Herschel Open Time Key Programme: TNOs are Cool: A Survey of the Transneptunian Region

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Over one thousand objects have been discovered orbiting beyond Neptune. These trans-Neptunian objects (TNOs) represent the primitive remnants of the planetesimal disk from which the outer planets formed, and is an analog for unseen dust parent-bodies in debris disks observed around other main-sequence stars. The dynamical and physical properties of these bodies provide unique and important constraints on formation and evolution models of the outer Solar System. While the dynamical architecture in this region (also known as the Kuiper Belt) is becoming relatively clear, the physical properties of the objects are only beginning to be revealed. In particular, fundamental parameters such as size, albedo, density and thermal properties are difficult to measure. Measurements of their thermal emission, which peaks at far-IR wavelengths, offer the best means available to determine those physical properties. While Spitzer has provided the first results, notably revealing a large albedo diversity in this population, the increased sensitivity of Herschel and its wavelength coverage will permit profound advances in the field.

Within our accepted project we propose to perform radiometric measurements of 139 objects, including 25 known multiple systems. This large sample will permit:

(i) A determination of the size distribution of the large (> 200 km) objects, thought to have remained unchanged from the accretion phase.

(ii) Systematic searches for correlations between size, albedo, and other physical and orbital parameters, diagnostic of formation and evolution processes.

(iii) Determination of mass-density for at least 20 binary TNOs, diagnostic of nebular chemistry and interior structure.

(iv) The first study of their thermophysical properties, including thermal inertia and surface emissivity.

When combined with measurements of the dust population beyond Neptune (e.g. from the New Horizons mission to Pluto), our results will provide a benchmark for understanding the Solar debris disk, and extra-solar ones as well.

Herschel will be the largest space telescope of its kind when launched (early 2009). Herschel's 3.5-metre diameter mirror will collect long-wavelength infrared radiation from some of the coolest and most distant objects in the Universe. Herschel will be the only space observatory to cover the spectral range from far-infrared to sub-millimetre wavelengths. Herschel's Photodetector Array Camera and Spectrometer (PACS) and its Spectral and Photometric Imaging Receiver (SPIRE) are perfectly suited for the characterisation of trans-Neptunian objects (TNOs), the observable targets of our own debris disk.