TMT Solar System ISDT: Rationale for TMT Solar System Key Programs

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Today's program

09:20 - 10:30 Parallel Session 1

- Contributed Talks
- Solar System Key Programs: Prior Experiences, and Ideas for the Future

11:00 - 12:30 Parallel Session 2

- Transforming Solar System Science with TMT: Key Questions, First Light Possibilities, and Future Instrumentation

13:30 - 15:30 Parallel Session 3

- Workshop: Drafting Solar System Key Programs

16:00 - 17:25 Parallel Session 4

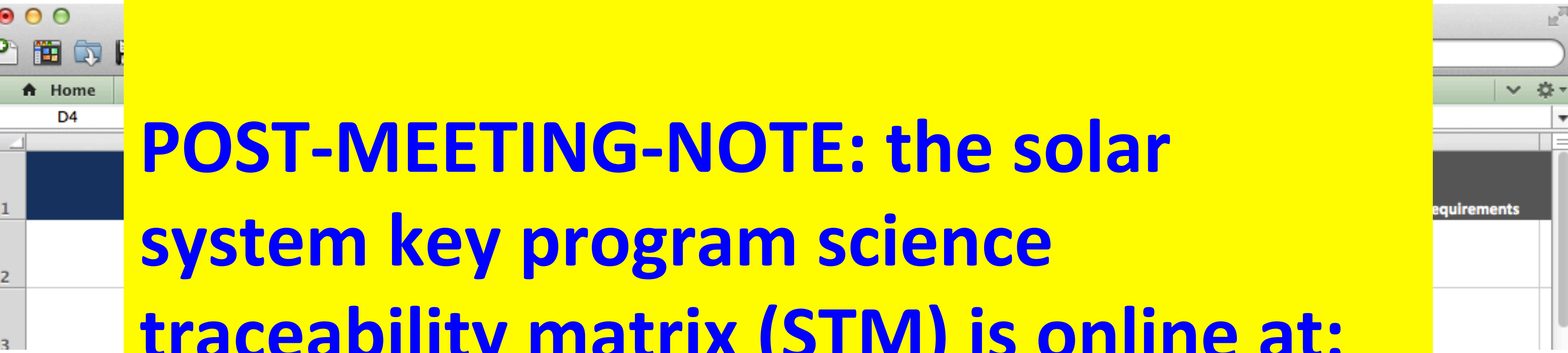
- ESO Conf. "Solar system as seen by the ELTs," Nov/Dec 2015
- TMT Workshop at DPS? Proposals due today.

Hidden agenda: make traceability matrix for key programs

tmt-sskptm-150624.xlsx

Science goals	Science objectives	Observables	Instrument requirements	Scheduling/ operational requirements
???	???	???	???	???

Hidden agenda: make traceability matrix for key programs



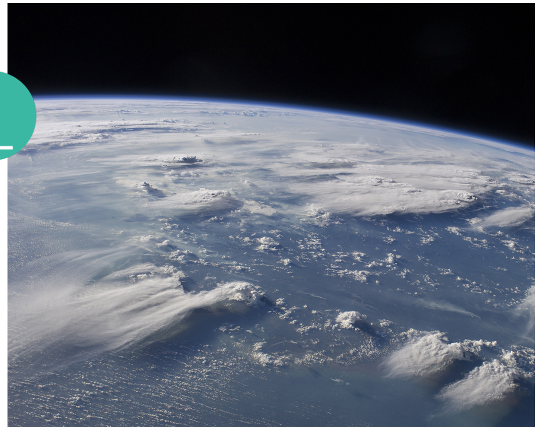
POST-MEETING-NOTE: the solar system key program science traceability matrix (STM) is online at:

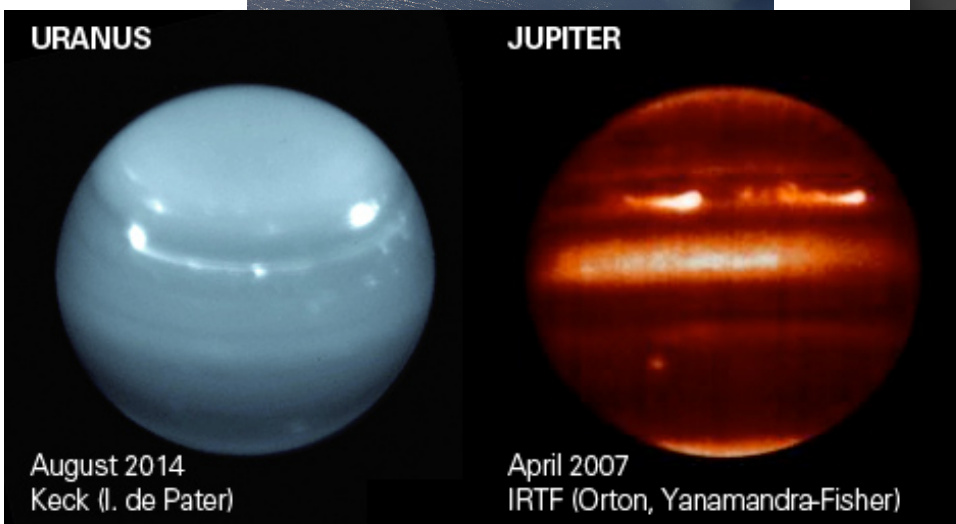
https://docs.google.com/spreadsheets/d/1fQC3vqsIXxlQMohN8niS30FvBGdDP8O4yY2GWR2YYdY

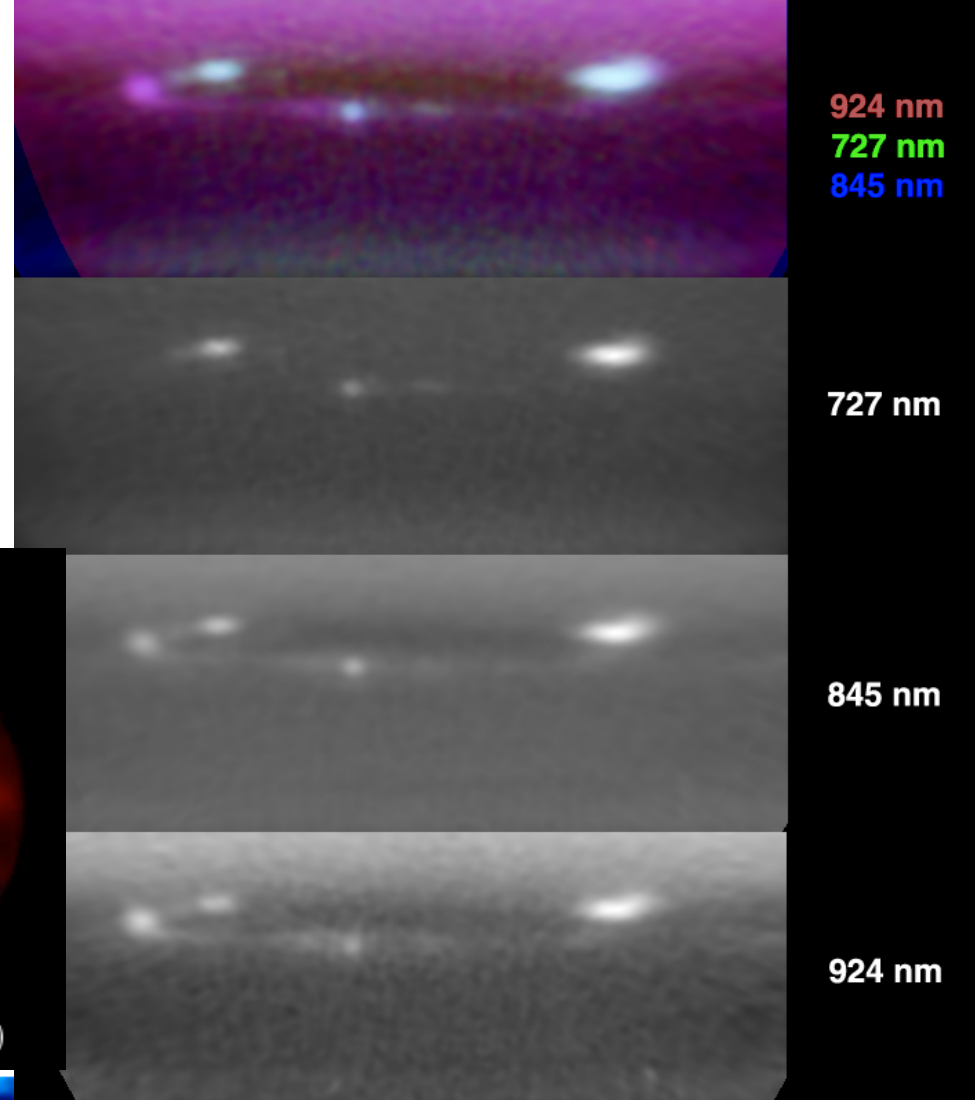
Examples of solar system key programs

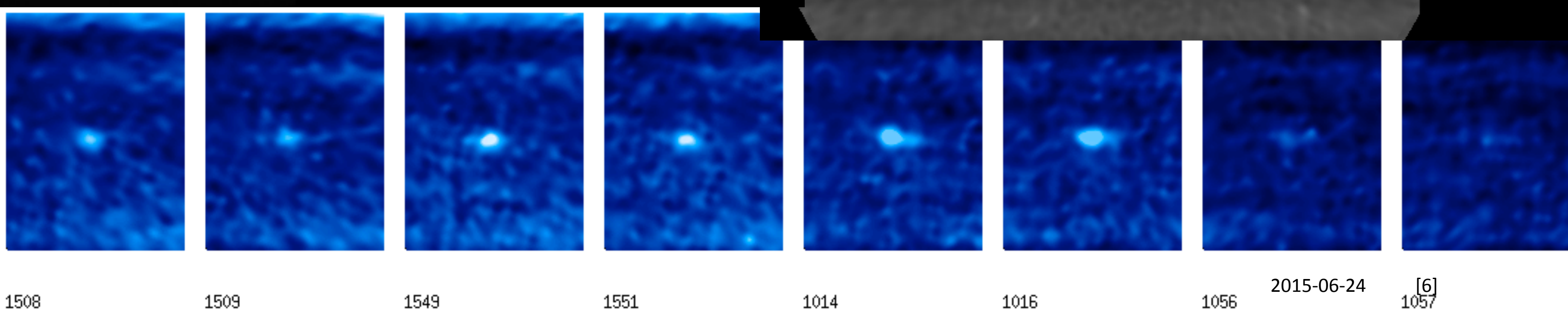
- HST Outer Planet Atmospheres Legacy (OPAL) program
  - DD selection process (Cycle 22, i.e. current cycle)
  - Large because multi-year
  - Cadence is 1x / year for each planet (except Saturn now)
  - Each year yields 2 consecutive global maps
  - Data immediately public
  - High-Level Science Products designed to facilitate access to the data
  - Papers being worked on Jupiter and Uranus data
  - Neptune data to be obtained in late summer

LPSC presentation









Demo of OPAL archive page

Barbara A. MIKULSKI ARCHIVE FOR SPACE TELESCOPES

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As of April 13, the archive is now using the STScI Single Sign-On (SSO) identity manager. To check on your account click here. For more information about how accounts were transitioned click here.

Outer Planet Atmospheres Legacy (OPAL)

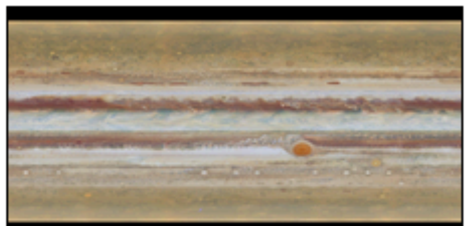
Simon et al., ????, ??, ??, ??

See also: Wong et al., 2015, LPI, 46, 2606

Introduction | Description of Data Products | Data Access

Introduction

OPAL is a project to obtain long time baseline observations of the outer planets in order to understand their atmospheric dynamics and evolution as gas giants. The yearly observations from OPAL throughout the remainder of Hubble's operation will provide a legacy of time-domain images for use by planetary scientists. The project will ultimately observe all of the giant planets in the solar system (Jupiter, Saturn, Uranus, and Neptune) in a wide range of filters. The images are processed using an ellipsoid limb-fitting technique, with an additional fringe correction applied to the narrow-band filters only (e.g., FQ889N for Jupiter 2014-2015), which amounts to a few percent correction. Mosaics are created for each observed filter in a projection that spans 360 degrees of longitude. See the README files (on disk or in the tables below) for additional details on the data processing. The mosaics from each filter (in FITS format), as well as previews (in TIF format) are provided.



Projections of the first two Jupiter rotations (look for subtle changes in the animation). The three-color images combine HST filters F395N, F502N, and F631N.

Description of Data Products

Each file name begins with the same prefix: "hlsp_opal_hst_wfc3-uvis_". The name of the planet is the next part of the filename. Each rotation/epoch is differentiated by a calendar year and a letter, e.g., "jupiter-2015a" is the first rotation of Jupiter from Cycle 22, "jupiter-2015b" is the second rotation from Cycle 22, etc. Keep in mind that HST cycles span two calendar years, since they start in Oct. and run through Sep. of the following year. The next part of the filename includes the HST filter for that mosaic/preview image, followed by a version number and the file extension. File extensions are:

1. *_globalmap.fits* = Mosaic (projection) for the given filter.
2. *_globalmap-medium.tif* = Preview image (width x height = 900 x 450 px).
3. *_globalmap-small.tif* = Preview image (width x height = 450 x 225 px).
4. *_globalmap.tif* = Preview image (width x height = 3600 x 1800 px).

Data Access

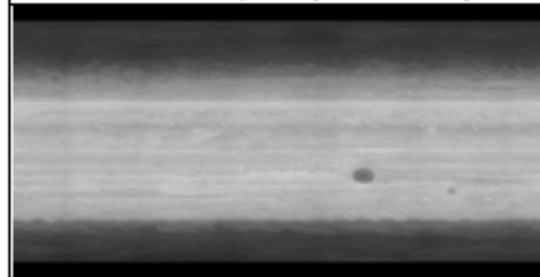
You can retrieve the images and previews from the table below, or directly at this URL.

Cycle (Year)	Jupiter	Saturn	Uranus	Neptune
22 (Oct 2014 - Sep 2015)	Load Table			
23 (Oct 2015 - Sep 2016)	Load Table			

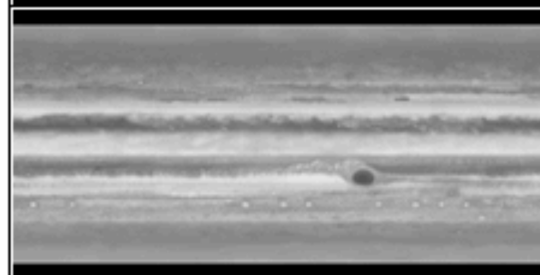
Cycle (Year)	Jupiter	Saturn	Uranus	Neptune
22 (Oct 2014 - Sep 2015)	Load Table			
23 (Oct 2015 - Sep 2016)	Load Table			

Cycle 22 Download README

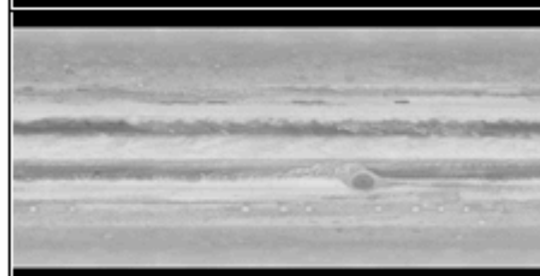
Jupiter (Rotation A)



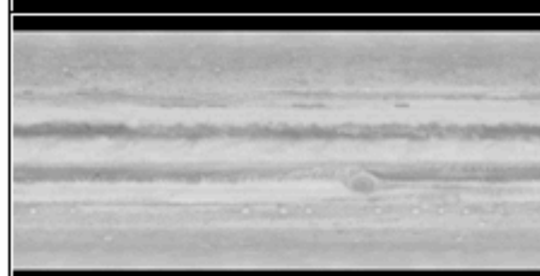
F275W
IMG (FITS)
FULL (TIF)
MED (TIF)
SMALL (TIF)



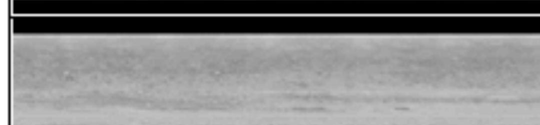
F395N
IMG (FITS)
FULL (TIF)
MED (TIF)
SMALL (TIF)



F502N
IMG (FITS)
FULL (TIF)
MED (TIF)
SMALL (TIF)



F547M
IMG (FITS)
FULL (TIF)
MED (TIF)
SMALL (TIF)



F631N
IMG (FITS)
FULL (TIF)
MED (TIF)

Other examples of solar system key programs?

Transforming Solar System Science with TMT:

Key Questions, First Light Possibilities, and Future Instrumentation

Key questions

- turn to the Decadal Survey
- for giant planets:
  - atmospheric circulation
  - long-term evolution
  - shorter-term variability
- for small bodies (based on Karen's talk):
  - chemical diversity
  - migration / mixing
  - delivery of organics and volatiles
- magnetospheric/auroral ?
  - need more help/contributors

First light possibilities

- IRIS IFUs, imager
- other instruments not well suited for giant planet atmospheres
- refer to SRD?

Early Light Capabilities:

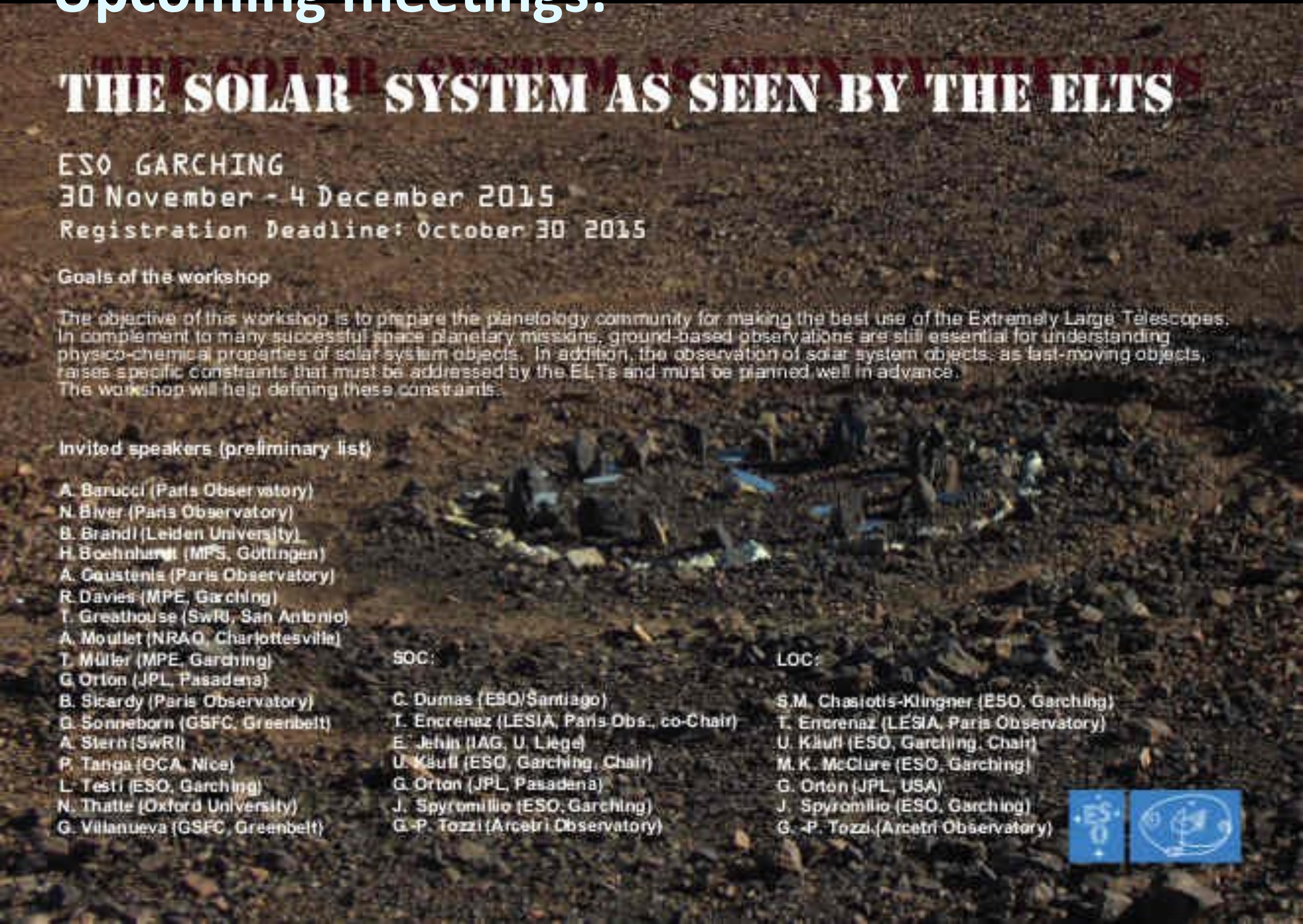
- Near-IR Adaptive Optics System (NFIRAOS): a dual-conjugate (MCAO) system provides diffraction-limited images over the wavelength range 0.8-2.5μm over a 30 arcsec field, and partially-corrected images over a >2 arcmin field.
- InfraRed Imaging Spectrometer (IRIS): Diffraction-limited, R~4000 spectral resolution, 0.8μm to 2.5μm spectroscopy (utilizing an integral field unit (IFU)) over a small field, and an imager covering a field of view of >15 arcsec. IRIS is behind the NFIRAOS AO system.
- Wide-field Optical Spectrometer (WFOS): Seeing-limited multiplexed 1000 < R < 6000 spectral resolution, 0.31-1μm spectroscopy over a wide (~40 arcmin^2) field.
- Infrared Multislit Spectrometer (IRMS): Near-IR (0.95-2.45μm) imaging spectrometer (R~3000-5000) that will use a multi-slit mechanism over a contiguous field of view of ~2' with >40 slits. IRMS is used behind the NFIRAOS AO system, taking advantage of the substantial AO correction over the full field; it is expected to provide some of the IRMOS capabilities for early light.

Future instrumentation

First Decade Capabilities:

- InfraRed Multi-Object Spectrometer (IRMOS): near-diffraction limited, R~2000 – 10000 IFU-based spectrometer operating over a wavelength range 0.8-2.5μm. Will use multiple IFUs and access a 5 arcmin diameter field. It is expected to benefit from developments in multi-object adaptive optics (MOAO).
- Mid-IR High-resolution Echelle Spectrometer (MIRES): Diffraction-limited, 5000 < R < 100,000 spectral resolution, 8-28μm spectroscopy. MIRES will also have a mid-IR imaging/slit viewing capability.
- Planet Formation Instrument (PFI): Very high-contrast imaging along with low-resolution spectroscopy for direct planet detection, on scales near the diffraction limit in the 1 – 2.5μm region. For bright stars (I<8) will be able to detect planets108 times fainter than the parent star, with a goal of 109, at angular distances greater than 50mas from the star.
- Near-IR High-resolution Echelle Spectrometer (NIRES): Diffraction-limited, high-spectral-resolution (20000 < R < 100,000) echelle spectroscopy in the 1-2.5μm and 3-5μm range. NIRES will operate behind an adaptive optics system appropriate to the wavelength range.
- High-resolution Optical Spectrometer (HROS): spectroscopy with R < 50,000 for wavelengths ranging from the atmospheric cutoff at 0.31μm to 1μm (or longer if detectors exist that will allow it) with wide spectral coverage in a single exposure. This capability will likely be achieved via a large, echelle spectrometer.
- Wide-field Infrared Camera (WIRC): Diffraction-limited imaging in the 0.8-5μm wavelength range over a > 30 arcsec contiguous field.

Upcoming meetings:



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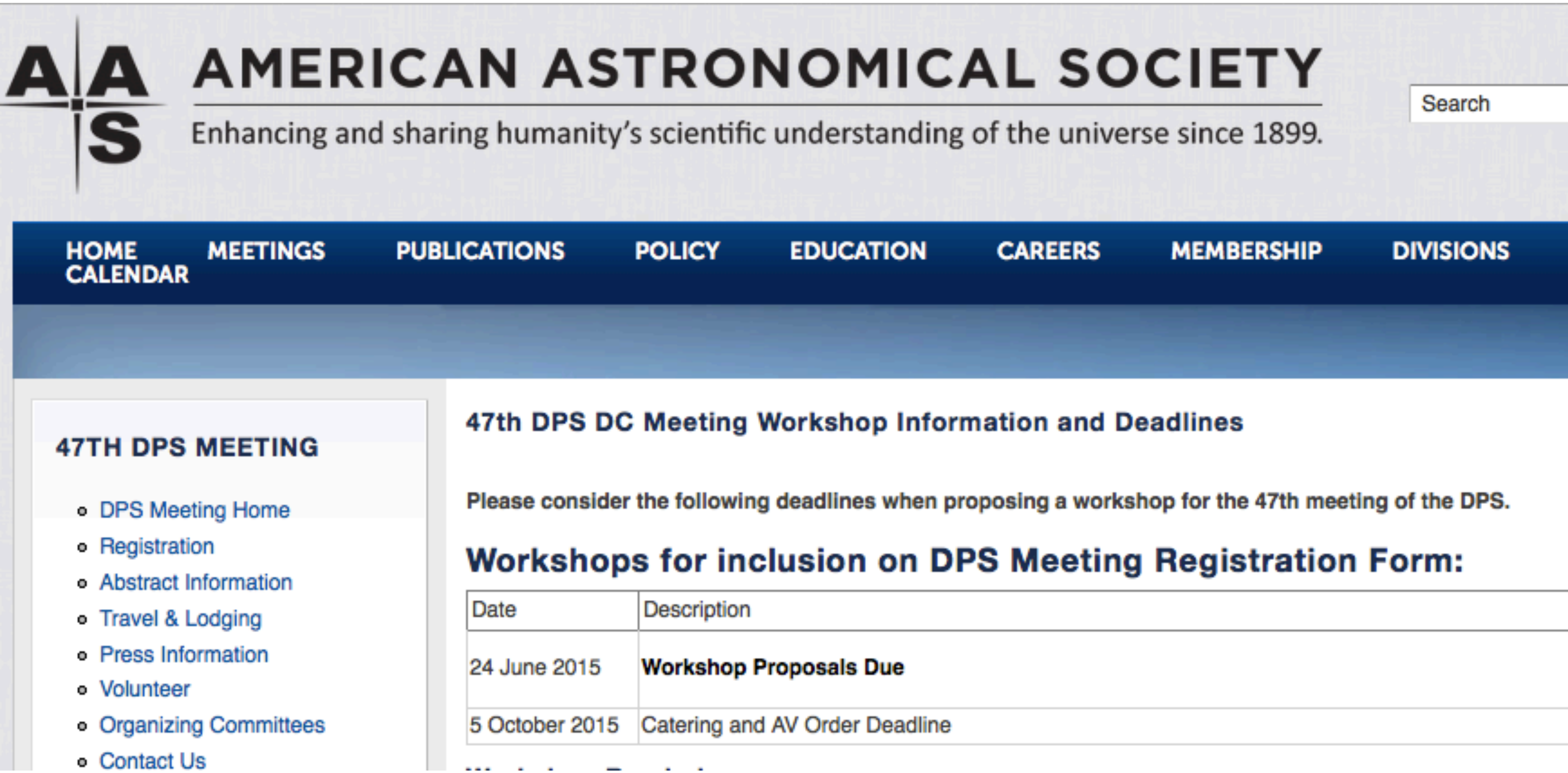
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47TH DPS MEETING

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47th DPS DC Meeting Workshop Information and Deadlines

Please consider the following deadlines when proposing a workshop for the 47th meeting of the DPS.

Workshops for inclusion on DPS Meeting Registration Form:

Date	Description
24 June 2015	**Workshop Proposals Due**
5 October 2015	Catering and AV Order Deadline

Upcoming meetings:

POST-MEETING-NOTE: solar system ISDT drafted a workshop proposal; we will hold a "town hall" workshop at DPS:

TMT Solar System Science Town Hall

Tuesday, 10 November | 12:00 pm- 1:30 pm
Organizer: Karen Meech
Free

We invite you to participate in a town hall discussion of capabilities for planetary system science with the Thirty-Meter Telescope. Part of the purpose is to generate and refine ideas for key programs that will drive requirements for operations and future instruments. A complimentary lunch will be provided for the first 50 attendees. At this town hall, we will present the status of the observatory, instrumentation, adaptive optics, and science planning. TMT will have a 30-meter, filled aperture segmented primary mirror. Its first light instruments range from wide-field, multi-object, seeing-limited spectrometers to an imager and integral field spectrograph operating at the 30-m diffraction limit, and enable a vast range of new, ground-breaking science. The international TMT partnership includes Canada, China, India, Japan, Caltech, and the University of California; AURA is an Associate Member of TMT on behalf of the US national community. Through a cooperative agreement with the NSF, TMT and a US TMT Science Working Group are developing a model for potential US national partnership in the TMT.

see: http://aas.org/meetings/dps47/events