

NASA's Laboratory Astrophysics Program

Hashima Hasan and Harley Thronson
Office of Space Science, NASA Headquarters
Washington D.C. 20546

1 Introduction

NASA's Office of Space Science (OSS) operates an active laboratory astrophysics program conducted primarily at universities, federally funded laboratories, and research institutes. Topic areas currently supported include electron impact cross sections, photodissociation processes, electron-ion collisions, oscillator strengths for a variety of atomic transitions, polycyclic aromatic hydrocarbons, interstellar grains, and compilation of atomic databases. Related theoretical work is also supported to complement the laboratory research. The objective of the program is to enable and maximize the scientific return from the data of NASA's past, present and future space science missions. A brief description of the scientific program and NASA's needs for laboratory astrophysics is given in this paper. A workshop encompassing laboratory needs for OSS in the fields of astrophysics, planetary atmospheres, and space physics is planned on April 1 - 3, 1998 at Harvard University.

2 Program Description

Laboratory Astrophysics needs for NASA are driven by the data from its ongoing and planned missions, as well as from archival data (Table 1). Currently, the program is split along wavelength lines into two subprograms. Specific research projects are proposed by the scientific community in response to solicitations by NASA in the form of NASA Research Announcements (NRA). An annual solicitation for the Ultraviolet, Visible and Gravitational Astrophysics Research & Analysis program provides the community an opportunity for a timely response to perform laboratory research for enabling the interpretation of new data from UV/Visible missions. The Infrared, Sub-mm and Radio Astrophysics program solicits proposals every three years. With the operation of the Near Infrared Camera and Imaging Spectrograph (NICMOS) and proposed launch of the Space Infrared Telescope Facility (SIRTF) and the Stratospheric Observatory for Infrared Astronomy (SOFIA), there may be need for more frequent solicitation in this area. Currently, only one program is funded in High Energy Astrophysics, though with the launch of the Advanced X-ray Facility (AXAF), there will perhaps be a need to expand this program.

A wide variety of projects, the focus of each of which is to enable the understanding of specific astrophysical phenomena, such as those within diffuse interstellar clouds, stellar atmospheres, dust grains, etc. are under study. Names of principal investigators, institutions, and project titles are listed in Tables 2 and 3. In a broad sense, the program supports the fundamental science questions defined by NASA's *Structure and Evolution of the Universe* and *Astronomical Search for Origins* science themes.

Table 1

NASA's Astrophysics Missions (partial list)
<p style="text-align: center;">Currently in operation</p> <p>Extreme Ultraviolet Explorer (EUVE) Hubble Space Telescope (HST) <i>Wide Field and Planetary Camera 2</i> <i>Space Telescope Imaging Spectrograph (STIS)</i> <i>Near-Infrared Camera & Multi-Object Spectrograph (NICMOS)</i></p>
<p style="text-align: center;">Archival phase</p> <p>International Ultraviolet Explorer (IUE) Orbiting & Retrievable Far & Extreme Ultraviolet Telescope (ORFEUS and ORFEUS2) Interstellar Medium Absorption Profile Spectrograph (IMAPS) Hubble Space Telescope (HST) <i>Wide Field and Planetary Camera (WFPC)</i> <i>Goddard High Resolution Spectrograph (GHRS)</i> <i>Faint Object Spectrograph (FOS)</i> <i>High Speed Photometer (HSP)</i> ASTRO and ASTRO2 <i>Ultraviolet Imaging Telescope (UIT)</i> <i>Hopkins Ultraviolet Telescope (HUT)</i> <i>Wisconsin Ultraviolet Photo-Polarimeter Experiment (WUPPE)</i></p>
<p style="text-align: center;">Missions in development</p> <p>Sub-millimeter Wave Astronomy Satellite (SWAS) Stratospheric Observatory for Infrared Astronomy (SOFIA) Space Infrared Telescope Facility (SIRTF) Wide Field Infrared Explorer (WIRE) Space Interferometry Mission (SIM) Far Ultraviolet Spectroscopic Explorer (FUSE) Hubble Space Telescope (HST) <i>Advanced Camera for Surveys (ACS)</i> <i>Cosmic Origins Spectrograph (COS)</i> Galaxy Evolution Explorer (GALEX)</p>

Table 2

UV/VISIBLE LABORATORY ASTROPHYSICS PROGRAM - FY98		
P.I.	Institution	Title
AJELLO, J.	JPL	UV Spectroscopy and Electron Impact Cross Sections of H ₂ , HD, O and H
BEIERSDORFER, P.	LLNL	Spectral Catalogue of the Intermediate Ionization States of Fe in the EUV
BLAKE, G.	Caltech	Novel, compact UV/Vis & VUV coherent light sources: application DIB carriers
CHUTJIAN, A.	JPL	Study of Basic Electron-Ion Collisions
FEDERMAN, S.	U. Toledo	Oscillator Strengths for UV Atomic Transitions
JAMES, G.	JPL	Hi Res Lab Study of Predissociation in Diatomic Molecules
KANIK, I.	JPL	Electron-Impact Excitation & Electron-Impact Induced Fluorescent Cross Sections
KHAKOO, M.	UC Fullerton	Electron impact excitation of molecular hydrogen
KURUCZ, R.	SAO	Research on Spectroscopy, Opacities and Atmospheres
KWONG, V.	UNLV	Studies of Thermal Energy Charge Transfer in Si & Fe Ions in Astrophysical Plasmas
LAWLER, J.	U. Wisconsin	The Measurement of VUV Atomic Transition Probabilities of Astrophysical Interest
MANSON, S.	Georgia St.	Absorption & Emission of Excited & Ground State Atoms & Ions in the UV/Visible
MARTIN, W.	NIST	Critical Compilations and Atomic Spectroscopic Database Needed for UV Astronomy
PARKINSON, W.	Harvard U.	Absolute Transition Probabilities of Lines in VUV spectra
READER, J.	NIST	Lab. Analysis of Spectra for determination of Heavy Element Abundances
SALAMA, F.	NASA/ARC	U/Visible Spectroscopy of PAHs, Fullerenes and Carbon Chains
SMITH, S.	JPL	Measurement & Lifetime of f-Values in Singly- and Multiply-charged Positive Ions
SNOW, T.	U. Colorado	Lab. Studies of the Visible Spectroscopy & Chemistry of PAH Ions in the Gas Phase
SRIVASTAVA, S.	JPL	Measurement of Electron Ionization & Attachment Cross Sections
TRAJMAR, S.	JPL	Electron Impact Cross Sections for Molecules of Astrophysical Interest
VIDALI, G.	Syracuse U.	Studies of Reactions on Interstellar Grain Analogues in a UV-Rich Environment
WDOWIAK, T.	U. Alabama	Investigation of the Contribution of PAHs to Interstellar Ultraviolet Extinction
WIESE, W.	NIST	Critical Evaluation and Compilation of Atomic Transition Probabilities
WIESE, W.	NIST	Lab. Measurements of Atomic Oscillator Strengths
WITT, A.	U. Toledo	Optical Properties of Carbonaceous Grain Mantle materials with Silicon Impurities

Table 3

IR/SUB-MM/RADIO LABORATORY ASTROPHYSICS PROGRAM - FY98		
P.I.	Institution	Title
ALLAMANDOLA, L.	NASA/ARC	Laboratory Spectroscopic Studies of Interstellar PAHs and Carbonaceous Materials
ANICICH, V.	JPL	Laboratory Studies of Interstellar Ion-Molecule Reactions
BERNATH, P.	U Arizona	Infrared Emission Spectroscopy of Astrophysical Molecules
BLAKE, G.	Caltech	Laboratory Studies of the Photophysics and Photochemistry of Isolated PAHs and PAH Cations
CODY, R.	NASA/GSFC	Laboratory Studies of Complex Organic Particles
EVENSON, K.	NIST	Submillimeter and Far Infrared Laser Spectroscopy
GUBERMAN, S.	Inst for Sci Resch	Theoretical Studies of Interstellar Processes
HERBST, E.	Ohio St. U	Submillimeter Laboratory Investigations: Spectroscopy and Collisions
MOORE, M.	NASA/GSFC	Spectroscopy of Ion-Irradiated and Photolyzed Ices and Ice/Silicate Composites
OKA, T.	U Chicago	Infrared Spectroscopy of Molecular Ions of Astrophysical Interest
PICKETT, H.	JPL	Submillimeter Laboratory Spectroscopy
SAYKALLY, R.	UC-Berkeley	Carbon and Silicon Carbide Clusters and Their Relation to Interstellar Dust
SIEVERS, A.	Cornell U	Laboratory Measurements of Celestial Solids
THADDEUS, P.	SAO	Exotic Molecules in Space: A Coordinated Astronomical, Laboratory, and Theoretical Study
VALA, M.	U Florida	Carbon Species as Possible Carriers of the UIRs
VIDALI, G.	Syracuse U	Experimental Studies of Hydrogenation and Other Reactions on Surfaces Under Astrophysically Relevant Conditions
WITT, ADOLF	U Toledo	Near-IR Emission and Absorption Characteristics of Carbonaceous Grain Mantle Materials
ZIURYS, LUCY	U Arizona	Submillimeter Spectroscopy of Astrophysically Important Metal-Containing Molecules