

The ASTRONET Infrastructure Roadmap

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(and many others ...)

Outline



- Background
- Roadmap Working Group and Panels
- Programme of Work
- Conclusions, including Priorities, Gaps and Opportunities
- Next Steps

The full Report and Executive Summary may be downloaded from

www.astronet-eu.org

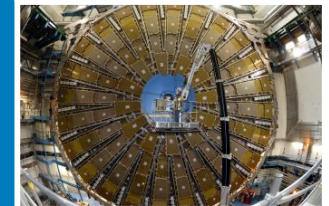
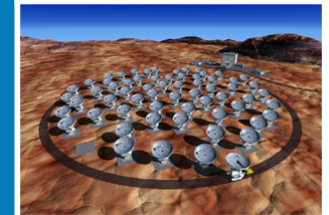
Developing the Roadmap

(See Chapters 1 and 2 of the final report)

Brief: To assemble a plan for the infrastructures that will enable European Astronomy to deliver the Science Vision (STFC lead agency)

- Taking the Science Vision as the point of departure
- Covering both ground & space-based facilities
- Including AVO, (super)computing, theory, HR issues, outreach, education and training, industrial links
- Incorporating existing ESO, ESA (etc.) plans as far as possible, and having a global perspective
- Fitting within reasonable budgetary envelopes & schedules!

Got underway in earnest Autumn 2006



Roadmap Panels (Chairs, Co-chairs)

A. high energy astrophysics, astroparticle astrophysics, gravitational waves (**Chapter 3**)

[Guenther Hasinger, Patrizia Caraveo]

B. UVOIR and radio/mm astronomy (**Chapter 4**)

[Michael Grewing, Laurent Vigroux]

C. solar telescopes, solar system missions, laboratory studies (**Chapter 5**)

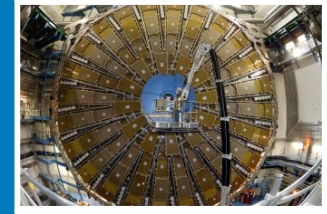
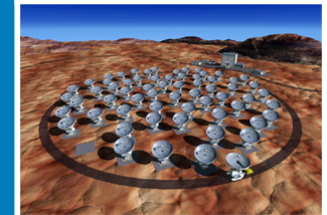
[Mats Carlsson, Therese Encrenaz]

D. theory, computing facilities and networks, virtual observatory (**Chapter 6**)

[Francoise Combes, Paolo Padovani]

E. education, recruitment and training, public outreach (**Chapter 7**)

[Rosa Maria Ros, Bob Fosbury]



Roadmap Working Group

Chair: Mike Bode

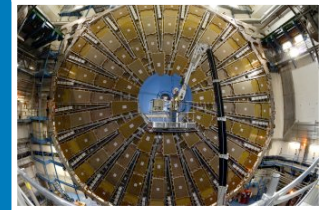
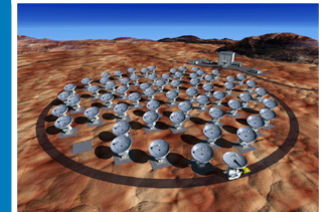
Ex-Officio Members: Chairs and Co-chairs of the 5 Panels

Members at Large: Catherine Turon (Observatoire de Paris), Xavier Barcons (CSIC-UC), Jean Clavel (ESA-ESTEC), Phil Diamond (RadioNet), Gerry Gilmore (OPTICON), Thijs van der Hulst (Groningen), Guy Monnet (ESO), Hans-Walter Rix (MPIA), Ian Robson (UK ATC), Guy Wormser (CNRS/IN2P3)

Assistant Scientists: Maria Cruz (Liverpool JMU), Frank Molster (NWO)

In attendance: Johannes Andersen (NOTSA, ASTRONET Board Chair); Jean-Marie Hameury (CNRS, ASTRONET Project Co-ordinator); Simon Berry (STFC - Roadmap lead agency)

> 60 people involved (including Panel members)



Criteria for Inclusion in Ranking (of Panels A-C - see Chapter 2)



- Main focus is on future facilities (includes well-defined major upgrades and significant operational prolongations).
- Only facilities with a significant European content (likely funding requirement) and well enough developed to be able to be judged adequately are included.
- European funding requirement > €10M capital cost and/or > €10M operational cost over 5 years (unless special reason).
- Only those facilities where a major European funding decision expected to be required from 2009- were included.
- It is however better to have too much than too little information overall!

Evaluation Framework



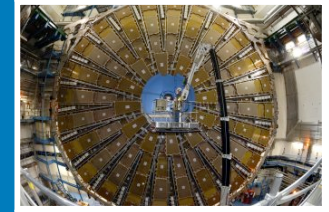
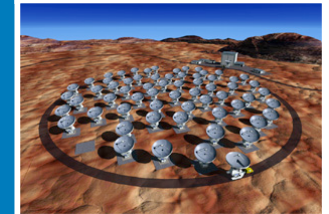
- Broad categories of prioritisation (**High**, **Medium** and **Low**; only High normally discussed in detail in final report; other facilities may be included for “context” and some smaller scale current facilities have been grouped).
- Sub-divided into cost categories:
Small €10M-€50M; **Medium** €50M-€400M; **Large** >€400M
(Small: cf. last Decadal Survey for Ground-based; Medium, Large: ~fits with Cosmic Vision wrt “M” missions and “Flagships (L)” for Space-based, including instruments)
- Timescale division (to “full operation”): **Short-term** (-2015); **Medium-term** (2016-2020); **Long-term** (2020+)
- Evaluation criteria included **Scientific Impact** (relation to delivering SV), **Competition/Uniqueness**, **European Involvement**, **User Base**, **Industrial Relevance** (+TRL) - gave a first-pass ranked list

Panels D and E

- Terms of reference somewhat different from Panels A, B, C
- Specific questions included in the questionnaire sent to facilities, but also undertook information gathering as detailed in Chapters 6 and 7 of the Report
- Panel D gave members responsibility for specific areas
- Panel E sub-divided into Task Groups
- Information exchange with other Panels

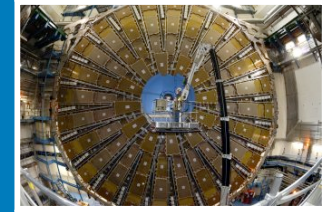
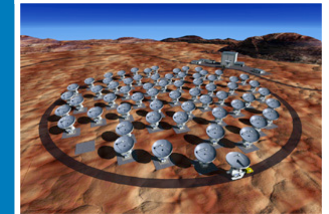
Interrelationships

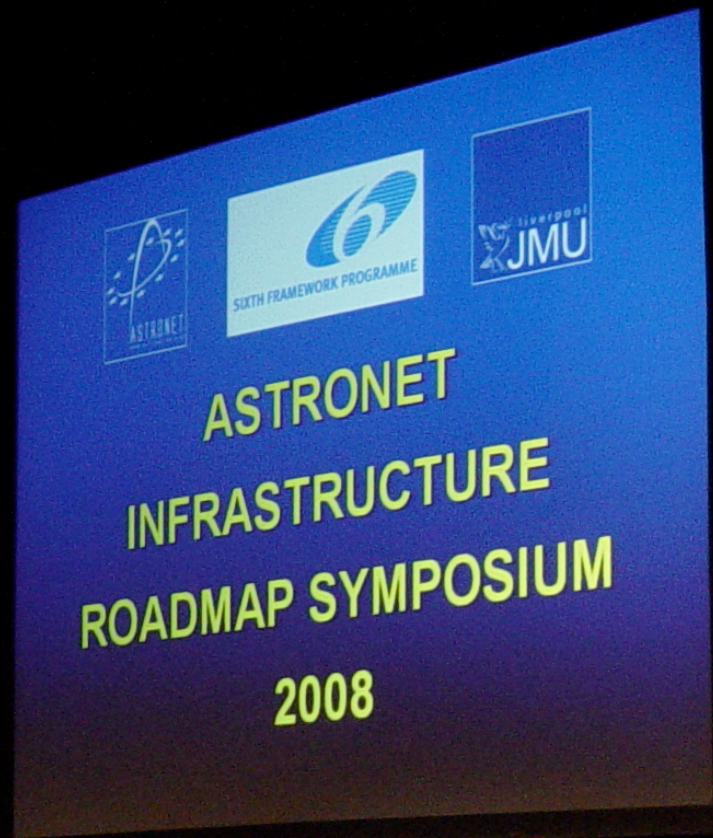
- ESO and ESA representatives on the WG
- Similarly for OPTICON and RadioNet
- Europlanet representation on Panel C (and on WG in initial phases)
- Information exchange with ASPERA, including round-table meetings
- ESFRI links



Outline timetable

- Appointment of Panel (Co-)Chairs and constitution of the Working Group **Jan 2007**
- Appointment of Panel Members and scheduled first Panel meetings **Mar 2007**
- First Draft Panel Reports **Oct 2007**
- First Draft Working Group Report **Dec 2007**
- Workshop with the Agencies **Feb 2008**
- **Public Draft Roadmap released and web forum opened** **May 2008**
- **Roadmap Symposium** **Jun 2008**
- **Web forum closed** and final Panel meetings **Jul 2008**
- Final WG meeting and submission to the ASTRONET Board **Sep 2008**
- Final Roadmap Document published **Nov 2008**





- Held in Liverpool
- 4 days in June 2008
- ~ 300 attendees

[Responses to all comments made on the Open Web Forum
were posted following the final release on 25/11/08]

Overall Prioritisation (A-C)

(out of >100 projects surveyed;
see detailed discussion in individual chapters, plus summary in Chapter 8)



Ground-based, Large Scale

1. E-ELT and SKA (phasing important - Chapter 4, p46)

Ground-based, Medium Scale

1. European Solar Telescope
2. Cherenkov Telescope Array
3. KM3NeT

Ground-based, Small scale

1. Wide Field, Multiplexed Spectrograph (4-10m tels, working group being established with OPTICON)

(+ Optimisation of access to existing telescopes: Solar, 2-4m and 8-10m optical/IR, mm-submm, radio - see below)

Prioritisation (cont.)



Space-Based, Large Scale

1. LISA and XEUS/IXO
 2. LAPLACE (EJSM) [TandEM (TSSM)]
 3. ExoMars
- (+ Darwin, FIRI and PHOIBOS for further R&D)

Space-Based, Medium Scale

1. GAIA Data Processing and Analysis
2. EUCLID (Dark Energy mission)
3. Solar Orbiter
4. Cross-scale, PLATO, [Simbol-X] and SPICA
5. Marco Polo

(Plus continued European contribution to operation of XMM-Newton, Integral, HST, Cluster, STEREO, Hinode over specified terms)

Gaps and Opportunities (Section 8.4)



- Small-scale and Fast-track Space Missions
- High Energy Astrophysics
 - 0.1-10MeV imaging and spectroscopy
 - All-sky monitoring
- UV Astronomy
 - Dedicated FUV/EUV astronomy mission
 - (E)UV (+X-ray) Solar mission
- Optical/IR Ground-based Interferometry over Kilometric Baselines
- mm-submm Astronomy
 - Large aperture single dish with array detectors on extremely high site
 - CMB polarisation studies post-Planck
- Radio Spectral Imaging of the Sun
- Arctic and Antarctic Sites

Other Important Recommendations made in the areas of:



- Laboratory Astrophysics: e.g. European Analysis and Curation Facility; Technical Fellowship Programme; new European Networks stimulated by Joint Calls (Chapter 5)
- Theory, Computing and VO: e.g. Astrophysical Software Lab; novel Data Grids; maintenance/enhancement of EVO (Ch 6)
- Education, Recruitment and Training, Public Outreach and Industrial Links: e.g. Inclusion of astronomy in national curricula; new or enhanced educational portals; European portal for public communication; appropriate funding and recognition of outreach activities; enhancing scientific exploitation of facilities (Chapter 7)
- Required Human Resources (Chapters 7 and 8.8)
- Necessary Tech Development and Industrial Spin-off (Sec 8.9)
- Finance (throughout, but see Section 8.10 for a summary)

Next...



- Produce reports on optimisation of 2-4m optical/IR and radio facilities with OPTICON (reporting in 2009) and RadioNet (2010) respectively
- Ditto 8-10m class optical/IR in the E-ELT era and mm-submm facilities in the ALMA era (reporting ~2013)
- Establishment of a working group on provision of a WF Multiplexed Spectrograph for large optical telescopes, with OPTICON (reporting 2010)
- Rationalisation of ground-based solar telescopes as we move into the EST era (reporting ~2013)

[See relevant chapters and e.g. Section 8.10]

Next... (cont.)



- Initiatives such as the Astrophysical Software Laboratory (Panel D), European Analysis and Curation Facility (Panel C), Portals for Science Education and Communication; “Fast Track” provision of Exploitation Funding (Panel E) etc. etc. need pursuing - clear continued role here for ASTRONET(2) to act as promoter and “broker” Europe-wide (**See Section 8.11**)
- Most importantly, to work with the Agencies to ensure that the recommendations of the Roadmap help to enhance future decision making, cooperation and coordination in Europe
- In addition, to use the results of our deliberations to emphasise at governmental level the importance and impact of our science, and not least the example we set for collaboration in Europe and beyond

Future of the Roadmap



- Dependent on how well received the current exercise is (“quality of the product”, and community support)
- Tied to the future of ASTRONET itself beyond 2009/10 (Now undergoing discussions with EC)
- Frequency of repetition of the full exercise: 5 years? 10 years?

The Bottom Line...



- To implement the **full** recommendations of the Roadmap would require a **~20%** increase in astronomy funding across Europe (~ €1 per citizen per year extra). Timing?
- To quote the French Minister of Science and Education *"We must invest in the future...it is one of the answers to the [current financial] crisis"* and the European Commissioner for Science and Research *"Astronomy has yet another function [aside from its key role in basic research and education]: as a lever for strong economic and social recovery"*.