deliver a high-quality training programme for new and excluded users, are in the same place.

OPTICON provides the opportunity for currently world-leading expert and specialist groups to develop science plans for the future competitiveness of European astronomy.

Overall, and the real reason for OPTICON's scale, is that RTD developments are pointless unless there is an optimised set of telescopes to benefit from the technologies. The programmes to push those facilities to their limits, and the number of facilities required, come from the community's research ideas. And the community's research ideas come from enabling and empowering the whole community. It is delivery of that joined-up vision which defines the OPTICON consortium, and which is enabled by that consortium.

Industrial involvement: Two OPTICON partners are specialist high-tech industries; CSEM (partner 16) and ONERA (partner 15). Additionally, all the RTD effort involves close collaboration with industrial partners, as described in the relevant text. A major part of most OPTICON RTD work is to develop and prototype processes and capabilities which will be applicable for next-generation astronomical instrumentation. Thus close industrial partnership is a primary goal of our RTD programme, and is structurally embedded inside most OPTICON activities.

B2.3.1 Subcontracts:
OPTICON is pushing state of the art technology, in many cases with large and/or highly specialised manufacturing required. Substantial sub-contracting to European high-tech industry is anticipated, since this is the most cost-effective approach to state-of-the-art complex component provision. In the most expensive cases, industrial scale processes are involved, which do not exist in partners' laboratories. Sub-contracting is planned as follows:

WP1: Annular groove phase mask coronagraph (in 2-3 subcontracts):
This type of component is similar to classical single-stage, un-apodised coronagraphs. A team composed of scientists from University of Liege, CNRS-INSU-LESIA and Jet Propulsion Laboratory will evaluate several manufacturing operations. Subcontracts to Centre Spatial de Liège (for the Fused Silica deep etching), ADAMANTIS AB (for the Synthetic Diamond etching) and optionally to Jet Propulsion Laboratory (for the Silicon Etching) will be launched.

Ferro-electric Liquid Crystal modulator may be required (tbc):
An FLC modulator was originally developed for Solar observations and requires a very specific know-how not available in the OPTICON consortium. Boulder Nonlinear Systems (BNS), Lafayette CO, USA will be the provider of the FLC modulator. This organisation is the only provider of high-quality, custom-made polarisation rotators based on fast switching ferro-electric liquid (FLC) crystals in the world we know of.

Achromatic half wave plate:
Bernhard Halle Nachfl. GmbH, Berlin will be the provider for the achromatic half wave plate. This is a most experienced company for custom made, high quality, polarisation components for astronomical applications. They are also able to provide an optical design of these components including all polarisation effects (cross-talks, dependence on incidence angle). They shall provide achromatic half wave retarder plates which are extremely well polished so that they introduce static wavefront aberrations of less than 5 nm RMS.

MCAO deformable mirror + drive electronics for SST:
Deformable mirrors are complex components with piezo actuators glued to optical surfaces and driven by high voltages requiring a specific process mastered by few industrial partners in the world

Sodium laser pre-production unit:
The main objective of WP 1.6 is to develop a robust Sodium laser source to be used in an operational observatory under severe environmental conditions. This requires industry know-how and engineering procedures not available in the OPTICON Consortium.

Advanced SW modules for SPARTA Light to Shaktiware:
The subcontracted activity will be the development of flexible Real time software required to control small or laboratory AO systems: thus the name SPARTA "light". Shaktiware has developed extensive expertise in the field of Real Time Computer Software for the Very Large Telescope. The amount of human resources with the necessary know-how available in the OPTICON Consortium does not permit us to develop the required product internally.

Wide field Adaptive Optics Control: identification and robustness study to the Laboratoire de Traitement et Transport de l' Information (L2TI):
L2TI has collaborated with ONERA in the field of Adaptive Optics Control over the last 10 years. The necessary expertise to address this specific subject is not available in the OPTICON consortium.

WP2: A contract for an LGS AO detector construction to specification will be an open industrial call.

WP3, WP4, WP5, WP6 – all have requirements for specialist fabrications of small industrial items, which require industrial processes. These will be industrial contracts partly by necessity, but also as a means to develop close partnerships with appropriate commercial production expertise for future applications. Specifically this includes photonic component provision, and polymer moulding processes, advanced thin film fabrication, and coating deposition. It also applies to VPHG device fabrication, which requires an expensive holographic setup available only in specialized industries.

Unless a need for a specific process/device not available in EU Countries emerges in the course of the project, we are not expecting to outsource anything outside the EU, apart from those cases listed above..

The total value of all industrial subcontracts in this contract is anticipated to be approximately 3M€.

B2.3.2 Other countries: The programme to develop software standards in WP9.2 is the European part of a global programme (initiated in FP6). Activity outside Europe will continue on a no-exchange of funds basis.

B2.3.3 Possible additional beneficiaries: two activities involve a Call for Proposals (CfP) for participation. WP4 will use a CfP to identify the best proposals for innovative interferometric concepts for further study. WP9 will have a CfP to host the staff working on the E-ELT science case. In both these cases it is anticipated that an extant consortium member will be awarded the contract, since all major active participants in these projects are already in OPTICON. If necessary, in pursuit of excellence, we will expand the partnership.

B2.4 Resources to be committed

The activities in this project and their balance were determined through an extensive open Europe-wide call, assessment of the responses followed by a careful review of financial, technical viability, and strategic balance. This review was overseen by the senior funding agency and international organisation representatives on the OPTICON FP6 Executive Committee.
This review and assessment by experienced senior agency managers, together with identification of experienced managers at the Work Package level, ensures the allocated resources were appropriate and adequate for the orginally proposed programme.
Matching funds are required for RTD activities. Identification of these resources, and their assessment, has been analysed in detail by the relevant agencies. Each organisation and agency has confirmed, through their own individual review and prioritisation processes, that matching funding is available. In some cases this involves cash; in many it involves staff effort. Occasionally a relatively small resource input via OPTICON triggers a large national activity – e.g. in WP4.

In any project involving cutting-edge technology assessment and prototype development there are necessary uncertainties, which can imply financial rebalancing compared to day-one planning. Financial management of OPTICON during FP7 will follow the methodology established in FP6. This means that the Executive Committee will maintain a close financial and technical overview of the activities, and will if necessary re-balance resources as the technology assessments develop. This process will be integrated with national and international agency development plans as appropriate, and is of course subject to regular EC approval. It is the OPTICON FP6 experience, and the OPTICON FP7 intention, that this may result in an increase of agency external funding where a particularly high-importance RTD activity meets unanticipated requirements.

Possible other major costs: all anticipated costs are described in the WP text. The primary major costs, apart from the access programme, are staff, or are in sub-contracting, which is described in detail above.

B3 Potential Impact

OPTICON exists to deliver goals of high European-wide impact. These are:

i) to broaden the European astronomy community by integrating currently excluded communities (often in central and southern Europe) into state of the art research using the best modern facilities and techniques;

ii) to strengthen the European astronomy community by providing the resources for subject- and technique- specific research groups dispersed across Europe to meet and share expertise together, to plan for future new facility developments together, and to train young scientists in their disciplines;

iii) to allow the development of European astronomy infrastructures, i.e. telescopes, instrumentation and software, by researching and prototyping state of the art technology to ensure next generation instruments will deliver international leadership in research quality;

iv) to develop, jointly with the community and national funding agencies, a strategic plan to evolve the current array of astronomical facilities into a viable, optimised, complementary set of the highest quality facilities providing state of the art access to all European astronomers.

B3.1 Strategic Impact: Expected impacts listed in the work programme

B3.1.1 Broadening the European astronomical user community

The OPTICON Access programme, begun in FP6, brings together every 2-4m telescope with (partial or total) European ownership into a single programme, and supports the scientists awarded time through open peer-review. In FP7 we will take the next step, making a pro-active programme which integrates funded access of new users through a single unified pool of OPTICON telescope time. Applications for all telescope access will be through a common (OPTICON-provided) interface for every (nationally-funded) facility, minimising complexity for users. We will adopt a single central peer-review process for all OPTICON supported facilities. This will set high standards, but with consideration of possible inexperience in proposal preparation, allowing provision of advice, both scientific and relating to the proposal. This will inform an expanded targeted training programme, to migrate new users onto the very best facilities. This is a revolutionary concept in optical-IR astronomy, and will we hope revolutionise the coherence and quality of the European astronomical research community. This activity involves WP7 **Trans-national access**, WP11 **Enhancing the community - Strengthening Skills** and WP12 **Enhancing the community – Optimising Science Access.**

B3.1.2 Strengthening the European astronomical user community

Networks are grouped into sets. One, WP9, **Europe of the Future: Technologies,** includes activities related to planning, enhancing and developing the future of astronomical technologies at a strategic level. Another, WP10 **Europe of the Future: Science** includes activities supporting geographically diverse activities related to future scientific facility planning. WP11.2 **Enhancing the community - Strengthening Skills,** includes the European Interferometry Initiative (EII), a collective of all European Institutes working in and developing Interferometry as an astronomical tool for all users, while WP12 **Enhancing the community – Optimising Science Access** additionally includes EAST, the collective of all Institutes involved in ground-based solar astronomy. Both EII and EAST were developed to build on, and operate inside, OPTICON, their existence illustrating the structuring effects OPTICON is providing. The activities in WP9 include development of a Technology RoadMap for astronomy (KTN), and European involvement in a global initiative to define and establish software standards for next generation software data reduction systems (FASE-II).

The European Extremely Large Telescope (E-ELT) is the next major project in ground-based astronomy. The OPTICON activities will maintain the widest community involvement in the developing European E-ELT project. By continuing to develop the science case in the community, and coordinating the E-ELT science activities around Europe with the E-ELT project, we will ensure that the E-ELT is optimised for the biggest challenges, and so will meet the needs of European researchers.

B3.1.3 Developing European astronomical technological capabilities

OPTICON includes six RTD activities, WP1 to WP6. The technology work is described fully in the relevant parts of Section 1.3. Since they are all RTD activities, all have a common impact, which involves development of world-leading scientific infrastructures for European astronomy. The six technology programmes are all consistent with major facility development RoadMaps and national and agency strategic investment plans. The balance of expenditure is calculated to invest most heavily in the most challenging, but highest pay-back, development which is delivery of turnkey adaptive optics facilities on modern telescopes.

WP1 The primary goal of JRA1 is to design and develop Laser Guide Star Adaptive Optics systems for the existing large telescopes (twin 8m Large Binocular Telescope, Very Large Telescope, William Herschel Telescope), upgrade Adaptive Optics systems for Solar telescopes (Swedish Solar Telescope, 1.5m GREGOR telescope) and upgrade the Very Large Telescope Planet Finder (SPHERE) to maintain its competitiveness in the period 2010-2012. These programmes are all pathfinders for the future 42m European Extremely Large Telescope and for the 4m European Solar Telescope.

WP2 provides the complementary fast, sensitive low-noise photon-counting systems essential to utilise laser guide stars, and also essential for interferometry. European industry is currently world-leader in developing these systems. This RTD effort will support that continuing leadership.

WP3 will exploit developments in photonics by the telecommunications industry for astronomy and stimulate European industry through identifying the demanding requirements of modern astrophysics.

WP4: This activity, coordinated through the EII, is to identify the most promising new developments which can be applied in next generation instruments for Europe's new VLT Interferometer. Interferometry has enormous scientific potential but requires considerable technological development to deliver sensitivity to a wide range of astronomical sources and considerable work in data modelling and analysis to allow common-use applications. This effort will help to make interferometry a common-user capability for Europe's astronomers.

WP5: The primary goal of the Smart Instrument Technologies WP is to provide instrument builders with a suite of building blocks that will enable a paradigm shift in the way the ground-based astronomical community builds optical and infrared instruments. Smart technologies and devices will be developed so that European astronomical instrument builders can meet the demands made by the science community for wider fields-of-view, higher spectral and spatial resolutions, wider bandwidths and simultaneous spectroscopy of multiple objects while fitting within demanding size-footprints, mass budgets and engineering tolerances.

WP6: The programme is aimed to enable new technologies in the area of holography, polymers and related subjects. These technologies are studied in order to be used in future astronomical instrumentation developed by the european astronomical community.

Overall, this balanced approach positions the community well for design and development of the next generation of new infrastructures, critically required to ensure continuing European astronomical leadership in the world community. OPTICON will assist Europe's astronomers to play a leading role in an internationally competitive European Research Area. This will feed directly into work on the next generation of telescopes and their instruments.

B3.2 Plan for the use and dissemination of foreground

The beneficiaries of the project results are in several categories, requiring separate consideration. These include individual research astronomers, astronomers interested in specific subjects or facilities, scientists involved in technical RTD activities, industry, and funding agencies. The coordinator and project scientist provide occasional invited overview talks of OPTICON activities, which are disseminated globally through the usual international astronomy e-preprint servers (arXiv).

The results of widest geographical and user interest are the access programme (WP7, WP12.1, WP12.3) and its associated training and scientific enhancement opportunities (WP11). Beneficiaries of this programme work in astronomy across Europe, distributing their experiences through local contact.

Project specific interests include the several organised communities which operate as networks under the OPTICON umbrella. These are EAST (WP12.3), covering all solar astronomy Institutes in Europe, EII (WP11.2 and WP4) , including all Institutes with an interest in Interferometric astronomy, HTRA (WP10.2), including all astronomers interested in high time resolution astrophysics, and E-ELT (WP10.1), including the extremely wide community with a scientific interest in definition of the next-generation large astronomical facilities. In all these cases OPTICON sponsors both specialised workshops, of specific interest to the expert; open conferences, of interest to all astronomers, as an opportunity to learn new subjects, and contribute new science ideas to them; and publication of the workshop and conference proceedings. These books, major publications in themselves, are (usually) part of astronomy series produced by major publishers, and so are routinely made available in every university and observatory library world-wide.

The technical results of RTD activities are of interest to scientists involved in instrument developments, experimental physicists, industry, and (potentially) to a wider commercial community. Scientists involved in instrumentation and technical development are kept informed both internally inside OPTICON – note that every major instrumentation group is involved in some way in OPTICON – and externally, through presentations at specialist meetings. The major international specialist meetings are those of SPIE. SPIE meetings attract thousands of scientists and engineers from both academe and industry, and are the primary global forum for technical information exchange. OPTICON acts as a co-sponsor of those SPIE meetings relevant to astronomical technology, ensuring an extremely high international information exchange profile. Internally inside OPTICON, communication between the participants is ensured at the project-wide level by a requirement that every OPTICON activity provides an overview of its activities at project-wide Board meetings.

Dissemination of results of industrial relevance is subject to the IPR issues covered in the Consortium Agreement. This ensures that all OPTICON participants have access to a free license for any patented technology during the project.

The primary deliverables from OPTICON of importance to national agencies are the outcomes of the technology RTD work packages, and the outcome of the joint strategic planning for the future use of medium sized telescopes. In the first of these the agencies are involved through their institutes, as described above and additionally through the Key Technology Planning activity (WP9.1). This activity exists to ensure an updated Future Technology RoadMap is developed and maintained. This Roadmap is developed in partnership with relevant national and international (ESA, ESO) strategic planning, and is disseminated back through those partnerships. The Strategic planning work is a joint activity with AstroNet, which is an agency partnership, and is being developed iteratively with the funding agencies, ensuring their full participation and involvement.

B4 Ethical Issues

The coordinator, on behalf of all participants, confirms that none of the ethical issues listed in the 'Ethical Issues Table' applies to this OPTICON contract.

B5 Consideration of gender aspects

We have set an internal ambition that every appointment at Executive and Board level will explicitly consider gender, and that we will expand the remit of appointments beyond the formal partner communities if and as necessary. Specific gender sensitivity training was organised for some of our management team during FP6. Similar activities will be organised in FP7 as required.