

Mark Marley (NASA Ames) and Heidi Hammel (AURA)

Characterizing Cold Giant Planets in Reflected Light: Lessons from 50 Years of Outer Solar System Exploration and Observation

A space based coronagraph, whether as part of the WFIRST/AFTA mission or on a dedicated space telescope such as Exo-C or -S, will be able to obtain photometry and spectra of multiple gas giant planets around nearby stars, including many known from radial velocity detections. Such observations will constrain the masses, atmospheric compositions, clouds, and photochemistry of these worlds. Giant planet albedo models, such as those of Cahoy et al. (2010) and Lewis et al. (this meeting), will be crucial for mission planning and interpreting the data. However it is equally important that insights gleaned from decades of solar system imaging and spectroscopy of giant planets be leveraged to optimize both instrument design and data interpretation. To illustrate these points we will draw on examples from solar system observations, by both HST and ground based telescopes, as well as by Voyager, Galileo, and Cassini, to demonstrate the importance clouds, photochemical hazes, and various molecular absorbers play in sculpting the light scattered by solar system giant planets. We will demonstrate how measurements of the relative depths of multiple methane absorption bands of varying strengths have been key to disentangling the competing effects of gas column abundances, variations in cloud height and opacity, and scattering by high altitude photochemical hazes. We will highlight both the successes, such as the accurate remote determination of the atmospheric methane abundance of Jupiter, and a few failures from these types of observations. These lessons provide insights into technical issues facing spacecraft designers, from the selection of the most valuable camera filters to carry to the required capabilities of the flight spectrometer, as well as mission design questions such as choosing the most favorable phase angles for atmospheric characterization.