ORIGINS SCIENCE MISSION CONCEPT STUDY
WINNING PROPOSAL ABSTRACTS

Leisawitz, **David** / Goddard Space Flight Center
SMCS04-0005-0001
The Space Infrared Interferometric Telescope

We propose a study of the Space Infrared Interferometric Telescope (SPIRIT), a mission recommended in the "Community Plan for Far-IR/Submillimeter Space Astronomy." SPIRIT is an imaging and spectral Michelson interferometer operating over the wavelength range 40 - 640 microns. Its sub-arcsecond angular resolution in the far-IR will enable revolutionary developments in the field of star and planet formation research. SPIRIT will also provide spectroscopic measurements of numerous high-z galaxies and contribute to our understanding of galaxy formation and evolution. Our preliminary studies suggest that SPIRIT may be ready to launch a decade from now.

ORIGINS SCIENCE MISSION CONCEPT STUDY
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Sembach, **Kenneth** / Space Telescope Science Institute
SMCS04-0000-0005
The Baryonic Structure Probe: Characterizing the Cosmic Web of Matter Through Ultraviolet Spectroscopy

Matter and radiation were rather smoothly distributed in the early universe, but condensed into a cosmic web or network of sheets, filaments, and clumps at later times. In addition to the properties of the cosmic microwave background and the abundances of light elements, the formation and development of structure is one of the testable predictions of cosmological theory. Understanding of the physics behind the evolution of the cosmic web is becoming more sophisticated as numerical simulations and measurements of the distribution of galaxies mature. Knowledge of the baryonic content of the web, its physical properties, and the interactions between its gas and galaxies is in a primitive state owing to the extreme faintness of the signals and the limited sensitivity of current observatories. Our concept study for The Baryonic Structure Probe will remedy this situation. We propose to refine expectations of the observable phenomena using modern physical theory and computational cosmology to estimate absorption and emission properties of the gas, and to develop a telescope and instrument concept capable of observing the warm-hot intergalactic medium at redshifts $z < 1.5$. Our team includes many of the world's foremost authorities in numerical astrophysics, optical technology and instrumentation, and the interpretation of critical observations. NASA's FUSE and HST observatories,in many cases by members of our team. The Baryonic Structure Probe will strengthen the foundations of observational cosmology by directly detecting, mapping, and characterizing the cosmic web, its inflow into galaxies, and its enrichment with the products of stellar and galactic evolution. Our study will provide a clear articulation of the scientific priority of these investigations, describe a mission concept capable of making major advances to our knowledge of cosmic structure, and define a roadmap for investments in enabling technologies. These will serve as inputs into NASA's strategic planning process.

ORIGINS SCIENCE MISSION CONCEPT STUDY
WINNING PROPOSAL ABSTRACTS

Sandford, **Scott** / NASA Ames Research Center
SMCS04-0002-0008
The Astrobiology SPace InfraRed Explorer (ASPIRE) Mission: A Concept Mission to Understand the Role Cosmic Organics Play in the Origin of Life

We propose to carry out a concept study for the Astrobiology SPace InfraRed Explorer (ASPIRE) space flight science mission. ASPIRE is an infrared space observatory optimized to spectroscopically detect and identify organic compounds and related materials in space in the mid- and far-infrared spectral windows, and understand how these materials are formed, how they evolve, and how they find their way to planetary surfaces. The observatory will be optimized to search for the spectral signatures of organics including: alkanes, alkenes, aromatics, ethers, alcohols, aldehydes, ketones, and nitriles, and will also be able to trace key gas phase species like H2O, OH, and H2. The missionís scientific tasks include: (1) determine the evolution of complex organic molecules in stellar outflows, (2) determine the identity of, and measure the distribution of, organic matter in the diffuse interstellar medium of our galaxy, (3) study the evolution of ices and organic matter in dense molecular clouds and star formation regions, (4) determine the identity of organics in the Solar System, with an emphasis on asteroids and comets, (5) survey the organics in local galaxies of a range of morphological types and metallicities, (6) survey the organics in galaxies as a function of distance (backward in time), (7) measure deuterium enrichments in interstellar organics, (8) determine the identity and distribution of refractory grains (particularly silicates) in all the environments being examined for organics and search for possible relationships between these materials, and (9) study gas phase species of particular astrobiological importance, particularly H2O. As part of this concept study, we would complete a detailed definition of the missionís science goals, establish rigorous science requirements that flow from these goals, and generate a preliminary mission design that meets the science requirements.

ORIGINS SCIENCE MISSION CONCEPT STUDY
WINNING PROPOSAL ABSTRACTS

Norman, **Colin** / The Johns Hopkins University
SMCS04-0000-0009
Hubble Origins Probe (HOP)

A no-new-technology HST-class facility utilizing COS and WFC3 as its core instrument complement can be deployed in low earth orbit (LEO) orbit by the end of this decade within the anticipated scope and budget of the Origins Science Mission program. The Hubble Origins Probe (HOP) Mission is the lowest risk path to continuing the science returns of Hubble through the era of Kepler and JWST. Combining COS and WFC3 on a lightweight 2.4-meter telescope enables a broad suite of forefront science in nearly all areas of modern astrophysics, with a unifying focus on the era from redshift z~0-3. This encompasses over 80% of the history of the universe and is the period when the great majority of star and planet formation, heavy element production, black hole growth, and galaxy assembly took place. WFC3 will take panchromatic images of the matter that formed planets, stars and galaxies and COS will perform UV spectroscopy of the gaseous matter from which they form. This will provide answers to many fundamental questions. Where are the majority of baryons in the universe today? How did the intergalactic medium collapse to form galaxies? What role does feedback from the formation of stars and black holes play in the origin and evolution of galaxies? When and how were galaxies assembled into their current form? What physical processes link the formation of supermassive black holes and galactic bulges? How do planetary systems form? Our proposed study will translate key science drivers for COS and WFC3 into a detailed and comprehensive HOP mission concept that is feasible in terms of cost and schedule. We will consider augmented capabilities, such as extending COS's UV sensitivity and employing a rapid slew capability for targets of opportunity. With our international partners we will explore cost-sharing and the concept of a third instrument, possibly a very wide field imager (VWFI). We have preliminary estimates for HOP in this proposal - in this study we will perform very detailed engineering, cost and schedule impact estimates as we further develop the science drivers and the impacts of HOP for the Origins Roadmap. The vision we present is of a 2-meter class mirror on a free-flyer carrying both COS and WFC3 to be launched in 48 months within the Origins Probe budget, offering NASA and the community a simple and low-risk approach to continuing Hubbleís Origins science. We consider enhancements that enhance the scientific mission and extend the Origins Roadmap.

ORIGINS SCIENCE MISSION CONCEPT STUDY
WINNING PROPOSAL ABSTRACTS

Johnston, **Kenneth** / U.S. Naval Observatory
SMCS04-0000-0010
Origins Billion Star Survey (OBSS)

The Origins Billion Star Survey (OBSS) will provide a complete census of giant extrasolar planets for all types of stars in the galaxy and the demographics of stars within 10KPC of the sun. It will leave as a legacy to the nation the measurement of a billion stellar positions, parallaxes (distances), proper motions, luminosities, binarity determinations, photometry, spectrometry and photometric variability. OBSS will provide observations of stars 7th to 20th visual magnitude (mv) with an astrometric precision of 10 microarcseconds at 14th magnitude. OBSS is optimized for the detection of extra-solar giant planets as well as enabling an astrophysical characterization of nearly all stars in the Solar neighborhood.

ORIGINS SCIENCE MISSION CONCEPT STUDY
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Melnick, **Gary** / Smithsonian Astrophysical Observatory
SMCS04-0000-0018
Cosmic Inflation Probe (CIP)

One of the greatest triumphs in our understanding of the early Universe is the invention of inflation (Guth 1981). Inflation is able to resolve the well-known problems of isotropy and flatness, as well as create the initial density fluctuations that provide the seeds for galaxy formation. It is, therefore, an essential component of the Big-Bang model. Yet inflation remains relatively unconstrained observationally. In this proposal we present a mission concept, the Cosmic Inflation Probe (CIP), along with an observational program that will provide significant constraints on inflation models. The goal is to measure the shape of the inflation potential by conducting a space-based 2.5ñ5 um large-area redshift survey capable of detecting objects between a z of 3 and 6.5. The matter-density fluctuations are a direct response to the shape of the inflation potential, and CIP will measure these fluctuations over a wide range of length scales. These results, combined with those from present and planned microwave background studies, will give us tremendous leverage on narrowing down the physics of the inflation epoch.

ORIGINS SCIENCE MISSION CONCEPT STUDY
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Thompson, **Rodger** / University of Arizona
SMCS04-0008-0021
GEOP: Galaxy Evolution and Origins Probe; An Origins Probe Concept for High Resolution Very Deep Multi-Color Imaging Over Several Degrees of Sky

GEOP, the Galaxy Evolution and Origins Probe, directly addresses the main themes of the Origins program. It observes the mass assembly of galaxies, the global history of star formation and the evolution of galaxy and UV luminosity functions over a volume large enough to determine the spatial fluctuations of these processes. In its 5 year mission GEOP images more than 5 million glaxies, becoming the equivalent of a high redshift Sloan Digital Sky Survey. GEOP is a radiatively cooled free flying 3 meter telescope that takes very deep, wide field images in 12 photometric bands from 0.3-5.0 microns. GEOP utilizes dichroics to observe simultaneously in 6 bands. The remaining 6 bands are also observed simultaneously after a change of dichroics and filters. The field of view is 6.8x6.8 arc minutes. During its 5 year mission GEOP will image 5.1 square degrees in all bands to a depth greater than the current HST Ultra Deep Field. All data from GEOP is non-proprietary. The wide area, high spatial resolution, very sensitive images covering more than a factor of 16 in wavelength will be an invaluable tool for almost every area of astrophysical study. Co-Investigators Glenn Schneider Daniel Eisenstein Harland Epps Xiaohui Fan Robert Kennicutt Michael Lesser John Peacock Adam Riess Donald Strecker Erick Young

ORIGINS SCIENCE MISSION CONCEPT STUDY
WINNING PROPOSAL ABSTRACTS

Morse, **Jon** / Arizona State University
SMCS04-0003-0022
HORUS: High ORbit Ultraviolet-visible Satellite

HORUS is a 2.4m-class observatory in L2 orbit with a wide-field imager and UV spectrograph. The imager has a field of view of 200 square-arcminutes, and multiplexes in wavelength using a dichroic. The combination of large FOV, multiplexing advantage, long target visibility, and improved detector QE and optical performance results in HORUS being over 100 times more efficient than HST for wide-field imaging surveys with <0.1 arcsec resolution. The UV spectrograph is optimized for point source spectroscopy and maximum throughput. Our science program focuses on core Origins science goals. In particular, HORUS will conduct a step-wise, systematic investigation of (1) star formation in the Milky Way, nearby galaxies, and the high-redshift universe; (2) the origin of the elements and cosmic structure; and (3) the composition of and physical conditions in the extended atmospheres of extrasolar planets. By optimizing the performance of the telescope and instruments for specific goals, we can reliably maintain the mission development costs within the $670M cost envelope. The two principal technology development/risk items are the large format detector arrays and data handling capabilities, both of which are tractable.

ORIGINS SCIENCE MISSION CONCEPT STUDY
WINNING PROPOSAL ABSTRACTS

Bradford, **Charles** / JPL
SMCS04-0015-0023
A Background-Limited Infrared-Submillimeter Spectrograph (BLISS) for SPICA: Revealing the History of Nucleosynthesis and Energy Production in the Galaxies Producing the Cosmic Far-IR Background

We propose to study potential approaches to BLISS - a background-limited IR-submm spectrometer for the Japanese SPICA mission, or any other future cryogenic space observatory. With its large (3.5 m), cold (4.5 K) aperture, SPICA will be the premier far-IR astrophysics platform in the decade after Spitzer and Herschel, and a background-limited spectrometer offers the potential for 4-5 orders of magnitude sensitivity improvement relative to the currently-planned platforms which are limited by their warm telescopes. BLISS on SPICA will enable far-IR spectroscopy of the galaxies that make up the far-IR background out to resdhifts of 5, and spectral surveys with BLISS will chart the history of nucleosynthesis and energy production through cosmic time. Because of the relatively low cost to NASA for a focal-plane instrument, BLISS on SPICA represents a timely opportunity and an excellent value for US scientists. We request Origins Probe funding to pursue this potential collaboration with the Japanese SPICA scientists, while simultaneously developing instrument concepts that will also be applicable to any future cryogenic far-IR mission such as SAFIR.