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Planetary studies with the James Webb Space Telescope

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Invited Talk

JWST provides particular capabilities unmatched by other telescopic facilities that are key to understanding the physical characteristics of cold bodies at the edge of the Solar System. These objects include Pluto and other Kuiper Belt Objects (KBOs), the icy moons of the giant planets, and comets. Recent discoveries of large objects in the Kuiper Belt, along with many smaller members, make it clear that this region represents a major constituent of our Solar System, one that was hidden until recently because it is so remote and challenging to observe. Similarly, a new class of comets that exist as part of the main asteroid belt between Mars and Jupiter was discovered in 2006. The near and mid-IR performance of JWST will be unique in its power to probe these objects and understand their role in the evolution of the Solar System. The observatory will also provide unique sensitivity in the 5-micron region for observing relatively deep into the atmospheres of Uranus and Neptune and searching for minor species. Its observations of Titan will extend beyond the 2017 end of mission for Cassini and potentially provide an important extension to the time-series of meteorological studies into northern hemisphere summer. JWST's strongest contribution to planetary studies, beyond the Kuiper Belt, will be to characterize exoplanet spectra via coronagraphic and transit observations, including superEarths around M-dwarfs.

The James Webb Space Telescope continues the legacy of Hubble Space Telescope in observing solar system objects with the unique wavelength coverage and image quality available to spaceborne observatories. JWST brings much higher sensitivity and wavelength range to observing such targets. The moving target capability to be implemented for the observatory will enable tracking and study of a wide range of interesting solar system objects. JWST also will have capabilities for observing exoplanets that extend beyond what can be done from the Earth, and particularly for M dwarfs will permit characterization of exoplanets down to sizes a few times that of the Earth. In this paper I summarize the types of observations JWST can do, as well as those that are difficult or impossible in our solar system because of target brightness or motion. For extrasolar planets, we only summarize studies that have been reported in more detail elsewhere. The material presented here is derived largely from a workshop conducted at the 40th DPS meeting in Ithaca New York, on October 10, 2008, and a paper in preparation with Heidi Hammel and George Sonneborn of the JWST Science Working Group.