

tometrically detecting a planet of a given size are the size and variability of the star it orbits. F, G, and K dwarf stars best fit the constraints set by these limitations and thus stellar spectral type and luminosity class are the criteria for selection of target stars for a photometric planetary search program. For solar-like stars with variability no greater than that shown by the Sun, the photometric method as applied in a spaceborne observing program should be able to detect *Earth-size* planets. However, a spaceborne program requires the selection of a large number of target stars ($\sim 10,000$) to a magnitude limit of $m_v = 13$. Current stellar catalogs do not provide information on both spectral and luminosity class to this magnitude limit. Here we show that classification and selection of target stars can be done by adopting observing techniques and stellar spectral classification methods from observers in the field of galactic dynamics. Spectral indices defined by the line ratios Sr II ($\lambda 4077$)/Fe I ($\lambda 4063$), and H- δ /Fe I ($\lambda 4063$), may be used to accurately and quickly classify stars by spectral type and luminosity class. By using a 135 Å (FWHM) filter centered at 4150 Å to take 85 Å/mm dispersion objective prism plates using the KPNO Burrell Schmidt telescope, one can minimize the problems of crowding and background sky-fogging normally associated with objective prism spectroscopy, and obtain classification spectra for thousands of stars per plate to $m_v = 13$.

33.14-P

The Dust Sub-disk in the Protoplanetary Nebula

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We present a self-consistent computation of the structure of the dust sub-disk in the protoplanetary nebula. The main physical processes governing the dynamics of the dust disk are reviewed. A (non-linear) vertical diffusion equation for the transport of dust particle is derived. It is based on a competition between sedimentation processes due to gravity and diffusion due to turbulence. The vertical structure of the sub-disk is computed by solving numerically the diffusion equation. The influence of both the particle size and the strength of the turbulence is studied. Large particles are found to settle down towards the midplane in a turbulent diffusive time scale. Small particles are more influenced by the turbulence and remain mixed within the whole gas disk. Simple analytical estimates of the dust height scale are given, and found to agree closely with the exact numerical solutions. The implications of our results on cosmochemistry and structure of the solar nebula are discussed.

33.15-P

Density Waves and Resonant Trapping in the Solar Nebula

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A planetesimal moving within a gaseous solar nebula suffers orbital decay due to gas drag. As a planetesimal spirals in toward a planetary embryo, it encounters a series of outer Lindblad resonances. Resonant perturbations contribute to the planetesimal's orbital energy and angular momentum; if the energy and momentum input due to perturbations compensates for the losses due to gas drag, the planetesimal can be resonantly trapped in a stable, eccentric orbit.

Resonant trapping of objects at an embryo's outer Lindblad resonance has been treated by Weidenschilling and Davis. They suggested, based on the large eccentricities trapped particles achieve, that such planetesimals collide with velocities strong enough to shatter them. Because the gas drag force increases with decreasing particle size, the disruption of planetesimals will ultimately drive them through the resonances. Malhotra (1993, preprint) reaches a similar conclusion, but also argues that planetesimals may escape trapping resonances due to their mutual gravitational scattering. Hence, the current notion is that resonant trapping merely slows down the delivery of mass to an embryo.

However, these single particle treatments of resonant trapping ignore the possible collective gravitational response of the planetesimal disk. Spiral density waves, launched at an embryo's Lindblad resonances, excite the planetesimals' epicyclic motion in a *coherent* fashion. The velocities and eccentricities of particles at resonance may be significantly less than the single particle predictions once the action of density waves are considered. Because of the reduced velocities and eccentricities, as well as the fact that the planetesimal disk responds coherently to perturbations by the embryo, the magnitude of scattering and collisions by planetesimals may be lessened. The consequences of density waves within the planetesimal disk and how they may influence the resonant barrier will be discussed.

33.16-P

The Search for Young Superplanets and the IRTF Pointspread Function.

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In two nights at the IRTF, we used the ProtoCam detector to obtain thousands of L'-band images of six stars looking for possible faint companions at angular separations 1"-3". These stars were taken from our sample of approximately 45 stars selected for possible stellar youth. Due entirely to self-luminosity, a 'superplanet' of mass $\sim 10 M_J$ and younger than a few hundred million years old would appear 6-10 magnitudes fainter than the primary. We have not found any companions to our sample stars, though a couple of our reference targets may have faint companions.

After aligning and coadding our large number of exposures to obtain composite images, we have learned the following about the IRTF L'-band image quality. The FWHMs of the composite image cores are in the range 0.4"-0.5". The encircled energy at 0.5" is 50-65%, and reaches 80% at 0.85"-1.0". Outside 0.5", the azimuthally averaged wing drops off accurately as the inverse cube of the angle, which is a signature of Airy diffraction. When the image is multiplied by the third power of the angle, we observe Airy rings to the edge of the detector.

The individual frames display non-azimuthally symmetric, instrumental features, some of which are static and others variable. From frame to frame on single star, low-order, atmospherically-induced aberrations appear as variable intensity spots on the Airy rings. Large, stable intensity patches are commonly shared by the sample and reference star, but are different for different pairs elsewhere in the sky. These patches appear to be associated with attitude-dependent telescope aberrations. We get quite good cancellation of these instrumental effects; our detection threshold is typically a flux ratio of 10^{-3} at 2.5" separation, and the sensitivity improves on the image wing approximately as the third power of the angle.

The fact that the L'-band image wings are due to Airy diffraction means that the wing intensity can be lowered by Lyot-type apodization. This capability, which is planned for the new NSFCam within the next year, will be a tremendous benefit to the search for young superplanets: both the photon noise and the systematic effects associated with the stellar wing should be strongly suppressed.

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