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TNOs are Cool: A Survey of the Transneptunian Region with Herschel Space Observatory

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Observing programme "TNOs are Cool"

More than one thousand Transneptunian objects (TNO) have been discovered so far. TNOs are remnants of the planetesimal disk; the size distribution of large TNOs is assumed to have remained unchanged although the surface material of TNOs has changed its composition over time due to collisions and space weathering.

About 400 hours of observing time have been granted to the *Herschel* Open Time Key Programme 'TNOs are Cool: A survey of the Transneptunian region' [1]. In this programme we are using photometric observing modes of the PACS [2] and SPIRE [3] instruments to obtain the fluxes of 139 objects representing different dynamical classes (resonant, classical, scattered disk and detached TNOs as well as Centaurs); almost half of the known binary TNOs are included in this sample. The four prime scientific goals of this programme are: (i) to determine sizes and albedos, (ii) to measure the density of binary TNOs, (iii) to constrain surface properties, and (iv) to determine light curves of selected objects by continuously observing them throughout an entire rotational period.

The fluxes of TNOs, with temperatures in the range 20 - 50 K, have their maxima in the PACS wavelength range. Thermal and thermophysical models (mainly NEATM [4] and TPM [5]) provide sizes and albedos and also give information on surface properties like thermal inertia. The whole sample will be observed in the three PACS channels (55 to 210 μm) while only the brightest ones (> 10 mJy) are detectable in the three SPIRE channels (194 to 672 μm). Each target is observed on two visits; a follow-on observation is made after the target has moved to a different sky background position. The final processed PACS image maps have pixel sizes of 1"-2" with a useful area for photometry of 50" in diameter; the corresponding values for SPIRE are 6"-14" with a diameter of 5'.

The absolute magnitude at visible wavelengths (the H value) is required as an additional input to the thermal models; H values are obtained from supporting ground-based observations.

Results

By the end of 2010 we have observed 82 targets with *Herschel*. Preliminary results of the Science Demonstration Phase have been published in [6], [7], and [8], which included Makemake, Orcus, Typhon, the far-IR lightcurve of Haumea, and six other TNOs. The target sizes of the sample analysed so far range from below 100 km to nearly 1000 km. The albedos of these objects were typically below 10%, except for classicals and SDOs, whose albedo distributions have a maximum in the range 10-50%. The light curve of Haumea at 100 μm shows a factor of 2 amplitude and positive correlation with the optical light curve [7]. We will present updated results based on about 110 TNOs in total, being the number we anticipate having observed by April. The results of a sub-sample of Plutinos will be presented by M. Mommert [EGU2011-9920], and a sub-sample of Scattered Disk Objects by P. Santos-Sanz [EGU2011-10243].

Outlook

Our final tally of 139 objects will include 25 binary TNOs as well as the light curves of Varuna, Haumea, 2003 VS2, and 2003 AZ84 over one rotational period. Our results are expected to provide a benchmark for understanding the solar system debris disk.

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