WP 10.3 - High Time Resolution Astrophysics (HTRA)

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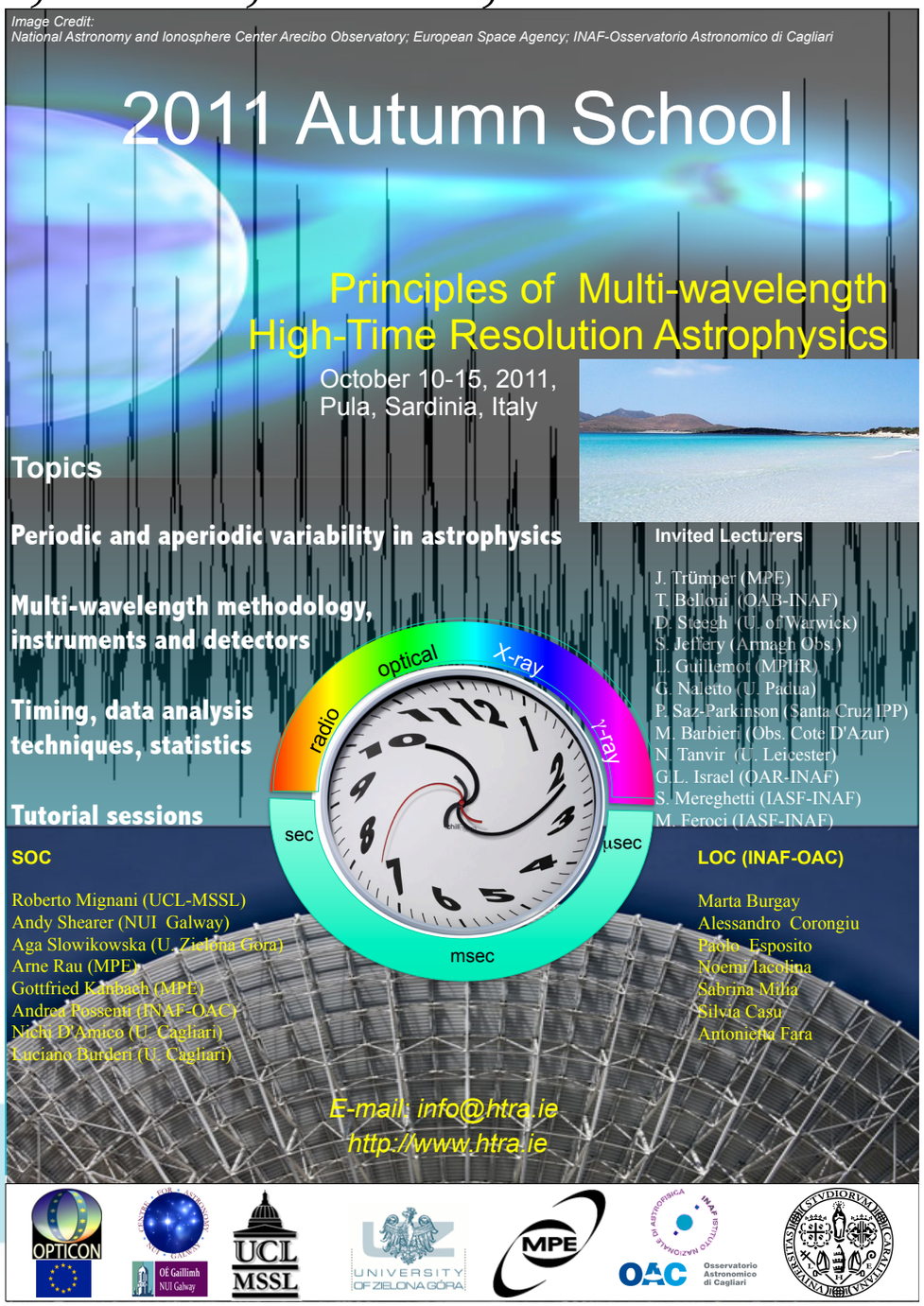
CENTRE FOR ASTRONOMY NUI GALWAY

Network Objectives and Deliverables Current Grant - 2009-2013

Develop the science case for HTRA for E-ELT

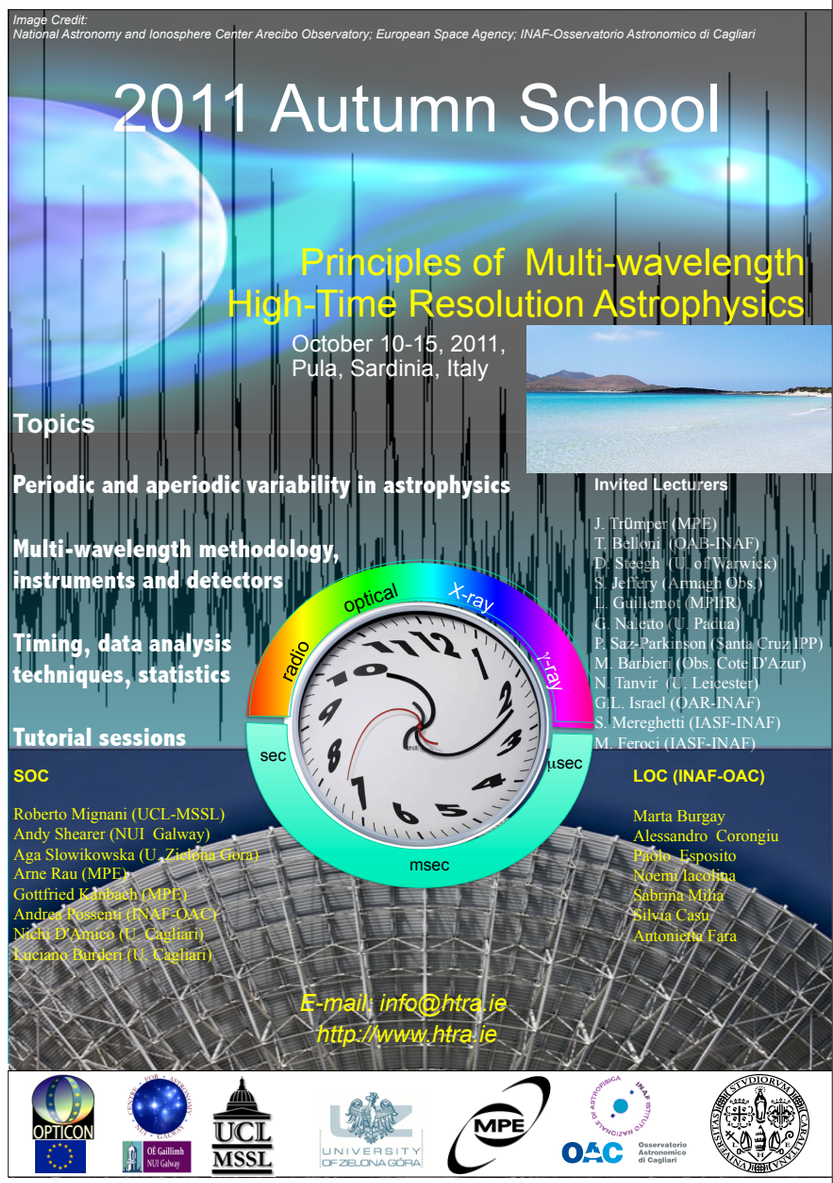
- Network meetings - Padua, Garching, MSSL, Crete, Rome, Zielona Gora, Lindau
- Science Workshop Crete 5-7th May 2010
  - 50 participants 42 presentations
  - Proceedings published on-line
  - White Paper on HTRA - 2011
- Sardina Winter School - 2011
- Preparation for Asiago Winter School 2012



Network Objectives and Deliverables Current Grant - 2009-2013

Develop cooperation and collaboration between network partners and expand number of partners

- 4 main private instruments UltraCam (UK), Optima (Germany), Iqueye (Italy), GASP (Ireland)
- student exchanges and visits
- student focussed meetings
- joint instrument / detector development



Overview from Crete workshop

- HTRA is active (growing) and fits well within Astronet's vision
  - Equation of State of neutron stars - magnetars, pulsars
  - Nature of gamma ray bursts
  - Population statistics for solar system objects through transits and occultations
  - Strong Gravity through black-hole binary systems
  - Supernovae Type 1a progenitors through WD-WD systems
- Need to coordinate observing and instrument development programmes
- Problems identified
  - normally private or semi common user instruments
  - only used for short campaigns
  - *primarily in the optical ($\lambda < 1\mu$) need to look towards IR*
  - HTRA is naturally included in other wavebands - future large facilities (e.g. SKA) will have fast timing, the E-ELT shouldn't be left behind.

HTRA and Surveys

- Surveys not feasible HTRA due to
  - Data constraints
  - Computational Constraints
  - Telescope availability
- Follow-up surveys are possible from (e.g.) LSST
  - requires real-time classification of events
  - instrument/telescope availability

Real Time Classification of Transient Events in Synoptic Sky Surveys

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Future Activity - E-ELT and HTRA

- HTRA for E-ELT through detector / instrument development
  - **science detectors with very low noise and fast timing into the near IR**
    - **including APDs, pnCCDs and MKIDs/STJs**
  - separate HTRA E-ELT instrument - difficult to justify, but would need
    - wide wavelength range 0.4-2 microns and *polarimetry*
    - time resolution of at least 1ms (better if lower)
  - parasite instrument or mode within ELT Cam type instrument as above with limited wavelength range.
  - development of HTRA instrument for 10m class telescopes

Network continuation for better integration of HTRA science, instrumentation and software across Europe

- Further development of multi-wavelength collaborations and coordinated observations
  - optical-radio
  - optical-gamma ray [Fermi, CTA]
- Development of HTRA on 4-10m telescopes
  - community instrument development - staff/student exchanges
  - long term observing programmes
  - investigation of software issues, pipelines
- Detector workshop (2013) : Summer School (2014) : HTRA Science Conference (2015)
- Funding ~ €70K for network activity including workshops
  - ~ €24K network meetings
  - ~ €40K workshops, conferences

Network Activity - 2013-2016

- Development of common user instrument
  - 2013
    - Network discussion (τ<1ms?, polarisation?)
    - HTRA Instrument(s) description
    - Industry meetings
    - Synergies with Fast Detectors work package
  - 2014
    - EU/national grant applications
  - 2015
    - HTRA Instrument definition

New grant 2013-2016 - ELT Science and HTRA

Tasks:

WP1. Management

WP2. Workshops and talks

- Long range ELT instrumentation conference 2013
  - highlighting HTRA and links with other OPTICON developments
- ELT science conference 2015
  - To be organised in collaboration with ESO
  - includes summer-school training sessions

WP3. Analysis tools

- White papers on AO photometry analysis tools and time series analysis tools for dealing with changing PSFs on short times scales and addressing problems with massive HTRA data sets for archiving and data analysis.

Network Activities 2013-2016

Milestones and Deliverables

Milestones

2013 - Asiago Winter school on HTRA
2013 - April 12th RAS Discussion meeting on HTRA + network meeting
2013 – November Conference on Long-range instrumentation ideas for E-ELT
2015 – Conference on science with the E-ELT

Deliverables

2014: Instrumentation Conference Proceedings
2015 : E-ELT Science Conference Proceedings Summer School report

2015 : Papers/White paper : Data Analysis Methodologies
Tools for E-ELT and HTRA

Network Activities 2013-2016

The HTRA future is reasonably bright with ELT and current generation of 8-10m telescopes

- Possible new instruments
  - HiperCam - Sheffield (t>1ms)
  - Equeye - Padua (t<<1ms + polarisation)
- HTRA instruments on 10m class telescopes
- ELT Instruments
  - ELT Cam (t > 1 ms)
- Advanced pipelines and standards