Session 17: Extra-Solar Planets and Impacts (Moderator TBA) 1:30–2:30, Garden Room

17.01

Astrometric Detection and Direct Imaging of Extra-Solar Planets with the Astrometric Imaging Telescope (AIT)

Richard J. Terrile (Jet Propulsion Laboratory, Caltech), David C. Black (Lunar and Planetary Institute) and Jakob J. van Zyl (Jet Propulsion Laboratory, Caltech)

The search for extra-solar planetary systems is one of the most exciting opportunities facing NASA in the last decade of this century. Several experimental methods have been proposed, but two have emerged as likely to be combinable into one integrated observatory. One is relative astrometry, in which the presence of a planet is inferred from the reflex motion (wobble) of the parent star. This method is embodied in the proposed Astrometric Telescope Facility (ATF). The other is direct imaging with a coronagraphic telescope, in which scattered and diffracted light are so effectively reduced that the planet can be detected in the image of the parent star. This method is embodied in the proposed Circumstellar Imaging Telescope (CIT). Both methods require a meter-class orbiting telescope and both can be carried out with only modest improvements in present technology. ATF and CIT have been reviewed by various NASA advisory panels and, in every instance, the complementary nature of both investigations was noted and a recommendation was made to combine the two experiments into a single telescope.

A preliminary review of the two experiments is underway to identify conflicting design requirements for the shared telescope, using a design team drawn largely from members of the two individual teams. By comparing the separate functional requirements and designs, several conflicting requirements were identified such as aberrations, aperture diameter, telescope configuration, field of view, mirror quality, access to the image at the first focus and pointing. For each of these conflicts, the team identified one or more compromise designs. The AIT design team obtained or developed enough information on the separate CIT and ATF requirements to determine that there were no fundamental incompatibilities, and have produced a baseline configuration for the AIT instrument.

17.02

POINTS, the Planet Finder, II

R.D. Reasenberg, R.W. Babcock, and J.F. Chandler (SAO/CfA)

It is ten years since we first presented our ideas to the DPS for a search for extra-solar planetary systems using POINTS. (Reasenberg and Shapiro, BAAS, 11, 554, 1979) The instrument is now smaller and better defined. Central to its architecture is a real-time metrology system, for which new optical technologies are being developed at SAO. Both the astrophysical applications and the conceptual design have been described by Reasenberg et. al. (Astron. J., 96, 1731, 1988.)

POINTS (Precision Optical INTerferometer in Space) would measure the angular separation of two stars, separated by about 90 deg on the sky, with a nominal accuracy of 5 microarcseconds. For a pair of mag 10 stars, an observation would require about 10 minutes; about 60 such pairs could be measured daily. The astrometric data would contain the closure information necessary to detect and correct time-dependent measurement biases. The 90 deg target separation would yield absolute parallax, obviating the need for adjacent zero-parallax objects.

Recent double-blind simulations have shown that, in a ten-year mission, POINTS would find planets which produce at least 0.01 "Jove" signatures, where the Jove is the astrometric wobble of the Sun due to Jupiter as seen from 10 pc. In half of the observing time of such a mission, over 500 stars within 20 pc could be examined; we would either find planetary systems or show reliably that such systems are rare.

This work has been supported by NASA grants NAGW 1355 and NAGW 1647 and by the Smithsonian Institution, both directly and through its Scholarly Studies Program.

17.03

The Companion Object to HD114762

W. D. Cochran, E. L. Robinson, A. L. Cochran, T. Hancock, A. P. Hatzes, A. W. Shafter (Univ. Texas), Zhang Erhe (Beijing)

The F9 dwarf HD114762 was recently discovered to have an invisible companion by Latham *et al.* (*Nature* **339**, 38, 1989), who had been monitoring the radial velocity of this star with the goal of establishing it as a radial velocity standard. This system has an orbital period of 84 days, and a velocity amplitude of about 600 m s^{-1}. This gives a companion mass of $M_c \sin i = 0.011 \pm 0.001 M_{\odot}$, where i is the inclination of the orbital plane. Thus, the companion could be a planet, a brown dwarf, or a low mass star, depending on the value of i. If i should happen to be near 90°, then transit events of the companion across the disk of the primary should be detectable photometrically. For this system, these transit events could be up to 6% deep and last up to 8 hours. However, the probability of such an event is relatively low. If the orbit of the unseen companion is randomly oriented in space, then the probability of transit is about 2%. We have conducted observations of HD114762 in an effort to detect such transit events. The primary uncertainties in the predicted event timing are the orbital period, the epoch of periastron, and the longitude of periastron. We have obtained high precision radial velocity variation measurements of the star in order to improved the orbit solution. We then conducted photometry of HD114762 during two predicted events in March and June 1989. We observed the star from four observatories spaced around the world, in order to get nearly full coverage of the possible events. No transit events were detected in the March run, during which observations covered about 45% of the time. Results from the June observations will be presented.

17.04

Spacial Non-Randomness of IRAS Main Sequence Disk Stars: Possible Correlation with Interstellar Clouds

John J. Matese and Daniel P. Whitmire (University of Southwestern Louisiana)

A number of nearby main sequence stars have non-photospheric far IR emissions that have been interpreted in terms of cool disks of orbiting grains (Backman and Gillett, 1987, "Cool Stars, Stellar Systems and the Sun", p. 340). We show that the A and F type disk stars within 25 parsecs have a non-random spacial distribution in contrast to the entire sample of A and F stars. The concentration correlates with the nearest interstellar dust cloud (Frisch and York, 1983, Ap. J. Letts 271, L59). Since these systems are not likely to be young, we argue that the correlation is the result of the fragmentation of stellar disk grains by multiple collisions with the much smaller cloud grains. Fragmentation results in enhanced optical depth and therefore IR emission. We present arguments that disk particles $\lesssim 50\ \mu m$ can be fragmented if a star passes through a cloud of hydrogen column density $> 3 \times 10^{18}$ cm^{-2}, a value typical of the nearest