THE ASTRONOMICAL SOCIETY OF NEW YORK

SPRING 2007 MEETING

Hofstra University
April 14, 2007

SCHEDULE

9 – 9:30 am: Coffee, tea, juice, donuts

9:30 am – 10:45 am Session I. Planetary Bodies and Nearby Stars
Chair: Harold M. Hastings (Hofstra University)

9:30 am The Gemini Planet Imager: Advances in Ground-Based Coronagraphy
Anand Sivaramakrishnan, Ben Oppenheimer, Dragoslav Scepanovic, Sasha Hinkley, Douglas Brenner, Remi Soummer (American Museum of Natural History)

9:45 am Toward Eclipse Mapping of Hot Jupiters
Emily Rauscher (Columbia University)

10:00 am Brown Dwarfs in Orion
Jackie Faherty (American Museum of Natural History)

10:15 am Solving the Mystery of Lunar Outgassing and Transient Phenomena
Cameron Hummels (Columbia University)

10:30 am A New Census of Nearby Stars
Sebastien Lepine (American Museum of Natural History)

10:45-11:15 am: Coffee, tea, juice, donuts

11:15 am – 12:30 pm Session II. Dark Energy and Cosmology
Chair: Brett Bochner (Hofstra University)

11:15 am Dark Energy Crisis: Breaking Our Addiction to Cosmic Fuels
Arthur Lue (MIT Lincoln Laboratory)

12:00 noon Cosmic Acceleration without Dark Energy: A Primer
Brett Bochner (Hofstra University)

12:15 pm Is Deuterium Cosmological?
Donald Lubowich (Hofstra University), Jay Pasachoff (Williams College), Christian Henkel (Max-Planck Institute fur Radioastronomie), Tom Millar (Queen's University Belfast), Helen Roberts (University of Manchester)

12:30 – 1:30 pm Lunch (sandwich assortment, pizza)

1:30 – 2:45 pm Session III. Rotating Stars and Spectroscopy
Chair: Stephen Lawrence (Hofstra University)

1:30 pm Resolving the Rotating A Stars
Deane Peterson (Stony Brook University)

2:15 pm The effects of rotation on early type stars as ground-based interferometry calibrators
Jinmi Yoon (University at Stony Brook)

2:30 pm Near Infrared Spectroscopy of Members of NGC 7129
Thomas Allen (University of Rochester)

2:45- 3:15 pm Coffee, Soda, Water

3:15 – 4:15 pm Session IV. Supernovae and Galaxies
Chair: Mark A. Edwards (Hofstra University)

3:15 pm Is There an Echo ~~in Here~~ Out There?
Stephen Lawrence, Lauren Palladino (Hofstra University), Arlin Crotts (Columbia University) and Ben Sugerman (Goucher College)

3:30 pm A Mechanism for Type Ia Supernova Explosions
Alan Calder (Stony Brook University)

3:45 pm A Morphological Analysis of Massive Interacting Galaxies
Jim Pizagno (Stony Brook University)

4:00 pm Star Formation in Luminous Infrared Galaxies
Tatjana Vavilkan (Stony Brook University)

4:15 pm Thermal Evolution of Ices around Young Stellar Objects: The CO_2 Diagnostic
Amanda Cook (Rensselaer Polytechnic Institute)

ABSTRACTS (in order of presentation)

9:30 am – 10:45 am Session I. Planetary Bodies and Nearby Stars

9:30 am The Gemini Planet Imager: Advances in Ground-Based Coronagraphy
Anand Sivaramakrishnan, Ben Oppenheimer, Dragoslav Scepanovic, Sasha Hinkley, Douglas Brenner, Remi Soummer (American Museum of Natural History)

Direct detection and characterization of young exojovian planets around nearby bright (V>7) stars requires coronagraphic suppression of the primary star. With the companion lost in the glare if the primary is not suppressed, relative astrometry and photometry between the primary and its companion becomes challenging. Without accurate astrometry, common proper motion between a potential companion and the bright adaptive optics guide star is hard to demonstrate. We present a simple

solution to this problem for the Gemini Planet Imager, which we tested on The Lyot Project near-IR coronagraph on AEOS in December 2006. Our technique also enables accurate astrometric and photometric measurements of disks around coronagraphically-suppressed stars.

9:45 am Toward Eclipse Mapping of Hot Jupiters
Emily Rauscher (Columbia University)

10:00 am Brown Dwarfs in Orion
Jackie Faherty (American Museum of Natural History)

Multicolor photometry is a proven method for finding very low mass objects. Follow-up JHK imaging and near-IR spectroscopy of two dozen very red (V-I>4) objects in the Orion OB1a and OB1b associations reveals the coolest and lowest mass PMS candidates in the association. These objects are mostly unreddened mid-to-late M spectral type objects (M6-M9) that fall on a few million-year isochrone. Masses are largely substellar reaching as low as 0.02 solar masses (20 Jovian Masses). The space density of the substellar objects is high. In this talk, we will speculate on why the density of substellar-mass objects appears so large in this fossil star forming region. We will also present on even deeper follow-up imaging currently being conducted with the Camera Panoramique Proche Infra Rouge. This 2K imager will cover roughly 4 square degrees of the belt of Orion, and the Sigma Ori Cluster. It will reach 2 magnitudes deeper then 2MASS and combined with the optical photometry already obtained, should lead to a refined IMF.

10:15 am Solving the Mystery of Lunar Outgassing and Transient Phenomena
Cameron Hummels (Columbia University)

10:30 am A New Census of Nearby Stars
Sebastien Lepine (American Museum of Natural History)

The SUPERBLINK survey of stars with large proper motions, conducted at the American Museum of Natural History, has now been completed over the entire sky. The database of over 2.5 million fast-moving sources is now being analyzed to recover >80% of all hydrogen-burning bodies located within 50 parsecs of the Sun. This census of ~50,000 very nearby stars will yield the most complete 3D-map of stellar systems in the immediate vicinity of the Sun.

11:15 am – 12:30 pm Session II. Dark Energy and Cosmology

11:15 am Dark Energy Crisis: Breaking Our Addiction to Cosmic Fuels
Arthur Lue (MIT Lincoln Laboratory)

In 1998 the Hubble Space Telescope found that the universe, rather than slowing down in its expansion, is actually accelerating. This startling observation is one of the most profound scientific discoveries of the 20th century. Nevertheless, the nature of the fuel that drives today's cosmic acceleration is an open and tantalizing mystery. I entertain the intriguing possibility that the acceleration is not the manifestation of yet another mysterious ingredient in the cosmic gas tank (called "dark energy"), but rather our first real lack of understanding of gravity itself, and even support for the outrageous idea that there might exist extra, unseen dimensions.

12:00 noon Cosmic Acceleration without Dark Energy: A Primer
Brett Bochner (Hofstra University)

12:15 pm Is Deuterium Cosmological?

Donald Lubowich (Hofstra University), Jay Pasachoff (Williams College), Christian Henkel (Max-Planck Institute fur Radioastronomie), Tom Millar (Queen's University Belfast), Helen Roberts (University of Manchester)

All the astronomical observations of deuterium (D) are consistent with a cosmological origin. Deuterium has been extensively studied because it is not produced via stellar nucleosynthesis and is thought to be primarily produced via the big-bang, so its abundance will only decrease with time unless there are additional sources of D. The D/H ratio is an important prediction of standard and non-homogeneous big-bang models because the abundance of D depends critically on the temperature and baryonic density during the epoch of nucleosynthesis (first 1000 seconds). In homogeneous inflationary or other flat models, the D/H ratio gives the amount of dark matter and an upper limit to the number of neutrino families. Any Galactic source of D would undermine its use to estimate the baryonic density of the universe and place constraints on big-bang nucleosynthesis models. D nucleosynthesis models have included supernovae, supernovae shock-waves, cosmic-ray spallation reactions, accretion disks around neutron stars or black holes, gamma-ray photospallation reactions, stellar flares, and a large proton flux during an early active phase of the Galaxy as possible sources for deuterium. If D is produced via any stellar or Galactic nucleosynthesis process, then its abundance would be a maximum value in the Galactic Center (which is the most active and heavily processed region of the Galaxy).

We review observations of deuterium in the Galaxy, external galaxies, active galaxies, and in quasar absorption systems, including our observations of D in Galactic molecular clouds. D has been detected in molecular clouds, diffuse clouds, and H II regions from observations of deuterated molecules, Lyman lines, Balmer lines, QSO absorption lines, and the DI 92-cm hyperfine-structure line. The Galactic D/H ratios range from 2 ppm in the Galactic Center to 23 ppm towards the anticenter (10 kpc from the GC). The QSO D/H ratios range from 20 – 30 ppm. Deuterium has not been detected in planetary nebulae, SNRs, or AGN. Because the D/H ratio is lowest value in the Galactic Center yet increases with distance from the Galactic Center, D is not produced via stellar or galactic activity (massive stars and star formation, cosmic rays, or stellar flares). Thus the observed D is cosmological with the D abundances reduced by astration, infall, mixing, and depletion onto grains.

1:30 – 2:45 pm Session III. Rotating Stars and Spectroscopy

1:30 pm Resolving the Rotating A Stars

Deane Peterson (Stony Brook University)

Astronomers have known almost since the invention of astronomical spectroscopy that stars significantly hotter than the sun tend to rotate rapidly. This lead to early investigations into the effects of rotation on the structure and shapes of stars by von Zeiple and Eddington, and predictions of flattening and substantial temperature gradients and in turn bright poles, dark equators and slowly circulating currents through the stars. Eighty years later, through the use of a new generation of long baseline optical interferometers, and advances in microprocessors which allow us to deal with the atmosphere, we are finally beginning to test these predictions. We have for the first time resolved the surfaces of these hot stars, first Altair and next Vega and have found that the theory is at first glimpse in very good agreement with the observed (highly asymmetric) light distributions. Even then, the recognition that Vega, the long-time spectral and photometric standard, is rotating near breakup has sent tremors through the astronomical community. And with constantly improving precision,

increasing baselines, and more sophisticated techniques to beat down the atmosphere, we expect to see the agreement with the simple theories begin to break down, which is when the fun will really begin.

2:15 pm The effects of rotation on early type stars as ground-based interferometry calibrators

Jinmi Yoon (University at Stony Brook)

I will explain the use of early type stars as calibrators for optical interferometry with the problem introduced by rotation. These early type stars have high surface brightnesses and hence are relatively bright even with small angular diameters. However, rotation can introduce changes in the predicted visibilities well in excess with the uncertainties in the various diameter-magnitude-color calibrations. Measurements of the projected rotational velocity constrain these effects, but the constraints are complicated and not easily evaluated when selecting potential calibrators. Further, the magnitude of the variations depends on the details of the interferometer such as latitude, baseline length and operating wavelength. Nevertheless, using measured magnitudes, colors, parallaxes and projected rotational velocities, and estimating masses from standard evolutionary grids it is possible to calculate histograms which approximate the probability distribution of visibilities, and characterize the width of the distribution of squared visibilities and the total range, induced by rotation. The proximity to the ZAMS adds a valuable constraint, allowing stars with moderate rotation to be reliable calibrators in a number of cases. Therefore, I will show the results based on the Navy Prototype Optical interferometer.

2:30 pm Near Infrared Spectroscopy of Members of NGC 7129

Thomas Allen (University of Rochester)

We present FLAMINGOS spectra, as well and near and mid-IR photometry of members of the young stellar cluster NGC 7129. After dereddening, these data are used to provide spectral types for the members of this young cluster, as well as ages and masses when combined with near-IR photometry. This is part of a broader survey combining ground-based near-IR and Spitzer mid-IR data to understand the initial configuration of young clusters, their dynamical evolution and the effect of the cluster environment for star and planet formation.

3:15 – 4:15 pm Session IV. Supernovae and Galaxies

3:15 pm Is There an Echo ~~in Here~~ Out There?

Stephen Lawrence, Lauren Palladino (Hofstra University), Arlin Crotts (Columbia University) and Ben Sugerman (Goucher College)

We report on progress regarding the mysterious ultraviolet light echo of Supernova 1987A. The light echo represents the only way to directly measure the initial intense flash of ultraviolet light from the shock breakout during the first few hours after the core collapse of SN 1987A. Crotts et al. made spectroscopic observations of a visibly-bright echo patch in 1995-96 with the International Ultraviolet Explorer satellite, and an ultraviolet echo signal is clearly present. Other UV imaging attempts have been less successful, however. We will discuss our research-in-progress on Hubble Space Telescope WFPC2 and STIS imaging at visible and UV wavelengths of a different echo patch in 2002-03.

3:30 pm A Mechanism for Type Ia Supernova Explosions

Alan Calder (Stony Brook University)

Type Ia Supernovae are one class of bright stellar explosions that are distinguished by a lack of hydrogen in the observed spectra. The most widely accepted scenario is a thermonuclear runaway occurring in a Carbon/Oxygen white dwarf that has gained mass from a main-sequence companion. I will present simulations of a proposed explosion mechanism, Gravitationally Confined Detonation, in which a deflagration, a subsonic flame front, born slightly off-center in the white dwarf produces a rising fire ball that eventually triggers a detonation, a supersonic flame front, at the surface of the star.

3:45 pm A Morphological Analysis of Massive Interacting Galaxies

Jim Pizagno (Stony Brook University)

Mergers of galaxies represent an important phase in galaxy evolution. The most massive galaxies are built through mergers, which drastically changes the morphology of the merging galaxies. Our group has been involved in a long term project to image merging galaxies with the high resolution Hubble Space telescope, and other space-based telescopes. This sample of 88 galaxies was selected to be Luminous Infrared Galaxies, where the high infrared luminosity is due to their high star formation and dust content induced by the interactions. I present an analysis of the morphology of the interacting/merging galaxies, how it relates to the un-interacting population of galaxies, and the plans for more data collection.

4:00 pm Star Formation in Luminous Infrared Galaxies

Tatjana Vavilkan (Stony Brook University)

Our group is investigating star formation in Luminous Infrared Galaxies as seen in form of star forming clusters in ACS/HST images. The goal of this project is to characterize the distribution of young clusters through the disk or in the overlap region between colliding disks at different interaction stages, correlate it with presence of large-scale instabilities (bars, bridges) and compare it to distribution of PAH emission in Spitzer Space Telescope images. Star formation rates inferred by different tracers such as PAH, FIR, 24 micron, radio will be calculated and compared.

4:15 pm Thermal Evolution of Ices around Young Stellar Objects: The CO_2 Diagnostic

Amanda Cook (Rensselaer Polytechnic Institute)

The formation of solid state carbon occurs on dust grains in interstellar clouds like the Taurus Molecular Cloud Complex. So far, detected species include CO, methane, methanol, formaldehyde, and other simple hydrocarbons. Carbon dioxide (CO_2) is readily formed in laboratory experiments in which a mixture of H2O and CO is subjected to radiation. This situation mimics the conditions near young stellar objects (YSOs), where ices grains are exposed to intense radiation from the embedded protostar. Therefore it is expected that CO would form with extreme efficiency in these regions. However, *Spitzer* observations of quiescent clouds (devoid of YSOs) indicate radiation processing is not a requirement for CO production; long time scales allow for diffusion at grain surfaces so that oxidation of CO may occur. Whittet et al has already published a paper characterizing these quiescent clouds toward field stars; this project aims to do the same for clouds around YSOs. The variations in luminosity and temperature at each of these sources provide a good test for our current astrochemical models. The goal is to be able to account for all of these variations with a consistent model of astrochemistry.