EPSC Abstracts
Vol. 7 EPSC2012-587 2012
European Planetary Science Congress 2012

TNOs are Cool: A sample of 18 Centaurs observed with the Herschel Space Observatory

R. Duffard (1), E. Vilenius (2), N. Pinilla-Alonso (1), Th. Müller (2), J.L. Ortiz (1), S. Fornasier (3), M. Mommert (4), P. Santos-Sanz (3), A. Pal (5), C. Kiss (5), M. Mueller (6), J. Stansberry (7), E. Lellouch (3), A. Delsanti (8).
(1) Instituto de Astrofisica de Andalucia - CSIC, Granada, Spain. (duffard@iaa.es)
(2) Max-Planck-Institut für extraterrestrische Physik, Giessenbachstr., 85748 Garching, Germany
(3) LESIA-Observatoire de Paris, CNRS, UPMC Univ. Paris 6, Univ. Paris-Diderot, 5 place J. Janssen, 92195 Meudon Cedex, France
(4) DLR Institute of Planetary Research, Berlin, Germany.
(5) Konkoly Observatory, Hungary.
(6) SRON, Netherlands Institute for Space Research, Low Energy Astrophysics, Groningen, Netherlands
(7) University of Arizona, Steward Observatory, USA.
(8) Observatoire de Marseille, France.

Abstract

We observed a sample of 18 Centaurs with the PACS instrument on-board Herschel Space Observatory. The observations cover the wavelength range where the thermal emission from trans-Neptunian objects has its maximum. After reduction, background cleaning, and flux extraction we determined the sizes and albedos for all the members of the sample using thermophysical models. In this work we will present new results on sizes and albedos and possible correlations with physical and dynamical parameters like colors, spectral slopes, semimajor axis, eccentricities, orbital inclinations, etc.

1 Introduction

Centaurs are a dynamical class of small bodies in our Solar System with orbits in the region between Jupiter and Neptune and crossing the orbits of one or more of the giant planets. They are a transient population between TNOs (trans-Neptunian objects a.k.a. Edgeworth-Kuiper belt objects) and Jupiter family comets. The first Centaur was discovered in 1977 [1] and named Chiron (son of Kronos and grandson of Uranus). It was the first minor planet (Pluto was listed as a planet) with a perihelion distance far beyond Jupiter's orbit. One quarter of the known Centaurs have been discovered only within the last two years, increasing their number to >100. There is no general consensus upon the definition of a Centaur. Here we use the Minor Planet Center definition that the semimajor axis a of a Centaur is less than that of Neptune's ($a < a_N$ = 30.1 AU) and the perihelion distance q is greater than the semimajor axis of Jupiter ($q > a_J$ = 5.2 AU).

The surface properties of Centaurs and TNOs are different because of a variety of factors including dynamical evolution and physical characteristics (e.g. size). Processes altering the surfaces include collisions (especially for bodies <=100 km), cometary activity and space weathering. Many Centaurs seem to have heterogeneous compositions. This can be explained as the result of replenishment of the surface with fresh material from the interior of the body after collisions and/or cometary activity [2] . Due to the changing orbits some Centaurs may have been closer to the Sun and therefore been more active before, even if they are currently inactive [5] . About 10% of Centaurs show comet-like activity even though they are far away from the Sun, which cannot be explained by direct water ice sublimation alone [7].

2. Observations

Our 18 targets are the Centaurs subsample of the open time key programme "TNOs are Cool" [3] for which we have three-band photometric observations with *Herschel* / PACS [4] instrument. We used the mini-scan map mode for point-sources, and observed all three bands (reference wavelengths 70.0, 100.0 and 160.0 μm) with a scan and a cross-scan. We used the follow-on strategy: the observations were repeated after the target had moved by a distance of 25″ to 50″. This allows us to reduce the sky background including background sources and confusion noise, which would otherwise lower the signal-to-noise ratio in the

100 and 160 μm bands. The follow-on strategy is very useful especially at the two longer wavelength channels (100.0 and 160.0 μm).

3 Modelling

In Table 1 we present the list of object observed using PACS at the Herschel Space Telescope. The Centaurs Chiron and Chariklo were also observed with SPIRE at the HSO. In order to derive diameters and albedos from thermal-IR observations a thermal model is used. This requires assumptions on the temperature distribution on the surface and the emissivity. We use the NEATM [6] with a fitted beaming parameter η. Definitive results on diameters and albedo will be presented and also the correlation with physical and dynamical parameters. In order to determine both the diameter and the geometric albedo we need data from both the far-infrared and optical wavelengths. This requires the knowledge of the latest H-magnitudes and light curves observed by ground based supporting programs.

Table 1: Target list with orbital parameters inclination, eccentricity and semimajor axis from Minor Planet Center (http://www.minorplanetcenter.net/iau/lists/Centaurs.html, accessed May 2012).

Target	*i* [deg]	*e*	*a* [AU]
2060 Chiron	6.9	0.379	13.670
5145 Pholus	24.7	0.573	20.283
8405 Asbolus	17.6	0.620	18.100
10199 Chariklo	23.4	0.170	15.735
10370 Hylonome	4.1	0.245	24.962
32532 Thereus	20.3	0.196	10.670
52872 Okyrhoe	15.7	0.306	8.337
54598 Bienor	20.7	0.201	16.564
55576 Amycus	13.3	0.392	24.951
60558 Echeclus	4.3	0.457	10.712
95626 2002 GZ32	15.0	0.217	22.993
120061 2003 CO1	19.8	0.472	20.676
136204 2003 WL7	11.2	0.262	20.265
145486 2005 UJ438	3.8	0.533	17.698
248835 2006 SX368	36.3	0.462	22.252
250112 2002 KY14	19.5	0.316	12.620
281371 2008 FC76	27.1	0.312	14.786
2005 RO43	35.4	0.520	29.005

4 Summary

We will present fluxes, albedo and size estimations of a collection of Centaurs observed with Herschel. We will put our results in context comparing with previous estimations obtained with other telescopes and with the estimations obtained for other populations of minor icy objects related with Centaurs. Some of the Centaurs from our sample were observed also by Spitzer and/or WISE, and those data will be taken into account for the modeling.

Acknowledgements

Herschel is an ESA space observatory with science instruments provided by European-led Principal Investigator consortia and with important participation from NASA.

Part of this work was supported by the German *Deutsches Zentrum für Luft- und Raumfahrt*, DLR project numbers 50 OR 0904 and 50 OR 1108.

References

[1] Kowal 1979, IAU Dyn. Sol. Sys., 245-250

[2] Barucci, A., Alvarez-Candal, A., Merlin, F., et al. 2011, Icarus, 214, 297-307

[3] Müller, T.G., Lellouch, E., Böhnhardt, H. et al.: "TNOs are Cool": A Survey of the Transneptunian Region, Earth, Moon and Planets, 105, 209-219, 2009.

[4] Poglitsch, A., Waelkens, C., Geis, N. et al.: The Photodetector Array Camera and Spectrometer (PACS) on the Herschel Space Observatory, A&A, 518, L2, 2010.

[5] Melita, M. and Licandro J. Links between the dynamical evolution and the surface color of the Centaurs. A&A, Volume 539, id.A144. 2012.

[6] Harris, A.W.: A Thermal Model for Near-Earth Asteroids, Icarus, 131, pp. 291, 1998.

[7] Meech and Svoren 2005, Comets II, Univ. Arizona Press