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DISTANT EKOs

The Kuiper Belt Electronic Newsletter

Edited by: Joel Wm. Parker

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NEWS & ANNOUNCEMENTS

After many years of ground and space-based KBO searches for a target that the New Horizons spacecraft could reach if it gets an extended mission, NASA, STScI, and the New Horizons team announced the discovery - using the Hubble Space Telescope - of some "potentially targetable" candidates for a flyby after next year's encounter with Pluto.
`http://hubblesite.org/newscenter/archive/releases/solar-system/2014/47/`
`http://pluto.jhuapl.edu/overview/piPerspective.php?page=piPerspective_10_23_2014`

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There were 6 new TNO discoveries announced since the previous issue of *Distant EKOs*:

2013 RB98, 2014 QL441, 2014 QM441, 2014 QN441, 2014 UH192, 2014 UM33

and 8 new Centaur/SDO discoveries:

2014 ON6, 2014 QF433 2014 RE12, 2014 SR303, 2014 SS303, 2014 SW223, 2014 TZ33, 2014 UT114

Reclassified objects:

2014 QF433 (SDO → TNO)

Objects recently assigned numbers:

2001 QJ298 = (408832)
2005 VJ119 = (413666)

Deleted/Re-identified objects:

2006 HH123

Current number of TNOs: 1284 (including Pluto)
Current number of Centaurs/SDOs: 407
Current number of Neptune Trojans: 9

Out of a total of 1700 objects:

656 have measurements from only one opposition
633 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

Formation of Pebble-Pile Planetesimals

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Asteroids and Kuiper belt objects are remnant planetesimals from the epoch of planet formation. The first stage of planet formation is the accumulation of dust and ice grains into mm-cm-sized pebbles. These pebbles can clump together through the streaming instability and form gravitationally bound pebble 'clouds'. Pebbles inside such a cloud will undergo mutual collisions, dissipating energy into heat. As the cloud loses energy, it gradually contracts towards solid density. We model this process and investigate two important properties of the collapse: (i) the timescale of the collapse and (ii) the temporal evolution of the pebble size distribution. Our numerical model of the pebble cloud is zero-dimensional and treats collisions with a statistical method. We find that planetesimals with radii larger than ∼100 km collapse on the free-fall timescale of about 25 years. Lower-mass clouds have longer pebble collision timescales and collapse much more slowly, with collapse times of a few hundred years for 10-km-scale planetesimals and a few thousand years for 1-km-scale planetesimals. The mass of the pebble cloud also determines the interior structure of the resulting planetesimal. The pebble collision speeds in low-mass clouds are below the threshold for fragmentation, forming pebble-pile planetesimals consisting of the primordial pebbles from the protoplanetary disk. Planetesimals above 100 km in radius, on the other hand, consist of mixtures of dust (pebble fragments) and pebbles which have undergone substantial collisions with dust and other pebbles. The Rosetta mission to the comet 67P/Churyumov-Gerasimenko and the New Horizons mission to Pluto will both provide valuable information about the structure of planetesimals in the Solar System. Our model predicts that 67P is a pebble-pile planetesimal consisting of primordial pebbles from the Solar Nebula, while the pebbles in the cloud which contracted to form Pluto must have been ground down substantially during the collapse.

To appear in: Astronomy & Astrophysics
For preprints, contact `kalle@astro.lu.se`
or on the web at `http://arxiv.org/abs/1408.2535`

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Dumb-Bell-Shaped Equilibrium Figures for Fiducial Contact-Binary Asteroids and EKBOs

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In this work, we investigate the equilibrium figures of a dumb-bell-shaped sequence with which we are still not well acquainted. Studies have shown that these elongated and nonconvex figures may realistically replace the classic "Roche binary approximation" for modeling putative peanut-shaped or contact binary asteroids. The best-fit dumb-bell shapes, combined with the known rotational period of the objects, provide estimates of the bulk density of these objects. This new class of mathematical figures has been successfully tested on the observed light curves of three noteworthy small bodies: main-belt Asteroid 216 Kleopatra, Trojan Asteroid 624 Hektor and Edgeworth-Kuiper-belt object 2001 QG298. Using the direct observations of Kleopatra and Hektor obtained with high spatial resolution techniques and fitting the size of the dumb-bell-shaped solutions, we derived new physical characteristics in terms of equivalent radius, 62.5 ± 5 km

and 92 ± 5 km, respectively, and bulk density, 4.4 ± 0.4 g cm^{-3} and 2.43 ± 0.35 g cm^{-3}, respectively. In particular, the growing inadequacy of the radar shape model for interpreting any type of observations of Kleopatra (light curves, AO images, stellar occultations) in a satisfactory manner suggests that Kleopatra is more likely to be a dumb-bell-shaped object than a "dog-bone."

Published in: Icarus, 245, 64 (2015 January 1)
For preprints, contact descamps@imcce.fr
or on the web at http://arxiv.org/abs/1410.7962

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The Intrinsic Neptune Trojan Orbit Distribution: Implications for the Primordial Disk and Planet Migration

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The present-day orbit distribution of the Neptune Trojans is a powerful probe of the dynamical environment of the outer solar system during the late stages of planet migration. In this work, I conservatively debias the inclination, eccentricity, and libration amplitude distributions of the Neptune Trojans by reducing *a priori* unknown discovery and follow-up survey properties to nuisance parameters and using a likelihood-free Bayesian rejection sampler for parameter estimation. Using this *survey-agnostic* approach, I confirm that the Neptune Trojans are a dynamically excited population: at >95% confidence, the Neptune Trojans' inclination width must be $\sigma_i > 11°$. For comparison and motivation purposes, I also model the Jupiter Trojan orbit distributions in the same basis and produce new estimates of their parameters (Jupiter Trojan $\sigma_i = 14.4° \pm 0.5°$, $\sigma_{L11} = 11.8° \pm 0.5°$, and $\sigma_e = 0.061 \pm 0.002$). The debiased inclination, libration amplitude, and eccentricity distributions of the Neptune Trojans are nominally very similar to those of the Jupiter Trojans. I use these new constraints to inform a suite of simulations of Neptune Trojan capture by an eccentric, rapidly-migrating Neptune from an initially dynamically-hot disk. These simulations demonstrate that if migration and eccentricity-damping timescales were short ($\tau_a \lesssim 10$ Myr, $\tau_e \lesssim 1$ Myr), the disk that Neptune migrated into *must* have been pre-heated (prior to Neptune's appearance) to a width comparable to the Neptune Trojans' extant width to produce a captured population with an inclination distribution width consistent with that of the observed population.

To appear in: Icarus, 247, 112 (2015 February)
For preprints, contact alexharrisonparker@gmail.com
or on the web at http://arxiv.org/abs/1409.6735

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Space Weathering and the Color-Color Diagram of Plutinos and Jupiter Trojans

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The Jupiter Trojan asteroids and the Plutinos are two peculiar populations. They are dynamically resonant, therefore with heliocentric distances relatively bounded for long timescales, as a fairly general rule. As a consequence, some correlation with the surface color properties of their respective members is expected. Indeed, there are apparent differences in the $B-V$ vs. $V-R$ color-color diagram of the two populations. Using a simple model based on the surface color due to the contribution of two components, one pristine and one altered, we find as plausible that the difference is due to the interplay of space weathering by energetic cosmic-radiation and collisional effects.

To appear in: Icarus

For preprints, contact melita@iafe.uba.ar

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Infrared Spectra and Optical Constants of Astronomical Ices: II. Ethane and Ethylene

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[1]Astrochemistry Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA

Infrared spectroscopic observations have established the presence of hydrocarbon ices on Pluto and other TNOs, but the abundances of such molecules cannot be deduced without accurate optical constants (n, k) and reference spectra. In this paper we present our recent measurements of near- and mid-infrared optical constants for ethane (C_2H_6) and ethylene (C_2H_4) in multiple ice phases and at multiple temperatures. As in our recent work on acetylene (C_2H_2), we also report new measurements of the index of refraction of each ice at 670 nm. Comparisons are made to earlier work where possible, and electronic versions of our new results are made available.

Published in: Icarus 243, 148 (2014 November 15)

For preprints, contact reggie.hudson@nasa.gov

Download data and preprints on the web at http://science.gsfc.nasa.gov/691/cosmicice

JOB ANNOUNCEMENTS

Plaskett Research Associate
NATIONAL RESEARCH COUNCIL of CANADA (NRC)

National Science Infrastructure Portfolio (NSI)
NRC Herzberg Astronomy and Astrophysics
Dominion Astrophysical Observatory (DAO)
5071 West Saanich Road
Victoria, BC V9E 2E7
CANADA
Fax: 709-772-4541
Telephone: 709-772-5012

E-mail enquiries: NRC.ExtHiring-EmbaucheExt.CNRC@nrc-cnrc.gc.ca
Related URL: `http://www.nrc-cnrc.gc.ca/eng/careers/index.html`

Desired starting date: 1 September 2015

The National Research Council (NRC) is pleased to announce the 2014 competition for two Plaskett Postdoctoral Research Associate (RA) positions tenable at DAO in Victoria, BC, Canada. The successful candidates will be outstanding recent doctoral graduates in astrophysics who are highly motivated to exploit facilities administered by NRC for Canadian astronomers and contribute to projects led by NRC Herzberg staff members. We are particularly seeking candidates who will contribute to one or more of the following research areas:

- Exoplanets and debris disks (direct detection, planetary atmospheres, dynamical evolution, collisional evolution, composition), utilizing GEMINI, ALMA, HST and/or exploitation of existing large survey data from Kepler, Spitzer, Herschel, WISE and other missions. Participation in the Gemini Planet Imager (GPI) Exoplanet Survey, which has both exoplanet and disk components, is a possibility. Candidates with expertise in the following areas will be given the highest consideration: expertise in direct detection of exoplanets and their characterization; dynamical modeling of disk/exoplanet systems; modeling of dust evolution in debris disks; synthesis of existing survey data). [NRC staff members: JJ Kavelaars, Christian Marois, Brenda Matthews, Jean-Pierre Véran]

- Outer solar system bodies (accretion processes, size-frequency distributions, surface properties, orbital dynamics, binaries, space-craft exploration), utilizing CFHT, GEMINI, ALMA, HST, Subaru, and the New Horizons spacecraft with possible participation in the Outer Solar System Origins Survey. Candidates with expertise in the following areas will be given the highest consideration: survey observations; modeling of orbital distributions; modeling of orbital evolution of resonant and scattering objects; observational studies of surface properties; modeling of surface processes. [NRC staff members: JJ Kavelaars]

- Star or planet formation processes (protostellar evolution, cluster formation, circumstellar disks, super-star clusters in external galaxies), utilizing ALMA, the Jansky VLA, or other facilities, and leveraging results from Herschel, Spitzer, or JCMT legacy programs (e.g., the JCMT Gould Belt Survey). Candidates with expertise in the following areas will be given the highest consideration: observations or modeling of planet formation processes within proto-planetary disks; regulation of star formation processes and the role of environment; episodic accretion and the luminosity problem in young stellar objects; origins of structure and energy balance in molecular clouds; star formation in extreme environments. [NRC staff members: James Di Francesco, Doug Johnstone, Lewis Knee, Brenda Matthews, Gerald Schieven]

- Photometric and spectroscopic studies of the structure and stellar content of the Milky Way, Local Group, and other nearby galaxies, including all areas of research associated with the broad field of 'near-field cosmology.' Examples of programs currently led by NRC Herzberg staff include the Legacy for the u-band all-sky Universe (Luau), a new large CFHT program beginning in 2015 to obtain over ∼3500 square degrees of deep u-band imaging of the Milky Way halo; the Pan-Andromeda Archaeological Survey (PAndAS) and associated datasets; and optical and near IR observations of Galactic globular clusters (including high spatial resolution Gemini/GeMS MCAO studies) [NRC staff members: Pat Côté, Stéphanie Côté, Tim Davidge, Alan McConnachie, Peter Stetson]

- Multi-wavelength investigations of galaxies and clusters, including studies of galaxy distances, dynamics, and structural properties; super-massive black holes and galactic nuclei; and star clusters and star formation at UV, optical, IR and sub-mm wavelengths. NRC-led projects include wide-field, high-resolution optical and IR imaging of nearby field and cluster (including Coma, Virgo and Fornax) galaxies with CFHT, VISTA, and the Blanco 4-m telescope, as well as numerous related spectroscopic programmes on 4-10 m-class facilities. [NRC staff members: John Blakeslee, Pat Côté, Stéphanie Côté, Tim Davidge, Laura Ferrarese, John Hutchings, David Schade, Luc Simard]

- Cosmological evolution of galaxies including physical processes such as accretion, outflow, feedback, metal enrichment, star formation, super-massive black hole growth, mergers, and strong lensing. Candidates should have an observational background or an interest in constraining theories with observations. Research in this area at NRC is mostly based on multi-wavelength (radio, mm, IR, optical, UV, X-ray) observations of star formation and AGN activity at high redshift. [NRC staff members: Laura Ferrarese, John Hutchings, Chris Willott]

The successful candidates are expected to work independently and perform original research in collaboration with NRC Herzberg staff members associated with projects most relevant to his or her area of expertise. Additionally, candidates are expected to keep an active engagement with the community to advance NRC Herzberg's mandate. In particular, NRC Herzberg is involved in several ground- and space-based telescopes of the present (e.g., ALMA, CFHT, Gemini, JCMT) and future (e.g., JWST, CASTOR, Astrosat, WFIRST, Astro-H, SKA, MSE, TMT), as well as in scientific data preservation, distribution, and analysis techniques. The Canadian Astronomy Data Centre, home to the Canadian Virtual Observatory, the CANFAR cloud computing network, and data archives including, e.g., CFHT, Canadian Galactic Plane Survey, Gemini, HST, and JCMT, are also located at NRC Herzberg. Candidates with interests in developing studies of next-generation instrumentation and facilities will be given highest consideration.

The successful candidates will share with other Plaskett RAs the organization of the weekly seminar series that runs September-April, and have access via Canada's TAC process to the astronomical facilities operated by NRC, as well as other facilities with open competition. The positions will constitute initial appointments of two years, which may be extended for one further year (subject to performance and availability of funds). In addition to highly competitive benefits and salary, Plaskett RAs will receive support for observing and conference travel, page charges, and access to professionally managed computers.

Applicants must have acquired their Ph.D. within the last five years or expect to obtain their degree before taking up the position. Applications should be made by 12 December 2014 via the process described at the URL provided.

NRC is an equal opportunity employer.

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`