Spitzer observations of two mission-accessible, tiny asteroids

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Small asteroids are most likely collisional fragments of larger objects and make up a large fraction of the near-Earth-object (NEO) population. Despite their abundance, little is known about the physical properties of these objects, which is mainly due to their faintness, which also impedes their discovery.

We report on Spitzer Space Telescope observations of two small NEOs, both of which are of interest as potential spacecraft targets. We observed NEOs 2009 BD using 25 hrs and 2011 MD using ∼20 hrs of Spitzer Infrared Array Camera Channel 2 time. For each target, we have combined the data into maps in the moving frame of the target, minimizing the background confusion. We did not detect 2009 BD and place an upper limit on its flux density, but we detected 2011 MD as a 2.2σ detection. We have analyzed the data on both objects in a combined model approach, using an asteroid thermophysical model and a model of non-gravitational forces acting on the object. As a result, we are able to constrain the physical properties of both objects.

In the case of 2009 BD (Mommert et al. 2014), a wealth of existing astrometry data significantly constrains the physical properties of the object. We find two physically possible solutions. The first solution shows 2009 BD as a 2.9 ± 0.3 m-sized massive rock body (bulk density $\rho = 2.9 \pm 0.5$ g cm^{-3}) with an extremely high albedo of $0.85^{+0.20}_{-0.10}$ that is covered with regolith-like material, causing it to exhibit a low thermal inertia (thermal inertia $\Gamma = 30^{+20}_{-10}$ SI units). The second solution suggests 2009 BD to be a 4 ± 1 m-sized asteroid with $p_{\rm V} = 0.45^{+0.35}_{-0.15}$ that consists of a collection of individual bare rock slabs ($\Gamma = 2000 \pm 1000$ SI units, $\rho = 1.7^{+0.7}_{-0.4}$ g cm^{-3}). We are unable to rule out either solution based on physical reasoning.

The preliminary analysis of 2011 MD shows this object as a ∼6 m-sized asteroid with an albedo of ∼0.3. Additional constraints on the physical properties of these objects will be available at the time of the conference (Mommert et al., in preparation).

2009 BD and 2011 MD are the smallest asteroids for which physical properties have been constrained, providing unique insights into a population of asteroids that gives rise to frequent impacts on the Earth and the Moon. Furthermore, both asteroids are among the most easily accessible objects in space.

References: Mommert, Hora, Farnocchia et al. 2014, accepted by ApJ.