OPTICON FP6 Networking

- Network N3 Structuring European Astronomy (JKD)
  - WP1: Extremely Large Telescopes (I. Hook)
  - WP2: UV-Net
  - WP3: High time-resolution Astrophysics
  - WP4: Interoperability (e.g. data archives)
  - WP5: Key technologies
  - WP6: Future Software

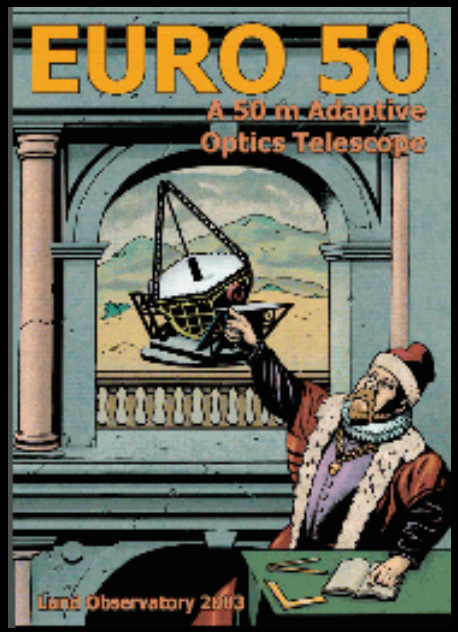
Development of the Science Case for an Extremely Large Telescope

- Goals of the OPTICON ELT activity
  - Development of the science case for ELT
- Recent developments
- Plans & deliverables for FP6 activity

Isobel Hook – April 2004

European ELT science case

- Building on previous work for 100m (e.g. Leiden Documents) & Euro-50
- 3 working groups have been formed
  - 2 co-chairs each
  - Stars & Planets - *Hans Zinnecker & Rafael Rebolo*
  - Stars & Galaxies - *Mike Merrifield & Sergio Ortolani*
  - Galaxies and Cosmology - *Jacqueline Bergeron & Bruno Leibundgut*
- + At least 50 volunteers from around Europe



OPTICON ELT science case meetings 2003

- Oxford, April 2003
  - 1 day meeting of group Chairs
  - Short talks and planning
- Marseille, November 2003
  - 2.5 day meeting of science working group
  - 50 participants
  - Goal 1) Identify exciting science highlights (for FP6 design study proposal)
  - Goal 2) Continue development of full science case

Marseille Meeting participants November 2003

Science Highlights from Marseille

- **Terrestrial Planets or "Extra-Solar Systems"**
  - Statistics (~1000)
  - Properties (+Spectroscopy)
  - Details of planetary systems and Orbits
  - Formation
- **Stellar populations across the Universe**
  - SFR from SNe up to z=10
  - Resolved stellar populations in representative sample of the Universe (Virgo/Fornax)
- **The Physics of Galaxies from z=2 to z=5**
  - Physics of baryons
  - Kinematics of sub-units in haloes
- **The First Objects and Re-ionisation structure of the Universe**
  - High-z galaxies from z=10 to 15 (in emission)
    - Clustering, Ly-alpha emission/quenching
  - Interplay with IGM (in absorption)
    - Use very bright GRB / QSO / SNe as background object

Highlights document now on web

FP6 design Study proposal

- Several projects united into one ELT Design Study proposal to the EU FP6
- Propose to study Design-independent issues
- PI: Gilmozzi, Manager: Dierickx
- Project scientist: Salinari, Deputy: Hook
- Proposal submitted March 2004
- Supporting science case based on
  - highlights from Marseille meeting
  - documents from 2001 OPTICON Leiden meeting

ELT in FP6 – Deliverables and plans

- Web site within first 6 months
- 1 community science WG meeting per year
  - Discuss developments in astronomy
  - Develop the detailed science case
  - Consider design requirements
- 1 smaller meeting (group Chairs) per year
  - Develop *and write* the detailed science case
- Major science case documents at mid & end point
  - 1st half of 2006 and end 2009
- Employ a scientist to coordinate this activity
- Coordinate with FP6 ELT design study work

New ELT Science Case Web pages

- Science case documents
  - European work and other cases from U.S., Canada etc.
- Science case meeting details
  - Programs
  - Presentations
- Science requirements
- Contact details

http://www-astro.physics.ox.ac.uk/~imh/ELT/

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ELT SCIENCE CASE

- Main page
- Science case highlights
- Marseille meeting
- Oxford meeting
- Previous work
- Tools
- People

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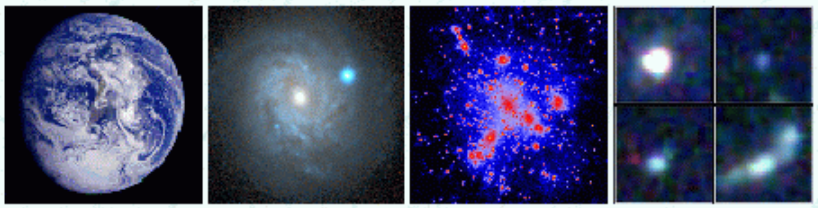
EUROPEAN LARGE TELESCOPE

SCIENCE CASE

These pages are a collection of ongoing work towards the science case for an Extremely Large Telescope (ELT). The goal of this work is to identify key science drivers for a telescope up to 100m in size, and develop the case sufficiently (through detailed calculations and simulations) to be able to drive the design of such a telescope.

This science case will include tradeoff studies, showing how science return is affected by the choice of key telescope design parameters such as size, wavelength range of operation etc. We aim to concentrate on developing the case for a 50-100m class telescope, while making use of the already well-developed case for a 30m class telescope (for example the GSMT and CELT cases linked below) when considering tradeoffs in telescope size.

ELT SCIENCE OVERVIEW



Click HERE for a summary of selected ELT science highlights

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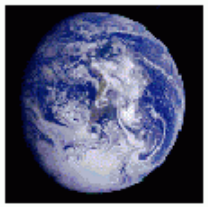
INTRODUCTION

The science case for Extremely Large Telescopes (ELTs) covers a huge range of topics from our own solar system to the furthest observable objects at the edge of the visible Universe. The following are a few selected highlights (discussed at a recent meeting of (mostly) European scientists in Marseille, France). These examples demonstrate areas where an ELT can make a dramatic advance in our understanding of the Universe around us.



TERRESTRIAL PLANETS IN EXTRA-SOLAR SYSTEMS

Image: NASA image of planet Earth. See http://pds.jpl.nasa.gov/planets/welcome.htm

One of the most exciting prospects for ELTs of 100m-class is the possibility of not only *directly detecting* (by imaging) earth-like planets orbiting other stars, but also *studying* large numbers of them in detail (via spectroscopy). Only by doing this can we determine to what extent our own solar system is unique, and assess the probability that other planetary systems could support life. To do this experiment involves the following:

- A large survey : A survey of the surroundings of about 1000 stars will give a large enough dataset to draw meaningful conclusions on the rarity of terrestrial planets. To survey this many stars requires observing out to distances of about 30 parsecs from us (100 light years). At these distances the projected separation between the star and its planets becomes very small (less than 0.1 arcsec, see below) and an extremely large telescope is needed to resolve them.
- Measuring planet properties : By obtaining spectra of exo-planets can we determine their surface properties (are they liquid or solid?) and search for "bio-markers" such as water, oxygen and carbon dioxide. Again an extremely large telescope is needed to collect sufficient light from a faint planet to be able to analyse it spectroscopically.

http://www-astro.physics.ox.ac.uk/~imh/ELT/Highlights/highlights.html

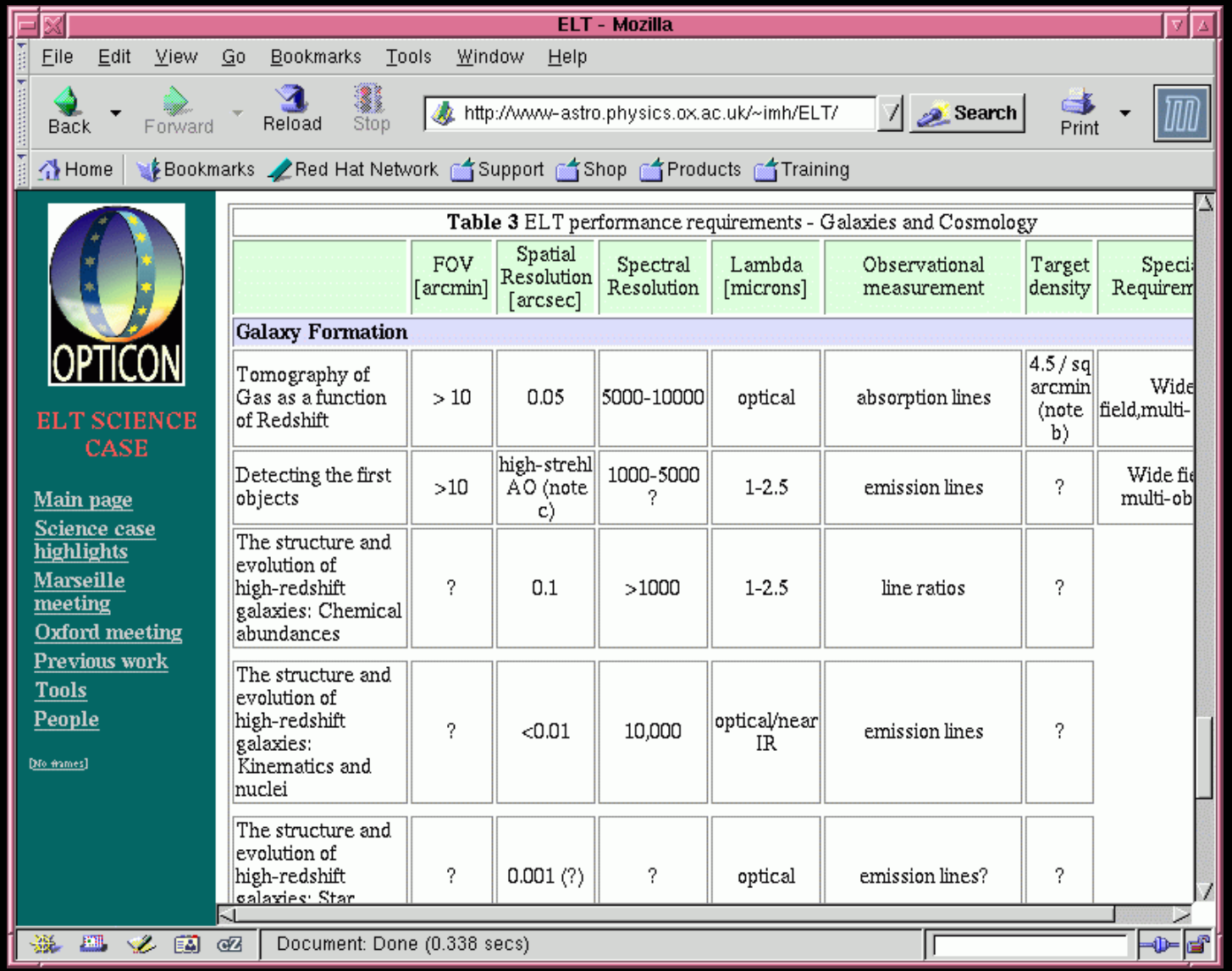

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Table 3 ELT performance requirements - Galaxies and Cosmology
FOV [arcmin]
Spatial Resolution [arcsec]
Spectral Resolution
Lambda [microns]
Observational measurement
Target density
Galaxy Formation
Tomography of Gas as a function of Redshift
> 10
0.05
5000-10000
optical
absorption lines
4.5 / sq arcmin (note b)
Detecting the first objects
>10
high-strehl AO (note c)
1000-5000 ?
1-2.5
emission lines
?
The structure and evolution of high-redshift galaxies: Chemical abundances
?
0.1
>1000
1-2.5
line ratios
?
The structure and evolution of high-redshift galaxies: Kinematics and nuclei
?
<0.01
10,000
optical/near IR
emission lines
?
The structure and evolution of high-redshift galaxies: Star
?
0.001 (?)
?
optical
emission lines?
?
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ELT science case meetings and documents

OPTICON SWG	DESIGN STUDY

- Nov 2004: OPTICON SWG meeting
- Jan 2005: OPTICON SWG co-chairs meet
- Mar 2005: Draft science case

- Update science case every year for 5 yrs
- Major drafts (science case book) mid 2006 and end 2009

- Oct 2004: Kickoff & study groups meet

Project scientists and science case coordinator

- Aug 2005 : Draft requirements document

- Iterate 2006, 2007
- Final requirements report end 2007

ELT in FP6 – other activity

- Dialogue with U.S. and Canadian SWGs
  - Setting up joint science meeting
- Attendance at conferences by European ELT SWG

Next 12 months – Outline

- May 04: Berlin meeting "Exploring the cosmic Frontiers"
  - Several members of the OPTICON ELT SWG will give talks
  - host joint 1-day science meeting with U.S/Canada
- Jun 04: SPIE meeting, Glasgow
- [Oct 04: FP6 design study kickoff meeting]
- Nov 04: Next European ELT science meeting
  - Similar size meeting to Marseille 2003 (~50 people)
  - Design study should have started
  - Begin work on the ELB
- Jan 2005: SWG Chairs meet
  - Work on writing the case
- Mar 2005: Draft science case

The End

Funding the ELT Working group in N3

- Structuring European Astronomy: Network coordinator J Davies
  - Total funds = 950kEuro
  - 350k Salaries for WP1 (ELTS) and WP5 (key technologies)
    - 165k+20% overhead for ELT-related staff (but some could go to travel + support)
  - Remaining 600kE for travel/ meeting room hire etc
  - JKD's proposed funding breakdown:
    - 3.1 ELT 192k (to cover whole SWG for 5 yrs)
    - 3.2 NUVA 62k
    - 3.3 HTRA 96k
    - 3.4 AVO 29k
    - 3.5 Key Tech 120k
    - 3.6 Software 96k

International Status of ELTs

Extremely/European Large Telescope

- In US Caltech+AURA joined Aug 18 into a 50:50 public:private $80M design study for a TMT. Canada equal partner
- Canada requested national funding C$150M first cut: positive outcome in March 2004
- Australia attempting fundraising
- Japan is establishing a national office, and priority ordering of new projects
- 30-m assumed maximum possible aperture with Keck technology: cost=US$750M

Immediate science case goals – from JKD at Merseille meeting

- NOW: A short top level summary (1-4 pages) of the key science drivers, plus images/simulation: for ESO Council, funding agencies, governments, OECD
- FEB 04: The 20pp(tbc) overview case to support the design study proposal: written for scientists
- 2007: An eventual `blue/red/… book', a major detailed justification for full funding
- Continuing technical work, to lead the detailed design study
- Involving the whole community, to develop support: for the ELT to happen soon, it must be `obvious' it is what the community supports