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DISTANT EKOs

The Kuiper Belt Electronic Newsletter

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CONTENTS

NEWS & ANNOUNCEMENTS

There were 5 new TNO discoveries announced since the previous issue of *Distant EKOs*:

2011 HL103, 2011 KW48, 2012 VR113, 2013 QO95, 2013 QP95

and 4 new Centaur/SDO discoveries:

2011 JD32, 2012 VS113, 2013 TV158, 2014 OG392

Reclassified objects:

2013 LU28 (Centaur → SDO)

Deleted/Re-identified objects:

2014 LJ9 = 2013 LU28

Current number of TNOs: 1277 (including Pluto)
Current number of Centaurs/SDOs: 401
Current number of Neptune Trojans: 9

Out of a total of 1687 objects:

646 have measurements from only one opposition

629 of those have had no measurements for more than a year

326 of those have arcs shorter than 10 days

(for more details, see: `http://www.boulder.swri.edu/ekonews/objects/recov_stats.jpg`)

PAPERS ACCEPTED TO JOURNALS

Photometric and Spectroscopic Evidence for a Dense Ring System around Centaur Chariklo

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Context. A stellar occultation observed on 3rd June 2013 revealed the presence of two dense and narrow rings separated by a small gap around the Centaur object (10199) Chariklo. The composition of these rings is not known. We suspect that water ice is present in the rings, as is the case for Saturn and other rings around the giant planets.

Aims. In this work, we aim to determine if the variability in the absolute magnitude of Chariklo and the temporal variation of the spectral ice feature, even when it disappeared in 2007, can be explained by an icy ring system whose aspect angle changes with time.

Methods. We explained the variations on the absolute magnitude of Chariklo and its ring by modeling the light reflected by a system as the one described above. Using X-Shooter at VLT, we obtained a new reflectance spectra. We compared this new set of data with the ones available in the literature. We showed how the water ice feature is visible in 2013 in accordance with the ring configuration, which had an opening angle of nearly 34° in 2013. Finally, we also used models of light scattering to fit the visible and near-infrared spectra that shows different characteristics to obtain information on the composition of Chariklo and its rings.

Results. We showed that absolute photometry of Chariklo from the literature and new photometric data that we obtained in 2013 can be explained by a ring of particles whose opening angle changes as a function of time. We used the two possible pole solutions for the ring system and found that only one of them, α=151.30±0.5, $\delta = 41.48 \pm 0.2$ ° ($\lambda = 137.9 \pm 0.5$, $\beta = 27.7 \pm 0.2$ °), provides the right variation of the aspect angle with time to explain the photometry, whereas the other possible pole solution fails to explain the photometry. From spectral modeling, we derived the composition of the Chariklo surface and that of the rings using the result on the pole solution. Chariklo surface is composed with about 60% of amorphous carbon, 30% of silicates and 10% of organics; no water ice was found on the surface. The ring, on the other hand, contains 20% of water ice, 40-70% of silicates, and 10-30% of tholins and small quantities of amorphous carbon.

Published in: Astronomy & Astrophysics, 568, A79 (2014 August)

For preprints, contact `duffard@iaa.es`

or on the web at `http://arxiv.org/abs/1407.4599`

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The Centaur 10199 Chariklo: Investigation into Rotational Period, Absolute Magnitude, and Cometary Activity

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Context. Rings have recently been discovered around the Centaur 10199 Chariklo.

Aims. In this paper we present new photometric data, obtained at the 4.2m SOAR telescope, aiming to investigate Chariklo's absolute magnitude and rotational period, which is still unknown, and to look for potential cometary activity.

Method. The field background of the images was very crowded so several approaches were used for the extraction of Chariklo fluxes. The background sources were subtracted using difference image analysis and then aperture photometry was applied. A Fourier polynomial fit was used to determine the period.

Results. We find a synodic rotation period of 7.004±0.036 h. The visual absolute magnitude derived from the SOAR data is H_v= 7.03±0.10. We model the rings' contribution to the flux, and find that the derived H_v is consistent with the predicted ring system aspect angle. We also revised the Chariklo system albedo (4.2%) and effective radius (119±5 km) from a re-analysis of HERSCHEL and WISE thermal data obtained during 2010 with the correct H_v value. No coma is detected from the SOAR data, nor in previous VLT images acquired in 2007-2008, where the rings' aspect angle was close to zero. The upper limit to the dust production rate is 2.5 kg/s.

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Available on the web at `http://dx.doi.org/10.1051/0004-6361/201424439`

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Rotational Properties of the Binary and Non-binary Populations in the Trans-Neptunian Belt

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We present results for the short-term variability of Binary Trans-Neptunian Objects (BTNOs). We performed CCD photometric observations using the 3.58 m Telescopio Nazionale Galileo (TNG), the 1.5 m Sierra Nevada Observatory (OSN) telescope, and the 1.23 m Centro Astronómico Hispano Alemán (CAHA) telescope at Calar Alto Observatory. We present results based on five years of observations and report the short-term variability of six BTNOs. Our sample contains three classical objects: (174567) 2003 MW_{12}, or Varda, (120347) 2004 SB_{60}, or Salacia, and 2002 VT_{130}; one detached disk object: (229762) 2007 UK_{126}; and two resonant objects: (341520) 2007 TY_{430} and (38628) 2000 EB_{173}, or Huya. For each target, possible rotational periods and/or photometric amplitudes are reported. We also derived some physical properties from their lightcurves, such as density,

primary and secondary sizes, and albedo. We compiled and analyzed a vast lightcurve database for Trans-Neptunian Objects (TNOs) including centaurs to determine the lightcurve amplitude and spin frequency distributions for the binary and non-binary populations. The mean rotational periods, from the Maxwellian fits to the frequency distributions, are 8.63±0.52 h for the entire sample, 8.37±0.58 h for the sample without the binary population, and 10.11±1.19 h for the binary population alone. Because the centaurs are collisionally more evolved, their rotational periods might not be so primordial. We computed a mean rotational period, from the Maxwellian fit, of 8.86±0.58 h for the sample without the centaur population, and of 8.64±0.67 h considering a sample without the binary and the centaur populations. According to this analysis, regular TNOs spin faster than binaries, which is compatible with the tidal interaction of the binaries.

Finally, we examined possible formation models for several systems studied in this work and by our team in previous papers.

To appear in: Astronomy and Astrophysics
For preprints, contact thirouin@iaa.es
or on the web at http://arxiv.org/abs/1407.1214

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"TNOs Are Cool": A Survey of the Transneptunian Region. XII. The Albedo-Color Diversity of Transneptunian Objects

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We analyze albedo data obtained using the Herschel Space Observatory that reveal the existence of two distinct types of surface among midsized transneptunian objects. A color-albedo diagram shows two large clusters of objects, one redder and higher albedo and another darker and more neutrally colored. Crucially, all objects located in dynamically stable orbits within the classical Kuiper belt region and beyond are confined to the brighter and redder of the two groups, implying a compositional link. Those objects are believed to have formed further from the Sun than the dark-neutral bodies. This color-albedo separation is evidence for a compositional discontinuity in the young solar system.

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For preprints, contact lacerda@mps.mpg.de or lacerda.pedro@gmail.com
or on the web at http://arxiv.org/abs/1406.1420

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Pluto: Improved Astrometry from 19 Years of Observations

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Context. We present astrometric positions of Pluto, consistent with the International Celestial Reference System, from 4412 CCD frames observed over 120 nights with three telescopes at the Observatório do Pico dos Dias in Brazil, covering a time span from 1995 to 2013, and also 145 frames observed over 11 nights in 2007 and 2009 with the ESO/MPG 2.2m telescope equipped with the Wide Field Imager (WFI).

Aims. Our aim is to contribute to the study and improvement of the orbit of Pluto with new astrometric methods and positions.

Methods. All astrometric positions of Pluto were reduced with the Platform for Reduction of Astronomical Images Automatically (PRAIA), using the USNO CCD Astrograph Catalogue 4 (UCAC4) as the reference catalogue. Modern planetary ephemeris was used for comparisons. The positions were corrected for differential chromatic refraction. The (x,y) center of Pluto was determined from corrections to the measured photocenter, which was contaminated by Charon. The corrections were obtained with an original procedure based on analytical expressions derived from a two-dimensional Gaussian function - the point spread function (PSF) fitted to the images to derive the (x,y) measurements.

Results. We obtained mean values of 4 mas and 37 mas for right ascension and declination, and standard deviations of $\sigma_\alpha = 45$ mas and $\sigma_\delta = 49$ mas, for the offsets in the sense observed minus ephemeris position, after the corrections. The astrometric positions of Pluto for 19 years of observations in Brazil, corrected for the differential chromatic refraction and for the Pluto/Charon photocenter effects, highlights a drift in declination of about 100 mas since 2005 when compared to DE421. This drift is the coherent with that when DE421 is compared to stellar occultation data and is no longer noticed when our positions are compared to more recent ephemerides. The results indicate that the DE421 Pluto ephemeris used in this work need to be corrected.

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The *Distant EKOs* Newsletter is dedicated to provide researchers with easy and rapid access to current work regarding the Kuiper belt (observational and theoretical studies), directly related objects (e.g., Pluto, Centaurs), and other areas of study when explicitly applied to the Kuiper belt.

We accept submissions for the following sections:
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⋆ Titles of submitted (but not yet accepted) papers and conference articles
⋆ Thesis abstracts
⋆ Short articles, announcements, or editorials
⋆ Status reports of on-going programs
⋆ Requests for collaboration or observing coordination
⋆ Table of contents/outlines of books
⋆ Announcements for conferences
⋆ Job advertisements
⋆ General news items deemed of interest to the Kuiper belt community

A LaTeX template for submissions is appended to each issue of the newsletter, and is sent out regularly to the e-mail distribution list. Please use that template, and send your submission to:

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