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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

CONTENTS

NEWS & ANNOUNCEMENTS

Echoes of earlier controversies: Hayden Planetarium in New York created a bit of a stir by omitting Pluto from its list of planets (`http://www.aas.org/~dps/nfc/01.html`).

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Reported in IAU Circular 7583 (`http://cfa-www.harvard.edu/iauc/07500/07583.html`): Tony Farnham of U. Texas detected a 0.5-mag amplitude visible lightcurve in 2000 WR106. The single-peak period is about 3 hours.

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As mentioned last month, 2000 WR106 has the honor of being the object that has gone from discovery to being eligible for numbering in the shortest amount of time (about one month, thanks to detections on historical plates). Not only has it been given one of the "thousands" numbers (20000) but is has also been named: Varuna. So to add yet another superlative upon the heap, this is the first TNO to be named. Not being familiar with the name, here's what I dug up as a short bio: Varuna is from pre-Vedic Hindu mythology, and was viewed as a lord of the cosmos, keeper of divine order, and bringer of rain. He is the master of oceans and rivers, and is the deity of fluidity and movement.

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There were 2 new TNO discoveries announced since publication of the previous issue of the *Distant EKOs* Newsletter:

2000 YW134, 2001 CZ31

and 1 new Centaur/SDO discovery:

2001 BL41

Reclassified objects:
2000 GV146 (TNO $\rightarrow$ SDO)
2000 GY146 (TNO $\rightarrow$ SDO)
2000 YC2 (TNO $\rightarrow$ SDO)
1999 CG119 (SDO $\rightarrow$ TNO)

Objects with recently assigned numbers and names:
2000 WR106: (20000) Varuna
1995 QZ9: (20108)
1996 TR66: (20161)

Current number of TNOs: 366 (and Pluto & Charon)
Current number of Centaurs/SDOs: 67

PAPERS ACCEPTED TO JOURNALS

Size Determination of the Centaur Chariklo from Millimeter-wavelength Bolometer Observations

W.J. Altenhoff[1], K.M. Menten[1], and F. Bertoldi[1]

[1] Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, 53121 Bonn. Germany

Using the Max-Planck Millimeter Bolometer Array (MAMBO) at the IRAM 30m telescope we detected emission at 250 GHz from the Centaur Chariklo (1997 CU26). The observed continuum flux density implies a photometric diameter of 273 km. The resulting geometric albedo is 0.055, somewhat higher than expected from a comparison with most of the other few Centaurs and cometary nuclei for which such data are available.

Published in: Astronomy & Astrophysics, 366, L9 (2001 February)
For preprints, contact waltenhoff@mpifr-bonn.mpg.de

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Discovery of the Bright Trans-Neptunian Object 2000 EB173

I. Ferrin[1], D. Rabinowitz[2], and the Quest Collaboration

[1] Universidad de Los Andes, Departamento de Fisica, 5101, Mérida, Venezuela

[2] Physics Department, Yale University, P.O. Box 208121, New Haven, CT 06520-8121, USA

We describe the discovery circumstances and photometric properties of 2000 EB173, now one of the brightest trans-Neptunian object with opposition magnitude $m_R = 18.9$ and also one of the largest Plutinos, found with the drift-scanning camera of the QUEST Collaboration, attached to the 1-m Schmidt telescope of the National Observatory of Venezuela. Shortward of 0.7 microns, we measure $B-V = 0.99 \pm 0.14$ and $V-R = 0.57 \pm 0.05$, a red color observed for many fainter TNOs. At longer wavelengths we measure a relatively neutral color $R-I = 0.38 \pm 0.09$, a color transition previously observed only for a few fainter TNOs. At our magnitude limit $m_R = 20.1 \pm 0.20$, our single detection reveals a sky density of $0.015^{+0.034}_{-0.012}$ TNOs per square degree (the error bars are 68% confidence limits), consistent with fainter surveys, showing a cumulative number proportional to $10^{0.5\alpha m_R}$. Assuming an inclination distribution of TNOs with FWHM exceeding 30 degrees, it is likely that there are one to several hundred objects brighter than $m_R = 20.1$ that remain to be discovered.

Published in: The Astrophysical Journal Letters, 548, L243, (2001 February 20)
For preprints, contact daver@hepvms.physics.yale.edu
or on the web at http://www.arXiv.org/abs/astro-ph/0011527

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The Inclination Distribution of the Kuiper Belt

Michael E. Brown[1]

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

We develop a general method of determining the unbiased inclination distribution of the Kuiper belt using only the inclination and latitude-of-discovery of known Kuiper belt objects (KBOs). These two parameters are well determined for each discovered object, so we can use all 379 known KBOs (as of 1 January 2001) – without knowing the object's precise orbit, or the area, detection efficiency or latitudinal coverage of the survey which found the object – to determine the inclination distribution. We find that a natural analytic form for the inclination distribution is a sine of the inclination times a gaussian. The inclination distribution of all KBOs is well fit by $\sin i$ times a sum of two gaussians with widths $2.6^{+.8}_{-.2}$ and 15 ± 1 degrees. For this inclination distribution, the Kuiper belt has an effective area of 8100^{+1500}_{-1100} square degrees and a FWHM of 12.5 ± 3.5 degrees in latitude. The inclination distribution of the different dynamical classes appear different. The plutinos are well fit by $\sin i$ times a single gaussian of width $10.2^{+2.5}_{-1.8}$ degrees, the classical KBOs canno t be fit to a single gaussian but are well fit by $\sin i$ times the sum of two gaussians of widths $2.2^{+.2}_{-.6}$ and 17 ± 3 degrees, and the scattered KBOs are poorly fit by $\sin i$ times a single gaussian of width 20 ± 4 degrees. The poor fit of the scattered objects is possibly a result of limitations of the method in dealing with large eccentricities.

The effective areas of the plutinos, classical KBOs, and scattered KBOs are 9300 ± 1800, 6100 ± 2100, and 17000 ± 3000 square degrees, respectively. The FWHMs are 23 ± 5, $6.8^{+2.0}_{-3.6}$, and 44 ± 10 degrees. In all cases, the inclinations of the Kuiper belt objects appear larger than expected from dynamical simulations of possible perturbations.

To appear in: The Astronomical Journal
Preprints on the web at `www.gps.caltech.edu/~mbrown/papers`

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Migration Timescale Thresholds for Resonant Capture in the Plutino Problem

L. Friedland[1]

[1] Racah Institute of Physics, Hebrew University of Jerusalem, 91904 Jerusalem, Israel

Dynamic autoresonance theory is applied to the problem of thresholds on migration timescales for capture into resonances in the planar-restricted three-body problem with $m_1 \gg m_2 \gg m_0$ and slowly migrating masses $m_{1,2}$. The thresholds are found analytically, scale as $(m_2/m_1)^{-4/3}$, and yield an order of magnitude longer timescales required for capture of m_0 into 2:1 outer resonance as compared with 3:2 and other resonances. The difference is due to the rotation of the primary mass m_1, affecting the 2:1 resonance only. This could explain the observed small abundance of Kuiper Belt objects in the 2:1 resonance and could define accurate bounds on the timescales involved in the early evolution of the solar system.

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The 1:1 Superresonance in Pluto's Motion

X.-S. Wan[1], T.-Y. Huang[1], and K.A. Innanen[2]

[1] Department of Astronomy, Nanjing University, 22 Hankou Lu, Nanjing, Jiangsu, 210093, China

[2] Department of Physics and Astronomy, York University, 4700 Keele Street, North York ONT M3J 1P3, Canada

Three resonances, the 3:2 mean motion resonance, the Kozai resonance, and the 1:1 superresonance, are known to govern the stability of the motion of Pluto concurrently. In this work, we report an extensive numerical exploration of the 1:1 superresonance region in element space and the effects of the giant planets on this resonance. It is shown that the 1:1 superresonance region is narrower than those for the other two resonances and that it is a second-order resonance. We use the orbits of known Plutinos to investigate our result. None of these Plutinos is in the 1:1 superresonance. We also find that the Jovian planets, especially Jupiter, play important roles in concert in the superresonance.

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For preprints, contact `xswan@nju.edu.cn`

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Updated Collisional Probabilities of Minor Body Populations

A. Dell'Oro[1], F. Marzari[2], P. Paolicchi[1], and V. Vanzani[2]

[1] Dipartimento di Fisica, Universitàdi Pisa, piazza Torricelli 2, 56127 Pisa, Italy

[2] Dipartimento di Fisica, Universitàdi Padova, Via Marzolo 8, 35131 Padova, Italy

The consistent increase in the discovery rate of new asteroids and Trans Neptunian Objects (TNOs) in these last years has urged an update of the values of intrinsic probability of collision and impact velocity for some minor body populations. With the statistical method of Dell'Oro & Paolicchi (1998), we have recomputed the values of impact probability and velocity for Hilda asteroids, for Trojans vs. Short Period Comets (SPC), and for TNOs. The algorithm of Dell'Oro and Paolicchi is particularly suited for the task since it can account for resonant behaviour (Dell'Oro et al. 1998) and for the clustering of the perihelion longitude of Main Belt asteroids and Hildas, caused by the presence of a forced component in the eccentricity. The Hilda population turns out to be well sampled in the orbital parameter space since no significant changes are found for the collision frequency among Hildas, and of Hildas with Main Belt asteroids, although a much larger sample of orbits has been used in our computations (232 objects) vs. the smaller group used in previous computation by Dahlgren (1998) (40 objects). We also computed the impact rate of SPCs vs. Trojans that turned out to be an order of magnitude lower respect to the Trojans vs. Trojans impact rate. The relative velocity is instead about 30% higher. Using reasonable estimates of SPC and Trojan number densities, we find that approximately 1 every 100 collisions involving Trojans may be with an SPC. In the case of TNOs there is a consistent discrepancy between our values of the collision probability and impact speed, and those computed by Davis & Farinella (1997). The consistent increase in the number of known TNOs (186 at present, only 16 at the time of the Davis and Farinella's work) has led to a better knowledge of their distribution in the phase space and, consequently, to more reliable estimates of the collisional probability and impact velocity.

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For preprints, contact `francesco.marzari@pd.infn.it`

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A Two-Color Map of Pluto's Sub-Charon Hemisphere

Eliot F. Young[1], Richard P. Binzel[2], and Keenan Crane[3]

[1] Southwest Research Institute, Department of Space Studies, Boulder, CO 80302, USA

[2] Massachusetts Institute of Technology, Department of Earth, Atmospheric, and Planetary Science, Cambridge, MA 02139, USA

[3] Boulder High School, Boulder, CO 80302, USA

Pluto and its satellite Charon regularly occulted or transited each other's disks from 1985 through 1990. The light curves resulting from these events (collectively called "mutual events") have been used to determine albedo maps of Pluto's sub-Charon hemisphere. We now use a data set of four light curves that were obtained in both B and V Johnson filters to construct a two-color map of Pluto's surface. We are able to resolve the central part of Pluto's sub-Charon hemisphere. We find that the dark albedo feature that forms a band below Pluto's equator is comprised of several distinct color units. We detect ratios of V-filter/B-filter normal reflectances ranging from $\sim$1.15 to $\sim$1.39 on Pluto's sub-Charon hemisphere.

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For preprints, contact `efy@boulder.swri.edu`
or on the web at `http://www.boulder.swri.edu/recent/pluto_map.html`

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Hubble Space Telescope NICMOS Spectroscopy of Charon's Leading and Trailing Hemispheres

Christophe Dumas[1], Richard J. Terrile[1], Robert H. Brown[2], Glenn Schneider[3], and Bradford A. Smith[4]

[1] Jet Propulsion Laboratory, Mail Stop 183-501, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109, USA

[2] Lunar and Planetary Laboratory, University of Arizona, 1629 East University Boulevard, Tucson, AZ 85721, USA

[3] Steward Observatory, University of Arizona, 933 North Cherry Avenue, Tucson, AZ 85721, USA

[4] Institute for Astronomy, University of Hawaii, 2680 Woodlawn Drive, Honolulu, HI 96822, USA

We used the near-infrared camera and multiobject spectrometer NICMOS on the Hubble Space Telescope to obtain 1.1–2.4 μm, low-resolution ($R \sim 200$) slitless grism spectrophotometry of the individual members of the Pluto-Charon system. Water ice is present in its crystalline state on both the leading and trailing hemispheres of Charon. A 2.21 μm absorption band, possibly due to the presence of ammonia hydrate in surface, is detected in the reflectance spectrum of its leading side only. Geological activity on Charon or implantation of ions escaped from Pluto's atmosphere could account for the formation of species such as $NH_3 \cdot H_2O$ locally on the satellite. We also measured a slightly higher geometric albedo for Charon than reported from the mid-1980s observations of the mutual events.

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For reprints, contact `Christophe.Dumas@jpl.nasa.gov`
or on the web at `http://eis.jpl.nasa.gov/~cjdumas/`

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

We accept submissions for the following sections:
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⋆ Status reports of on-going programs
⋆ Requests for collaboration or observing coordination
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⋆ Announcements for conferences
⋆ Job advertisements
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