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DISTANT EKOs

The Kuiper Belt Electronic Newsletter

Edited by: Joel Wm. Parker

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CONTENTS

NEWS & ANNOUNCEMENTS

A special "Pluto" issue of Icarus is being planned, with a submission deadline of January 31, 2016. This special issue is open to the entire planetary science community and is not restricted to New Horizons results. If you have a Pluto-related paper in preparation, you are encouraged to submit your manuscript for the Icarus special issue. Follow all of the usual Icarus submission procedures and simply indicate your desire to be included in the Pluto Special Issue.

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

2013 RM98, 2014 QS441, 2014 QU441, 2015 PF312, 2015 SO20, 2015 SP20, 2015 SW20

and 8 new Centaur/SDO discoveries:

2013 TJ159, 2013 VD24, 2014 SB349, 2015 PD312, 2015 SV20, 2015 TS350,
2015 UH67, 2015 VV1

Reclassified objects:
2015 SO20 (TNO → SDO)

Objects recently assigned numbers:
2005 RO43 = (447178)
2012 UT68 = (449097)
2012 WD36 = (451657)
2003 WU172 = (450265)

Objects recently assigned names:
2004 UP10 = Otrera

Current number of TNOs: 1451 (including Pluto)
Current number of Centaurs/SDOs: 483
Current number of Neptune Trojans: 12

Out of a total of 1946 objects:
666 have measurements from only one opposition
646 of those have had no measurements for more than a year
331 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

OSSOS II: A Sharp Transition in the Absolute Magnitude Distribution of the Kuiper Belt's Scattering Population

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We measure the absolute magnitude, H, distribution, $dN(H) \propto 10^{\alpha H}$ of the scattering Trans-Neptunian Objects (TNOs) as a proxy for their size-frequency distribution. We show that the H-distribution of the scattering TNOs is not consistent with a single-slope distribution, but must transition around $H_g \sim 9$ to either a knee with a shallow slope or to a divot, which is a differential drop followed by second exponential distribution. Our analysis is based on a sample of 22 scattering TNOs drawn from three different TNO surveys — the Canada-France Ecliptic Plane Survey (CFEPS, Petit et al. 2011), Alexandersen et al. 2014, and the Outer Solar System Origins Survey (OSSOS, Bannister et al. 2016), all of which provide well characterized detection thresholds — combined with a cosmogonic model for the formation of the scattering TNO population. Our measured absolute magnitude distribution result is independent of the choice of cosmogonic model. Based on our analysis, we estimate that number of scattering TNOs is (2.4-8.3)$\times 10^5$ for $H_r < 12$. A divot H-distribution is seen in a variety of formation scenarios and may explain several puzzles in Kuiper Belt science. We find that a divot H-distribution simultaneously explains the observed scattering TNO, Neptune Trojan, Plutino, and Centaur H-distributions while simultaneously predicting a large enough scattering TNO population to act as the sole supply of the Jupiter-Family Comets.

To appear in: The Astronomical Journal

For preprints, contact `cshankm@uvic.ca`

or on the web at `http://arxiv.org/abs/1511.02896`

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Absolute Magnitudes and Phase Coefficients of Trans-Neptunian Objects

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Context: Accurate measurements of diameters of trans-Neptunian objects are extremely complicated to obtain. Thermal modeling can provide good results, but accurate absolute magnitudes are needed to constrain the thermal models and derive diameters and geometric albedos. The absolute magnitude, H_v, is defined as the magnitude of the object reduced to unit helio- and geocentric distances and a zero solar phase angle and is determined using phase curves. Phase coefficients can also be obtained from phase curves. These are related to surface properties, yet not many are known.

Aims: Our objective is to measure accurate V band absolute magnitudes and phase coefficients for a sample of trans-Neptunian objects, many of which have been observed, and modeled, within the 'TNOs are cool' program, one of Herschel Space Observatory key projects.

Methods: We observed 56 objects using the V and R filters. These data, along with those available in the literature, were used to obtain phase curves and measure V band absolute magnitudes and phase coefficients by assuming a linear trend of the phase curves and considering magnitude variability due to rotational light-curve.

Results: We obtained 237 new magnitudes for the 56 objects, six of them with no reported previous measurements. Including the data from the literature we report a total of 110 absolute magnitudes with their respective phase coefficients. The average value of H_v is 6.39, bracketed by a minimum of 14.60 and a maximum of -1.12. In the case of the phase coefficients we report 0.10 mag per degree as the median value and a very large dispersion, ranging from -0.88 up tp 1.35 mag per degree.

To appear in: Astronomy and Astrophysics
Preprints available on the web at `http://arxiv.org/abs/1511.09401`

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CCD Photometry of Active Centaur 166P/2001 T4 (NEAT)

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To study the secular evolution of the activity of Centaur 166P/2001 T4 (NEAT) and its physical properties, we present the results of optical observations of the Centaur taken on March 29, 2009 with the Keck 10-m telescope located atop Mauna Kea, Hawaii. It was still active at $r_h = 11.9$ au post-perihelion. An upper limit of the nucleus radius of $a_N < 14.32$ km is derived. The color index is $B - R = 1.59 \pm 0.05$. The $Af\rho$ value is measured to be 288 ± 19 cm and the corresponding dust production rate is 252 kg s^{-1}. Finally, a possible mechanism of activity is discussed.

Published in: Monthly Notices of the Royal Astronomical Society, 454, 3635 (2015 December 21)
For preprints, contact `jcshi@pmo.ac.cn`

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Color Systematics of Comets and Related Bodies

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Most comets are volatile-rich bodies that have recently entered the inner solar system following long-term storage in the Kuiper belt and the Oort cloud reservoirs. These reservoirs feed several distinct, short-lived "small body" populations. Here, we present new measurements of the optical colors of cometary and comet-related bodies including long-period (Oort cloud) comets, Damocloids (probable inactive nuclei of long-period comets) and Centaurs (recent escapees from the Kuiper belt and precursors to the Jupiter family comets). We combine the new measurements with published data on short-period comets, Jovian Trojans and Kuiper belt objects to examine the color systematics of the comet-related populations. We find that the mean optical colors of the dust in short-period and long-period comets are identical within the uncertainties of measurement, as are the colors of the dust and of the underlying nuclei. These populations show no evidence for scattering by optically-small particles or for compositional gradients, even at the largest distances from the Sun, and no evidence for ultrared matter. Consistent with earlier work, ultrared surfaces are common in the Kuiper belt and on the Centaurs, but not in other small body populations, suggesting that this material is hidden or destroyed upon entry to the inner solar system. The onset of activity in the Centaurs and the disappearance of the ultrared matter in this population begin at about the same perihelion distance (∼10 AU), suggesting that the two are related. Blanketing of primordial surface materials by the fallback of sub-orbital ejecta, for which we calculate a very short timescale, is the likely mechanism. The same process should operate on any mass-losing body, explaining the absence of ultrared surface material in the entire comet population.

To appear in: The Astronomical Journal, 150, 201 (2015 December)
Preprints available on the web at `http://www2.ess.ucla.edu/~jewitt/papers/2015/J15b.pdf`

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Ice Chemistry on Outer Solar System Bodies: Electron Radiolysis of N_2-, CH_4-, and CO-Containing Ices

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Radiation processing of the surface ices of outer Solar System bodies may be an important process for the production of complex chemical species. The refractory materials resulting from radiation processing of known ices are thought to impart to them a red or brown color, as perceived in the visible spectral region. In this work, we analyzed the refractory materials produced from the 1.2 keV electron bombardment of low-temperature N_2-, CH_4-, and CO-containing ices (100:1:1), which simulates the radiation from the secondary electrons produced by cosmic ray bombardment of the surface ices of Pluto. Despite starting with extremely simple ices dominated by N_2, electron irradiation processing results in the production of refractory material with complex oxygen- and nitrogen-bearing organic molecules. These refractory materials were studied at room temperature using multiple analytical techniques including Fourier-transform infrared spectroscopy, X-ray absorption near-edge

structure (XANES) spectroscopy, and gas chromatography coupled with mass spectrometry (GC-MS). Infrared spectra of the refractory material suggest the presence of alcohols, carboxylic acids, ketones, aldehydes, amines, and nitriles. XANES spectra of the material indicate the presence of carboxyl groups, amides, urea, and nitriles, and are thus consistent with the IR data. Atomic abundance ratios for the bulk composition of these residues from XANES analysis show that the organic residues are extremely N-rich, having ratios of $N/C \sim 0.9$ and $O/C \sim 0.2$. Finally, GC-MS data reveal that the residues contain urea as well as numerous carboxylic acids, some of which are of interest for prebiotic and biological chemistries.

Published in: The Astrophysical Journal, 812, 150 (2015 October 20)

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Physical Characterization of TNOs with the James Webb Space Telescope

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Studies of the physical properties of Trans-Neptunian Objects (TNOs) are a powerful probe into the processes of planetesimal formation and solar system evolution. JWST will provide unique new capabilities for such studies. Here we outline where the capabilities of JWST open new avenues of investigation, potential valuable observations and surveys, and conclude with a discussion of community actions that may serve to enhance the eventual science return of JWST's TNO observations.

To appear in: Publication of the Astronomical Society of the Pacific

For preprints, contact `aparker@boulder.swri.edu`
or on the web at `http://arxiv.org/abs/1511.01112`

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Orbit Determination of Transneptunian Objects and Centaurs for the Prediction of Stellar Occultations

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The prediction of stellar occultations by Transneptunian objects (TNOs) and Centaurs is a difficult challenge that requires accuracy both in the occulted star position as for the object ephemeris. Until now, the most used method of prediction involving tens of TNOs/Centaurs was to consider a constant offset for the right ascension and for the declination with respect to a reference ephemeris, usually, the latest public version. This offset is determined as the difference between the most recent observations of the TNO and the reference ephemeris. This method can be successfully applied when the offset remains constant with time, i.e. when the orbit is stable enough. In this case, the prediction holds even for occultations to occur several days after the last observations.

This paper presents an alternative method of prediction based on a new accurate orbit determination procedure, which uses all the available positions of the TNO from the Minor Planet Center database plus sets of new astrometric positions from unpublished observations.

The orbit determination is performed through a numerical integration procedure called NIMA, in which we develop a specific weighting scheme that takes into account the individual precision of observation, the number of observations performed during one night in a same observatory and the presence of systematic errors in the positions.

The NIMA method was applied for 51 selected TNOs and Centaurs. For this purpose, we have performed about 2900 new observations in several observatories (European South Observatory, Observatório Pico dos Dias, Pic du Midi, etc) during the 2007-2014 period. Using NIMA, we succeed in predicting the stellar occultations of 10 TNOs and 3 Centaurs between July 2013 and February 2015. By comparing the NIMA and JPL ephemerides, we highlighted the variation of the offset between them with time, showing that in general the constant offset hypothesis is not valid, even for short time scales of a few weeks. Giving examples, we show that the constant offset method could not accurately predict 6 out of the 13 observed positive occultations successfully predicted by NIMA. The results indicate that NIMA is capable of efficiently refine the orbits of these bodies.Finally, we show that the astrometric positions given by positive occultations can help to further refine the orbit of the TNO and consequently the future predictions. We also provide the unpublished observations of the 51 selected TNOs and their ephemeris in a usable format by the SPICE library.

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For preprints, contact desmars@imcce.fr

or on the web at http://arxiv.org/abs/1509.08674

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Orbit Classification in the Planar Circular Pluto-Charon System

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We numerically investigate the orbital dynamics of a spacecraft, or a comet, or an asteroid in the Pluto-Charon system in a scattering region around Charon using the planar circular restricted three-body problem. The test particle can move in bounded orbits around Charon or escape through the necks around the Lagrangian points L_1 and L_2 or even collide with the surface of Charon. We explore four of the five possible Hill's regions configurations depending on the value of the Jacobi constant which is of course related with the total orbital energy. We conduct a thorough numerical analysis on the phase space mixing by classifying initial conditions of orbits and distinguishing between three types of motion: (i) bounded, (ii) escaping and (iii) collisional. In particular, we locate the different basins and we relate them with the corresponding spatial distributions of the escape and collision times. Our results reveal the high complexity of this planetary system. Furthermore, the numerical analysis shows a strong dependence of the properties of the considered basins with the total orbital energy, with a remarkable presence of fractal basin boundaries along all the regimes. Our results are compared with earlier ones regarding the Saturn-Titan planetary system.

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2008 OG_{19}: A Highly Elongated Trans-Neptunian Object

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From two observing runs during the 2014 summer at Calar Alto Observatory in Almería (Spain) and at Sierra Nevada Observatory in Granada (Spain), we were able to derive CCD photometry of the Trans-Neptunian Object 2008 OG_{19}. We analyzed the time series and obtained a double-peaked light curve with a peak to valley amplitude of (0.437±0.011) mag and a rotational period of (8.727±0.003) h. This implies that this object is very elongated, closely resembling Varuna's case. The photometry also allowed us to obtain an absolute magnitude in R-band of (4.39±0.07) mag. From this result we estimated an equivalent diameter of 2008 OG_{19} which is 619^{+56}_{-113} km using an average albedo for Scattered Disk Objects. Finally we interpreted the results under the assumption of hydrostatic equilibrium and found a lower limit for the density of 544^{+42}_{-4} $\mathrm{kg\,m^{-3}}$. However, a more likely density is 609±4 $\mathrm{kg\,m^{-3}}$ using an aspect angle of 60°, which corresponds to the most likely configuration for the spin axis with respect to the observer assuming random orientations.

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For preprints, contact estela@iaa.es
or on the web at http://arxiv.org/abs/1511.06584

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An Improved Model for Interplanetary Dust Fluxes in the Outer Solar System

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We present an improved model for interplanetary dust grain fluxes in the outer solar system constrained by in-situ dust density observations. A dynamical dust grain tracing code is used to establish relative dust grain densities and three-dimensional velocity distributions in the outer solar system for four main sources of dust grains: Jupiter-family comets, Halley-type comets, Oort-Cloud comets, and Edgeworth-Kuiper Belt objects. Model densities are constrained by in-situ dust measurements by the *New Horizons* Student Dust Counter, the *Pioneer* 10 meteoroid detector, and the *Galileo* Dust Detection System (DDS). The model predicts that Jupiter-family comet grains dominate the interplanetary dust grain mass flux inside approximately 10 AU, Oort-Cloud cometary grains may dominate between 10 and 25 AU, and Edgeworth-Kuiper Belt grains are dominant outside 25 AU. The model also predicts that while the total interplanetary mass flux at Jupiter roughly matches that inferred by the analysis of the *Galileo* DDS measurements, mass fluxes to Saturn, Uranus, and Neptune are at least one order-of-magnitude lower than that predicted by extrapolations of dust grain flux models from 1 AU. Finally, we compare the model predictions of interplanetary dust oxygen influx to the giant planet atmospheres with various observational and photochemical constraints and generally find good agreement, with the exception of Jupiter, which suggests the possibility of additional chemical pathways for exogenous oxygen in Jupiter's atmosphere.

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For preprints, contact `poppe@ssl.berkeley.edu`

or on the web at `http://research.ssl.berkeley.edu/~poppe/papers/Poppe_2016.pdf`

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Origin and Evolution of the Cometary Reservoirs

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Comets have three known reservoirs: the roughly spherical Oort Cloud (for long-period comets), the flattened Kuiper Belt (for ecliptic comets), and, surprisingly, the asteroid belt (for main-belt comets). Comets in the Oort Cloud were thought to have formed in the region of the giant planets and then placed in quasi-stable orbits at distances of thousands or tens of thousands of AU through the gravitational effects of the planets and the Galaxy. The planets were long assumed to have formed in place. However, the giant planets may have undergone two episodes of migration. The first would have taken place in the first few million years of the Solar System, during or shortly after the formation of the giant planets, when gas was still present in the protoplanetary disk around the Sun. The Grand Tack (Walsh et al., Nature 475:206–209, 2011) models how this stage of migration could explain the low mass of Mars and deplete, then repopulate the asteroid belt, with outer-belt asteroids originating between, and outside of, the orbits of the giant planets. The second stage of

migration would have occurred later (possibly hundreds of millions of years later) due to interactions with a remnant disk of planetesimals, i.e., a massive ancestor of the Kuiper Belt. Safronov (Evolution of the Protoplanetary Cloud and Formation of the Earth and the Planets, 1969) and Fernández and Ip (Icarus 58:109–120, 1984) proposed that the giant planets would have migrated as they interacted with leftover planetesimals; Jupiter would have moved slightly inward, while Saturn and (especially) Uranus and Neptune would have moved outward from the Sun. Malhotra (Nature 365:819–821, 1993) showed that Pluto's orbit in the 3:2 resonance with Neptune was a natural outcome if Neptune captured Pluto into resonance while it migrated outward. Building on this work, Tsiganis et al. (Nature 435:459–461, 2005) proposed the Nice model, in which the giant planets formed closer together than they are now, and underwent a dynamical instability that led to a flood of comets and asteroids throughout the Solar System (Gomes et al., Nature 435:466–469, 2005b). In this scenario, it is somewhat a matter of luck whether an icy planetesimal ends up in the Kuiper Belt or Oort Cloud (Brasser and Morbidelli, Icarus 225:40–49, 2013), as a Trojan asteroid (Morbidelli et al., Nature 435:462–465, 2005; Nesvorný and Vokrouhlický, Astron. J. 137:5003–5011, 2009; Nesvorný et al., Astrophys. J. 768:45, 2013), or as a distant "irregular" satellite of a giant planet (Nesvorný et al., Astron. J. 133:1962–1976, 2007). Comets could even have been captured into the asteroid belt (Levison et al., Nature 460:364–366, 2009). The remarkable finding of two "inner Oort Cloud" bodies, Sedna and 2012 VP113, with perihelion distances of 76 and 81 AU, respectively (Brown et al., Astrophys. J. 617:645–649, 2004; Trujillo and Sheppard, Nature 507:471–474, 2014), along with the discovery of other likely inner Oort Cloud bodies (Chen et al., Astrophys. J. Lett. 775:8, 2013; Brasser and Schwamb, Mon. Not. R. Astron. Soc. 446:3788–3796, 2015), suggests that the Sun formed in a denser environment, i.e., in a star cluster (Brasser et al., Icarus 184:59–82, 2006, 191:413–433, 2007, 217:1–19, 2012b; Kaib and Quinn, Icarus 197:221–238, 2008). The Sun may have orbited closer or further from the center of the Galaxy than it does now, with implications for the structure of the Oort Cloud (Kaib et al., Icarus 215:491–507, 2011). We focus on the formation of cometary nuclei; the orbital properties of the cometary reservoirs; physical properties of comets; planetary migration; the formation of the Oort Cloud in various environments; the formation and evolution of the Kuiper Belt and Scattered Disk; and the populations and size distributions of the cometary reservoirs. We close with a brief discussion of cometary analogs around other stars and a summary.

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Application of Gas Dynamical Friction for Planetesimals. I. Evolution of Single Planetesimals

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The growth of small planetesimals into large planetary embryos occurs much before the dispersal of the gas from the protoplanetary disk. The planetesimal - gaseous-disk interactions give rise to migration and orbital evolution of the planetesimals/planets. Small planetesimals are dominated by aerodynamic gas drag. Large protoplanets, $m \sim 0.1 M_{\oplus}$, are dominated by type I migration *differential* torque. There is an additional mass range, $m \sim 10^{21} - 10^{25}$ g of *intermediate mass* planetesimals (IMPs), where gravitational interactions with the disk dominate over aerodynamic gas drag, but for which such interactions were typically neglected. Here we model these interactions using the *gas dynamical friction* (GDF) approach, previously used to study the disk-planet interactions at the

planetary mass range. We find the critical size where GDF dominates over gas drag, and then study the implications of GDF on single IMPs. We find that planetesimals with small inclinations rapidly become co-planar. Eccentric orbits circularize within a few Myrs, provided the the planetesimal mass is large, $m \gtrsim 10^{23}$ g and that the initial eccentricity is low, $e \lesssim 0.1$. Planetesimals of higher masses, $m \sim 10^{24} - 10^{25}$ g inspiral on a time-scale of a few Myrs, leading to *an embryonic migration* to the inner disk. This can lead to an over-abundance of rocky material (in the form of IMPs) in the inner protoplanetary disk (< 1AU) and induce rapid planetary growth. This can explain the origin of super-Earth planets. In addition, GDF damps the velocities of IMPs, thereby cooling the planetesimal disk and affecting its collisional evolution through quenching the effects of viscous stirring by the large bodies.

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Preprints available on the web at http://arxiv.org/abs/1503.02668

PAPERS RECENTLY SUBMITTED TO JOURNALS

Application of Gas Dynamical Friction for Planetesimals. II. Evolution of Binary Planetesimals

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One of first the stages of planet formation is the growth of small planetesimals and their accumulation into large planetesimals and planetary embryos. This early stage occurs much before the dispersal of most of the gas from the protoplanetary disk. At this stage gas-planetesimal interactions play a key role in the dynamical evolution of *single* intermediate-mass planetesimals ($m_p \sim 10^{21} - 10^{25}$ g) *through gas dynamical friction* (GDF). A significant fraction of all Solar system planetesimals (asteroids and Kuiper-belt objects) are known to be binary planetesimals (BPs). Here, we explore the effects of GDF on the evolution of *binary* planetesimals embedded in a gaseous disk using an N-body code with a fiducial external force accounting for GDF. We find that GDF can induce binary mergers on timescales shorter than the disk lifetime for masses above $m_p \gtrsim 10^{22}$ g at 1 AU, independent of the binary initial separation and eccentricity. Such mergers can affect the structure of merger-formed planetesimals, and the GDF-induced binary inspiral can play a role in the evolution of the planetesimal disk. In addition, binaries on eccentric orbits around the star may evolve in the supersonic regime, where the torque reverses and the binary expands, which would enhance the cross section for planetesimal encounters with the binary. Highly inclined binaries with small mass ratios, evolve due to the combined effects of Kozai-Lidov cycles with GDF which lead to chaotic evolution. Prograde binaries go through semi-regular Kozai-Lidov evolution, while retrograde binaries frequently flip their inclination and ∼50% of them are destroyed.

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On the Surface Composition of Triton's Southern Latitudes

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We present the results of an investigation to determine the longitudinal (zonal) distributions and temporal evolution of ices on the surface of Triton. Between 2002 and 2014, we obtained 63 nights of near-infrared (0.67-2.55 μm) spectra using the SpeX instrument at NASA's Infrared Telescope Facility (IRTF). Triton has spectral features in this wavelength region from N_2, CO, CH_4, CO_2, and H_2O. Absorption features of ethane (C_2H_6) and ^{13}CO are coincident at 2.405 μm, a feature that we detect in our spectra. We calculated the integrated band area (or fractional band depth in the case of H_2O) in each nightly average spectrum, constructed longitudinal distributions, and quantified temporal evolution for each of the chosen absorption bands. The volatile ices (N_2, CO, CH_4) show significant variability over one Triton rotation and have well-constrained longitudes of peak absorption. The non-volatile ices (CO_2, H_2O) show poorly-constrained peak longitudes and little variability. The longitudinal distribution of the 2.405 μm band shows little variability over one Triton rotation and is 97±44° and 92±44° out of phase with the 1.58 μm and 2.35 μm CO bands, respectively. This evidence indicates that the 2.405 μm band is due to absorption from non-volatile ethane. CH_4 absorption increased over the period of the observations while absorption from all other ices showed no statistically significant change. We conclude from these results that the southern latitudes of Triton are currently dominated by non-volatile ices and as the sub-solar latitude migrates northwards, a larger quantity of volatile ice is coming into view.

Submitted to: Icarus

For preprints, contact `bryan.holler@colorado.edu`
or on the web at `http://arxiv.org/abs/1508.05924`

JOB ANNOUNCEMENTS

Post-Doc Positions at University of Hawai'i

The Reaction Dynamics Group, Department of Chemistry, University of Hawai'i at Manoa, invites applications for three postdoctoral positions. The appointment period is initially for one year, but can be renewed annually based on availability of funds and satisfactory progress. The salary is competitive and commensurate with experience. Successful applicants should have a strong background in one or more of the following: experimental reaction dynamics, molecular beams, low temperature condensed phase, soft matter, UHV technology, pulsed laser systems. Programming experience in labview is desirable. A description of our current research group can be found at `http://www.chem.hawaii.edu/Bil301/welcome.html`

Position I: Reaction Dynamics. The prime directive of the experiments is to investigate the formation of carbonaceous and silicon-bearing molecules in extreme environments ranging from combustion flames, CVD processes, and interstellar/circumstellar environments exploiting the crossed molecular beams method.

Position II: Soft Matter and Material Sciences. The main objective of these experimental studies is to explore the fundamental mechanisms and electron transfer processes involved in the reaction and ignition of prototype boron-based energetic ionic liquids (EILs) doped with passivated nanoparticles in levitated droplets.

Position III: Planetary Chemistry. The goal of these experiments is to probe the formation of water and/or hydroxyl radicals via interaction of the solar wind particles such as keV protons and deuterons with silicates at lunar temperatures. Reaction products will be probed via condensed phase spectroscopy and photoionization of the subliming molecules.

Solid communication skills in English (written, oral), a publication record in internationally circulated, peer-reviewed journals, and willingness to work in a team are mandatory. Only self-motivated and energetic candidates are encouraged to apply. Please send a letter of interest, three letters of recommendation, CV, and publication list to:
Prof. Ralf I. Kaiser
Department of Chemistry
University of Hawai'i at Manoa
Honolulu, HI 96822-2275, USA
`ralfk@hawaii.edu`

Applicants must demonstrate their capability to prepare manuscripts for publications independently. The review of applications will start October 15, 2015, and continues until the position is filled.

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 papers submitted, in press, or recently published in refereed journals
⋆ Titles of conference presentations
⋆ 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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Moving ... ??

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