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DISTANT EKOs

The Kuiper Belt Electronic Newsletter

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CONTENTS

NEWS & ANNOUNCEMENTS

There were 4 new TNO discoveries announced since the previous issue of *Distant EKOs*:

2003 SR422, 2003 WN193, 2003 WO193, 2006 TK121

3 new Centaur/SDO discoveries:

2003 SS422, 2003 UC414, 2004 VN112

and 1 new potential Neptune Trojan discovery:

2007 RW10

Objects recently assigned names:
1999 RZ253 = Borasisi

Current number of TNOs: 1067 (including Pluto)
Current number of Centaurs/SDOs: 208
Current number of Neptune Trojans: 6

Out of a total of 1281 objects:
548 have measurements from only one opposition
531 of those have had no measurements for more than a year
278 of those have arcs shorter than 10 days
(for more details, see: `http://www.boulder.swri.edu/ekonews/objects/recov_stats.gif`)

PAPERS ACCEPTED TO JOURNALS

Deep Search for Carbon Monoxide in Cometary Precursors Using Millimeter Wave Spectroscopy

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Carbon monoxide is abundant in comets and is volatile throughout most of the planetary region of the Solar system, raising the possibility that it might be detectable in the cometary precursor classes known as the Centaurs and the Kuiper belt objects. In this paper we present a search for carbon monoxide in Centaurs and Kuiper belt objects focussed on the J=2-1 rotational transition at 230 GHz. No CO emission is detected. We use upper limits from the radio spectra to infer that the surfaces of these objects are strongly depleted in supervolatile ices: CO can cover no more than 0.1–1 percent of the surface area. Two possibilities for the survival of sub-surface CO ice are considered. First, bulk CO ice could survive undetected at depths much greater than the annual thermal skin depth. Inward drift of the perihelion distance would allow heat conducted from the surface to reach the CO ice, driving outgassing through short-lived vents at rates generally too small to be detected. Second, CO might be physically trapped within a porous, amorphous ice matrix and released where the local temperatures are sufficient to promote the transformation of amorphous into crystalline ice. In either case, the non-detections in our data would reflect the large perihelia and low temperatures of the sampled objects but would not set useful constraints on the interior abundances of CO or other supervolatiles.

To appear in: Astronomical Journal

Preprints on the web at `http://www.ifa.hawaii.edu/faculty/jewitt/papers/2007/JGA07.pdf`

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Detection of Methane on Kuiper Belt Object (50000) Quaoar

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The near-infrared spectrum of (50000) Quaoar obtained at the Keck Observatory shows distinct absorption features of crystalline water ice, solid methane and ethane, and possibly other higher order hydrocarbons. Quaoar is only the fifth Kuiper belt object on which volatile ices have been detected. The small amount of methane on an otherwise water ice dominated surface suggests that Quaoar is a transition object between the dominant volatile-poor small Kuiper belt objects (KBOs) and the few volatile-rich large KBOs such as Pluto and Eris.

Published in: Astrophysical Journal Letters, 670, L49 (2007 November 20)

Preprints available at `http://arxiv.org/abs/0710.3591`

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A Search for Rotational Variations on Trans-Neptunian Objects

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Aims. Our aim is to investigate the surface composition of TNOs. In particular we would like to confirm diverse spectral absorption features and to search for rotational inhomogeneities on one scattered disk object (26375) 1999 DE_9, two plutinos (38628) Huya and (47932) 2000 GN_{171}, and one centaur (83982) Crantor.

Methods. We observed the targets with a new instrument available at the VLT, the near-infrared integral field spectrograph SINFONI. We obtained complete near-infrared spectra between 1.4 and 2.4 μm and compared them with data recorded previously by various groups.

Results. Two objects, (38628) Huya and (83982) Crantor, have evidence of an absorption feature in their spectra at 2.0 μm, probably associated with water ice. (83982) Crantor shows a feature at 2.3 μm which could be associated with methanol. On the other hand, no features were found for (26375) 1999 DE_9 and (47932) 2000 GN_{171} above the signal-to-noise ratio. Possible rotational heterogeneity can be seen on two objects: (38628) Huya as the 2.0 μm band is present on some spectra and absent on others, while (47932) 2000 GN_{171} shows a flat reflectance in contrast to an absorption in the H region previously seen.

Published in: Astronomy & Astrophysics, 475, 369 (2007 November)
For preprints, contact `alvaro.alvarez@obspm.fr`

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The Meudon Multicolor Survey (2MS) of Centaurs and Trans-Neptunian Objects: From Visible to Infrared Colors

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We present the latest results of the Meudon Multicolor Survey. This survey is aimed at characterizing the color properties and trends of Centaurs and trans-Neptunian objects. We report $IJHK$ photometry of objects obtained with CFHT-IR at the 3.6 m Canada-France-Hawaii Telescope (Hawaii), JHK photometry with INGRID at the 4.2 m William Hershel Telescope (La Palma), and $BVRI$ photometry with OIG at the 3.6 m Telescopio Nazionale Galileo Telescope (La Palma). We present visible-near-IR colors for 38 objects. Either these were acquired simultaneously, or the new near-IR photometry was tied to previously published visible measurements using the I magnitude measured in both sets. This large sample allows an extended characterization of the color properties of these primitive objects over the B (0.4 μm) to K (2.2 μm) wavelength range. We performed a detailed statistical analysis of all available IR colors in order to search for significant trends. The most relevant conclusion about visible and near-IR color-color correlations is that, basically, JHK bands alone do not show evidence of correlations, either between them or with $BVRIJ$ bands. Only

Centaurs show an anticorrelation between visible colors and $H - K$. Colors within each dynamical family compare very similarly.

To appear in: The Astronomical Journal, 134, 2186 (2007 December)
For preprints, contact alain.doressoundiram@obspm.fr

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Evidence for Two Populations of Classical Transneptunian Objects: The Strong Inclination Dependence of Classical Binaries

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We have searched 101 Classical transneptunian objects for companions with the Hubble Space Telescope. Of these, at least 21 are binary. The heliocentric inclinations of the objects we observed range from 0.6–34°. We find a very strong anticorrelation of binaries with inclination. Of the 58 targets that have inclinations of less than 5.5°, 17 are binary, a binary fraction of $29\pm^{7}_{6}\%$. All 17 are similar-brightness systems. On the contrary, only 4 of the 42 objects with inclinations greater than 5.5° have satellites and only 1 of these is a similar-brightness binary. This striking dichotomy appears to agree with other indications that the low eccentricity, non-resonant Classical transneptunian objects include two overlapping populations with significantly different physical properties and dynamical histories.

To appear in: Icarus
Preprints on the web at http://arxiv.org/abs/0711.1545

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Formation of Kuiper Belt Binaries

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The discovery that a substantial fraction of Kuiper Belt objects (KBOs) exists in binaries with wide separations and roughly equal masses, has motivated a variety of new theories explaining their formation. Goldreich et al. (2002) proposed two formation scenarios: In the first, a transient binary is formed, which becomes bound with the aid of dynamical friction from the sea of small bodies (L^2s mechanism); in the second, a binary is formed by three body gravitational deflection (L^3 mechanism). Here, we accurately calculate the L^2s and L^3 formation rates for sub-Hill velocities. While the L^2s formation rate is close to previous order of magnitude estimates, the L^3 formation rate is about a factor of 4 smaller. For sub-Hill KBO velocities ($v \ll v_H$) the ratio of the L^3 to the L^2s formation rate is $0.05(v/v_H)$ independent of the small bodies' velocity dispersion, their surface density or their mutual collisions. For Super-Hill velocities ($v \gg v_H$) the L^3 mechanism dominates over the L^2s mechanism. Binary formation via the L^3 mechanism competes with binary destruction by passing bodies. Given sufficient time, a statistical equilibrium abundance of binaries forms.

We show that the frequency of long-lived transient binaries drops exponentially with the system's lifetime and that such transient binaries are not important for binary formation via the L^3 mechanism, contrary to Lee et al. (2007). For the L^2s mechanism we find that the typical time, transient binaries must last, to form Kuiper Belt binaries (KBBs) for a given strength of dynamical friction, D, increases only logarithmically with D. Longevity of transient binaries (with lifetimes $\geq 15\Omega^{-1}$ as suggested by Astakhov et al. (2005)) only becomes important for very weak dynamical friction (i.e. $D \lesssim 0.002$) and is most likely not crucial for KBB formation.

To appear in: The Astrophysical Journal
For preprints, contact hes@astro.caltech.edu
or on the web at http://arxiv.org/abs/0709.3107

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A Stability Study of Kuiper Belt Binaries

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The dynamical structure of the orbital element space of seven Kuiper Belt binary systems is studied by numerical methods in the model of the spatial elliptic restricted three-body problem. It is shown that three systems have an extended region of stability where additional satellites could exist.

Published in: Astronomische Nachrichten, 328, 797 (2007 October)
For preprints, contact i.nagy@astro.elte.hu

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Detectability of Occultations of Stars by Objects in the Kuiper Belt and Oort Cloud

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The serendipitous detection of stellar occultations by outer solar system objects is a powerful method for ascertaining the small end ($r \lesssim 15$ km) of the size distribution of Kuiper Belt objects and may potentially allow the exploration of objects as far out as the Oort Cloud. The design and implementation of an occultation survey is aided by a detailed understanding of how diffraction and observational parameters affect the detection of occultation events. In this study, stellar occultations are simulated, accounting for diffraction effects, finite source sizes, finite bandwidths, stellar spectra, sampling, and signal-to-noise ratios. Finally, the possibility of detecting small outer solar system objects from the Kuiper Belt all the way out to the Oort Cloud is explored for three photometric systems: a proposed space telescope, Whipple, the Taiwanese-American Occultation Survey, and the MMT.

Published in: The Astronomical Journal, 134, 1596 (2007 October)
Preprints available at http://arxiv.org/abs/astro-ph/0703460

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What Can the Cosmic Microwave Background Tell Us about the Outer Solar System?

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[2] California Institute of Technology, Theoretical Astrophysics, MC 130-33, Pasadena, CA 91125, USA

We discuss two new observational techniques that use observations of the cosmic microwave background (CMB) to place constraints on the mass, distance, and size distribution of small objects in the Kuiper Belt and inner Oort Cloud, collectively known as trans-Neptunian objects (TNOs). The first new technique considers the spectral distortion of the isotropic, or monopole, CMB by TNOs that have been heated by solar radiation to temperatures above that of the CMB. We apply this technique to the spectral measurements of the CMB by the Far Infrared Absolute Spectrophotometer on the *Cosmic Background Explorer*. The second technique utilizes the change in amplitude of the TNO signal due to the orbital motion of the observer to separate the TNO signal from the invariant extragalactic CMB and construct a map of the mass distribution in the outer solar system. We estimate the ability of future CMB experiments to create such a map.

Published in: The Astrophysical Journal, 669, 1406 (2007 November 10)
For preprints, contact `dbabich@cfa.harvard.edu`
or on the web at `http://arxiv.org/abs/0705.0986`

PAPERS RECENTLY SUBMITTED TO JOURNALS

A series of papers about the New Horizons mission to Pluto and the Kuiper belt were submitted to Space Science Reviews and recently posted on the arXiv preprint server:

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The New Horizons Pluto Kuiper Belt Mission: An Overview with Historical Context

S.A. Stern

Available at: `http://arxiv.org/abs/0709.4417`

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The New Horizons Spacecraft

G.H. Fountain, et al.

Available at: `http://arxiv.org/abs/0709.4288`

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Overview of the New Horizons Science Payload

H.A. Weaver, et al.

Available at: `http://arxiv.org/abs/0709.4261`

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Alice: The Ultraviolet Imaging Spectrograph aboard the New Horizons Pluto-Kuiper Belt Mission

S.A. Stern, et al.

Available at: `http://arxiv.org/abs/0709.4279`

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Ralph: A Visible/Infrared Imager for the New Horizons Pluto/Kuiper Belt Mission

D.C. Reuter, et al.

Available at: `http://arxiv.org/abs/0709.4281`

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Long-Range Reconnaissance Imager on New Horizons

A.F. Cheng, et al.

Available at: `http://arxiv.org/abs/0709.4278`

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The Pluto Energetic Particle Spectrometer Science Investigation (PEPSSI) on the New Horizons Mission

R.L. Mcutt, et al.

Available at: `http://arxiv.org/abs/0709.4428`

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The Solar Wind Around Pluto (SWAP) Instrument Aboard New Horizons

D. McComas, et al.

Available at: `http://arxiv.org/abs/0709.4505`

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New Horizons: Anticipated Scientific Investigations at the Pluto System

L.A. Young, et al.

Available at: `http://arxiv.org/abs/0709.4270`

CONFERENCE INFORMATION

Astrobiology Science Conference (AbSciCon)

April 15 - 18, 2008
Santa Clara, California, USA

The organizers of Special Session 16: *Extraterrestrial Organic Chemistry - Biological, Pre-Biological, and Abiological* encourage contributions related to organics and TNOs.
Deadline for Abstract: December 3, 2007
Co-Organizers: Reggie Hudson and Marla Moore
See: `http://abscicon.seti.org/science-program/sessions/16.php`

JOB OPENINGS

Plaskett Fellowship

National Research Council of Canada (NRC)

NRC Herzberg Institute of Astrophysics (NRC-HIA)
Dominion Astrophysical Observatory (DAO)
5071 West Saanich Road
Victoria, BC V9E 2E7
CANADA
Fax: 250-363-8766
Telephone: 250-363-3436
E-mail enquiries: `plaskett@nrc.gc.ca`
Related URL: `http://plaskett.hia.nrc.gc.ca`

The NRC-HIA invites applications for Plaskett Fellowships tenable at DAO. The awards are made to outstanding recent doctoral graduates in astrophysics or a closely related discipline to conduct independent research in a stimulating, collegial environment. The award is for a maximum of three years; the initial appointment of two years may be extended for one further year (subject to performance and availability of funds). In addition to highly competitive benefits and salary, Fellows receive support for observing and conference travel, page charges, and access to professionally managed computers and the Canadian Astronomy Data Centre, which is home to the Canadian Virtual Observatory and data archives from, e.g., CFHT, CGPS, HST, Gemini, JCMT.

Staff expertise is in observational astrophysics, but we welcome applications from theoreticians whose research requires close interaction with observers. Fellows are eligible to apply for Canadian time on ALMA, CFHT, Gemini & JCMT, to use the optical and radio telescopes operated by NRC-HIA in Victoria and Penticton, and/or to apply for time on other facilities with open proposal processes. NRC-HIA is a leading developer of instrumentation for ground- and space-based telescopes (e.g., ALMA, CFHT, Gemini, JCMT, JWST, TMT), and Fellows are welcome to participate in development or commissioning of new instruments.

Applicants must have acquired their Ph.D. within the last five years or expect to obtain the degree before taking up the Fellowship in 2008. To apply, please refer to our web site: `http://plaskett.hia.nrc.gc.ca`.

The review of applications will commence on 19 December 2007.

NRC is committed to employment equity. We thank all those who apply and advise that only those selected for further consideration will be contacted.

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:
⋆ Abstracts of accepted papers
⋆ 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:

`ekonews@boulder.swri.edu`

The *Distant EKOs* Newsletter is available on the World Wide Web at:

`http://www.boulder.swri.edu/ekonews`

Recent and back issues of the newsletter are archived there in various formats. The web pages also contain other related information and links.

Distant EKOs is not a refereed publication, but is a tool for furthering communication among people interested in Kuiper belt research. Publication or listing of an article in the newsletter or the web page does not constitute an endorsement of the article's results or imply validity of its contents. When referencing an article, please reference the original source; *Distant EKOs* is not a substitute for peer-reviewed journals.

Moving ... ??

If you move or your e-mail address changes, please send the editor your new address. If the newsletter bounces back from an address for three consecutive issues, the address will be deleted from the mailing list. All address changes, submissions, and other correspondence should be sent to:

`ekonews@boulder.swri.edu`