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Jacobus M. Oschmann, Jr.
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Editors

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L. Puig, S. Carpano, N. Rando, A. Stankov, I. Escudero, European Space Research and Technology Ctr. (Netherlands)

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P. Laporte, G. Fasola, S. Mignot, Observatoire de Paris à Meudon, CNRS, Univ. Paris-Diderot (France)

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J. Farinato, INAF, Osservatorio Astronomico di Padova (Italy); V. Viotto, INAF, Osservatorio Astronomico di Padova (Italy) and Univ. degli Studi di Padova (Italy); G. Gentile, M. Dima, D. Magrin, INAF, Osservatorio Astronomico di Padova (Italy); D. Piazza, Univ. of Bern (Switzerland); R. Ragazzoni, INAF, Osservatorio Astronomico di Padova (Italy); G. Piotto, Univ. degli Studi di Padova (Italy); I. Pagano, INAF, Osservatorio Astrofisico di Catania (Italy); C. Arcidiacono, INAF, Osservatorio Astrofisico di Arcetri (Italy); S. Basso, INAF, Osservatorio Astronomico di Brera (Italy); W. Benz, Univ. of Bern (Switzerland); L. Gambicorti, Istituto Nazionale di Ottica Applicata (Italy); M. Ghigo, INAF, Osservatorio Astronomico di Brera (Italy); M. Munari, INAF, Osservatorio Astrofisico di Catania (Italy); E. Pace, Univ. degli Studi di Firenze (Italy); S. Scuderi, INAF, Osservatorio Astrofisico di Catania (Italy); C. Catala, Observatoire de Paris à Meudon (France)

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G. S. Hennessy, U.S. Naval Observatory (United States); B. F. Lane, The Charles Stark Draper Lab., Inc. (United States); D. Veillette, C. Dieck, U.S. Naval Observatory (United States)

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J. E. Krist, L. Pueyo, S. B. Shaklan, Jet Propulsion Lab. (United States)

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S. H. Pravdo, S. B. Shaklan, P. D. Lisman, Jet Propulsion Lab. (United States)

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T. Glassman, A. Johnson, A. Lo, D. Dailey, H. Shelton, J. Vogrin, Northrop Grumman Aerospace Systems (United States)

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R. Samuele, R. Varshneya, T. P. Johnson, A. M. F. Johnson, T. Glassman, Northrop Grumman Aerospace Systems (United States)

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D. Sirbu, Princeton Univ. (United States); C. Vad Karsten, Princeton Univ. (United States) and DTU Space, Technical Univ. of Denmark (Denmark); N. J. Kasdin, Princeton Univ. (United States)

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M. W. Thomson, P. D. Lisman, R. Helms, P. Walkemeyer, A. Kissil, O. Polanco, Jet Propulsion Lab. (United States); S.-C. Lee, Applied Sciences Lab. (United States)

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G. Guerri, Ctr. Spatial de Liège (Belgium) and Institut d'Astrophysique et de Géophysique, Univ. de Liège (Belgium); S. Roose, Y. Stockman, A. Mazzoli, Ctr. Spatial de Liège (Belgium); J. Surdej, Institut d'Astrophysique et de Géophysique, Univ. de Liège (Belgium); J.-M. Defise, Ctr. Spatial de Liège (Belgium)

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Introduction

This conference continues a SPIE biannual series[1] devoted to space-based astronomical sciences across the spectrum from the optical to the infrared, with occasional excursions into the millimeter wave region. As noted in this year's call for papers, 2010 looks to be a pivotal year for these sciences due particularly to the outcomes of two interrelated selection processes in Europe and the United States:

- Mission selection from the results of the European Space Agency (ESA) Cosmic Vision 2015–2025 Competitive Definition Phase, currently scheduled for 2010–2011 (and already well advanced)
- Recommendations of Astro2010: The Astronomy and Astrophysics Decadal Survey being conducted for the National Aeronautics and Space Administration (NASA) by the National Academy of Sciences and scheduled for release in September 2010.

Implementation of the results of these processes will, of course, be governed by multiple external factors, most importantly including:

- The ongoing global economic crisis, the resultant reduction of available resources, and the shifting personal and national priorities resulting from the crisis
- Possible competition from and/or synergies with the NASA manned exploration infrastructure that is continuing to undergo definition and refinement.

This Introduction is intended to identify and outline some of the most significant discussion threads that can be found in the papers. It does not pretend to follow the conference flow in detail or to summarize all important points found in the presentations. Emphasis is placed on the papers presented orally, but important supporting material was also presented throughout the poster sessions, and many of these manuscripts are also published in these proceedings.

DEVELOPMENT AND ACQUISITION STRATEGIES

The first session of the conference was devoted to papers addressing strategies relating to development of space telescope concepts in general. These specifically included realistic cost analysis; the availability and potential use of new enabling technologies; and possible benefits to be realized from systems designed for on-orbit servicing.

[1] Supplemented during alternate years by a similar but briefer conference at SPIE Optics+Photonics, the annual SPIE summer conference generally held in San Diego.

CURRENT CONSTELLATION

Several sessions were devoted to updating the status and latest results from space telescopes presently in various phases of their operational lives. This was particularly timely, since many of the extant systems have either been launched or have entered new operational phases since the 2008 Marseille conference[2]. To be more specific:

- The Hubble Space Telescope (HST) received Servicing Mission 4 (SM4) in May 2009 that included the installation of two new instruments and repairs to the two other instruments that remained on the telescope, as well as maintenance for the spacecraft itself
- ESA launched the Herschel far infrared observatory[3] in May 2009 as well. The vehicle has been successfully checked out and is now fully operational and producing results of great scientific merit
- Earlier in 2009 (March), NASA launched the Kepler observatory to search for transiting exoplanets, and has been rewarded with early and continuing success
- At the time of the conference, the NASA Wide Field Infrared Survey Explorer (WISE) was well into its ten month survey (launch occurred in December 2009) of the infrared sky which will provide a detailed foundation for future observational campaigns, most notably those of the James Webb Space Telescope (see below)
- Finally, results from two IR space telescopes currently operating in their warm modes (i.e., limited to the near-IR due to cryogen depletion) were reported. These telescopes are NASA's Spitzer (launched in 2003) and the Japanese AKARI (launched in 2006).

JAMES WEBB SPACE TELESCOPE (JWST)

JWST is clearly the flagship space telescope acquisition for the coming decade. Scheduled for launch in 2014, its many pieces are beginning to come together, perhaps most spectacularly the Optical Telescope Element (OTE), whose individual segments are completing polishing and testing in readiness for assembly. Several sessions were accordingly devoted to JWST and addressed multiple aspects of the total program, notably:

- Derivation of the science goals for JWST and flowdown to the specifications and design
- An overview of the complete development and acquisition program, including the measurement and testing programs
- A more focused overview of the development and fabrication of the OTE
- Detailed discussions of each of the science instruments as well as the Integrated Science Instrument Module (ISIM) as a whole

[2] Astronomical Telescopes and Instrumentation 2008: Telescopes and Systems.
[3] Along with its companion Planck space telescope.

- Specific, high priority foundational technologies (such as the wavefront sensing and control system) essential to enable the system.

FUTURE SYSTEM POSSIBILITIES

Approximately a third of the conference was devoted to consideration of possible future systems, including their science capabilities, system concepts, instrument designs and expected data output, and foundational technologies. We can expect that these potential systems will become the subjects of intense competition over the next year or two, particularly once the Decadal Survey recommendations have been published. Several thematic threads, mostly based upon significant science problems, are apparent in the papers.

- Planet finding, always with an underlying emphasis upon finding and characterizing terrestrial analogs, was addressed in a number of sessions. Four[4] principal technical approaches were presented and discussed: astrometric measurements of stellar systems, planetary transits of the parent star, internal coronagraphs for direct viewing of exoplanets, and external occulters using a separate telescope and starshade some tens of thousands of kilometers from the telescope, also for direct viewing. Contributing subsystem technologies and testbeds were also considered, and there was a growing attention to concepts that would enable partial solutions (such as limiting attention to giant planets only, characterization of proto-planetary dust disks, and so on) while staying within severe fiscal constraints
- Investigation of dark energy provided a second area of major emphasis. A number of papers addressed general considerations for a Joint Dark Energy Mission (JDEM), but the majority of papers on this subject were specific to the ESA Euclid mission concept, specifically addressing the science requirements for the mission and the design and capabilities of proposed instruments. In general, concepts under consideration for the JDEM mission include instrumentation capable of addressing all three of the known scientific approaches to the study of dark energy: Baryonic Acoustic Oscillation, Weak Gravitational Lensing, and Type 1A Supernovae
- Two sessions were devoted to infrared astronomy that may be enabled by Japanese development of the Space IR Telescope for Cosmology and Astrophysics (SPICA). As in other cases, these sessions treated the science that could be realized with this observatory, provided an overview of the mission and system concept, and described a possible suite of instruments
- A small number of papers distributed throughout several different sessions[5] addressed technology and concepts for astrometry. This discipline contributes to almost all astrophysical topics: exoplanet detection and

[4] Use of a space-based interferometer for planet finding has been considered in the past, but no papers were presented on the topic at this Conference.
[5] Based upon specific applications of the technology.

mass determination (as noted above), cosmological mass distribution for dark matter and energy studies, and gravitational curvature of light for general relativity studies

- Finally, several papers presented throughout the conference discussed concepts for space telescopes that could be used for general purpose astronomy and astrophysics, notably in infrared spectral regions. These included both small (i.e., meter class apertures) and medium/large (4 meter class) systems, and several papers addressed approaches to increasing the affordability of such systems
- The conference concluded with a session addressing various aspects of the Advanced Technology Large Aperture Telescope (ATLAST) concept for a large UV to Near IR telescope at aperture sizes ranging from 8 meters to 16 meters or larger. Such a large general purpose telescope would have a wide range of possible applications, and would be capable of addressing almost all of the scientific issues discussed during the course of the conference.

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