32nd DDA meeting, Houston, Texas, April 2001

This talk will highlight one of the SIM Key Science projects: quasar astrophysics. There are 3 basic goals: (1) Does the most compact optical emission from an AGN come from an accretion disk or from a relativistic jet? (2) Do the relative positions of the radio core and optical photocenter of quasars used for the reference frame tie change on the timescales of their photometric variability, or is the separation stable? (3) Do the cores of galaxies harbor binary supermassive black holes remaining from galaxy mergers?

A variety of AGN phenomena are expected to be visible to SIM on microarcsecond scales, including time and spectral dependence in position offsets between accretion disk and jet emission. As well as absolute astrometry, SIM can measure position shifts as a function of color. This is a very powerful technique, allowing us to study quasar structure on angular scales well below the nominal interferometer resolution.

4.01

Status of the UCAC project

N. Zacharias (USNO), M.I. Zacharias (USRA / USNO), T.J. Rafferty (USNO)

By mid September 2001 operations of the USNO CCD astrograph (UCA) at CTIO will come to an end. The instrument will be relocated to Flagstaff, AZ in October. The entire Southern Hemisphere was covered by August 2000. The goal is to reach as far north as +30 degree declination for most right ascensions. The current UCA Catalog is used to validate 2MASS astrometry, is part of the Sloan Digital Sky Survey reduction pipeline and is widely used in the minor planet community. Plans for a second, intermediate data release (UCAC2) will be presented, which again will include proper motions. The UCAC2 will be based on over 130,000 frames and it will contain an estimated 40 million stars between red magnitudes 8 and 16, with 20 mas accurate positions for the 10 to 14 mag range. However issues like completeness, multiple stars, object classification and resolving of systematic errors to the limit of the data will be handled only in the final catalog release, expected for 2004.

4.02

Transport and Capture of Comets

S.D. Ross, W.S. Koon (Control and Dynamical Systems, Caltech), M.W. Lo (Navigation and Mission Design, Jet Propulsion Laboratory), J.E. Marsden (Control and Dynamical Systems, Caltech)

The dynamics of comets and other solar system objects which have a three-body energy close to that of the collinear libration points are known to exhibit a complicated array of behaviors such as rapid transition between the interior and exterior Hill's regions, temporary capture, and collision. The invariant manifold structures of the collinear libration points for the restricted three-body problem, which exist for a range of energies, provide the framework for understanding these transport phenomena from a geometric point of view. In particular, the stable and unstable invariant manifold "tubes" associated to libration point orbits are the phase space conduits transporting material to and from the smaller primary body (e.g., Jupiter), and between primary bodies for separate three-body systems (e.g., Saturn and Jupiter).

This point of view has worked well in describing the planar circular restricted three-body problem. The current work seeks to extend the results to three degrees of freedom.

This work was supported by the National Science Foundation Grant No. KDI/ATM-9873133 under a contract with the Jet Propulsion Laboratory, NASA.

4.03

Dust Stream Evolution from Long Period Comets

A.A. Jackson (Lunar and Planetary Institute)

A simple model is constructed for the evolution of dust ejected from long period comets at perihelion. The initial distribution of particle states are modeled using the Whipple formula for the emission velocity of comet dust, then modification of the orbits by radiation pressure are accounted for. The initial ejected cloud and its lifetime then can be analytically computed. The time history of the particles in this stream are then followed by numerical integration accounting for Poynting-Robertson drag and gravitational perturbations of the planets. The structure of the resulting stream is displayed.

4.04

First Light for USNO 1.3-meter Telescope

A.K.B. Monet, F.H. Harris, H.C. Harris, D.G. Monet, R.C. Stone (USNO, Flagstaff)

The US Naval Observatory Flagstaff Station has recently achieved first light with its newest telescope – a 1.3–meter, f/4 modified Ritchey-Chretien,located on the grounds of the station. The instrument was designed to produce a well-corrected field 1.7–degrees in diameter, and is expected to provide wide-field imaging with excellent astrometric properties. A number of test images have been obtained, using a temporary CCD camera in both drift and stare mode, and the results have been quite encouraging. Several astrometric projects are planned for this instrument, which will be operated in fully automated fashion. This paper will describe the telescope and its planned large-format mosaic CCD camera, and will preview some of the research for which it will be employed.

4.05

Free Libration in the Motion of the Galilean Satellites and the Reassessment of Tidal Effects

S. Musotto, F. Varadi, G. Schubert, W. Moore (UCLA)

Numerical simulations of the orbits of the Galilean satellites are being carried out using realistic physical models in order to better understand their coupled orbital and thermal evolution. We are able to isolate from the simulated orbits the so-called free libration of the Laplace angle which is the primary quantity in the classical description of the tidal evolution of the Laplace resonance. The amplitude and period of the libration could only be estimated in the past through J. Lieske's motion theory in which they are two of the parameters fitted to observations. Our direct numerical simulations, together with standard digital signal processing, confirm Lieske's values. However, the commonly used formulae for tidal dissipation are incorrect because they do not take into account the large deviations from Keplerian ellipses due to the gravity field of Jupiter. While the formulae assume very small variations in eccentricity on the orbital time scale, those are, in fact, about one quarter of the orbital average. We will address this important issue.

4.06

Lower Bounds on Astrometric Errors from a Spinning, Precessing Astrometric Satellite due to the Geometry of the Observation Scanning Pattern

M.A. Murison (U.S. Naval Observatory)

The scanning pattern of observations from a spin-stabilized, precessing astrometric spacecraft constrains the mission astrometric errors through the geometry that determines two distributions on the sky: the distribution of observation density and the distribution of scan angle (the angle of scan direction with respect to an ecliptic meridian through a given location). In this paper, the geometry underlying the distributions is presented. Then, assuming a given single-measurement error, simulated astrometric observations are accumulated on an equal-area grid on the sky. The behaviors of the