Joint Research Activity 1
2nd generation Adaptive Optics for 8-10 m telescopes

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JRA1 Charter

DESIGN THE NEXT GENERATION OF ADAPTIVE OPTICS SYSTEMS FOR THE CURRENT EUROPEAN TELESCOPE FACILITIES

DEVELOP THE KEY TECHNOLOGY ENABLING THE CONSTRUCTION OF THESE SYSTEMS

Future AO needs in the European Community

- **AO-MCAO and XAO at the LBT**
- **AO and MCAO at the GTC**
- **XAO with high-contrast NIR instrument⇨ VLT Planet Finder**
- **Low background XAO in MIR ⇨ VISIR with VLT Adaptive M2**
- **Seeing reducer (6-8’ FOV – NIR)⇨ HAWK-I with VLT Adaptive M2**
- **Seeing reducer (1’ FOV–Visible-high SC)⇨ MUSE GLAO + multi-lasers**
- **Seeing reducer multi-buttons (30’ patrol - I-band)⇨ FALCON**
- **“Significant” Strehl -Sr(vis)=10%)- in 5”⇨ MUSE GLAO + multi-lasers**
- **Large FOV medium Sr(K)=60% ⇨ MCAO Imager a la Gemini**

R&D for 2nd generation AO

XAO GLAO MCAO concept definition

Piezo DM
41² act.

JRA 2

WFS CCD

256² pixels

0.5 -1.5 kfps

3-1e RON

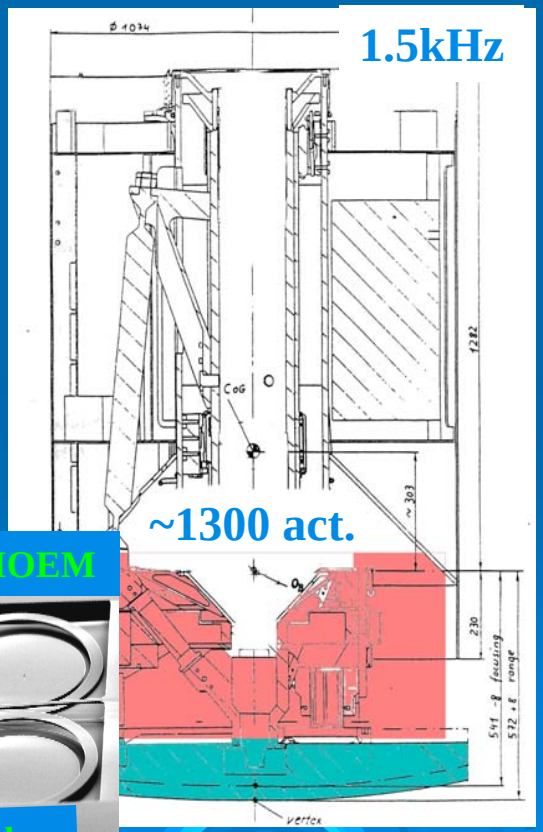
QE: 90%

LETI-LAOG MOEM

800 µm pitch

VLT Deformable M2

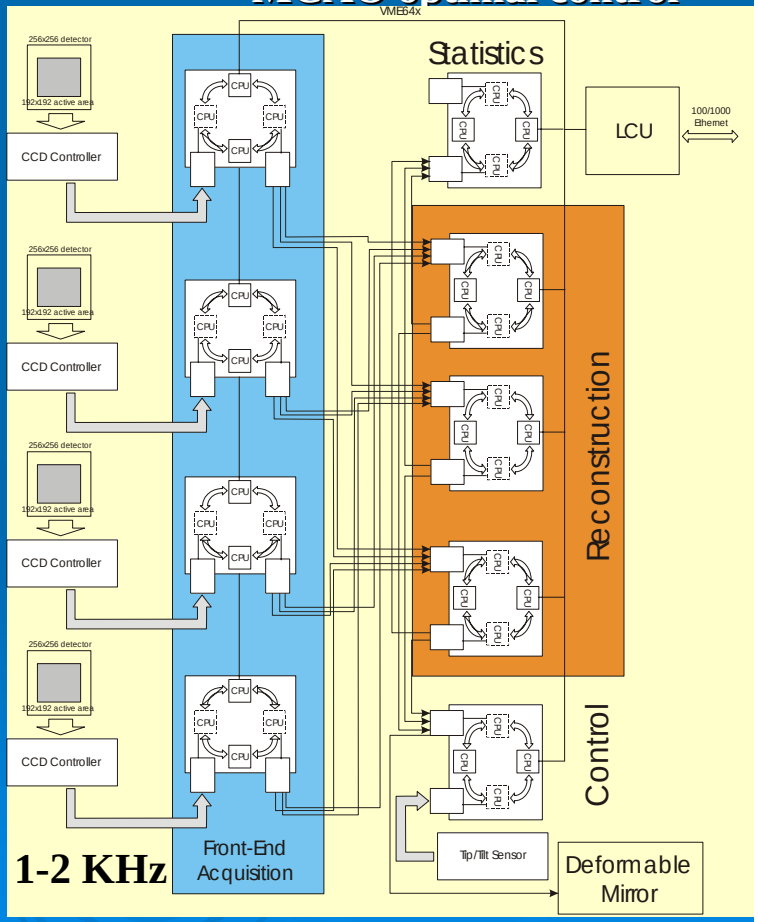
1.5kHz



~1300 act.

RTC Platform control

MCAO optimal control



1-2 KHz

WPs description (1)

WP	Title	Description
1	Management	This WP will mainly coordinate the JRA activities, prepare the key specifications for the other WPs, organize study and design reviews, prepare the 18-months period reports and detailed work plans for the OPTICON management.
2	System design	This WP will concentrate mainly on the system study and design of new AO-MCAO facilities for the current Infrastructures.
2.1	XAO system conceptual design	Feasibility studies and conceptual design for an Extreme Adaptive Optics system dedicated to planet search science. Definition of the high level specification of all key components required for this system and intended to be developed within this JRP (Deformable mirror, wavefront sensor, Real Time computer, control)
2.2	L/NGS MCAO design for the VLT	Conceptual and preliminary design of a L/NGS MCAO system dedicated to large (1') FOV correction at short wavelength. Feasibility and conceptual design of a very large FOV multi-WFS AO system (FALCON)
2.3	Multi-object WFS for GTC	Design and prototype development of a multi-object WFS for the GTC MCAO system (best effort)
2.4	Multi-FOV WFS for LBT	Design and prototype development of a Multiple FOV WFS for the LBT telescope

WPs description (2)

WP	Title	Description
3	Technology R&D	This WP contains all R&D activities required to support the above AO-MCAO systems
3.1	2nd generation RTC platform	2nd generation of Real Time Computer (RTC) platform for XAO and MCAO systems. A new H&SW RTC architecture will be designed and prototyped. Performance according to WP 2.1 and 2.2 will be demonstrated
3.2	Optimal control for MCAO systems	A theoretical study and experimental demonstration of an optimal MCAO control will be performed on the ESO MCAO demonstrator.
3.3	High-density piezo- stack DM	Design and prototype of a Piezo stack Deformable Mirror with >1000 actuators will be developed and tested.
3.4	Piezo DM control electronics	Design and demonstration prototype of a Piezo stack deformable mirror control electronic able to drive the DM in WP3.3 will be developed and tested. The prototype will not necessarily control the 1000 actuators.

WPs description (3)

WP	Title	Description
3.5	VLT adaptive secondary design study	Feasibility, conceptual and preliminary design of the VLT adaptive secondary will be developed. Required sub-systems prototypes will be developed to overcome issues identified during the design phase.
3.6	Manufacturing of a large convex glass shell	Design, manufacturing and testing of a large (~1m) convex glass shell for large deformable mirror will be performed
3.7	2k & low order Micro-deformable mirrors R&D	2k act. & low order MDM R&D. A full design of a 2k act. and low order MDM will be performed and prototypes will be developed. Corresponding control electronics will be designed and prototyped. Testing of these prototypes will be done on a best effort basis depending on remaining funds for the test bench.
3.8	High order WFS experimental study	A Pyramid and Shack Hartmann high order wavefront sensors will be developed and their performance compared on a dedicated test bench

Interaction between Work packages

RTC Platform R&D: WP 3.1

1600 act. Piezo DM: WP 3.3-3.4

CCD R&D: JRA2

High Order WFS experiment: WP 3.8

VLT PLANET FINDER I: CHEOPS

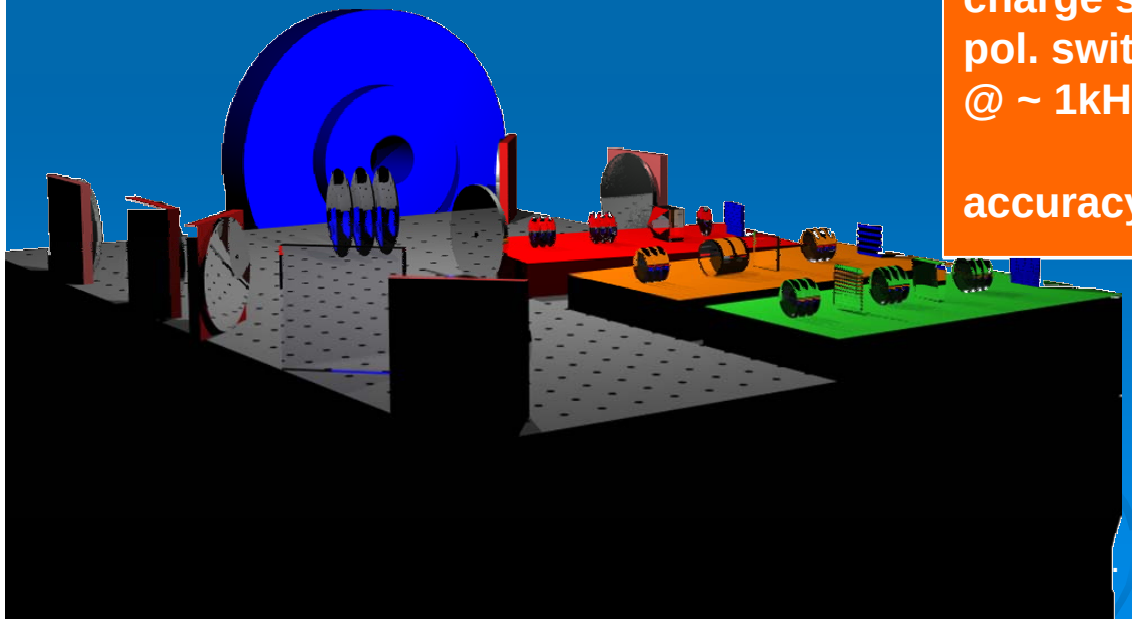
VLT Nasmyth Platform

~1600 Act.
~ 2kHz
SR~ 0.8 @ 1μm

256^2 elements
R ~ 15
2k x 2k chip

simultaneous charge shifting pol. switching @ ~ 1kHz

accuracy ~ 10^{-6}



Courtesy MPIA

Nasmyth focus

Common Path

Vis

NIR

AO sensing

Visible Channel

Coronograph

Imaging Spectrograph

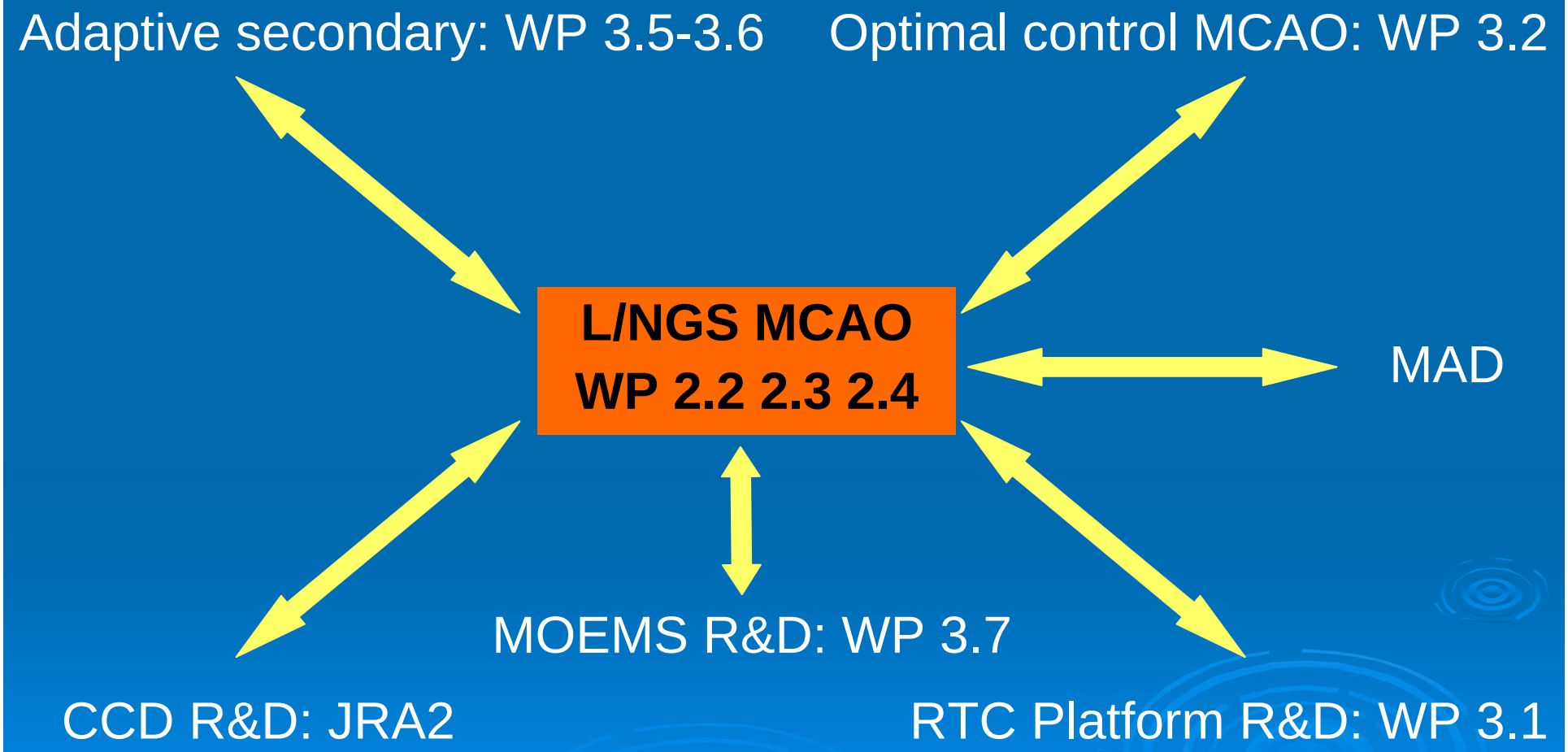
NIR Imaging channel

Courtesy LAOG

WP 2.1: Schedule and deliverables

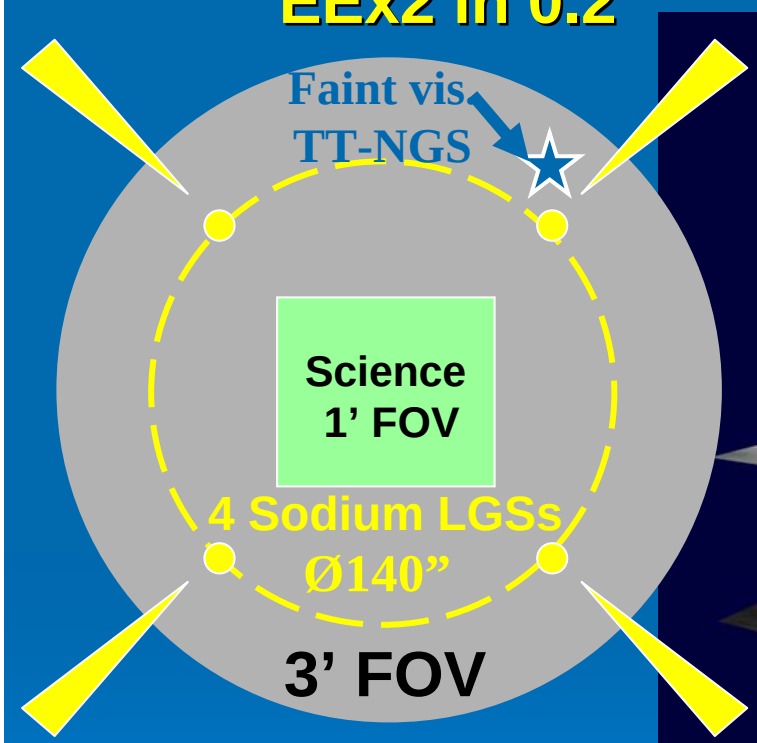
Milestones	Date
Feasibility Kick-off	May, 2003
Mid Term Review: CCD, DM, RTC specs	May, 2004
Phase A Conceptual design study	November, 2004
Start of phase B	May, 2005
Preliminary design Review	May , 2006
Final Design Review	May, 2007

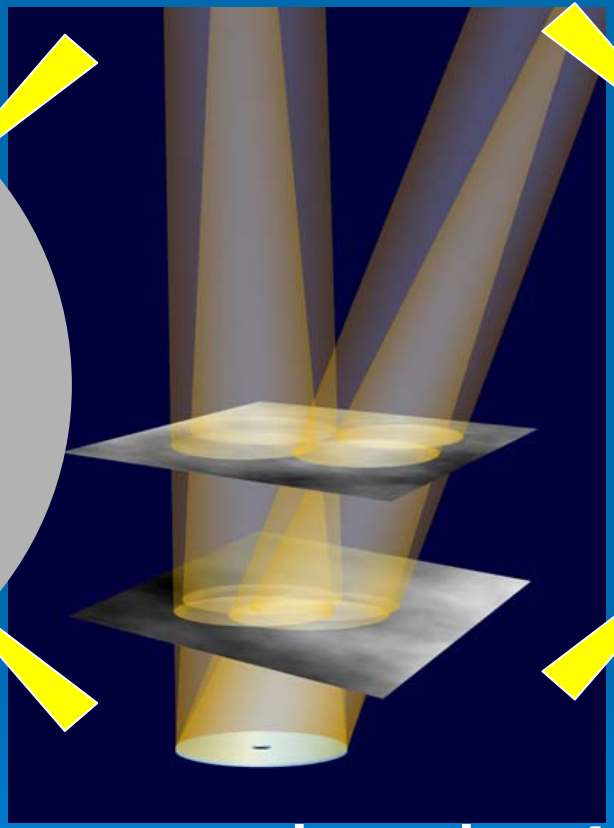
Interaction between Work packages



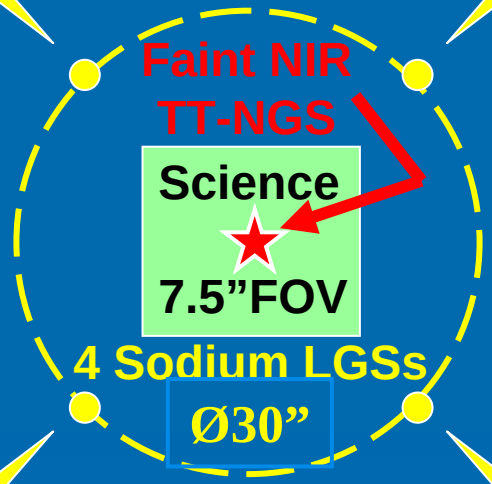
WP 2.2: MUSE Ground Layer AO

MUSE Wide Field Mode
EEx2 in 0.2”



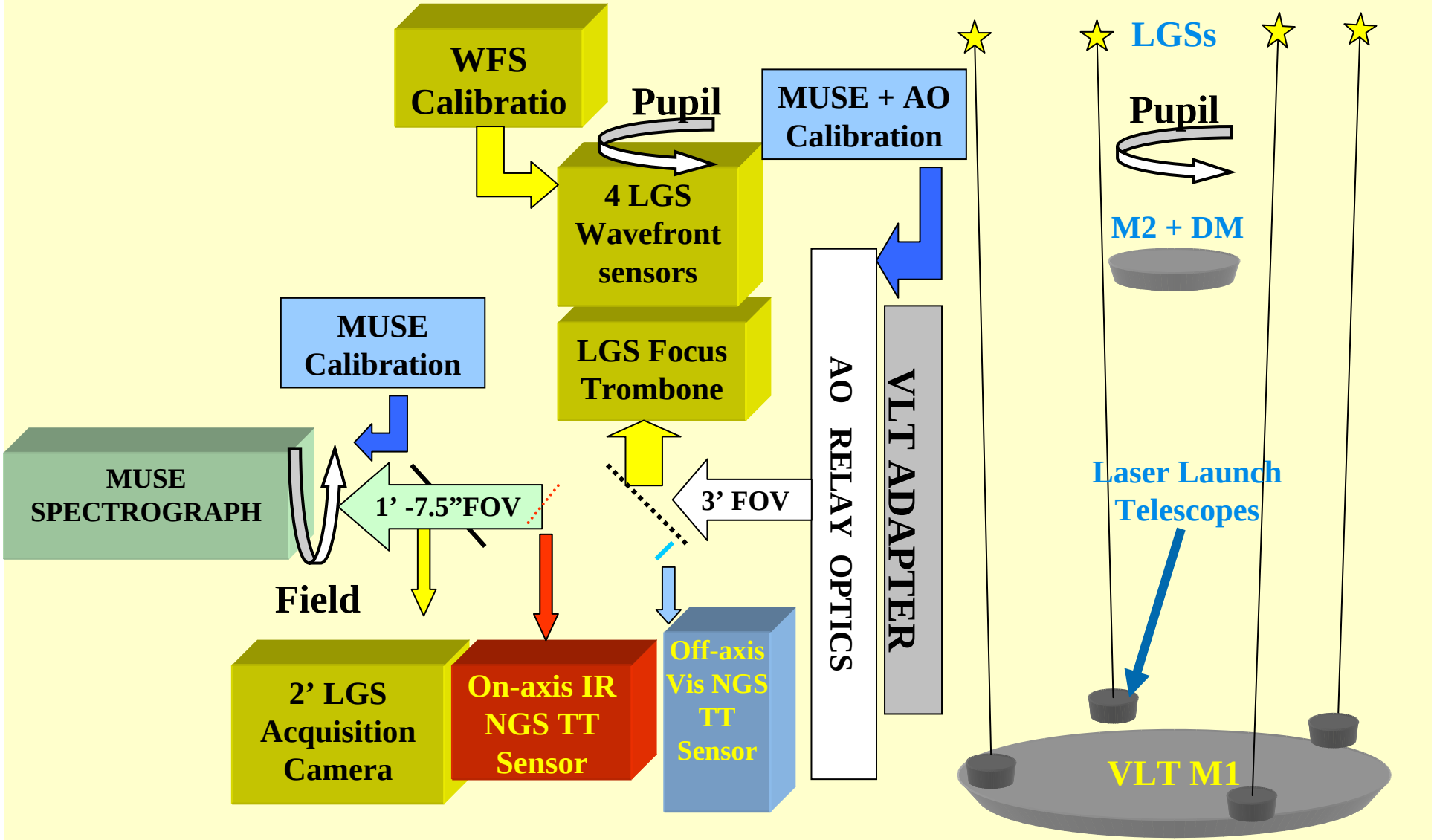


MUSE Narrow Field Mode
Sr(R)~10%

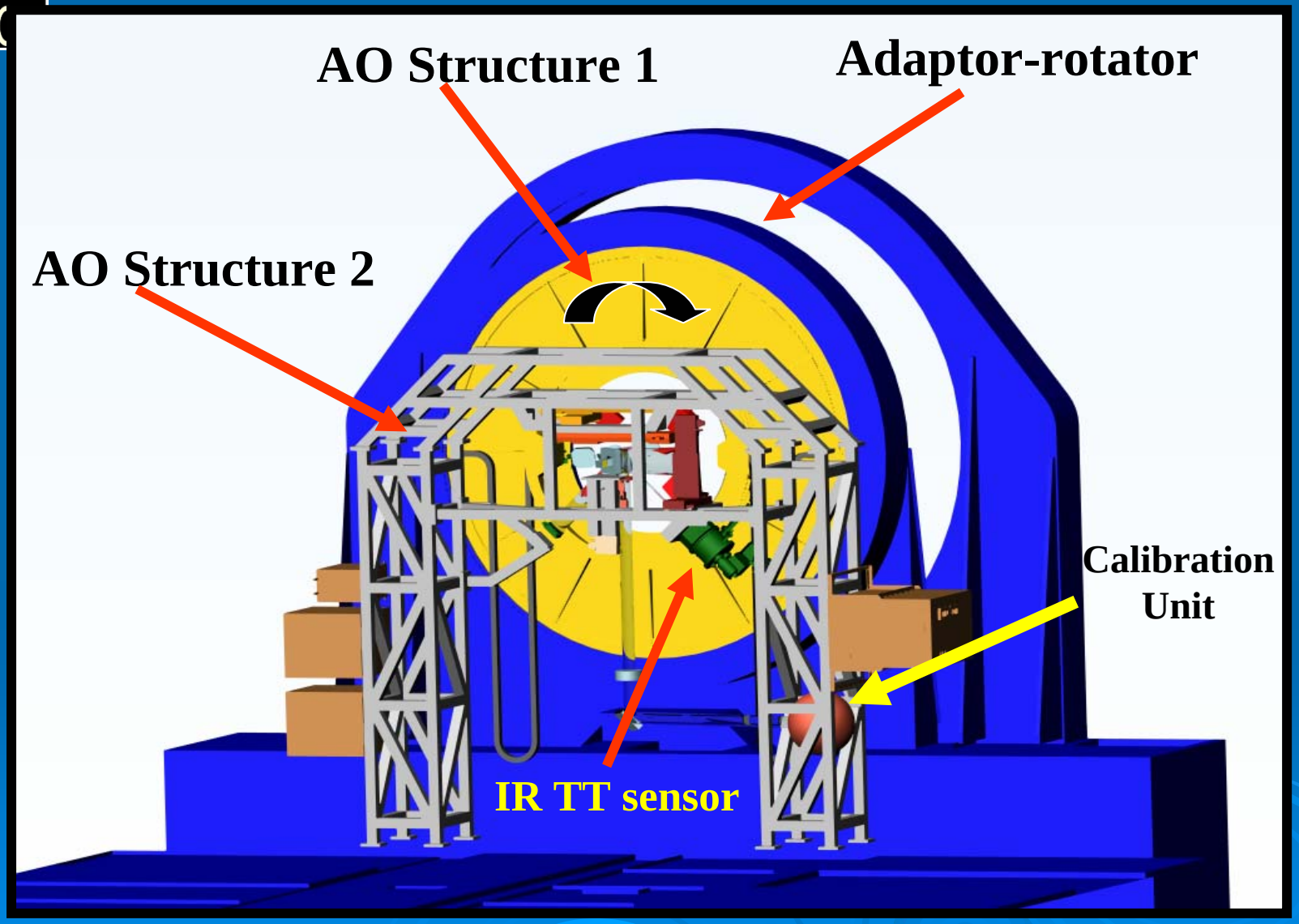


Wavefront tomography using 4 sodium LGSs
Ground layer correction: one Deformable Mirror

WP 2.2: MUSE GROUND LAYER AO



WP2.2: MUSE GROUND LAYER AO



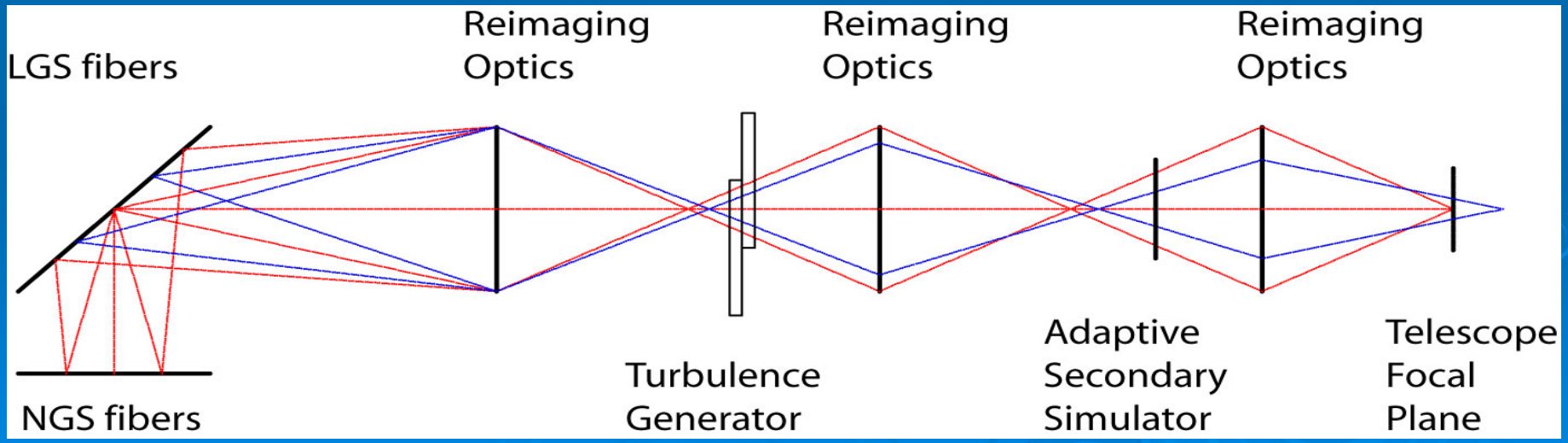
WP 2.2: ASSIST

Adaptive Secondary Simulator and Instrument Test bed

Requirement	Operating range	Comment
Wavelength Range	0.45-2.5 µm	MUSE 465-930, X-Shooter V+IR, HAWK-I
Number of act.	~1300	Pattern equal to Adaptive Secondary
Field size	3’ => 8’	Optionally 9’ x 9’ (TBD)
Operating frequency	> 2 kHz (TBC)	>Temporal behaviour
Output f-number	f/15	= f/# Nasmyth VLT focus
Seeing	0.5-1”	Median seeing Paranal
NGS location	Free within 3’-8’	= MUSE to HAWK-I or KMOS
LGS location	Free within 1.5’- 4.5’	= MUSE to HAWK-I or KMOS
NGS wavelength	0.45 – 2.5 µm	IR or VIS WFS
LGS wavelength	589 nm	Sodium
NGS shape	Point like	
LGS shape	Elongated	Mimic spot elongation LGS

WP 2.2: ASSIST

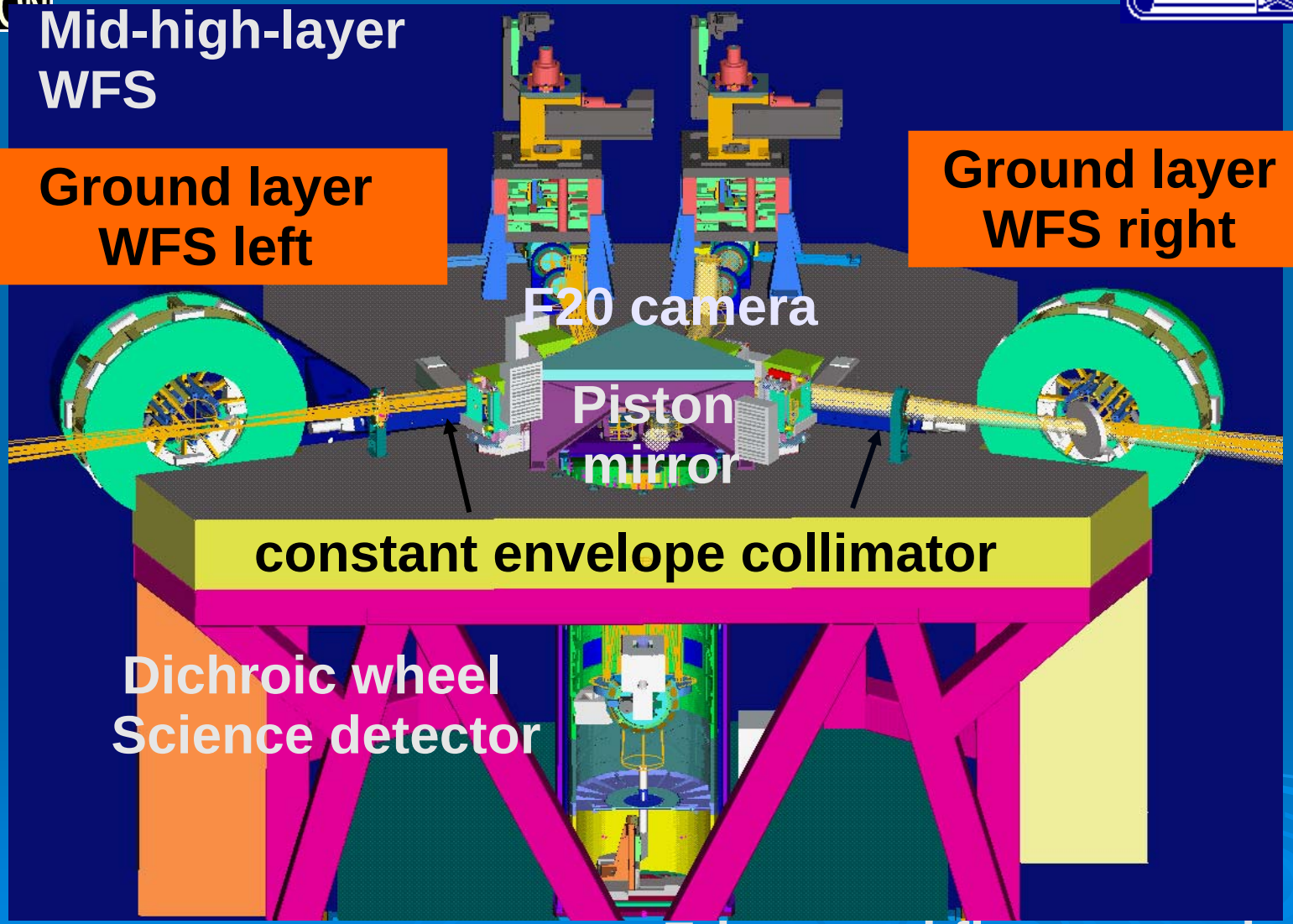
- Initial design based on MAD concept
- Voice-coil actuated Deformable Mirror
- Influence functions of existing DSM
- Developed in Leiden AO Laboratory: LAOLAB



WP 2.2 deliverables

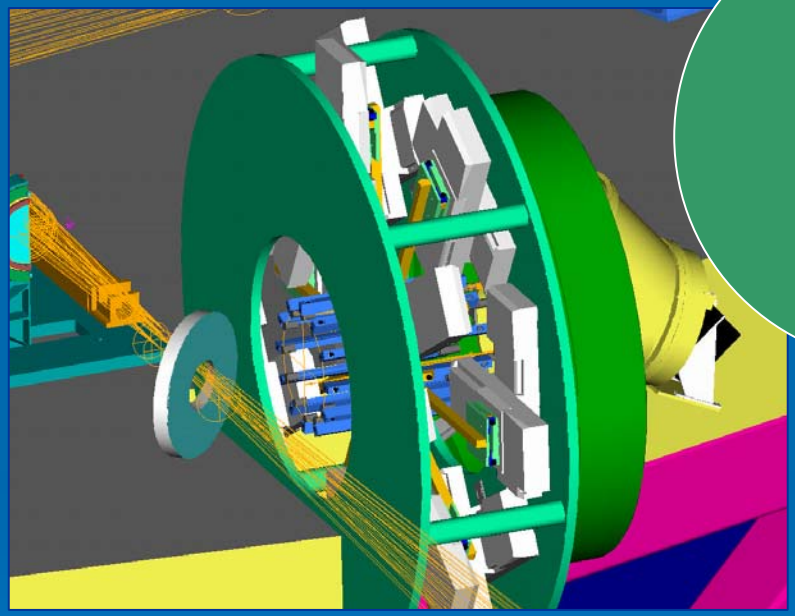
Milestones	Time
MUSE conceptual design study	To+9
MUSE instrument KO	To+10
Trade-off review	To + 16
MUSE-AO+ DSM simulator PDR	To + 28
MUSE-AO + DSM simulator FDR	To + 40

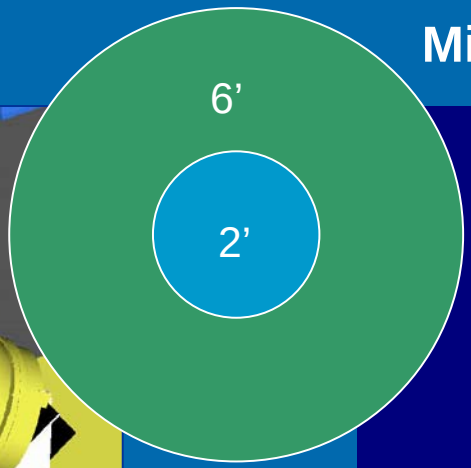
WP2.3: LINC-NIRVANA



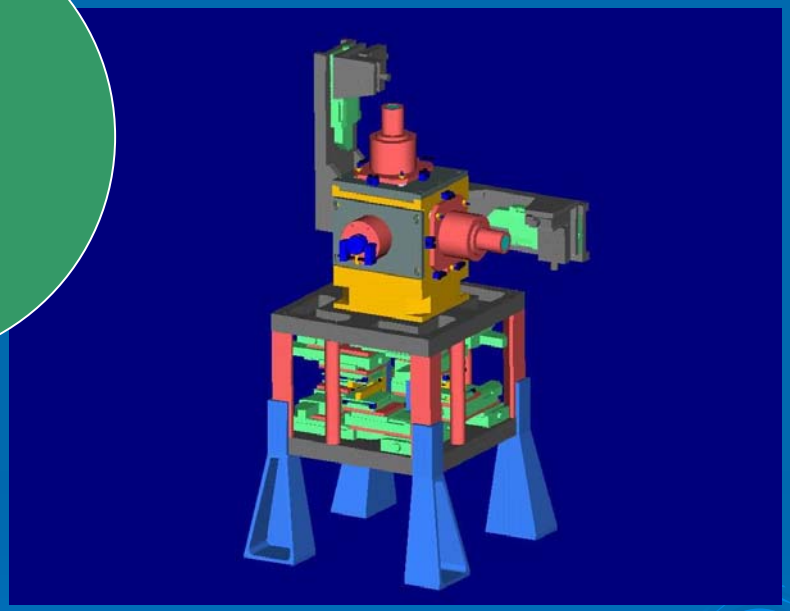
WP 2.3: Multiple FOV WFS

Ground Layer WFS 2’- 6’





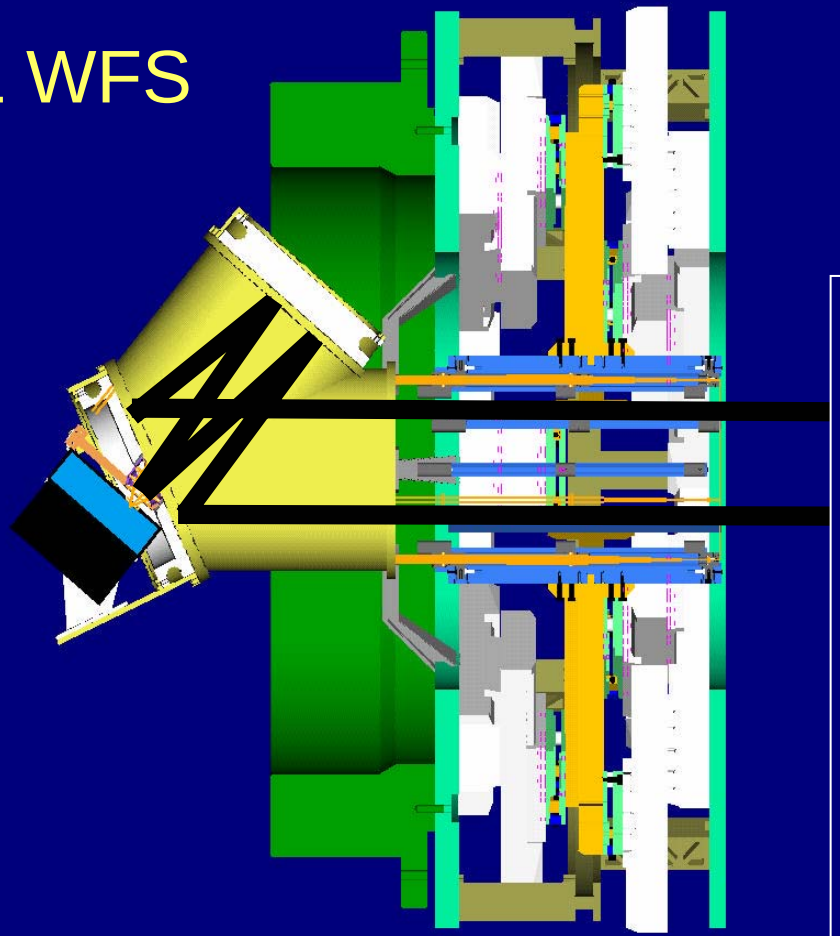
Mid and High Layer WFS 2’



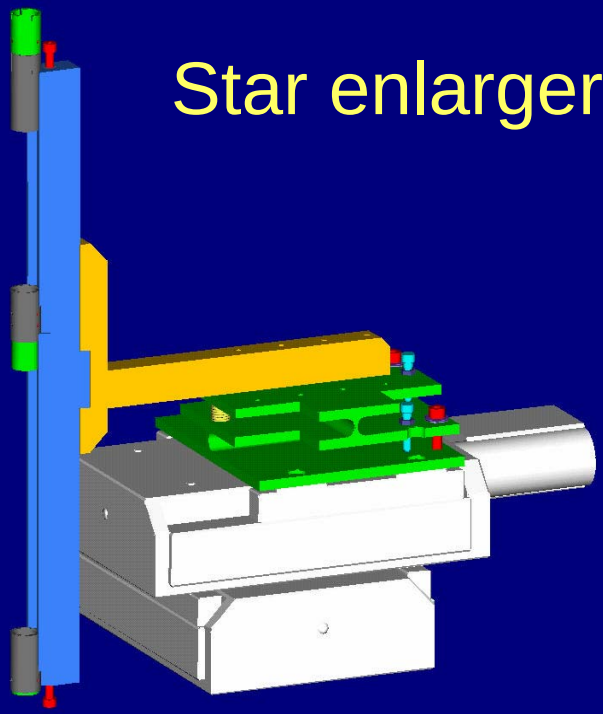
Pyramid sensor
optical co-adding
12 stars in GWS
8 stars in MHWS

WP2.3: 6' FoV Ground Layer WFS

GL WFS

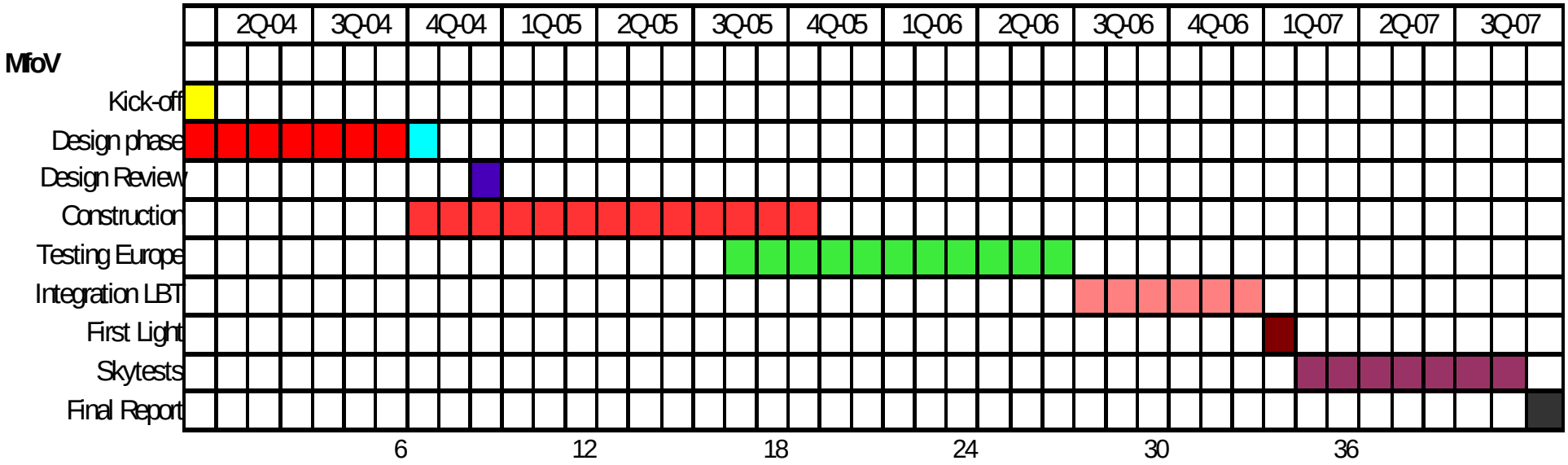


Star enlarger



WP2.3: Deliverables/Schedule

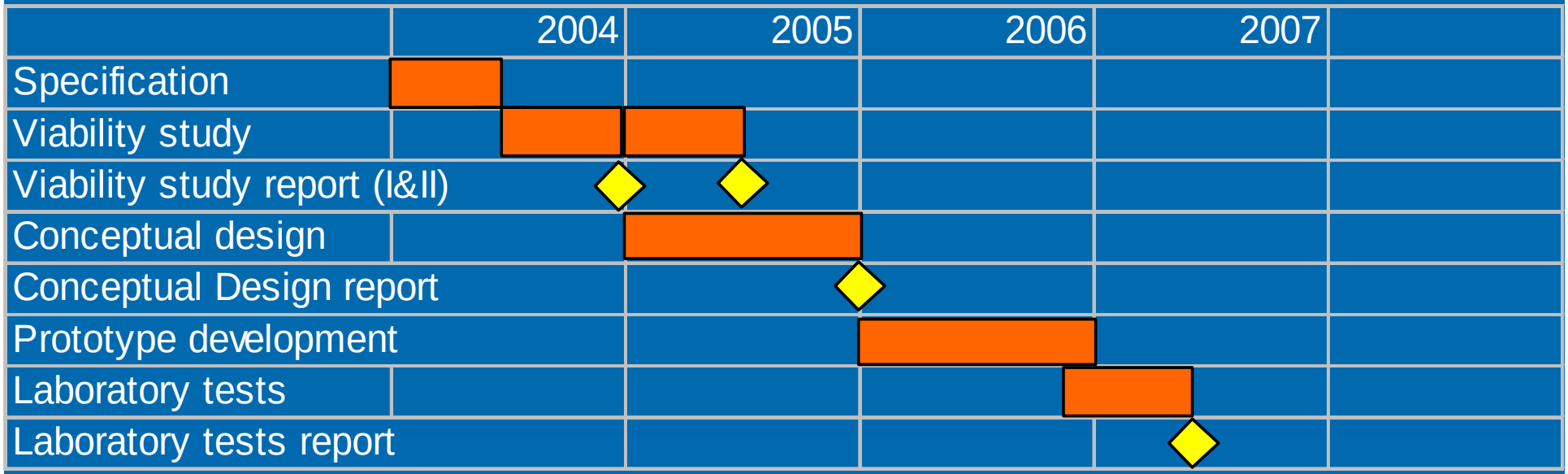
- Design report: 07. 2004
- First light on LBT: 01. 2007
- Test Report: 10. 2007



WP 2.4: OBJECTIVES IAC

- Determine what type of multi-object wavefront sensor will be used in the GTCAO dual-conjugate mode
  - Determine viability of multi-object curvature sensing
  - compare with Shack-Hartmann/pyramid sensing
- Design a laboratory prototype, together with multi-layer turbulence simulator
- Develop algorithms to be tested on the prototype

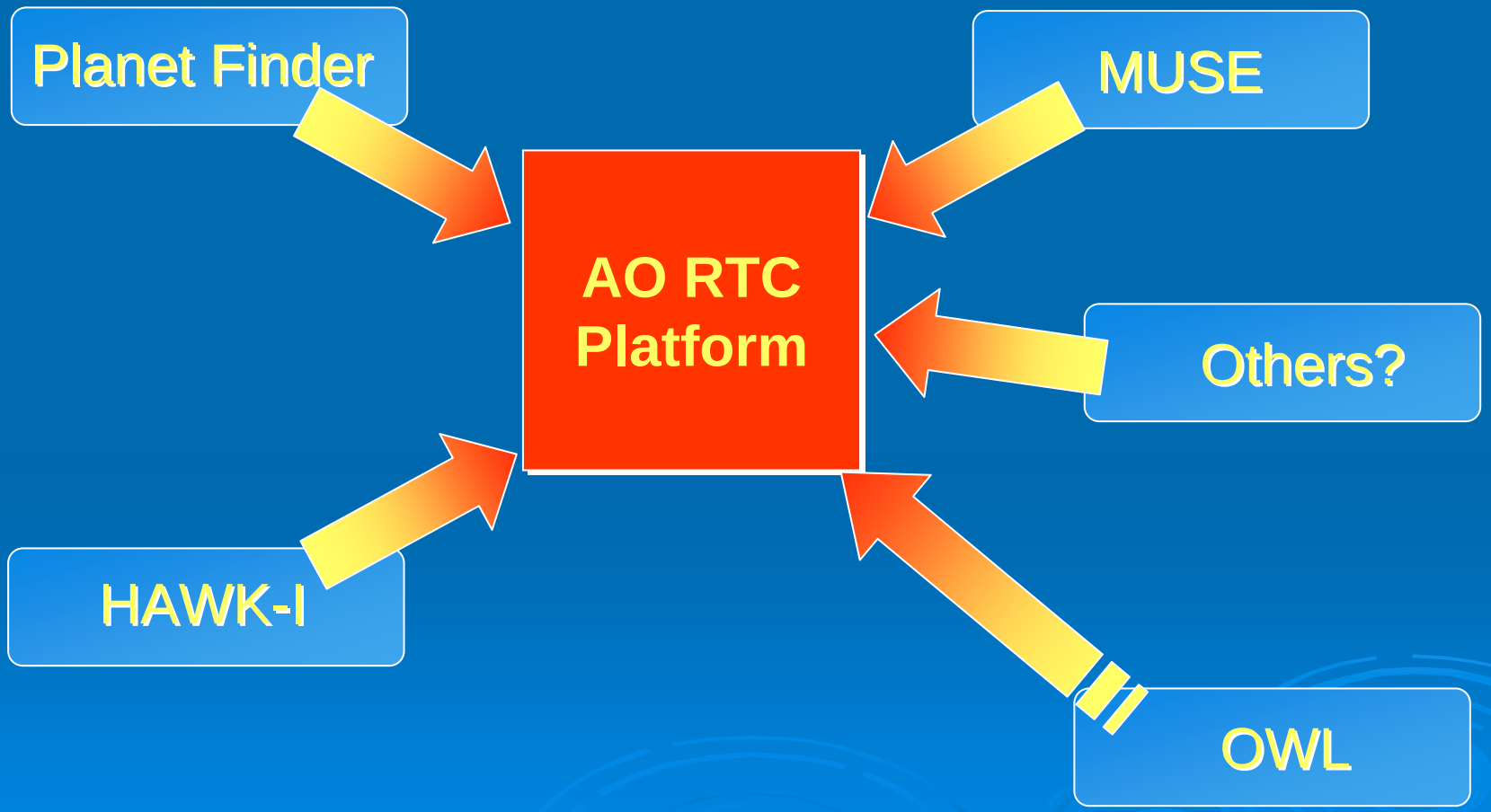
WP 2.4: DEVELOPMENT PLAN



WP 3: Key Component R&D

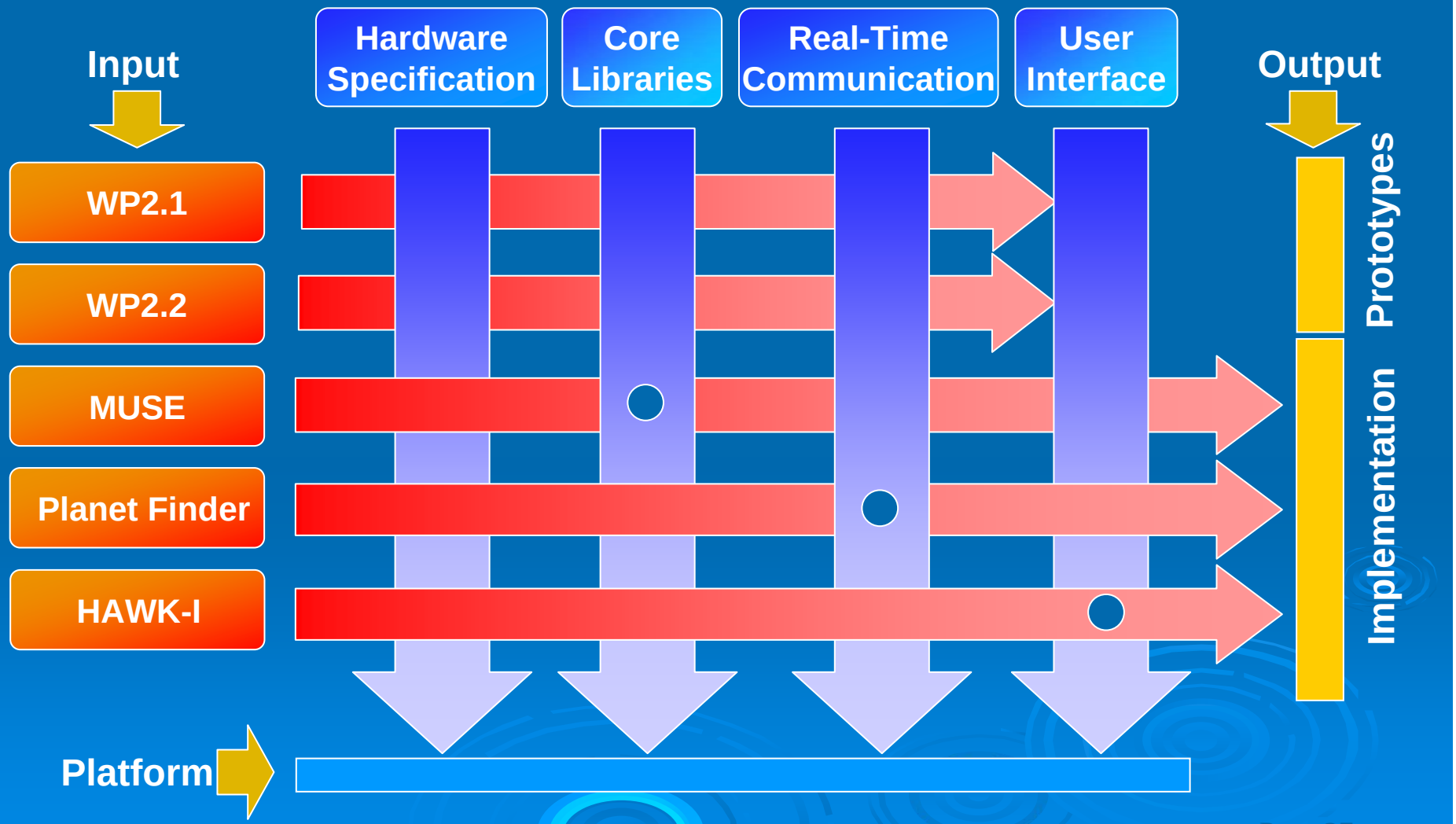
WP 3.1: AO Real Time platform ESO

Inputs: the AO-RTC Platform grows around real projects



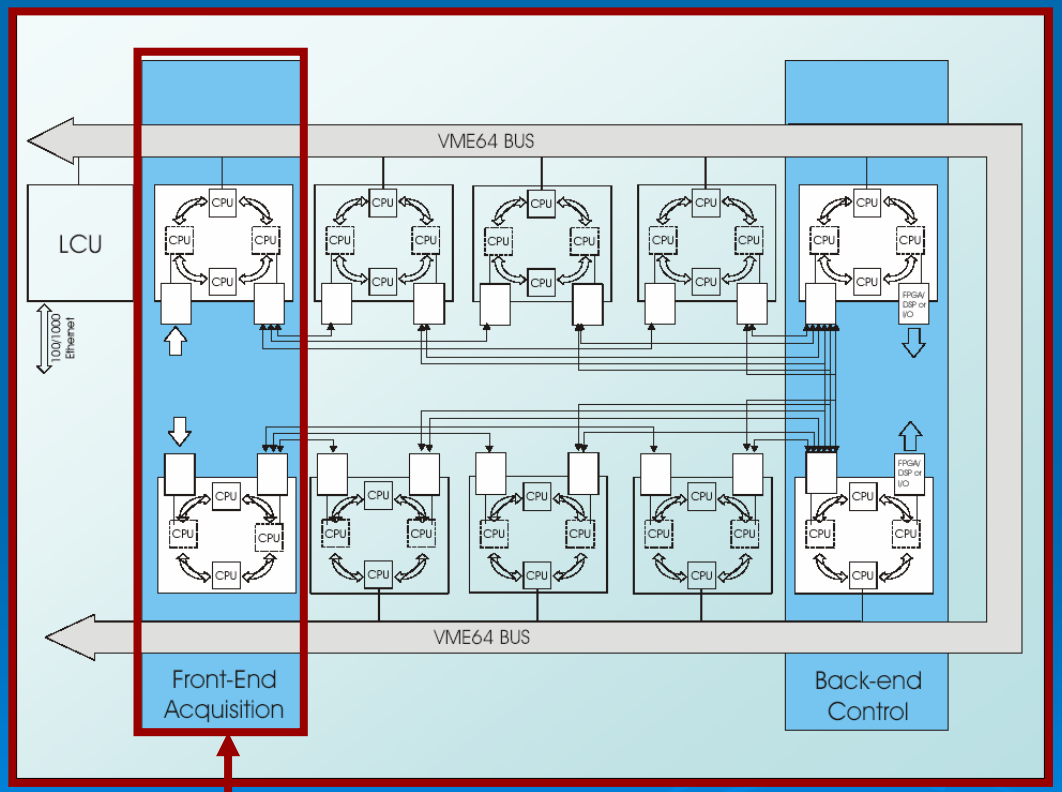
WP 3.1: Implementation strategy

The AO platform serves several projects but does not end with them



WP 3.1: FPGA development for RTC platform

Contribution from Durham



COTS FPGA PMC module

WP 3.1: Schedule & deliverables

Specification of the 2nd generation AO and MCAO RTC Platform	01.01.04	3 M
Conceptual Design Study & Procurement	05.04.04	10 M
Conceptual Design Review	21.01.05	Milestone
Computational module testing	24.01.05	2 M
Performance and test report	18.03.05	Milestone
AO Platform Prototype development (HW & SW)	21.03.05	11 M
AO Platform Prototype testing	04.03.06	6 M
Test Report	26.08.06	Milestone
AO-MCAO RTC Platform Design	18.01.07	5M
Final Design Report	19.07.04	Milestone
AO-MCAO RTC Platform Final Design	22.01.07	7M
Final Design Report	10.08.07	Milestone

M1

M2

WP 3.2 MCAO optimal control

- Optimal Control methods for MCAO
  - Theoretical study of the optimal control in MCAO: robustness to model errors, simulation and performance with realistic end-to-end model
  - Demonstration on Onera AO laboratory bench: single GS Mono Conjugate AO with off-axis optimization
  - Development & Test on MAD star oriented @ ESO

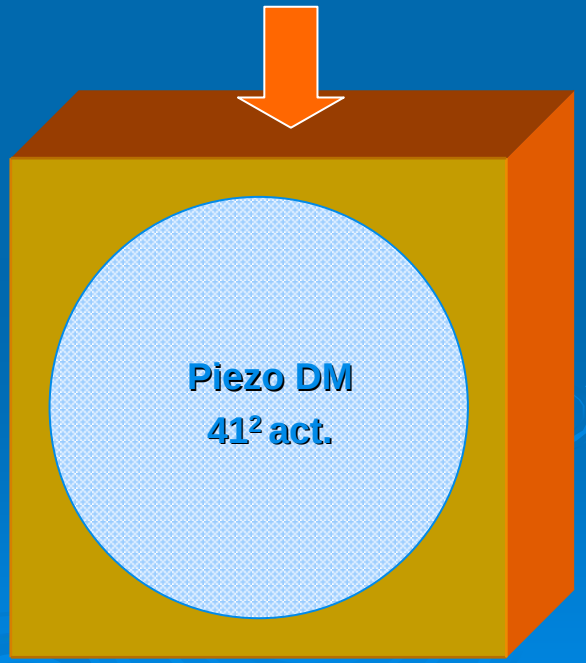
- High performance WFS in MCAO
  - Theoretical studies and identification of key performance issues:
    - linearity versus corrected FoV (e.g. GS separation…),
    - sensitivity versus dynamics
  - Experimental validation:
    - Select key issues to be validated by experiment on MAD,
    - Perform the validation with ESO

WP 3.2: Schedule and deliverables

Milestones	Time
Optimal control theoretical study report	T0 + 12
Optimal control demonstration on AO bench & test report	T0 + 20
Optimal control experimental validation on MAD	T0 + 36
High performance WFS in MCAO: Concepts & key parameters; report	T0 + 12
High perf. WFS in MCAO: Criteria, key issues for WFS devices; report	T0 + 24
High perf. WFS in MCAO: Experimental validation on MAD; report	T0 + 36

WP 3.3 & 3.4: Piezo DM R&D ESO

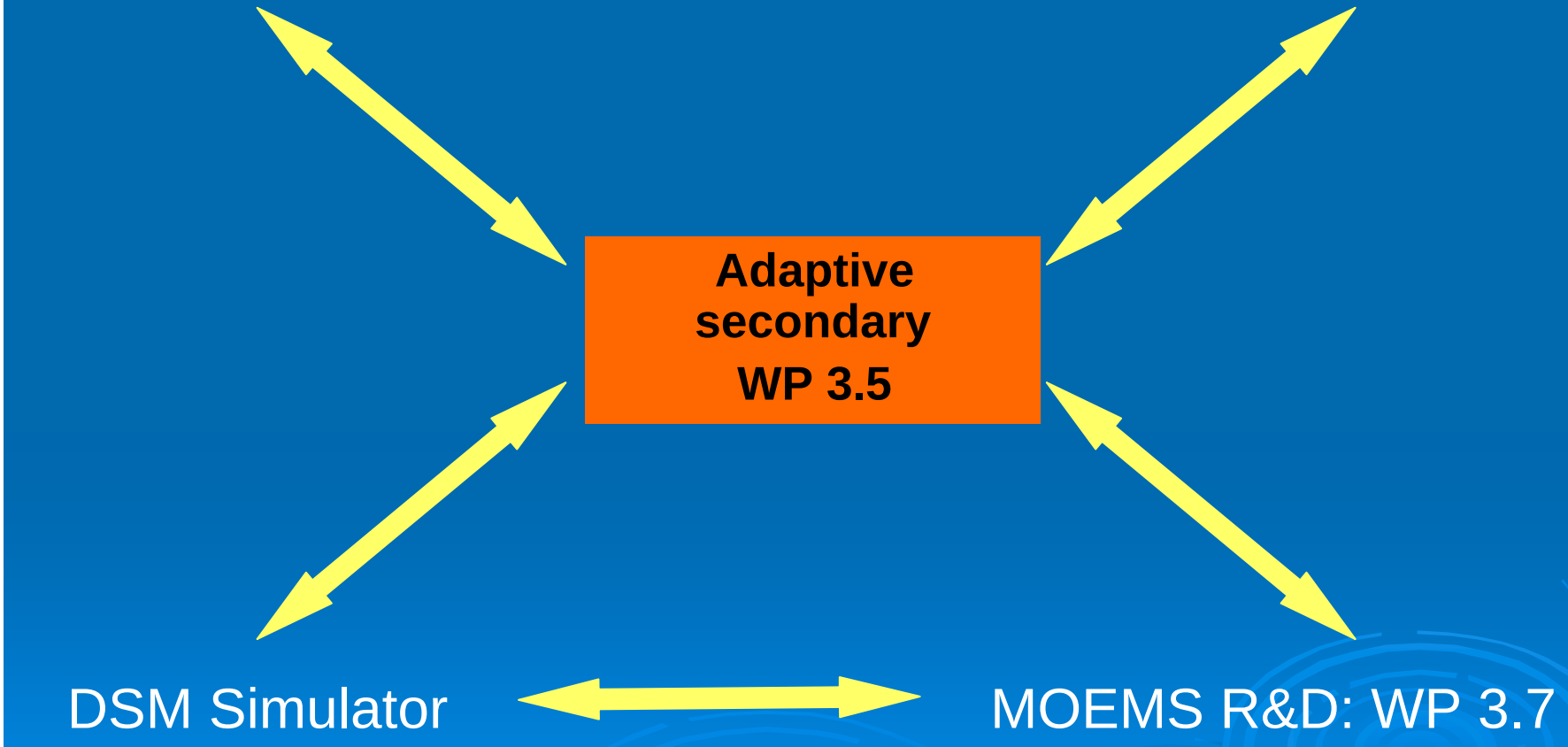
- DM Top Level specifications
  - 40x40 rectangular -> 1304 total
  - 5 mm spacing -> 200mm diameter
  - Actuator stroke: ±5µm
  - Inter-actuator stroke: ±1.2µm
  - Residual WFE: 10 nm rms
- DM Control electronic
  - Up to 1500 channels
  - ±400 V



WP 3.3 & 3.4: Piezo-DM & control schedule

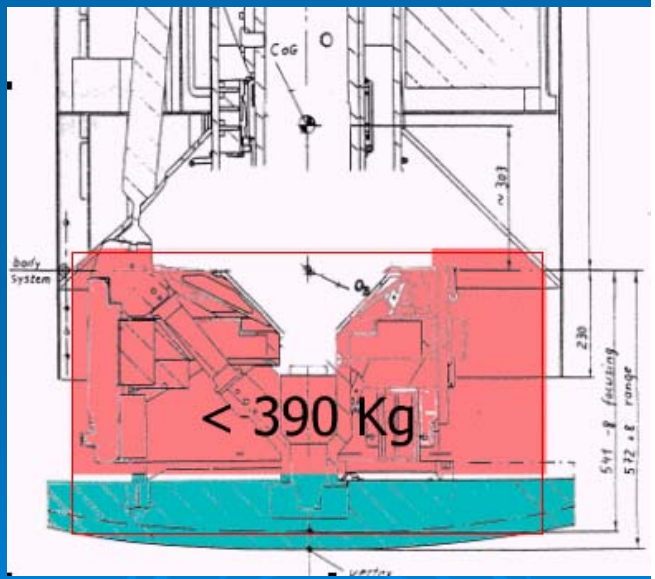
- CfT to be issued: July 04
- Start of contract: Nov 04
- DM control electronic Specs: Jan. 05
- Design review, end of phase 1: June 05
- DM control electronic design review: Sept. 05
- DM control electronic prototype: Feb. 06
- DM manufactured, end of phase 2: May 07
- Test report, end of phase 3: July 07
- Provisional acceptance, phase 4: Oct.07

Interaction between Work packages ESO



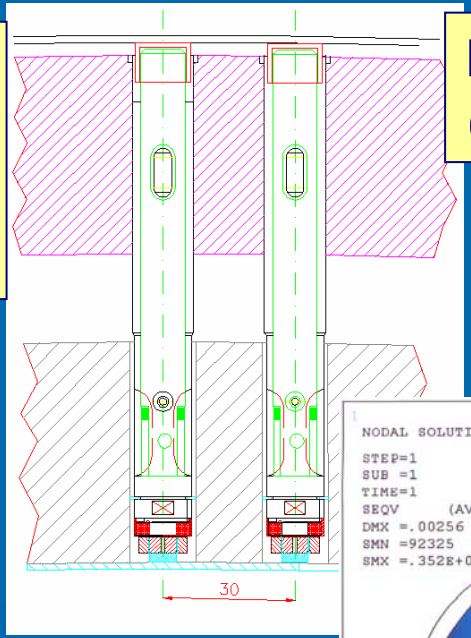
WP 3.5: VLT adaptive M2 design

- Specifications prepared
- 15 months feasibility/ conceptual design study (01.04)
  - Validate I/Fs with present VLT (volume, weight, dissipation)
  - Number of actuator & actuator spacing
  - Actuator response time
  - Total and inter actuator stroke requirements
  - Thin shell requirement and feasibility ⇨WP3.6
  - Calibration issues

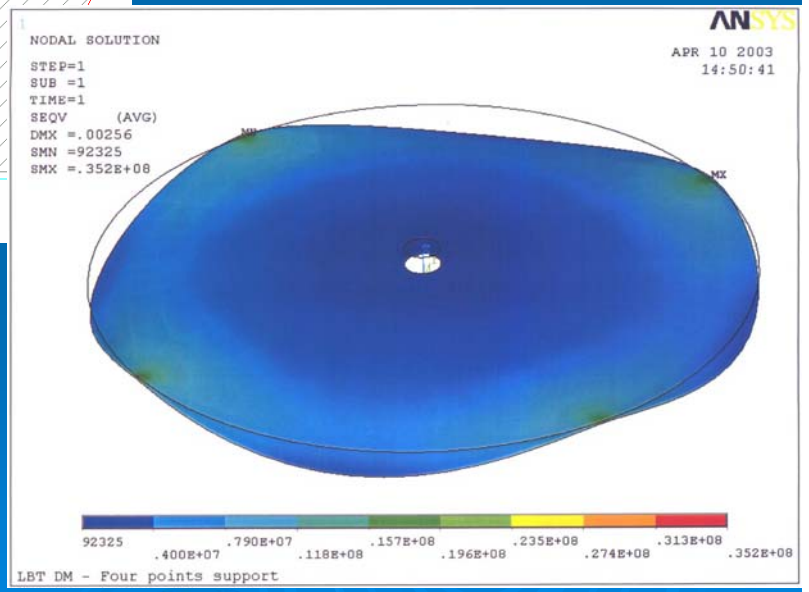


WP 3.5: VLT Adaptive secondary

CURRENT (LBT)
ACT.S SPACING → 1015 ACTs
NEW MAGNET DESIGN
26.5mm PITCH → 1300 ACTs



LBT672 POWER = 2000 W
(1300 ACTs → 3000 W)



SHELL THICKNESS vs ACT.S SP.
SHELL < 15 nm RMS WF
MMT < 64 nm, P45 < 28 nm

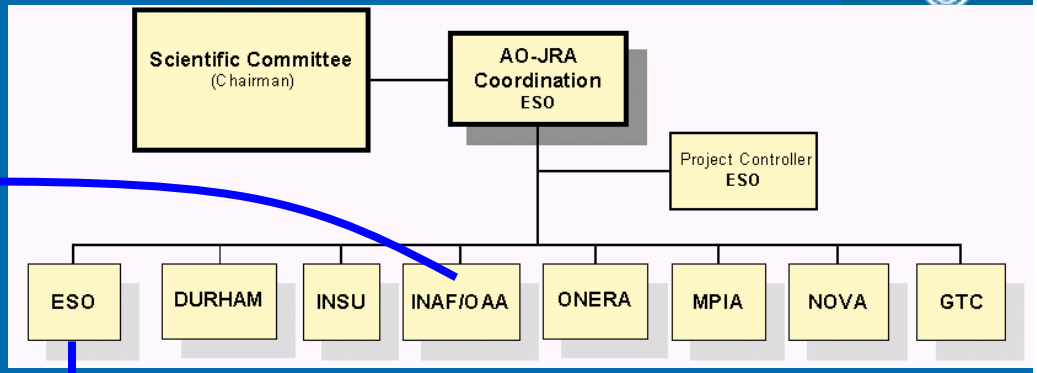
MAGNET GLUING TEST (Phase 2)

MICROGATE

WP 3.5: VLT DM2 coordination

Istituto Nazionale di Astrofisica
Osservatorio Astrofisico di Arcetri

- system & specs overview
- control law design
- optical claibration & testing
- engineering SW



- control system simulation

POLITECNICO DI MILANO
DIPARTIMENTO DI INGEGNERIA AEROSPAZIALE

- control system design • embedded SW design
- HW design • HW prototyping (dynamic performance opt.)
- optimization of size & power consumption

MICROGATE

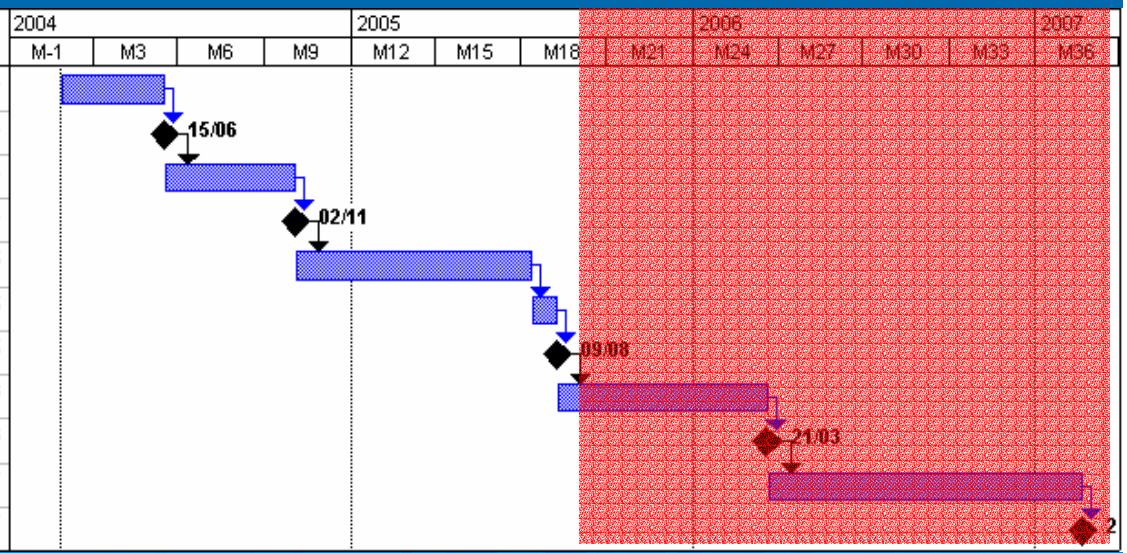
- mechanical/thermal design • FEA
- actuators/magnet design
- handling, integration procedures + MGSE

ADS International

WP 3.5: VLT Adaptive secondary Plan

$T_o + 4_M$	**Phase 1:**	**I/Fs analysis and straw-man design**
$5_M \div 9_M$	**Phase 2:**	**Deformable mirror surface quality and dynamical performance**
$10_M \div 15_M$	**Phase 3:**	**Conceptual design and analysis**

ID	Nome attività	Durata	Inizio	Fine
1	Phase 1	80 g	mer 25/02/04	mar 15/06/04
2	Milestone 1	0 g	mar 15/06/04	mar 15/06/04
3	Phase 2	100 g	mer 16/06/04	mar 02/11/04
4	Milestone 2	0 g	mar 02/11/04	mar 02/11/04
5	Phase 3	180 g	mer 03/11/04	mar 12/07/05
6	CDR	20 g	mer 13/07/05	mar 09/08/05
7	Milestone 3	0 g	mar 09/08/05	mar 09/08/05
8	Phase 4	160 g	mer 10/08/05	mar 21/03/06
9	PDR	0 g	mar 21/03/06	mar 21/03/06
10	Phase 5	240 g	mer 22/03/06	mar 20/02/07
11	FDR	0 g	mar 20/02/07	mar 20/02/07



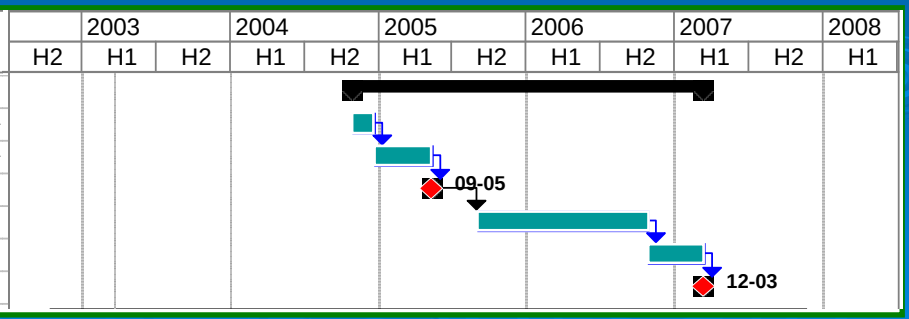
WP 3.6: Thin shell R&D plan

- Spec. of a ~ 1m convex glass shell prototype **INSU/INAF/ESO**

Call for tender will be issued

- Manufacturing process and test set-up study **INSU**
- Study review **INSU**
- Manufacturing of the ~ 1m glass shell prototype
- Testing of the ~ 1m glass shell **INSU**
- Acceptance review **INSU**

Task Name	Duration	Start
Demonstration of a large convex glass shell manufa	**620 days**	**26-10-04**
Spec. of a ~1-m convex glass shell prototype	2 mons	26-10-04
Manufacturing process and Test set-up study of a ~1-m glass	5 mons	21-12-04
Study review	0 days	09-05-05
Manufacturing of a ~1m glass shell prototype	15 mons	30-08-05
Testing of the ~1m glass shell	5 mons	24-10-06
Acceptance review	0 days	12-03-07



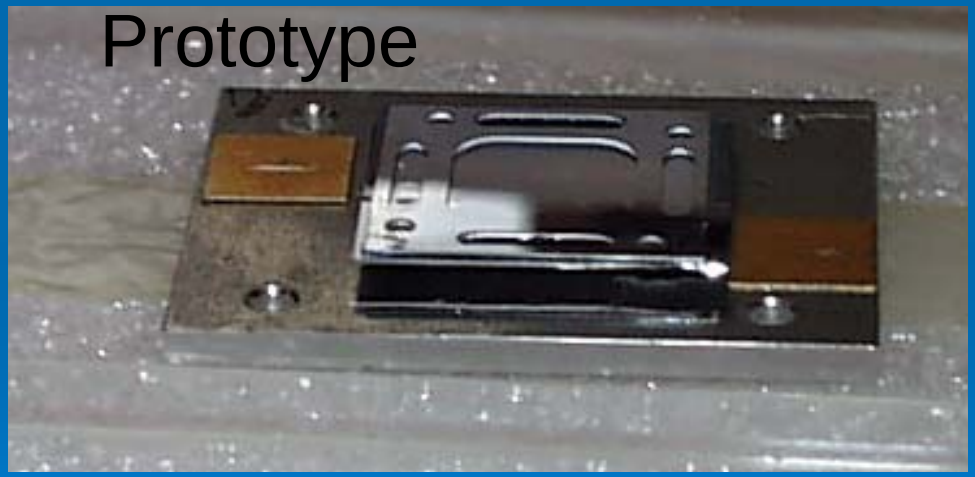
WP 3.7: Specification of MOEMS

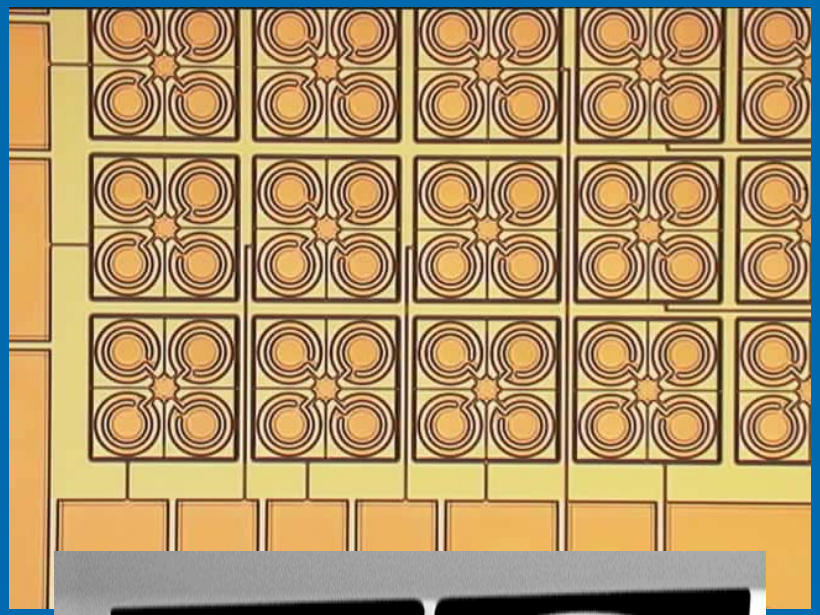
Micro – DM specification overview	VLT-8m Falcon AO Buttons	OWL-ELT 100m-60m Buttons	X-AO on 8m	X-AO for OWL-ELT	VLTI-AT (1.8m)	MUSE M2 Simulator	Ophtamology (TBC)
# Actuators	100	10 000	1500	40 000 (200x200)	100	1300	~100
Principle? / Comment	magnetic	electro static	electr o static	electro static	magn etic	Circular geometry	?
Actuator spacing	1mm	1 mm	1mm	<1mm	2mm	~2mm	~1mm
Mech. stroke	10 µm	10 µm	10 µm	2 µm	2 µm	10 µm	10-15µm
Inter-actuator stroke	-	1.2 µm	1.1 µm	1 µm	1 µm	1.2 µm	?
Frequency cut off	<1kHz	<1kHz	2kHz	2kHz	1kHz	1.5kHz TBC	<500Hz?
Best flat WFE rms	30nm	30nm	15nm	15nm	30nm	15nm	30nm?

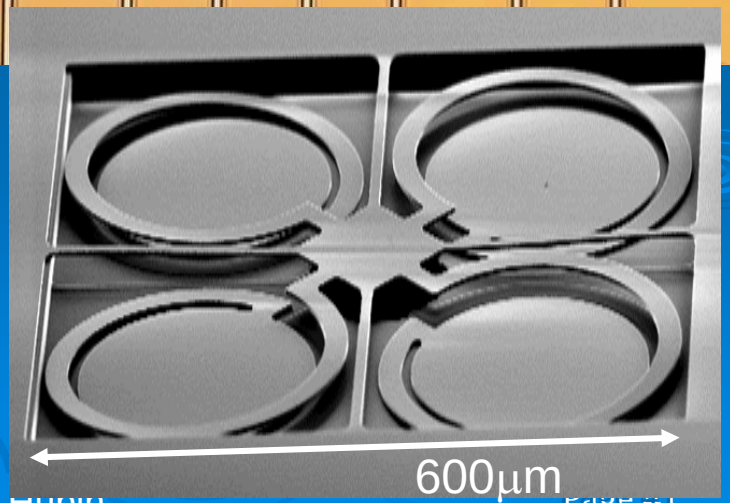
WP 3.7: toward 2K MOEMS R&D

- LAOG/LETI : electrostatic mirror
  - 64 actuators
  - 2 kHz, 8um stroke

Prototype





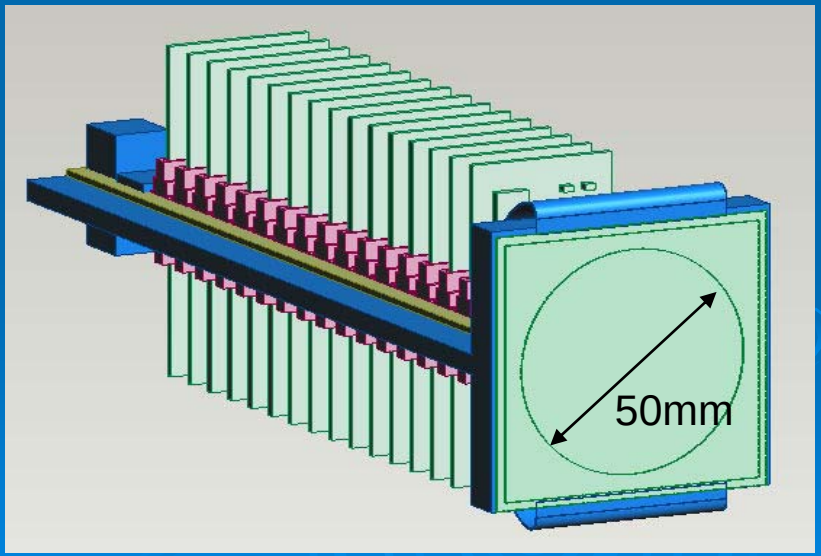


WP 3.7: Voice coil MOEMS DM

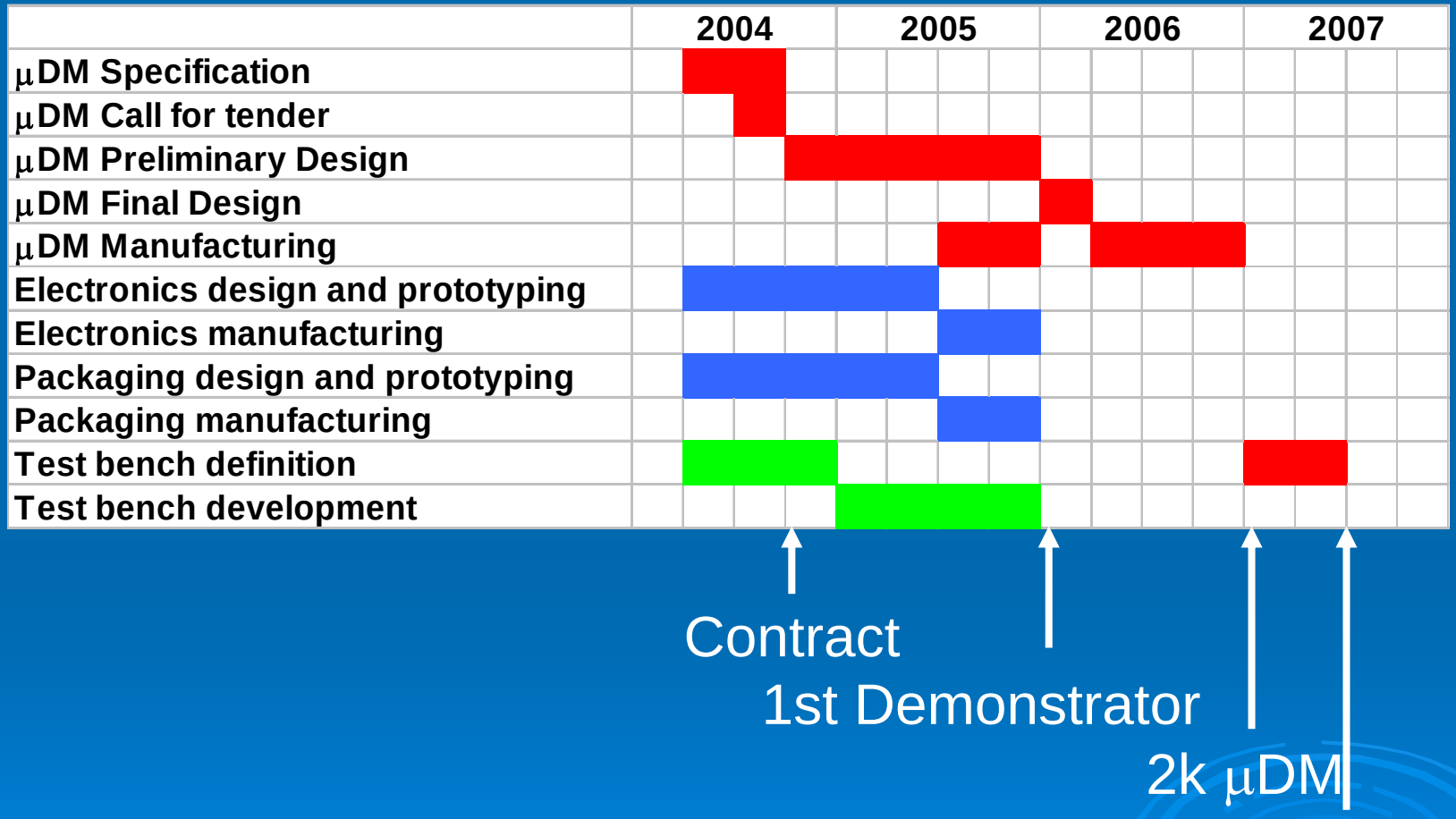
- LAOG/LETI: Voice coil mirror
  - Silicon membrane
  - 2mm pitch
  - 52 actuators
  - Stroke > 50um

WP 3.7: MOEMS control electronics

- Developped by LAOG:
  - 32 channel modules including DAC and HV amplifier (200V)
  - Scalable to >2000 channels
  - Digital Interface
  - Frame update = 32us



WP 3.7: MOEMS R&D schedule



+ 60 actuators magnetic DM (2005Q4)

WP 3.8: High Order WFS experiment INAF

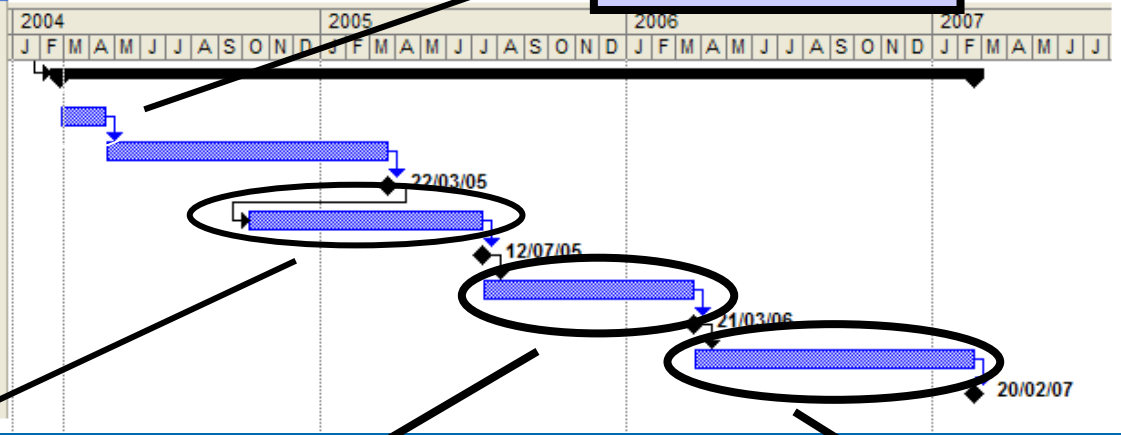
XAO systems will require very high accuracy WFSs.

- 2 WFS candidates Pyramid and Shack Hartmann
- Simulation on-going at ONERA-MPIA and ESO.
- Experiment to cross check critical issues for high order WFS
- Open loop comparison then low temporal frequency (~2Hz)

WP 3.8: High Order WFS experiment

Definition of the exp. study

WBS	Task Name
3.8	**High Order Wavefront Sensor (HOWFS) Exp. Study**
3.8.1	Specification of the HOWFS theoretical and Exp. Study
3.8.2	HOWFS theoretical study and performance criteria definition
3.8.3	**Study report delivery**
3.8.4	Design of the HOWFSs (SH-WFS and P-WFS) & test bench
3.8.5	***Design review***
3.8.6	Development of the HOWFSs and test bench
3.8.7	**Delivery of the P & SH WFS and test bench**
3.8.8	HOWFSs (SH-WFS and P-WFS) performance evaluation
3.8.9	***Test reports***

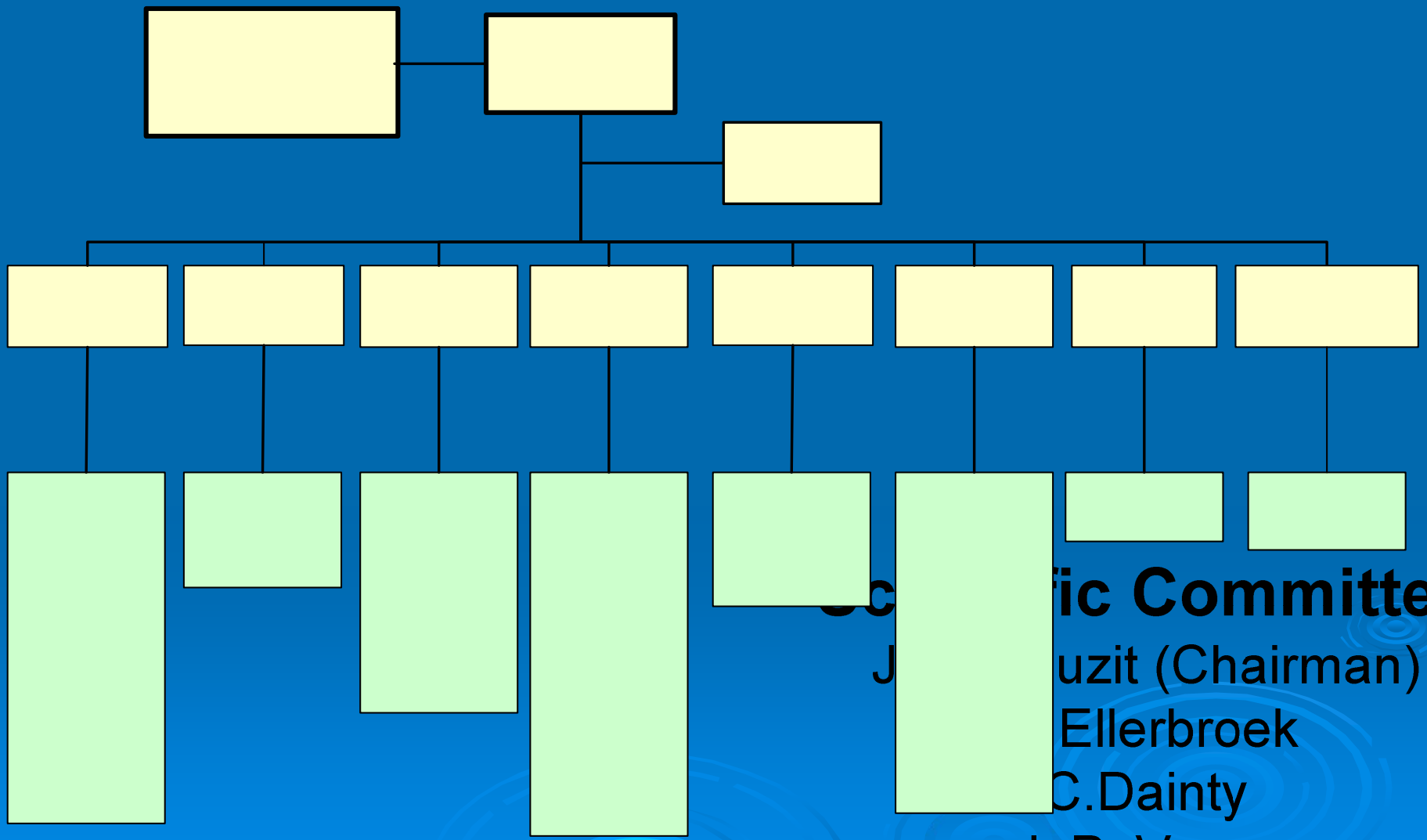


SH & PWFS design (ESO-INAF-Durham

Design of the test bench:
1) **Using the LBT672b unit (Sep05)**
2) **Using Xinetics 349 DM in Heidelberg**

WFSs characterization:
Interaction matrix identification
Measurements SNR and repetability
Aliasing contributions to WF error

JRA 1 Organization



Sc ific Committee

J uzit (Chairman)

Ellerbroek

C.Dainty

J. P. Veran

JRA1 Management tool: FTEs

WORK PACKAGE	AO- JRP		ESO		INAF		Durham		INSU		MPIA		ONERA		NOVA	
	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested
Total/Requested FTE (in pyear) to EC	116.60	17.65	36.9	6.25	8.50	1.00	9.00	4.50	25.10	2.00	20.10	0.00	3.80	1.90	11.4	2.00
Total/Requested FTE (in k€) to EC	8551.10	1370.80	2952	500	425	50	454	227	1632	130	1407	0	608	304	912	160
Adaptive Optics JRP Management	3.40	3.00	*3.4*	*3*												
Proposal phase	0.00	0.00														
AO-JRP Proposal Preparation	0.10	0.00	0.1	0												
AO-JRP consolidation with I3 OPTICON	0.10	0.00	0.1	0												
OPTICON I3 proposal evaluation by EC	0.00	0.00	0	0												
OPTICON I3 contract negociation with EC/partners	0.20	0.00	0.2	0												
Joint Research Project management and follow-up	3.00	3.00	3	3												
2nd Generation AO Systems Design	72.35	2.00	*19.5*	*0*	*3.5*	*0*	*0*	*0*	*16.1*	*0*	*20.1*	*0*	*0*	*0*	*11.4*	*2*
XAO System design study	30.70	0.00	2.5	0					14.1	0	14.1	0				
XAO Phase A Study specifications	0.00	0.00														
XAO Phase A Study 1 (2004)	4.10	0.00	0.1	0					4	0						
XAO Phase A Study 2 (2004)	4.10	0.00	0.1	0							4	0				
Review of Phase A Studies; Concept selection	0.30	0.00	0.1	0					0.1	0	0.1	0				
Specification for the XAO development	0.20	0.00	0.2	0												
XAO Design phase	22.00	0.00	2	0					10	0	10	0				
L/NGS MCAO System design Studies	29.60	2.00	16.2	0					2	0					11.4	2
AO Top level requirements	0.00	0.00														
L/NGS MCAO Simulation & Performance	0.00	0.00														
L/NGS MCAO Conceptual Design Study	0.00	0.00														
Conceptual Design Study review & evaluation	0.00	0.00	0	0											0	0
N/LGS MCAO system specifications	1.60	0.00	0.2	0					1	0					0.4	0
N/LGS MCAO system design	28.00	2.00	16	0					1	0					11	2
Multiobject WFS prototype for GTC	1.80	0.00														
Specification of the Multi-object WFS prototype development	0.20	0.00														
Feasibility study	0.40	0.00														
Multi-object WFS conceptual design	0.40	0.00														
Multi-object WFS prototype development	0.40	0.00														
Multi-object WFS prototype testing in the laboratory	0.40	0.00														
Multiple FOV MCAO System with NGS	10.25	0.00	0.75	0	3.5	0					6	0				
MFOV-MCAO Simulation & Performance	1.00	0.00	0.5	0	0.5	0					0	0				
6' FOV ground layer prototype design	5.00	0.00	0.25	0	0.75	0					4	0				
6' FOV ground layer prototype manufacturing	1.00	0.00			0.5	0					0.5	0				
6' FOV ground layer prototye AIT	3.25	0.00			1.75	0					1.5	0				

Status of Partner committed FTEs (2)

WORK PACKAGE	AO- JRP		ESO		INAF		Durham		INSU		MPIA		ONERA		NOVA		Grantecan	
	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested
Enabling Techno. for 2nd Gen./ELT AO Systems	**40.85**	**12.65**	***14.1***	***3.3***	***5***	***1***	***9***	***4.5***	***9***	***2***	***0***	***0***	***3.8***	***1.9***	***0***	***0***	***0***	***0***
2nd generation of AO Real-Time Computer platform	**14.50**	**6.75**	**7.5**	**3.25**			**7**	**3.5**										
Specification of the 2nd gen. AO and MCAO RTC Platform	**1.00**	**0.50**	0.5	0.25			0.5	0.25										
Conceptual design study	**2.00**	**0.50**	1	0			1	0.5										
Computational module procurement & testing	**2.50**	**1.25**	1	0.5			1.5	0.75										
AO Platform prototype development (HW & SW)	**3.50**	**1.75**	2	1			1.5	0.75										
AO Platform prototype testing	**2.50**	**1.25**	1.5	0.75			1	0.5										
Test report	**1.00**	**0.50**	0.5	0.25			0.5	0.25										
AO-MCAO RTC platform Final design	**2.00**	**1.00**	1	0.5			1	0.5										
Optimal control methods for MCAO systems	**3.90**	**1.20**	**1.5**	**0**									**2.4**	**1.2**				
Specification for MCAO Optimal control methods study	**0.10**	**0.00**	0.1	0									0	0				
Theoretical-experimental Study of the optimal control in MCAO	**0.90**	**0.30**	0.1	0									0.8	0.3				
Development of the optimal control for MAD	**1.00**	**0.50**	0.3	0									0.7	0.5				
Implementation of Recons. Method on MAD	**0.70**	**0.00**	0.5	0									0.2	0				
Testing of reconstruction method on MAD	**1.20**	**0.40**	0.5	0									0.7	0.4				
2nd Generation Piezo DM	**0.65**	**0.00**	**0.65**	**0**														
Specification of the 1.5K-actuator piezzo stack DM	**0.10**	**0.00**	0.1	0														
Call for Tender for the design and prototyping	**0.10**	**0.00**	0.1	0														
Design of 1.5K-Actuator DM Prototype	**0.10**	**0.00**	0.1	0														
Development of 1.5K-Actuator DM Prototype	**0.10**	**0.00**	0.1	0														
Testing & evaluation of the 1.5K-Actuator Prototype	**0.25**	**0.00**	0.25	0														
2nd generation Piezo DM drive electronics R&D	**0.60**	**0.00**	**0.6**	**0**														
Conceptual design study specifications	**0.10**	**0.00**	0.1	0														
Conceptual design study	**0.00**	**0.00**	0	0														
Specification of the 1.5K act.DM Drive electronics	**0.10**	**0.00**	0.1	0														
Call for Tender for the design and prototyping	**0.10**	**0.00**	0.1	0														
1.5K act. Piezo DM Drive Elec. Design	**0.10**	**0.00**	0.1	0														
DM Drive Electronics demonstration Prototype development	**0.10**	**0.00**	0.1	0														
DM drive electronics prototype testing	**0.10**	**0.00**	0.1	0														
VLT Adaptive secondary design Study	**2.85**	**1.00**	**0.85**	**0**	**2**	**1**												
Spec. of the VLT Adaptive secondary feasibility study	**0.25**	**0.00**	0.25	0														
Feasibility/concept Study of VLT Adaptive Secondary	**0.25**	**0.00**	0.25	0														
Feasibility Study review	**0.25**	**0.00**	0.25	0														
Preliminary design of VLT Adaptive secondary	**2.10**	**1.00**	0.1	0	2	1												

Status of Partner committed FTEs (3)

WORK PACKAGE	AO- JRP		ESO		INAF		Durham		INSU		MPIA		ONERA		NOVA		Grantecan	
	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested
Large convex glass shell manufacturing demo.	**2.90**	**2.00**	**0.4**	**0**					**2.5**	**2**								
Spec. of a ~1-m convex glass shell prototype	**0.20**	**0.00**	0.1	0					0.1	0								
Manuf. process and Test set-up study of a ~1m glass shell proto	**1.10**	**0.50**	0.1	0					1	0.5								
Manufacturing of a ~1m glass shell prototype	**1.10**	**1.00**	0.1	0					1	1								
Testing of the ~1m glass shell	**0.50**	**0.50**	0.1	0					0.4	0.5								
2K act. Micro- Deformable Mirror (MDM) R&D	**7.05**	**0.00**	**0.55**	**0**					**6.5**	**0**								
MDM subcomponent pre-studies and R&D (Patent)	**0.00**	**0.00**																
Preliminary specifications of a 2K act. & low order MDMs	**0.00**	**0.00**	0	0					0	0								
Preliminary Inquiry for the development of MDMs	**0.00**	**0.00**	0	0					0	0								
Final specification of the MDMs prototypes	**0.35**	**0.00**	0.1	0					0.25	0								
MDM-MDM control electronic I/F definition	**0.35**	**0.00**	0.1	0					0.25	0								
Call For Tender for a 2k act. MDM	**0.05**	**0.00**	0.05	0					0	0								
Preliinary design of 2K-Actuator MDM Prototype	**1.55**	**0.00**	0.05	0					1.5	0								
Final design of a 2K Act. MDM Prototype	**0.55**	**0.00**	0.05	0					0.5	0								
Development of 2K-Actuator MDM Prototype	**1.25**	**0.00**	0	0					1.25	0								
Design of a ~60 act. magnetic MDM prototype	**0.00**	**0.00**	0	0					0	0								
1st ~60 act. magnetic MDM prototype and validation	**0.25**	**0.00**	0	0					0.25	0								
2nd ~60 act. magnetic MDM prototype and testing	**0.50**	**0.00**	0	0					0.5	0								
MDM Control electonic conceptual design	**0.55**	**0.00**	0.05	0					0.5	0								
MDM Control Electronics Final Design	**0.55**	**0.00**	0.05	0					0.5	0								
MDM Control Electronics Prototype development	**0.50**	**0.00**	0	0					0.5	0								
MDM Test and Calibration plan	**0.60**	**0.00**	0.1	0					0.5	0								
High-Order WFS Experimental Study	**8.40**	**1.70**	**2**	**0**	**3**	**0**	**2**	**1**					**1.4**	**0.7**				
Specification of the HOWFS Experimental Study	**0.10**	**0.00**	0.1	0	0	0	0	0					0	0				
HOWFS theoretical study and performance criteria definition	**0.90**	**0.25**	0.3	0	0.1	0	0.2	0.1					0.3	0.15				
Design of the HOWFSs (SH & P-WFS) & of the test bench	**2.30**	**0.60**	0.1	0	1	0	0.8	0.4					0.4	0.2				
Development of the HOWFSs and test bench	**2.00**	**0.00**	1	0	1	0	0	0					0	0				
HOWFSs performance testing and evaluation	**3.10**	**0.85**	0.5	0	0.9	0	1	0.5					0.7	0.35				

JRA1 Management tool: HWs investment

ACTIVITY	AO- JRP		ESO		INAF		Durham		INSU		MPIA		ONERA		NOVA		Grantecan	
	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested
Total/Requested (in k€) to EC	**13450**	**4800**	**5715**	**2303**	**749**	**339**	**599**	**312**	**2969**	**1052**	**1653**	**246**	**621**	**317**	**922**	**170**	**223**	**61**
Total/Requested FTE (in k€) to EC	**8551**	**1371**	**2952**	**500**	**425**	**50**	**454**	**227**	**1632**	**130**	**1407**	**0**	**608**	**304**	**912**	**160**	**162**	**0**
Total/Requested HW (in k€) to EC	**4714**	**3244**	**2684**	**1724**	**310**	**275**	**130**	**70**	**1305**	**890**	**235**	**235**	**0**	**0**	**0**	**0**	**50**	**50**
Total/Requested Travel (in k€) to EC	**185**	**185**	**79**	**79**	**14**	**14**	**15**	**15**	**32**	**32**	**11**	**11**	**13**	**13**	**10**	**10**	**11**	**11**
	0	**0**																
Proposal phase	**0**	**0**																
AO-JRP Proposal Preparation	**0**	**0**																
AO-JRP consolidation with I3 OPTICON	**0**	**0**																
OPTICON I3 proposal evaluation by EC	**0**	**0**																
OPTICON I3 contract negociation with EC/partners	**0**	**0**																
Joint Research Project management and follow-up	**0**	**0**																
2nd Generation AO Systems Design	***710***	***430***	***270***	***0***	***130***	***120***	***0***	***0***	***25***	***25***	***235***	***235***	***0***	***0***	***0***	***0***	***50***	***50***
XAO System design study	**320**	**50**	**270**	**0**					**25**	**25**	**25**	**25**						
XAO Phase A Study specifications	**0**	**0**																
XAO Phase A Study 1 (2004)	**135**	**0**	135	0					0	0	0	0						
XAO Phase A Study 2 (2004)	**135**	**0**	135	0					0	0	0	0						
Review of Phase A Studies; Concept selection	**0**	**0**							0	0	0	0						
Specification for the XAO development	**0**	**0**							0	0	0	0						
XAO Design phase	**50**	**50**							25	25	25	25						
L/NGS MCAO System design Studies	**0**	**0**																
AO Top level requirements	**0**	**0**																
L/NGS MCAO Simulation & Performance	**0**	**0**																
L/NGS MCAO Conceptual Design Study	**0**	**0**																
Conceptual Design Study review & evaluation	**0**	**0**																
N/LGS MCAO system specifications	**0**	**0**																
N/LGS MCAO system design	**0**	**0**																
Multiobject WFS prototype for GTC	**50**	**50**															**50**	**50**
Specification of the Multi-object WFS prototype development	**0**	**0**															0	0
Feasibility study	**0**	**0**															0	0
Multi-object WFS design	**0**	**0**															0	0
Multi-object WFS prototype development	**40**	**40**															40	40
Multi-object WFS prototype testing in the laboratory	**10**	**10**															10	10
Multiple FOV MCAO System with NGS	**340**	**330**			**130**	**120**					**210**	**210**						
MFOV-MCAO Simulation & Performance	**0**	**0**																
6' FOV ground layer prototype design	**40**	**40**			0	0					40	40						
6' FOV ground layer prototype manufacturing	**300**	**290**			130	120					170	170						
6' FOV ground layer prototye AIT	**0**	**0**			0	0					0	0						
6' FOV ground layer on sky testing	**0**	**0**																

Status of Partner committed HWs (2)

ACTIVITY	AO- JRP		ESO		INAF		Durham		INSU		MPIA		ONERA		NOVA		Grantecan	
	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested
Enabling Techno. for 2nd Gen./ELT AO Systems	***4004***	***2814***	***2414***	***1724***	***180***	***155***	***130***	***70***	***1280***	***865***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
2nd generation of AO Real-Time Computer platform	**410**	**265**	**310**	**225**			**100**	**40**										
Specification of the 2nd gen. AO and MCAO RTC Platform	**0**	**0**																
Conceptual design study	**150**	**95**	100	75			50	20										
Computational module procurement & testing	**200**	**140**	150	120			50	20										
AO Platform prototype development (HW & SW)	**60**	**30**	60	30														
AO Platform prototype testing	**0**	**0**																
Test report	**0**	**0**																
AO-MCAO RTC platform Final design	**0**	**0**																
Optimal control methods for MCAO systems	**115**	**0**	**115**	**0**														
Specification for MCAO Optimal control methods study	**0**	**0**																
Theoretical-experimental Study of the optimal control in MCAO	**115**	**0**	115	0														
Development of the optimal control for MAD	**0**	**0**																
Implementation of Recons. Method on MAD	**0**	**0**																
Testing of reconstruction method on MAD	**0**	**0**																
2nd Generation Piezo DM	**1200**	**850**	**1200**	**850**														
Specification of the 1.5K-actuator piezzo stack DM	**0**	**0**																
Call for Tender for the design and prototyping	**0**	**0**																
Design of 1.5K-Actuator DM Prototype	**150**	**100**	150	100														
Development of 1.5K-Actuator DM Prototype	**1050**	**750**	1050	750														
Testing & evaluation of the 1.5K-Actuator Prototype	**0**	**0**																
2nd generation Piezo DM drive electronics R&D	**230**	**190**	**230**	**190**														
Conceptual design study specifications	**0**	**0**																
Conceptual design study	**0**	**0**																
Specification of the 1.5K act.DM Drive electronics	**0**	**0**																
Call for Tender for the design and prototyping	**0**	**0**																
1.5K act. Piezo DM Drive Elec. Design	**90**	**90**	90	90														
DM Drive Electronics demonstration Prototype development	**140**	**100**	140	100														
DM drive electronics prototype testing	**0**	**0**																
VLT Adaptive secondary design Study	**589**	**474**	**559**	**459**	**30**	**15**												
Spec. of the VLT Adaptive secondary feasibility study	**0**	**0**																
Feasibility/concept Study of VLT Adaptive Secondary	**100**	**0**	100	0														
Feasibility Conceptual design study review	**0**	**0**																
Preliminary design	**489**	**474**	459	459	30	15												
Large convex glass shell manufacturing demo.	**385**	**220**							**385**	**220**								
Spec. of a ~1-m convex glass shell prototype	**0**	**0**																
Manuf. process & Test set-up study of a ~1-m glass shell proto.	**105**	**30**							105	30								
Manufacturing of a ~1m glass shell prototype	**280**	**190**							280	190								
Testing of the ~1m glass shell	**0**	**0**																

Status of Partner committed HWs (3)

ACTIVITY	AO- JRP		ESO		INAF		Durham		INSU		MPIA		ONERA		NOVA		Grantecan	
	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested	Total	Requested
2K act. Micro- Deformable Mirror (MDM) R&D	**895**	**645**							**895**	**645**								
MDM subcomponent pre-studies and R&D (Patent)	**0**	**0**																
Specification of a 2K act. MDM	**0**	**0**																
MDM-MDM control electronic I/F definition	**0**	**0**																
Call For Tender for a 2k act. MDM	**0**	**0**																
Preliinary design of 2K-Actuator MDM Prototype	**270**	**150**							270	150								
Final design of a 2K Act. MDM Prototype	**200**	**160**							200	160								
Development of 2K-Actuator MDM Prototype	**270**	**235**							270	235								
Design of a ~60 act. magnetic MDM prototype	**0**	**0**							0	0								
1st ~60 act. magnetic MDM prototype and validation	**20**	**10**							20	10								
2nd ~60 act. magnetic MDM prototype and testing	**30**	**15**							30	15								
MDM Control electonic conceptual design	**40**	**10**							40	10								
MDM Control Electronics Final Design	**20**	**20**							20	20								
MDM Control Electronics Prototype development	**45**	**45**							45	45								
MDM Test and Calibration plan	**0**	**0**							0	0								
High-Order WFS Experimental Study	**180**	**170**			**150**	**140**	**30**	**30**										
Specification of the HOWFS Experimental Study	**0**	**0**																
HOWFS theoretical study and performance criteria definition	**0**	**0**																
Design of the HOWFSs & of the test bench	**0**	**0**																
Development of the HOWFSs and test bench	**180**	**170**			150	140	30	30										
HOWFSs performance testing and evaluation	**0**	**0**																

Financial contractual situation before the last change recommended by EC

FINANCIAL INFORMATION- WHOLE DURATION OF THE PROJECT (K€)			
Organisation short name	Estimated eligible costs and requested EC contribution		RTD activities
ESO	Eligible costs	Direct cost	5223
		of which subcontracting	2524
		indirect cost	492
		Total eligible costs	5715
	Requested EC contribution		2303
INAF-OAA	Eligible costs	Direct cost	724
		of which subcontracting	0
		indirect cost	26
		Total eligible costs	749
	Requested EC contribution		339
Durham	Eligible costs	Direct cost	523
		of which subcontracting	0
		indirect cost	76
		Total eligible costs	599
	Requested EC contribution		312
INSU	Eligible costs	Direct cost	2697
		of which subcontracting	820
		indirect cost	272
		Total eligible costs	2968
	Requested EC contribution		1052
MPIA	Eligible costs	Direct cost	1395
		of which subcontracting	0
		indirect cost	258
		Total eligible costs	1653
	Requested EC contribution		246
ONERA	Eligible costs	Direct cost	384
		of which subcontracting	0
		indirect cost	237
		Total eligible costs	621
	Requested EC contribution		317
NOVA	Eligible costs	Direct cost	922
		of which subcontracting	0
		indirect cost	0
		Total eligible costs	922
	Requested EC contribution		170
GTC	Eligible costs	Direct cost	196
		of which subcontracting	0
		indirect cost	27
		Total eligible costs	223
	Requested EC contribution		61
TOTAL	Eligible costs	Direct cost	12062.7
		of which subcontracting	3344.0
		indirect cost	1387.1
		Total eligible costs	13449.8
	Requested EC contribution		4800.0

Financial situation for the first 18-months (before EC modification)

FINANCIAL INFORMATION- FIRST 18-months(K€)			
Organisation short name	Estimated eligible costs and requested EC contribution		RTD activities
ESO	Eligible costs	Direct cost	2831
		of which subcontracting	1689
		indirect cost	187
		Total eligible costs	3018
	Requested EC contribution		1353
INAF-OAA	Eligible costs	Direct cost	354
		of which subcontracting	0
		indirect cost	12
		Total eligible costs	367
	Requested EC contribution		184
Durham	Eligible costs	Direct cost	271
		of which subcontracting	0
		indirect cost	30
		Total eligible costs	301
	Requested EC contribution		151
INSU	Eligible costs	Direct cost	1393
		of which subcontracting	350
		indirect cost	142
		Total eligible costs	1534
	Requested EC contribution		468
MPIA	Eligible costs	Direct cost	747
		of which subcontracting	0
		indirect cost	135
		Total eligible costs	883
	Requested EC contribution		159
ONERA	Eligible costs	Direct cost	198
		of which subcontracting	0
		indirect cost	119
		Total eligible costs	317
	Requested EC contribution		165
NOVA	Eligible costs	Direct cost	442
		of which subcontracting	0
		indirect cost	0
		Total eligible costs	442
	Requested EC contribution		90
GTC	Eligible costs	Direct cost	101
		of which subcontracting	0
		indirect cost	12
		Total eligible costs	113
	Requested EC contribution		41
TOTAL	Eligible costs	Direct cost	6338.3
		of which subcontracting	2039.0
		indirect cost	636.9
		Total eligible costs	6975.2
	Requested EC contribution		2610.0

JRA1 cash-flow

ESTIMATED BREAKDOWN OF THE EC CONTRIBUTION PER REPORTING PERIOD

Reporting Periods	Month x - Month y	Estimated Grant to the Budget	
		TOTAL	in which first 6 months
Reporting Periods 1	M1 - M12	1800	
Reporting Periods 2	M12 - M24	1700	850
Reporting Periods 3	M25 - M36	1000	500
Reporting Periods 4	M36 - M48	300	200
Reporting Periods 5	M49 - M60	0	0

Change of EC financial rules (1)

- 1) Organizations with AC financial model MUST charge 20% indirect costs. Request exactly 100% of Eligible costs
  - (a) direct costs: A of which sub-contracting
  - (b) indirect costs: 0.2 x (A - subcontracting)
  - (c) Total eligible costs: C= A+ B
  - (d) EC contribution: C
- 2) Organizations with FCF model MUST charge indirect costs at 20% of direct costs. (FC contractors can use any indirect value they wish, for later audit)
- 3) Organizations with either FC or FCF model must claim from the EC exactly 50% of their listed total eligible cost.

Partner contract changes required

- ESO FCF Eligible costs reduced 5223K ⇨ 4606K,
- INSU FCF Eligible costs reduced 2969K ⇨ 2104K,
- INAF FCF Eligible costs reduced 750K ⇨ 678K,
- MPIA AC Eligible costs reduced 1653K ⇨ 246K,
- NOVA AC Eligible costs reduced 922K ⇨ 170K
- IAC FCF Eligible costs reduced 223K ⇨ 122K
- ONERA FC no change needed
- Durham AC Eligible costs reduced 599K t ⇨ 312K

NO IMPACT ON MONEY ACTUALLY RECEIVED FROM EC

EC AUDIT WILL BE BASED ON THESE NEW NUMBERS

BUT NO CHANGE ON DELIVERABLES

THEREFORE INTERNAL MONITORING WILL BE BASED ON THE AGREED RESSOURCES DURING NEGOTIATION

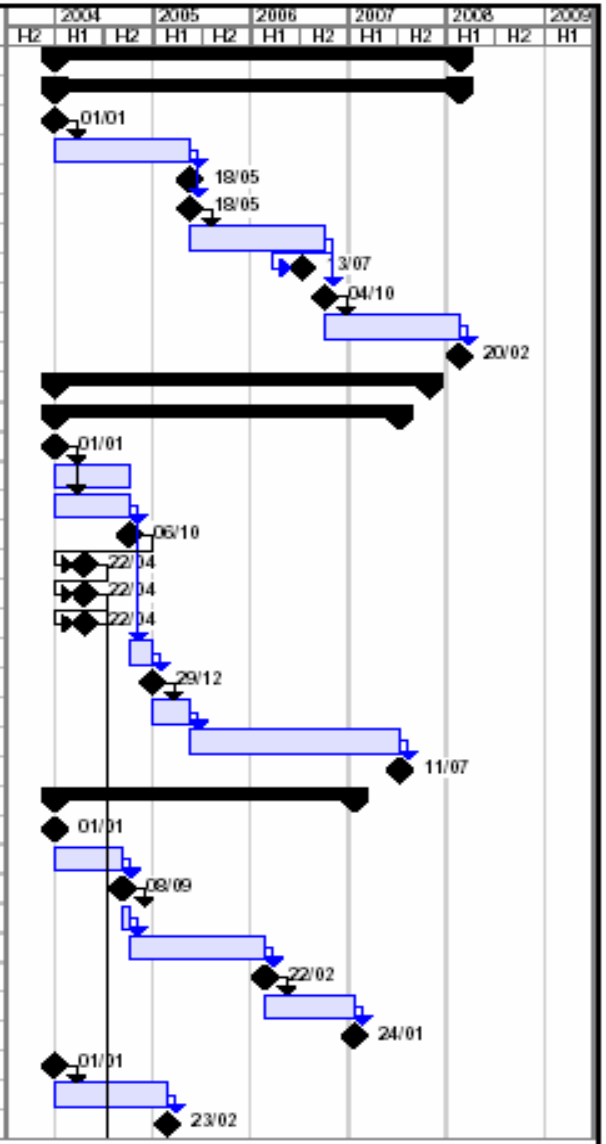
Financial contractual situation after the change of financial rule

CAREFULL:
Absolutely no change in term of deliverables
Partner should keep internal resources as promised during negotiation

FINANCIAL INFORMATION- WHOLE DURATION OF THE			
Organisation short name	Estimated eligible costs and requested EC contribution		RTD activities
ESO	Eligible costs	Direct cost	4259
		of which subcontracting	2524
		indirect cost	347
		Total eligible costs	4606
	Requested EC contribution		2303
INAF-OAA	Eligible costs	Direct cost	565
		of which subcontracting	0
		indirect cost	113
		Total eligible costs	678
	Requested EC contribution		339
Durham	Eligible costs	Direct cost	260
		of which subcontracting	0
		indirect cost	52
		Total eligible costs	312
	Requested EC contribution		312
INSU	Eligible costs	Direct cost	1890
		of which subcontracting	820
		indirect cost	214
		Total eligible costs	2104
	Requested EC contribution		1052
MPIA	Eligible costs	Direct cost	205
		of which subcontracting	0
		indirect cost	41
		Total eligible costs	246
	Requested EC contribution		246
ONERA	Eligible costs	Direct cost	384
		of which subcontracting	0
		indirect cost	237
		Total eligible costs	621
	Requested EC contribution		317
NOVA	Eligible costs	Direct cost	142
		of which subcontracting	0
		indirect cost	28
		Total eligible costs	170
	Requested EC contribution		170
GTC	Eligible costs	Direct cost	102
		of which subcontracting	0
		indirect cost	20
		Total eligible costs	122
	Requested EC contribution		61
TOTAL	Eligible costs	Direct cost	7806.1
		of which subcontracting	3344.0
		indirect cost	1052.8
		Total eligible costs	8858.8
	Requested EC contribution		4800

JRA1 detailed schedule tool

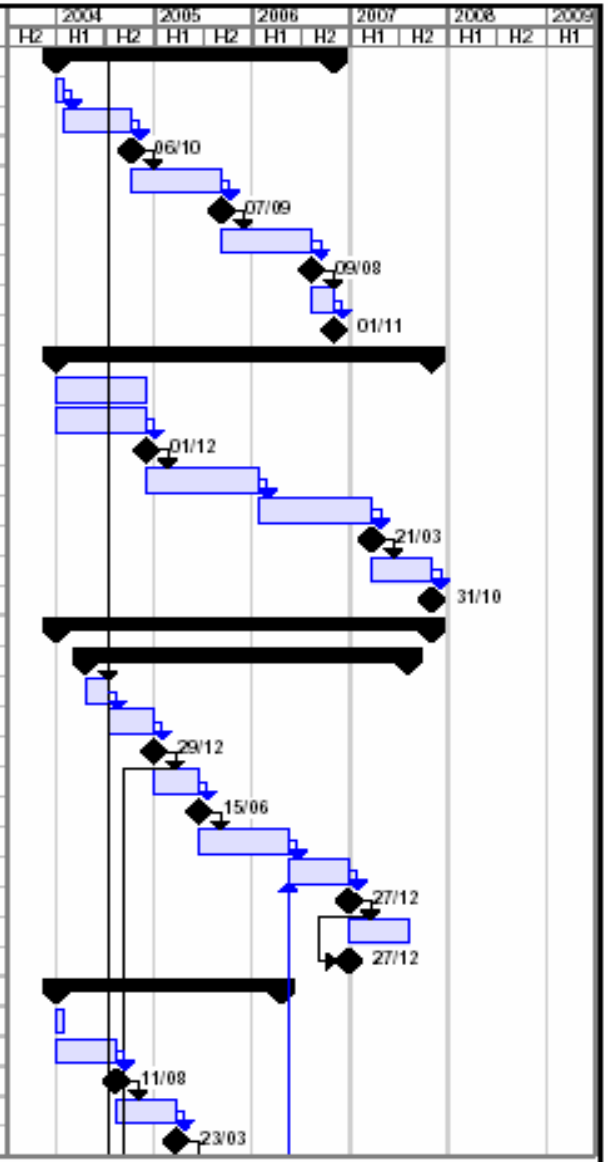
ID	Task Name	Duration	Start	Finish	WP & deliverable Responsible
1	JOINT RESEARCH ACTIVITY 1	1080 days	Thu 01/01/04	Wed 20/02/08	ESO
2	Management	1080 days	Thu 01/01/04	Wed 20/02/08	ESO
3	*AO Joint Research Project KO*	0 days	Thu 01/01/04	Thu 01/01/04	ESO
4	JRA Period 1	18 mons	Thu 01/01/04	Wed 18/05/05	ESO
5	Detailed Work Plan for Period 2	0 days	Wed 18/05/05	Wed 18/05/05	ESO
6	Report of JRA Period 1	0 days	Wed 18/05/05	Wed 18/05/05	ESO
7	JRA Period 2	18 mons	Thu 19/05/05	Wed 04/10/06	ESO
8	Detailed Work Plan for Period 3	0 days	Thu 13/07/06	Thu 13/07/06	ESO
9	Report of JRA Period 2	0 days	Wed 04/10/06	Wed 04/10/06	ESO
10	JRA Period 3	18 mons	Thu 05/10/06	Wed 20/02/08	ESO
11	Report of JRA Period 3/ Final report	0 days	Wed 20/02/08	Wed 20/02/08	ESO
12	2nd Generation AO Systems Design	1000 days	Thu 01/01/04	Wed 31/10/07	All
13	XAO System design study	920 days	Thu 01/01/04	Wed 11/07/07	ESO
14	XAO Phase A Study specifications	0 mons	Thu 01/01/04	Thu 01/01/04	ESO
15	XAO Phase A Study 1	10 mons	Thu 01/01/04	Wed 06/10/04	INSU-ESO
16	XAO Phase A Study 2	10 mons	Thu 01/01/04	Wed 06/10/04	MPIA-ESO
17	*XAO Phase A Studies reports*	0 days	Wed 06/10/04	Wed 06/10/04	INSU-MPIA-ESO
18	*Visible WFS CCD camera specs for JRA detector*	0 days	Thu 22/04/04	Thu 22/04/04	INSU-MPIA-ESO
19	*2nd generation AO RTC platform specs*	0 days	Thu 22/04/04	Thu 22/04/04	INSU-MPIA-ESO
20	*Deformable mirror specs*	0 days	Thu 22/04/04	Thu 22/04/04	INSU-MPIA-ESO
21	Review of Phase A Studies; Concept selection	3 mons	Thu 07/10/04	Wed 29/12/04	ESO
22	*Concept selection by ESO and KO for Prel. design*	0 days	Wed 29/12/04	Wed 29/12/04	ESO
23	Specification for the XAO development	5 mons	Thu 30/12/04	Wed 18/05/05	ESO
24	XAO Design phase	28 mons	Thu 19/05/05	Wed 11/07/07	TBD-ESO
25	*XAO design Reports*	0 days	Wed 11/07/07	Wed 11/07/07	ESO
26	L/NGS MCAO System design Studies	800 days	Thu 01/01/04	Wed 24/01/07	ESO-NOVA
27	MUSE- GLAO Specifications	0 days	Thu 01/01/04	Thu 01/01/04	ESO
28	L/NGS MCAO Conceptual Design Study	9 mons	Thu 01/01/04	Wed 08/09/04	ESO-NOVA
29	*Conceptual design report*	0 days	Wed 08/09/04	Wed 08/09/04	ESO
30	N/LGS MCAO system specifications	1 mon	Thu 09/09/04	Wed 06/10/04	ESO
31	N/LGS MCAO system preliminary design	18 mons	Thu 07/10/04	Wed 22/02/06	ESO-NOVA
32	N/LGS MCAO final design report	0 days	Wed 22/02/06	Wed 22/02/06	ESO-NOVA
33	N/LGS MCAO system final design	12 mons	Thu 23/02/06	Wed 24/01/07	ESO-NOVA
34	N/LGS MCAO final design report	0 days	Wed 24/01/07	Wed 24/01/07	ESO-NOVA
35	Spec. feasi. of a very large FOV Multi WFS AO syst. (FALCON)	0 mons	Thu 01/01/04	Thu 01/01/04	ESO
36	Feasibility study of a very FOV multi WFS AO syst. (FALCON)	15 mons	Thu 01/01/04	Wed 23/02/05	INSU
37	Feasibility report	0 days	Wed 23/02/05	Wed 23/02/05	INSU



Schedule JRA1 N.HUBIN Kick-off meeting

JRA1 schedule (2)

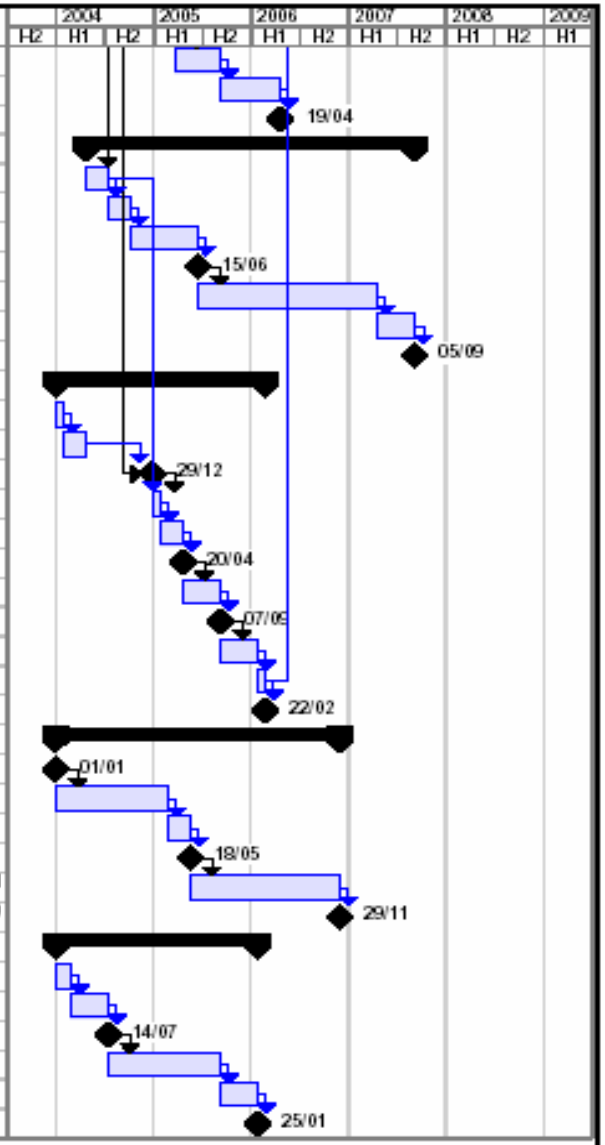
ID	Task Name	Duration	Start	Finish	WP & deliverable Responsible
38	Multiobject WFS prototype for GTC	740 days	Thu 01/01/04	Wed 01/11/06	GTC
39	Specification of the Multi-object WFS prototype development	1 mon	Thu 01/01/04	Wed 28/01/04	GTC
40	Feasibility study	9 mons	Thu 29/01/04	Wed 06/10/04	GTC
41	Study report	0 days	Wed 06/10/04	Wed 06/10/04	GTC
42	Multi-object WFS conceptual design	12 mons	Thu 07/10/04	Wed 07/09/05	GTC
43	Multi-object WFS lab. design report	0 days	Wed 07/09/05	Wed 07/09/05	GTC
44	Multi-object WFS lab. prototype development	12 mons	Thu 08/09/05	Wed 09/08/06	GTC
45	Multi-object WFS lab. prototype delivery	0 days	Wed 09/08/06	Wed 09/08/06	GTC
46	Multi-object WFS lab. prototype testing	3 mons	Thu 10/08/06	Wed 01/11/06	GTC
47	Multi-object WFS lab. test report	0 days	Wed 01/11/06	Wed 01/11/06	GTC
48	Multiple FOV MCAO System with NGS	1000 days	Thu 01/01/04	Wed 31/10/07	MPIA-INAF
49	MFOV-MCAO Simulation & Performance	12 mons	Thu 01/01/04	Wed 01/12/04	INAF-ESO
50	6' FOV ground layer prototype design	12 mons	Thu 01/01/04	Wed 01/12/04	MPIA-INAF
51	*Design report*	0 days	Wed 01/12/04	Wed 01/12/04	MPIA-INAF
52	6' FOV ground layer prototype manufacturing	15 mons	Thu 02/12/04	Wed 25/01/06	MPIA-INAF
53	6' FOV ground layer prototye AIT	15 mons	Thu 26/01/06	Wed 21/03/07	MPIA-INAF
54	*First light of 6' FOV ground layer prototype at LBT*	0 days	Wed 21/03/07	Wed 21/03/07	MPIA-INAF
55	6' FOV ground layer on sky testing	8 mons	Thu 22/03/07	Wed 31/10/07	MPIA-INAF
56	*Test report*	0 days	Wed 31/10/07	Wed 31/10/07	MPIA-INAF
57	Enabling Technology for 2nd Gen. AO	1000 days	Thu 01/01/04	Wed 31/10/07	All
58	2nd Gen. AO Real-Time Computer platform	960 days	Thu 22/04/04	Wed 08/08/07	ESO
59	Specs of the 2nd gen. AO and MCAO RTC Platform	3 mons	Thu 22/04/04	Wed 14/07/04	ESO
60	Conceptual design study	6 mons	Thu 15/07/04	Wed 29/12/04	ESO-Durham
61	Conceptual design review	0 days	Wed 29/12/04	Wed 29/12/04	ESO-Durham
62	Computational module procurement & testing	6 mons	Thu 30/12/04	Wed 15/06/05	ESO-Durham
63	Module Performance and test report	0 days	Wed 15/06/05	Wed 15/06/05	ESO-Durham
64	AO Platform prototype development (HW & SW)	12 mons	Thu 16/06/05	Wed 17/05/06	ESO-Durham
65	AO Platform prototype testing	8 mons	Thu 18/05/06	Wed 27/12/06	ESO-Durham
66	Prototype test report	0 mons	Wed 27/12/06	Wed 27/12/06	ESO-Durham
67	AO-MCAO RTC platform Final design	8 mons	Thu 28/12/06	Wed 08/08/07	ESO-Durham
68	Final design report	0 mons	Wed 27/12/06	Wed 27/12/06	ESO-Durham
69	Optimal control methods for MCAO systems	600 days	Thu 01/01/04	Wed 19/04/06	ONERA-ESO
70	Specification for MCAO Optimal control methods study	1 mon	Thu 01/01/04	Wed 28/01/04	ESO
71	Theoretical-experimental Study of the optimal control in MCAO	8 mons	Thu 01/01/04	Wed 11/08/04	ONERA
72	*Theoretical-experimental Study review and report*	0 days	Wed 11/08/04	Wed 11/08/04	ONERA-ESO
73	Development of the optimal control for MAD	8 mons	Thu 12/08/04	Wed 23/03/05	ONERA
74	*Delivery of study report*	0 days	Wed 23/03/05	Wed 23/03/05	ONERA



Schedule JRA1 N.HUBIN Kick-off meeting

JRA1 schedule (3)

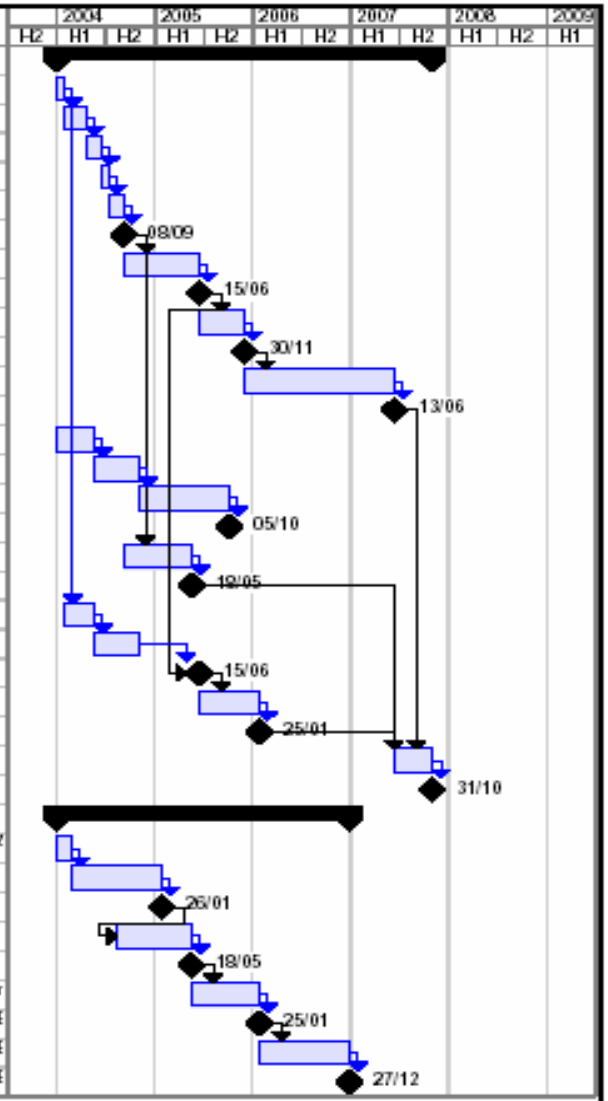
ID	Task Name	Duration	Start	Finish	WP & deliverable Responsible
75	Implementation of Recons. Method on MAD	6 mons	Thu 24/03/05	Wed 07/09/05	ESO
76	Testing of reconstruction method on MAD	8 mons	Thu 08/09/05	Wed 19/04/06	ONERA-ESO
77	*Test report*	0 days	Wed 19/04/06	Wed 19/04/06	ONERA-ESO
78	2nd Generation Piezo DM	880 days	Thu 22/04/04	Wed 05/09/07	ESO
79	Specification of the 1.5K-actuator piezzo stack DM	3 mons	Thu 22/04/04	Wed 14/07/04	ESO
80	Call for Tender for the design and prototyping	3 mons	Thu 15/07/04	Wed 06/10/04	ESO
81	Design of 1.5K-Actuator DM Prototype	9 mons	Thu 07/10/04	Wed 15/06/05	ESO
82	*DM Prototype design Review*	0 days	Wed 15/06/05	Wed 15/06/05	ESO
83	Development of 1.5K-Actuator DM Prototype	24 mons	Thu 16/06/05	Wed 18/04/07	ESO
84	Testing & evaluation of the 1.5K-Actuator Prototype	5 mons	Thu 19/04/07	Wed 05/09/07	ESO
85	*1.5K-act. piezzo DM test and final design report*	0 days	Wed 05/09/07	Wed 05/09/07	ESO
86	2nd generation Piezo DM drive electronics R&D	560 days	Thu 01/01/04	Wed 22/02/06	ESO
87	Conceptual design study specifications	1 mon	Thu 01/01/04	Wed 28/01/04	ESO
88	Conceptual design study	3 mons	Thu 29/01/04	Wed 21/04/04	ESO
89	*DM control elec. conceptual design review*	0 days	Wed 29/12/04	Wed 29/12/04	ESO
90	Specification of the 1.5K act.DM Drive electronics	1 mon	Thu 30/12/04	Wed 26/01/05	ESO
91	Call for Tender for the design and prototyping	3 mons	Thu 27/01/05	Wed 20/04/05	ESO
92	*Contract KO*	0 days	Wed 20/04/05	Wed 20/04/05	ESO
93	1.5K act. Piezo DM Drive Elec. Design	5 mons	Thu 21/04/05	Wed 07/09/05	ESO
94	*DM drive elect. design Review*	0 days	Wed 07/09/05	Wed 07/09/05	ESO
95	DM Drive Electronics demonstration Prototype development	5 mons	Thu 08/09/05	Wed 25/01/06	ESO
96	DM drive electronics prototype testing	1 mon	Thu 26/01/06	Wed 22/02/06	ESO
97	*DM drive electronics test report*	0 days	Wed 22/02/06	Wed 22/02/06	ESO
98	VLT Adaptive secondary design Study	760 days	Thu 01/01/04	Wed 29/11/06	ESO
99	Spec. of the VLT Adaptive secondary feasibility study	0 mons	Thu 01/01/04	Thu 01/01/04	ESO
100	Feasibility Study of VLT Adaptive Secondary	15 mons	Thu 01/01/04	Wed 23/02/05	ESO-Microgate
101	Feasibility and conceptual design review	3 mons	Thu 24/02/05	Wed 18/05/05	ESO-Microgate
102	*Feasibility confirmed for VLT?*	0 days	Wed 18/05/05	Wed 18/05/05	ESO
103	Preliminary design phase + relevant prototypes	20 mons	Thu 19/05/05	Wed 29/11/06	Microgate-INAF-DI
104	Preliminary design review	0 days	Wed 29/11/06	Wed 29/11/06	Microgate-INAF_D
105	Demonstration of a large convex glass shell manufactu	540 days	Thu 01/01/04	Wed 25/01/06	INSU-INAF
106	Spec. of a ~1-m convex glass shell prototype	2 mons	Thu 01/01/04	Wed 25/02/04	INAF-INSU-ESO
107	Manufacturing process and Test set-up study of a ~1-m glass shell	5 mons	Thu 26/02/04	Wed 14/07/04	INSU
108	*Study review*	0 days	Wed 14/07/04	Wed 14/07/04	INSU
109	Manufacturing of a ~1m glass shell prototype	15 mons	Thu 15/07/04	Wed 07/09/05	INSU
110	Testing of the ~1m glass shell	5 mons	Thu 08/09/05	Wed 25/01/06	INSU
111	*1m glass shell acceptance review*	0 days	Wed 25/01/06	Wed 25/01/06	INSU



Schedule JRA1 N.HUBIN Kick-off meeting

JRA1 schedule (4)

ID	Task Name	Duration	Start	Finish	WP & deliverable Responsible
112	2K act. Micro- Deformable Mirror (MDM) R&D	1000 days	Thu 01/01/04	Wed 31/10/07	INSU-ESO
113	Preliminary specifications of a 2K act. & low order MDMs	1 mon	Thu 01/01/04	Wed 28/01/04	ESO-INSU
114	Preliminary Inquiry for the development of MDMs	3 mons	Thu 29/01/04	Wed 21/04/04	ESO-INSU
115	Final MDMs R&D specifications	2 mons	Thu 22/04/04	Wed 16/06/04	ESO-INSU
116	MDM-MDM control electronic I/F definition	1 mon	Thu 17/06/04	Wed 14/07/04	INSU
117	Call For Tender for a 2k act. & low order MDMs	2 mons	Thu 15/07/04	Wed 08/09/04	INSU-ESO
118	*Contract KO*	0 days	Wed 08/09/04	Wed 08/09/04	INSU-ESO
119	Preliinary design of the MDM Prototypes	10 mons	Thu 09/09/04	Wed 15/06/05	INSU
120	*MDM PDR*	0 days	Wed 15/06/05	Wed 15/06/05	INSU
121	Final design of the MDM Prototypes	6 mons	Thu 16/06/05	Wed 30/11/05	INSU
122	*MDM FDR*	0 days	Wed 30/11/05	Wed 30/11/05	INSU
123	Development of 2K-Actuator and low order MDM Prototype	20 mons	Thu 01/12/05	Wed 13/06/07	INSU
124	Delivery of the 2K-Actuator and low order MDMD prototype	0 days	Wed 13/06/07	Wed 13/06/07	INSU
125	Design of a ~60 act. magnetic MDM prototype	5 mons	Thu 01/01/04	Wed 19/05/04	INSU
126	1st ~60 act. magnetic MDM prototype and validation	6 mons	Thu 20/05/04	Wed 03/11/04	INSU
127	2nd ~60 act. magnetic MDM prototype and testing	12 mons	Thu 04/11/04	Wed 05/10/05	INSU
128	~60 act. magnetic MDM prototype test report	0 days	Wed 05/10/05	Wed 05/10/05	INSU
129	MDM Control Electronics Prototype development	9 mons	Thu 09/09/04	Wed 18/05/05	INSU
130	Delivery of the MDM Control Electronics	0 mons	Wed 18/05/05	Wed 18/05/05	INSU
131	MDM Test and Calibration plan	4 mons	Thu 29/01/04	Wed 19/05/04	INSU
132	MDM test bench design (best effort)	6 mons	Thu 20/05/04	Wed 03/11/04	INSU
133	*MDM test bench design review (best effort)*	0 days	Wed 15/06/05	Wed 15/06/05	INSU
134	MDM test bench manufacturing (best effort)	8 mons	Thu 16/06/05	Wed 25/01/06	INSU
135	Delivery of the test bench (best effort)	0 days	Wed 25/01/06	Wed 25/01/06	INSU
136	MDM prototype Testing & Characterization (best effort)	5 mons	Thu 14/06/07	Wed 31/10/07	INSU
137	MDM prototype test report (best effort)	0 days	Wed 31/10/07	Wed 31/10/07	INSU
138	High Order Wavefront Sensor (HOWFS) Exp. Study	780 days	Thu 01/01/04	Wed 27/12/06	INAF
139	Specification of the HOWFS theoretical and Exp. Study	2 mons	Thu 01/01/04	Wed 25/02/04	ESO-INAF-ONERA
140	HOWFS theoretical study and performance criteria definition	12 mons	Thu 26/02/04	Wed 26/01/05	ONERA
141	Study report delivery	0 mons	Wed 26/01/05	Wed 26/01/05	ONERA
142	Design of the HOWFSs (SH-WFS and P-WFS) & test bench	10 mons	Thu 12/08/04	Wed 18/05/05	INAF-ESO
143	*Design review*	0 days	Wed 18/05/05	Wed 18/05/05	INAF-ESO
144	Development of the HOWFSs and test bench	9 mons	Thu 19/05/05	Wed 25/01/06	ESO-INAF-Durham
145	Delivery of the P & SH WFS and test bench	0 days	Wed 25/01/06	Wed 25/01/06	INAF-Durham-ONE
146	HOWFSs (SH-WFS and P-WFS) performance evaluation	12 mons	Thu 26/01/06	Wed 27/12/06	INAF-Durham-ONE
147	*Test reports*	0 days	Wed 27/12/06	Wed 27/12/06	INAF-Durham-ONE



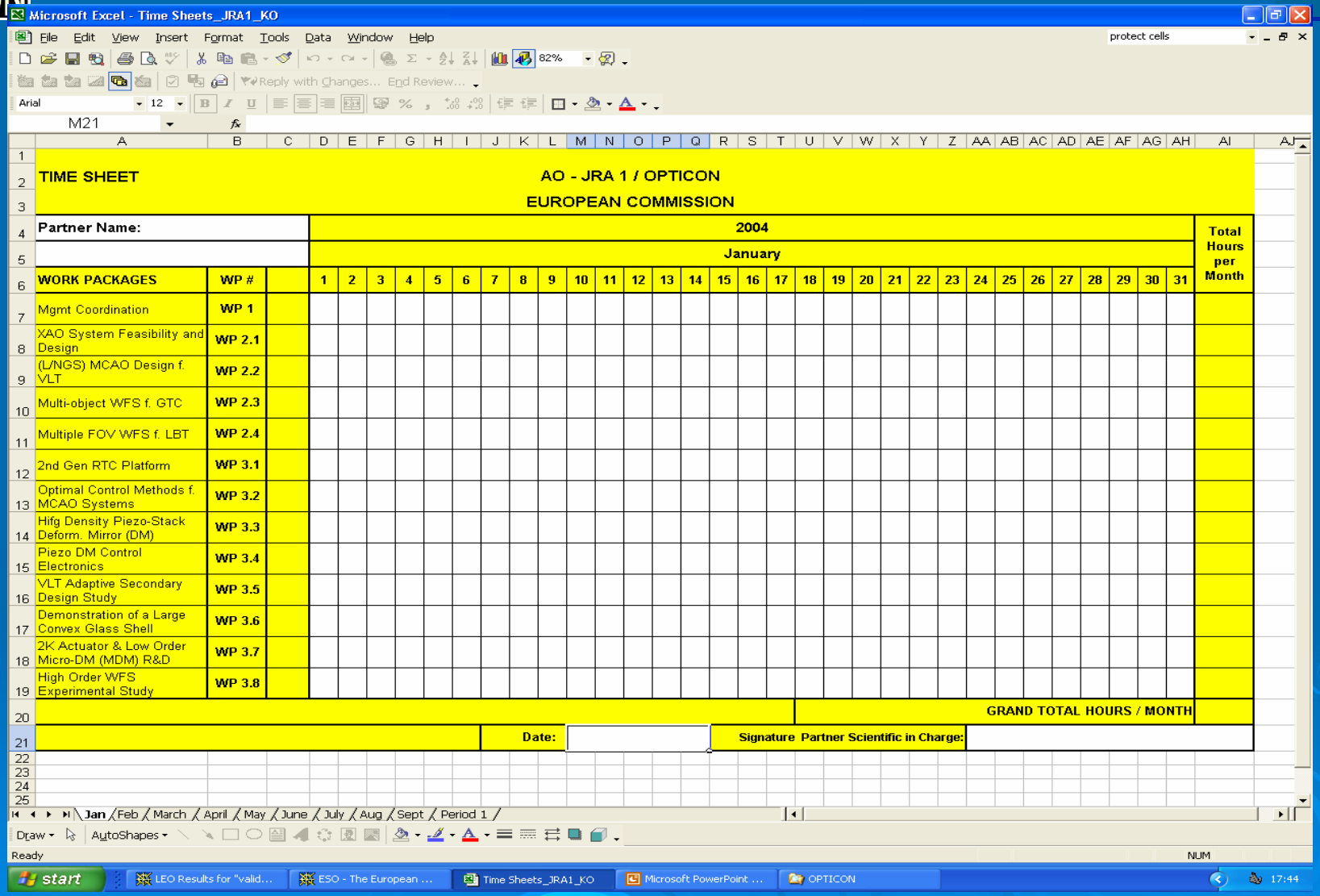
JRA1 MONITORING

- JRA1 general meeting every 9 months
- JRA1 progress report / each partner every 9 months (.doc template will be provided) including technical annex
- FTE & HW sheets (.xls template will be provided)
- General meeting viewgraphs to be provided in .ppt
- WEB page with password will be created

JRA 1 Monitoring: Progress reports

- Scope: WPs concerned by the report
- WP XX
  - Status of WP xx (max 2 pages) as far as possible refer to the technical annex avoid blabla….
  - Milestones achieved, actions completed (w.r.t JRA1 schedule)
  - Area of concerns: change of specs, schedule, deliverables, cost, FTEs….
  - Plan for next period: activities, deliverables
- WP YY etc…..
- Technical annex shall include (in electronic form):
  - Specifications/ Statement of work
  - Conceptual-Preliminary-Final design reports
  - Test reports
  - Papers mentioning OPTICON & present EC contract (info to be provided)
- FTE time sheets & list of expenditures (.xls)

RECOMMENDED EXAMPLE OF FTE TIME SHEETS / MONTH



Microsoft Excel - Time Sheets_JRA1_KO

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M21

TIME SHEET

AO - JRA 1 / OPTICON

EUROPEAN COMMISSION

Partner Name:			2004																													Total Hours per Month
			January																													
WORK PACKAGES	**WP #**		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Mgmt Coordination	**WP 1**																																
XAO System Feasibility and Design	**WP 2.1**																																
(L/NGS) MCAO Design f. VLT	**WP 2.2**																																
Multi-object WFS f. GTC	**WP 2.3**																																
Multiple FOV WFS f. LBT	**WP 2.4**																																
2nd Gen RTC Platform	**WP 3.1**																																
Optimal Control Methods f. MCAO Systems	**WP 3.2**																																
Hifg Density Piezo-Stack Deform. Mirror (DM)	**WP 3.3**																																
Piezo DM Control Electronics	**WP 3.4**																																
VLT Adaptive Secondary Design Study	**WP 3.5**																																
Demonstration of a Large Convex Glass Shell	**WP 3.6**																																
2K Actuator & Low Order Micro-DM (MDM) R&D	**WP 3.7**																																
High Order WFS Experimental Study	**WP 3.8**																																
																				GRAND TOTAL HOURS / MONTH											
																				Date:												
																				Signature Partner Scientific in Charge:											

Jan / Feb / March / April / May / June / July / Aug / Sept / Period 1

Draw AutoShapes

Ready NUM

start | LEO Results for "valid... | ESO - The European ... | Time Sheets_JRA1_KO | Microsoft PowerPoint ... | OPTICON | 17:44

Reporting: Time sheet report

TIME SHEET — **AO - JRA 1 / OPTICON**

EUROPEAN COMMISSION

Partner:			**REPORTING PERIOD 1**									**Total Hours**	**Total in FTE (EUR)**
Name of staff:			**JANUARY - SEPTEMBER 2004**										
WORK PACKAGES	**WP #**		**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**		
Mgmt Coordination	**WP 1**		**11**									**11**	**0.01**
XAO System Feasibility and Design	**WP 2.1**												
(L/NGS) MCAO Design f. VLT	**WP 2.2**												
Multi-object WFS f. GTC	**WP 2.3**												
Multiple FOV WFS f. LBT	**WP 2.4**												
2nd Gen RTC Platform	**WP 3.1**												
Optimal Control Methods f. MCAO Systems	**WP 3.2**												
Hifg Density Piezo-Stack Deform. Mirror (DM)	**WP 3.3**												
Piezo DM Control Electronics	**WP 3.4**												
VLT Adaptive Secondary Design Study	**WP 3.5**												
Demonstration of a Large Convex Glass Shell	**WP 3.6**												
2K Actuator & Low Order Micro-DM (MDM) R&D	**WP 3.7**												
High Order WFS Experimental Study	**WP 3.8**												
	Please indicate the Cost (EUR) of 1 FTE / Year (including overhead):								**50,000**				
EC funded manpower (Y/N)	**Y**										**GRAND TOTAL HOURS/FTE**	**11**	**0.01**
Hours/Year	**1760**										**EC FUNDED GRAND TOTAL MANPOWER COST(EUR)**		**313**
											PARTNER FUNDED GRAND TOTAL MANPOWER COST (EUR)		
	Date:				**Signature by Partner Scientific in Charge:**								

Reporting: HW / travel Expenditures

HARDWARE & TRAVEL EXPENDITURES REPORT							
AO - JRA 1 OPTICON							
Partner:		REPORTING PERIOD 1		Total Amount (k€) (w/o Overhead)		Total Amount (k€) charged to EC (w/o Overhead)	
		January 2004 - September 2004					
WORK PACKAGES	WP #	DESCRIPTION		Subcontract	Hardware	Subcontract	Hardware
Mgmt Coordination	WP 1			10	10	5	5
XAO System Feasibility and Design	WP 2.1						
(L/NGS) MCAO Design f. VLT	WP 2.2						
Multi-object WFS f. GTC	WP 2.3						
Multiple FOV WFS f. LBT	WP 2.4						
2nd Gen RTC Platform	WP 3.1						
Optimal Control Methods f. MCAO Systems	WP 3.2						
Hifg Density Piezo-Stack Deform. Mirror (DM)	WP 3.3						
Piezo DM Control Electronics	WP 3.4						
VLT Adaptive Secondary Design Study	WP 3.5						
Demonstration of a Large Convex Glass Shell	WP 3.6						
2K Actuator & Low Order Micro-DM (MDM) R&D	WP 3.7						
High Order WFS Experimental Study	WP 3.8						
		TRAVEL COSTS (k€)	2				
		GRAND TOTAL		10	10	5	5
		GRAND TOTAL TO BE INVOICED TO EC (including 20% overhead)				13	
		GRAND TOTAL (including 20% overhead)		24			
		GRAND TOTAL FUNDED BY THE PARTNER (including 20% overhead)		11			
		Date:		Signature by Partner Scientific in Charge:			

Additional tables might be necessary to detail & justify all expenditures per WP.

AURA-ESO agreement

- Agreement has been signed between ESO and AURA to collaborate on critical ELT technology developments
- This agreement includes AO R&D & in particular:
  - Large Deformable mirror
  - Large thin shell
  - CCD for AO
  - Piezo stack Deformable mirror
  - MCAO reconstruction
- Objectives is to share development cost or explore alternative technologies for a given specification
- OPTICON board position on if / how coordinate with related JRA 1-2 activities is required

CONCLUSIONS

- WPs defined: Tasks, milestones, resources
- Management tools are defined
- Monitoring/reporting tools have been defined:
  - Time sheet,
  - HW expenditures,
  - Matching funds
  - Regular progress report from each partner
- National agencies should maintain the original level of funding independently of EC contract