ABSTRACTS

Mid-Infrared Astronomy with the NGST


We present an overview of the science capabilities enabled by a mid-infrared camera/spectrometer on board the NGST. Even without full mid-IR optimization, a mid-infrared (5-30 microns) instrument on the NGST will be orders of magnitude more sensitive than any equivalent ground-based instrument/telescope combination. In the extragalactic arena, the mid-IR region is critical for a complete understanding of the high-redshift universe, dusty star-formation regions at low and high redshifts, and starburst vs. AGN transition. In the local universe, great strides forward can be made using mid-IR imaging, spectroscopy, and chronography of dusty and rocky disks of all ages, from protostellar to remnant debris disks. Near-neighbor detection and characterization can also be greatly advanced by mid-infrared observations.

Interferometer Designs for the Terrestrial Planet Finder

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The Terrestrial Planet Finder (TPF) is a space-based infrared interferometer that will combine high sensitivity and spatial resolution to detect and characterize planetary systems within 15 pc of our sun. TPF is a key element of NASA's Origins Program and is presently being considered by NASA for a new start in 2007 after the successful completion of key technological milestones during the development of the Space Interferometry Mission (SIM) and the Next Generation Space Telescope (NGST).

We review some of the interferometer designs that have been considered so far, with particular attention to the architecture and subarrays of the central beam-combiner.

The Full-sky Astronomic Mapping Explorer Concept Study


NASA has selected the Full-sky Astronomical Mapping Explorer (FAME) as one of five MIDEX missions to be funded for a concept study. This concept study will be submitted to NASA on 18 June, with final selection, delayed for September, of two of these missions for flight in 2003 or 2004.

FAME is designed to perform an all-sky, astronomical survey with unprecedented accuracy. It will create a rigid astrometric catalog of 40,000 stars, with visual band magnitudes 5<V<15. For bright stars, 5<V<9, FAME will determine positions and parallaxes accurate to <50 microarcseconds, with proper motion errors <70 microarcseconds/year. For fainter stars, 9<V<15, FAME will determine positions and parallaxes accurate to <1 microarcseconds, with proper motion errors <300 microarcseconds/yr. FAME will also collect photometric data on these 40,000,000 stars in the Sloan DSS colors.

During the concept study, the team has worked to optimize the scientific return from FAME while minimizing cost and risk. The optical design was altered for improved accuracy of individual observations and improved mechanical design. The optical, mechanical, and thermal design of the instrument have been improved. Tests using CCDs in TDI mode are being conducted to confirm the accuracy obtainable from individual observations as well as determine the optimal clocking scheme for astrometric devices operated in TDI mode. The use of solar radiation pressure for spacecraft precession has undergone further feasibility study, as have the mechanisms for deploying the solar shield. Numerous other trade studies have been conducted, including orbit/communications, on board processing, and the use of neutral density filters for astronomy of bright stars versus other options. A detailed error budget has been formulated and the mission requirements have been defined.

We look forward to selection for launch and a successful FAME mission that will redefine the extragalactic distance scale and provide a large, rich database of information on stellar properties that will enable numerous science investigations into stellar structure and evolution, the dynamics of the Milky Way, and stellar companions including brown dwarfs and giant planets.

FAME is a joint development effort of the US Naval Observatory, the Smithsonian Astrophysical Observatory, the Infrared Processing and Analysis Center, Lockheed Martin Missiles and Space, the Naval Research Laboratory, and Omnitron Incorporation.

Diffuse/Multi-Object Spectral Imaging of the Interstellar Medium Using Tomographic Inversion of Ultraviolet Sources

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We present a novel concept for spectral imaging suitable for the study of the interstellar medium at ultraviolet wavelengths. The technique is capable of performing simultaneous multi-object spectroscopy on point sources and imaging spectroscopy of faint diffuse sources. Unlike conventional spectral imaging techniques, our method encodes three dimensions of data (RA, DEC, wavelength) into a two-dimensional signal, using an optical system where photons from the entire science are collected at all times. Inversion of this data back into the three-dimensional space is accomplished by formulating a tomographic reconstruction problem. Intrinsic presence of noise, however, poses difficulties on conventional inversion methods such as the filtered back-projection (FBP) or the minimum-norm least square methods such that they often produce unacceptable results. This limitation is overcome by incorporating sophisticated regularization schemes. We investigate issues concerning the required inversion, and develop a suitable approach to image reconstruction using stochastic regularization by minimizing appropriate L1 and L2-norm functionals. We demonstrate the performance of our technique quantitatively in comparison with conventional spectral imaging techniques.

OPUS 3: A Mission Concept for Low Cost UV Astrophysics

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Current NASA strategic plans for the next decade do not include new UV astrophysics missions, and HST is expected to remain the primary data gathering tool for this field. HST's impressive capabilities for UV astronomy support this plan, however, exclusive reliance on HST also leaves the community perilously dependent on an aging, high cost platform where only a small fraction of the orbits will be committed to the UV. Since space based observations are essential in this bandwidth, it is prudent to develop additional UV-capable facilities both to complement HST's capabilities and as a hedge against its eventual loss as a science tool.

We present a concept for a high performance space observatory designed for focused space science research from a low cost Spartan-400 spacecraft in low Earth orbit. The observatory employs a 1.3m f/34 Ritchey-Chretien telescope feeding a 20-channel all-reflective imager and a 6-channel Row-

The new Space Telescope Imaging Spectrograph (STIS) imaging coupled with the Advanced Camera for Surveys (ACS) wide field imaging will closely approach the performance of the proposed Space Telescope Incorporation of All Sky Measurements (SPIRIT) mission. We also discuss implications of the operation of the all-sky survey.