EPSC Abstracts
Vol. 6, EPSC-DPS2011-1124, 2011
EPSC-DPS Joint Meeting 2011

Sedna, Eris and Quaoar: physical properties of prominent trans-Neptunian objects, based on Herschel observations

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Abstract

The family of Trans-Neptunian objects (TNOs) may represent the most ancient form of the material from which the entire Solar System has been formed. Thus, studying both the physical and dynamical properties of these objects helps us to better understand the origin and evolution of the Solar System and we might be able to extrapolate our conclusions to other stellar, disk and planetary systems as well. Due to the enormous distance of these objects, it is not obvious to obtain even their basic physical properties. Complex and combined methods are required to derive these properties, including diameter, albedo, mass, rotational period, shape elongation and other surface parameters. Techniques obtaining these data include optical photometry, direct imaging, detection of companions, differential astrometry and detecting thermal emission.

The Herschel Space Observatory provides a unique opportunity to detect thermal radiation from TNOs at the mJy level. In this work we present recent thermal measurements using the PACS instrument ([1]) of the prominent objects Sedna, Eris and Quaoar, observed in the framework of the "TNOs are Cool!" Open Time Key Program ([2],[3]).

(90377) Sedna is a detached object, known for to be the one with the largest semimajor axis and therefore its largest orbital period. Here we present the first direct measurements for this object in the thermal regime that yield a direct estimation for the diameter and the albedo as well.

(136199) Eris, a scattered disk object is the most massive known dwarf planet and currently the most distant observable body from the class of TNOs. Previous diameter estimations based only on marginal far-infrared detections which have shown this object might have larger diameter than Pluto. Our recent PACS measurements confirms these previous results with clear detections in the shorter PACS passbands and therefore now more reliable and independent diameter estimations are available for this object.

(50000) Quaoar, a classical TNO of which current estimations for its density places it among one of the most interesting objects, namely it is assumed to have a density comparable with rocky planets. Our high signal-to-noise detections of thermal radiation of Quaoar (see also Fig.1) and the interpretation of these far-infrared data clearly show that the density of Quaoar has previously been overestimated; however, it is still among the most dense TNOs.

In our presentation, we discuss these findings and results in more details.

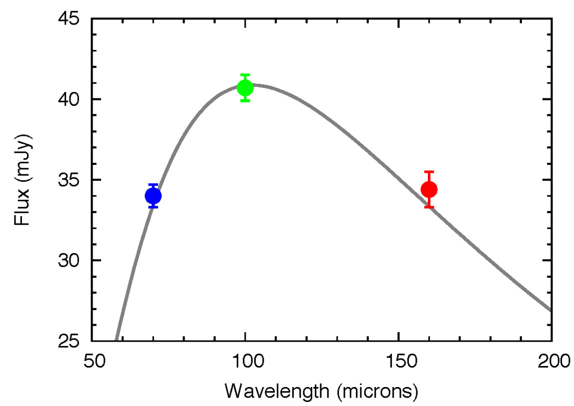

Figure 1: PACS photometry and the best-fit surface model for the classical TNO Quaoar. The blue, green and red dots refer to the measurements using the $70\,\mu$m, $100\,\mu$m and $160\,\mu$m passbands of the instrument, respectively.

References

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