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Ices in Kuiper Belt Object (50000) Quaoar

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The Kuiper Belt is a heavily populated reservoir of icy bodies located beyond Neptune and having scientific relevance to several areas of astrophysics. Included are accretion physics, the origin of the solar system and the formation of the dusty (debris) disks observed encircling many nearby main-sequence stars. The Kuiper Belt is also the likely source of most short-period comets. It is widely thought that Kuiper Belt Objects (KBOs) hold volatiles that have been trapped since accretion. Study of these volatiles might be of value in understanding the initial conditions in the outer parts of the Suns accretion disk.

Unfortunately, most KBOs are astronomically formidable targets, even with the worlds largest telescopes. Object (50000) Quaoar is a large (1200 km diameter) that presents the most favorable opportunities for compositionally diagnostic spectra. We have observed Quaoar in the near infrared using the 8-m diameter Subaru telescope in Hawaii [1]. Water ice is clearly detected, including a band at 1.65 micron wavelength that is diagnostic of crystalline (as opposed to amorphous) structure in the ice. A weak band at 2.2 micron is attributed to ammonia hydrate. These detections are especially interesting in the context of the low surface temperature (50 K) and radiation environment on Quaoar.

In particular, crystalline ice and ammonia hydrate are both unstable to bombardment by energetic particles, implying that they have been recently (within 10 Myr?) emplaced. Possible mechanisms include impact gardening of buried (protected) crystalline, ammoniated ice from subsurface layers and outgassing driven by cryovolcanism. We will discuss the spectra and their consequences and attempt to draw connections to laboratory work that could help us understand our data.

References

[1] D. Jewitt and J. Luu (2004). Nature, 432, 731-733.