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DISTANT EKOs

The Kuiper Belt Electronic Newsletter

Edited by: Joel Wm. Parker

ekonews@boulder.swri.edu www.boulder.swri.edu/ekonews

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NEWS & ANNOUNCEMENTS

As reported in IAUC 8960, 2008 KV42 is the first TNO discovered with a retrograde orbit: $a = 45.99$, $e = 0.56$, $i = 103.50$.
IAUC: `http://cfa-www.harvard.edu/iauc/08900/08960.html`
MPEC: `http://cfa-www.harvard.edu/mpec/K08/K08O02.html`
more info at: `http://www.cfeps.net/CFEPS/KV42_Press.html`

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In IAUC 8962, Sheppard and Trujillo report that 2007 TY430 has a satellite, with a present separation of 0.6 arcsec, and a magnitude different less than 0.1 mag.
`http://cfa-www.harvard.edu/iauc/08900/08962.html`

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New Horizons is Twittering updates and news bits; interested parties can sign up at:
`http://twitter.com/NewHorizons2015`

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There were 7 new TNO discoveries announced since the previous issue of *Distant EKOs*:

2007 TV431, 2007 TW431, 2007 TX431, 2007 JF45, 2007 TC434, 2008 NW4, 2008 OG19

and 3 new Centaur/SDO discoveries:

2007 TU431, 2007 DU112, 2007 TB434,

Reclassified objects:

2001 XA255 (SDO → Centaur)

Objects recently assigned names:

2001 UQ18 = Altjira

Current number of TNOs: 1084 (including Pluto)
Current number of Centaurs/SDOs: 233
Current number of Neptune Trojans: 6

Out of a total of 1323 objects:

559 have measurements from only one opposition
534 of those have had no measurements for more than a year
283 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

Color-Inclination Relation of the Classical Kuiper Belt Objects

Nuno Peixinho[1,2,3], Pedro Lacerda[1], and David Jewitt[1]

[1] Institute for Astronomy, University of Hawaii, USA

[2] Centre for Computational Physics, University of Coimbra, Portugal

[3] Astronomical Observatory of the University of Coimbra, Portugal

We re-examine the correlation between the colors and the inclinations of the Classical Kuiper Belt Objects (CKBOs) with an enlarged sample of optical measurements. The correlation is strong ($\rho = -0.7$) and highly significant ($> 8\,\sigma$) in the range $0^\circ - 34^\circ$. Nonetheless, the optical colors are independent of inclination below $\approx 12^\circ$, showing no evidence for a break at the reported boundary between the so-called dynamically "hot" and "cold" populations near $\approx 5^\circ$. The commonly accepted parity between the dynamically cold CKBOs and the red CKBOs is observationally unsubstantiated, since the group of red CKBOs extends to higher inclinations. Our data suggest, however, the existence of a different color break. We find that the functional form of the color-inclination relation is most satisfactorily described by a non-linear and stepwise behavior with a color break at $\approx 12^\circ$. Objects with inclinations $\geq 12^\circ$ show bluish colors which are either weakly correlated with inclination or are simply homogeneously blue, whereas objects with inclinations $< 12^\circ$ are homogeneously red.

To appear in: The Astronomical Journal

For preprints, contact peixinho@ifa.hawaii.edu

or on the web at http://arxiv.org/abs/0808.3025

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Tentative Detection of the Rotation of Eris

H.G. Roe[1], R.E. Pike[2], and M.E. Brown[3]

[1] Lowell Observatory, Flagsta, AZ 86001, USA

[2] Gemini Observatory, Hilo, HI 96720, USA

[3] California Institute of Technology, Division of Geological and Planetary Sciences, Pasadena, CA 91125, USA

We report a multi-week sequence of B-band photometric measurements of the dwarf planet Eris using the *Swift* satellite. The use of an observatory in low-Earth orbit provides better temporal sampling than is available with a ground-based telescope. We find no compelling evidence for an unusually slow rotation period of multiple days, as has been suggested previously. A $\sim$1.08 day rotation period is marginally detected at a modest level of statistical confidence ($\sim$97%). Analysis of the combination of the *Swift* data with the ground-based B-band measurements of Rabinowitz et al. (2007) returns the same period ($\sim$1.08 day) at a slightly higher statistical confidence ($\sim$99%).

To appear in: Icarus

For preprints, contact hroe@lowell.edu

or on the web at http://arxiv.org/abs/0808.4130

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Long-wavelength Density Fluctuations Resolved in Pluto's High Atmosphere

D.W. McCarthy[1], W.B. Hubbard[2], C.A. Kulesa[1], S.D. Benecchi[3], M.J. Person[4], J.L. Elliot[4,5], and A.A.S. Gulbis[4,6]

[1] Steward Observatory, The University of Arizona, 933 N. Cherry Ave, Tucson, AZ 85721, USA

[2] Lunar and Planetary Laboratory, The University of Arizona, 1629 E. University Blvd., Tucson, AZ 85721, USA

[3] Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA

[4] Earth, Atmospheric and Planetary Sciences, MIT, 77 Massachusetts Ave., Cambridge, MA 02139, USA

[5] Department of Physics, MIT, 77 Massachusetts Ave., Cambridge, MA 02139, USA

[6] South African Astronomical Observatory, P.O. Box 9, Observatory, 7935 Cape Town, South Africa

Near-infrared measurements of the occultation of star P445.3 by Pluto on 2007 March 18 reveal that Pluto's upper atmosphere (∼200–400 km altitude) is unexpectedly dynamic. At a wavelength of 1.6 μm, numerous vertical fluctuations (8–20 km) of density are detected with unprecedented signal-to-noise. These fluctuations are achromatic, nearly limb-aligned, and fully resolved along a ∼1000 km path over a pressure range of ∼0.1-0.7 μbar (0.01 to 0.07 Pa). Vertical wavelength increases with altitude indicating a high-frequency cutoff operating on a broad-band spectrum of buoyancy ("gravity") waves generated deeper in Plutos atmosphere.

To appear in: The Astronomical Journal, v136 (2008 October)
For preprints, contact dmccarthy@as.arizona.edu

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A Derivation of the Luminosity Function of the Kuiper Belt from a Broken Power-Law Size Distribution

W.C. Fraser[1] and JJ. Kavelaars[2]

[1] Department of Physics and Astronomy, University of Victoria, Victoria, BC, Canada

[2] Herzberg Institute of Astrophysics, National Research Council of Canada, Victoria, BC V9E 2E7, Canada

We have derived a model of the Kuiper belt luminosity function exhibited by a broken power-law size distribution. This model allows direct comparison of the observed luminosity function to the underlying size distribution. We discuss the importance of the radial distribution model in determining the break diameter. We determine a best-fit break-diameter of the Kuiper belt size-distribution of $30 < D_b < 90$ km via a maximum-likelihood fit of our model to the observed luminosity function. We also confirm that the observed luminosity function for $m(R) \sim 21 - 28$ is consistent with a broken power-law size distribution, and exhibits a break at $m(R) = 26.0^{+0.7}_{-1.8}$.

To appear in: Icarus
For preprints, contact wesley.fraser@nrc.ca
or on the web at http://arxiv.org/abs/0809.0313

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Detection of Additional Members of the 2003 EL61 Collisional Family via Infrared Spectroscopy

E.L. Schaller [1] and M.E. Brown[1]

[1] California Institute of Technology, Pasadena, CA 91125, USA

We have acquired near-infrared spectra of Kuiper belt objects 2003 UZ117, 2005 CB79 and 2004 SB60 with NIRC on the Keck I Telescope. These objects are dynamically close to the core of the 2003 EL61 collisional family and were suggested to be potential fragments of this collision by Ragozzine and Brown (2007). We find that the spectra of 2003 UZ117 and 2005 CB79 both show the characteristic strong water ice absorption features seen exclusively on 2003 EL61, its largest satellite, and the six other known collisional fragments. In contrast, we find that the near infrared spectrum of 2004 SB60 is essentially featureless with a fraction of water ice of less than 5%. We discuss the implications of the discovery of these additional family members for understanding the formation and evolution of this collisional family in the outer solar system.

To appear in: The Astrophysical Journal, 684, L107 (2008 September 10)
For preprints, contact schaller@ifa.hawaii.edu

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On a Scattered-Disk Origin for the 2003 EL_{61} Collisional Family — an Example of the Importance of Collisions on the Dynamics of Small Bodies

H. Levison[1], A. Morbidelli[2,1], D. Vokrouhlický[3,1], and W. Bottke[1]

[1] SwRI, Boulder, CO, USA

[2] Observatoire de la Côte d'Azur, Nice, France

[3] Charles University, Prague, Czech Republic

The recent discovery of the 2003 EL_{61} collisional family in the Kuiper belt (Brown et al. 2007) is surprising because the formation of such a family is a highly improbable event in today's belt. Assuming Brown et al.'s estimate of the size of the progenitors, we find that the probability that a Kuiper belt object was involved in such a collision since primordial times is less than roughly 0.001. In addition, it is not possible for the collision to have occurred in a massive primordial Kuiper belt because the dynamical coherence of the family would not have survived whatever event produced the currently observed orbital excitation. Here we suggest that the family is the result of a collision between two scattered disk objects. We show that the probability that a collision occurred between two such objects with sizes similar to those advocated in Brown et al. (2007) and that the center of mass of the resulting family is on an orbit typical of the Kuiper belt can be as large as 47%. Given the large uncertainties involved in this estimate, this result is consistent with the existence of one such family. If true, this result has implications far beyond the origin of a single collisional family, because it shows that collisions played an important role in shaping the dynamical structure of the small body populations that we see today.

To appear in: The Astronomical Journal
For preprints, contact hal@boulder.swri.edu
or on the web at http://lanl.arxiv.org/abs/0809.0553

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Collisional and Dynamical Evolution of Plutinos

G.C. de Elía[1], A. Brunini[1], and R.P. Di Sisto[1]

[1] Facultad de Ciencias Astronómicas y Geofísicas, Universidad Nacional de La Plata, IALP-CONICET, Paseo del Bosque S/N (1900), La Plata, Argentina.

In this paper, we analyze the collisional and dynamical evolution of the population of Plutinos. To do this, we test different collisional parameters and include a dynamical treatment that takes into account the stability and instability zones of the 3:2 mean motion resonance with Neptune. This procedure allows us to estimate the size distribution of Plutinos, to study their mean collisional lifetimes, to analyze the formation of families, to obtain ejection rates of fragments from the resonance and to discuss their possible contribution to the ecliptic comet population. Our simulations are developed assuming the existence of one Pluto-sized object in the 3:2 Neptune resonance.

The Plutino population larger than a few kilometers in diameter is not significantly altered by catastrophic collisions over the age of the Solar System. Thus, we infer that the break suggested by previous works at a diameter D near 40–80 km in the Plutino cumulative size distribution should be primordial and not a result of the collisional evolution. The existence of such a break is still a matter of debate. On the other hand, our analysis indicates that one large family was formed in the 3:2 Neptune resonance over the Solar System history. Concerning Plutino removal, we find that one object with a diameter $D > 1$ km is ejected from the 3:2 resonance with Neptune every ∼300–1200 yr. Then, we study the sensitivity of our results to the number of Pluto-sized objects in the 3:2 Neptune resonance. Our simulations suggest that the larger the number of Pluto-sized bodies, the higher the ejection rate of fragments from that resonant region and the number of families formed over 4.5 Gyr. Thus, if a maximum of five Pluto-sized objects are assumed to be in the 3:2 Neptune resonance, one body with a diameter $D > 1$ km is ejected every tens of years while ∼30 large families are formed over the Solar System history. From these estimates, we conclude that it is necessary to specify the number of Pluto-sized objects present in the 3:2 Neptune resonance to determine if this region can be considered an important source of ecliptic comets. Finally, we find that the current orbital distribution of the Plutinos does not offer a strong constraint on the dynamical origin of this population.

To appear in: Astronomy & Astrophysics
For preprints, contact gdeelia@fcaglp.unlp.edu.ar

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Growth and Evolution of Small Porous Icy Bodies with an Adaptive-grid Thermal Evolution Code

Dina Prialnik[1] and Rainer Merk[1]

[1] Department of Geophysics and Planetary Sciences, Tel Aviv University, Ramat Aviv, Tel Aviv 69978, Israel

We present a new 1-dimensional thermal evolution code suited for small icy bodies of the Solar System, based on modern adaptive grid numerical techniques, and suited for multiphase flow through a porous medium. The code is used for evolutionary calculations spanning 4.6×10^9 yr of a growing body made of ice and rock, starting with a 10 km radius seed and ending with an object 250 km in radius. Initial conditions are chosen to match two different classes of objects: a Kuiper belt object, and Saturn's moon Enceladus. Heating by the decay of ^{26}Al, as well as long-lived radionuclides is taken into account. Several values of the thermal conductivity and accretion laws are tested. We find that in all cases the melting point of ice is reached in a central core. Evaporation and flow of water and vapor gradually remove the water from the core and the final (present) structure is

differentiated, with a rocky, highly porous core of 80 km radius (and up to 160 km for very low conductivities). Outside the core, due to refreezing of water and vapor, a compact, ice-rich layer forms, a few tens of km thick (except in the case of very high conductivity). If the ice is initially amorphous, as expected in the Kuiper belt, the amorphous ice is preserved in an outer layer about 20 km thick. We conclude by suggesting various ways in which the code may be extended.

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A Possible Icy Kuiper Belt around HD 181327

Christine H. Chen[1], Michael P. Fitzgerald[2], and Paul S. Smith[3]

[1] NOAO/STScI, Baltimore, MD 21218, USA

[2] Lawrence Livermore National Laboratory, L-413, Livermore, CA 94551, USA

[3] Steward Observatory, University of Arizona, Tucson, AZ 85721, USA

We have obtained a Gemini South T-ReCS Q_a-band (18.3 μm) image and a *Spitzer* MIPS SED-mode observation of HD181327, an F5/F6V member of the ∼12 Myr old β Pictoris moving group. We resolve the disk in thermal-emission for the first time and find that the northern arm of the disk is 1.4 times brighter than the southern arm. In addition, we detect a broad peak in the combined *Spitzer* IRS and MIPS spectra at 60–75 μm that may be produced by emission from crystalline water ice. We model the IRS and MIPS data using a size distribution of amorphous olivine and water ice grains ($dn/da \propto a^{-2.25}$ with a_{min} consistent with the minimum blow out size and $a_{max} = 20$ μm) located at a distance of 86.3 AU from the central star, as observed in previously published scattered-light images. Since the photo-desorption lifetime for the icy particles is ∼1400 yr, significantly less than the estimated ∼12 Myr age of the system, we hypothesize that we have detected debris that may be steadily replenished by collisions among icy Kuiper belt object-like parent bodies in a newly forming planetary system.

To appear in: The Astrophysical Journal
For preprints, contact cchen@stsci.edu
or on the web at http://arxiv.org/abs/0808.2273

PAPERS RECENTLY SUBMITTED TO JOURNALS

Chaotic Diffusion of Resonant Kuiper Belt Objects

Matthew S. Tiscareno[1] and Renu Malhotra[2]

[1] Department of Astronomy, Cornell University, Ithaca, NY 14853, USA

[2] Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721, USA

Submitted to: *For preprints, contact* matthewt@astro.cornell.edu
or on the web at http://arxiv.org/abs/0807.2835

CONFERENCE CONTRIBUTIONS

Meeting Report: The Great Planet Debate Laurel, Maryland; 14-16 August 2008

contributed by Alan Stern, Hal Weaver, and Mark Sykes

Researchers debate planet definitions agreeing the current IAU definition is flawed, but reaching no consensus beyond that.

Two years ago the International Astronomical Union (IAU) elected to define the term planet, restricting it to the eight largest bodies orbiting the Sun, and deleting Pluto from the list. The demotion of Pluto sparked considerable public controversy. Numerous planetary scientists and astronomers rejected the IAUs definition as not useful.

Recognizing the need for further scientific debate on planet definition, almost 100 scientists and educators representing a wide range of viewpoints on the issue converged for three days on the Applied Physics Laboratory of Johns Hopkins University for "The Great Planet Debate: Science as Process" conference (`http://gpd.jhuapl.edu/`) last month.

There was general agreement that the IAU definition for planet is flawed, but there was no consensus on whether it should be abandoned, refined, or replaced. Different positions were advocated, ranging from reworking the IAU definition (but yielding the same outcome of eight or even less planets), replacing it with a geophysically-based definition (that would increase the number of planets well beyond eight), and rescinding the definition for planet altogether (leaving that up to popular usage) and instead focusing on defining various kinds of subcategories that serve different purposes.

BOOKS

The Kuiper Belt and Other Debris Disks

David Jewitt[1], Amaya Moro-Martin[2], and Pedro Lacerda[1]

[1] University of Hawaii, USA

[2] Princeton University, USA

We discuss the current knowledge of the Solar system, focusing on bodies in the outer regions, on the information they provide concerning Solar system formation, and on the possible relationships that may exist between our system and the debris disks of other stars. Beyond the domains of the Terrestrial and giant planets, the comets in the Kuiper belt and the Oort cloud preserve some of our most pristine materials. The Kuiper belt, in particular, is a collisional dust source and a scientific bridge to the dusty debris disks observed around many nearby main-sequence stars. Study of the Solar system provides a level of detail that we cannot discern in the distant disks while observations of the disks may help to set the Solar system in proper context.

to appear in: *Astrophysics in the Next Decade,* edited by H. Thronson, M. Stiavelli and A. Tielens; Springer Verlag (2009)
Preprints available or on the web at
`http://www.ifa.hawaii.edu/faculty/jewitt/papers/2008/JML08.pdf`

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`