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DISTANT EKOs

The Kuiper Belt Electronic Newsletter

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CONTENTS

NEWS & ANNOUNCEMENTS

The discovery that 2000 CF105 is a binary TNO was announced in IAUC 7857 by Noll et al.. The components differ in brightness by $\Delta V = 0.87$ mag and $\Delta I = 0.56$ mag, with a separation of 0.78 arcsec (~23,000 km at 41.32 AU).
IAUC: `http://cfa-www.harvard.edu/iauc/07800/07857.html`

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The program for "From Here to Pluto-Charon: A New Horizons PKB Mission Workshop" (to be held May 20-21 in Boulder, Colorado) is now available online at:
`http://www.boulder.swri.edu/~layoung/PKBWorkshop02/`

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As the number of Kuiper belt-related objects with well-known orbits grows, are you starting to no longer recognize references to your favorite objects? A new table of cross references between provisional designations, numbers, and names has been added to the Objects page at the *Distant EKOs* website: `http://www.boulder.swri.edu/ekonews/objects/`

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There were 13 new TNO discoveries announced since the previous issue of the *Distant EKOs* Newsletter:

2001 DU108, 2001 DV108, 2001 YJ140, 2002 CY248, 2002 CC249, 2002 FU6,
2002 FV6, 2002 FW6, 2002 FX6, 2002 CC251, 2002 CD251, 2002 CE251, 2002 FP7

and 11 new Centaur/SDO discoveries:

2001 YH140, 2002 CA249, 2002 CB249, 2002 CZ248, 2001 FJ194, 2001 FK194,
2001 FL194, 2001 FM194, 2001 FN194, 2002 GB10, 2002 GO9

Reclassified objects:
2001 FL194 (SDO → TNO)
2001 KP77 (SDO → TNO)
2001 UQ18 (TNO → SDO)
2001 UR163 (TNO → SDO)
2001 XA255 (Centaur → SDO)
2001 XP254 (SDO → TNO)
2001 XS254 (SDO → TNO)
2002 CR46 (Centaur → SDO)

Objects recently assigned numbers:
1999 HB12 = (38084)
1999 HX11 = (38083)
2000 EB173 = (38628)

Objects recently assigned names:
1998 WH24 = Chaos
2001 KX76 = Ixion

Current number of TNOs: 529 (and Pluto & Charon, and 7 other TNO binary companions)
Current number of Centaurs/SDOs: 110

PAPERS ACCEPTED TO JOURNALS

Colors of Minor Bodies in the Outer Solar System: A Statistical Analysis

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We present a compilation of all available colors for 104 Minor Bodies in the Outer Solar System (MBOSSes); for each object, the original references are listed. The measurements were combined in a way that does not introduce rotational color artifacts. We then derive the slope, or reddening gradient, of the low resolution reflectance spectra obtained from the broad-band color for each object.

A set of color-color diagrams, histograms and cumulative probability functions are presented as a reference for further studies, and are discussed. In the color-color diagrams, most of the objects are located very close to the "reddening line" (corresponding to linear reflectivity spectra). A small but systematic deviation is observed toward the I band indicating a flattening of the reflectivity at longer wavelengths, as expected from laboratory spectra. A deviation from linear spectra is noticed toward the B for the bluer objects; this is not matched by laboratory spectra of fresh ices, possibly suggesting that these objects could be covered with extremely evolved/irradiated ices. Five objects (1995 SM_{55}, 1996 TL_{66}, 1999 OY_3, 1996 TO_{66} and (2060) Chiron) have almost perfectly solar colors; as two of these are known or suspected to harbour cometary activity, the others should be searched for activity or fresh ice signatures. In the color-color diagrams, 1994 ES_2, 1994 EV_3, 1995 DA_2 and 1998 HK_{151} are located very far from the main group of objects; it is suspected that this corresponds to inaccurate measurements and not intrinsically strange objects.

The color distributions were analyzed as functions of the orbital parameters of the objects and of their absolute magnitude. No significant correlation is observed, with the following exceptions: Cubewanos with low orbital excitation (low i, e and/or $\mathcal{E} = \sqrt{e^2 + \sin^2 i}$), and therefore experiencing on average fewer and less violent collisions have significantly redder colors; Cubewanos with faint absolute magnitude $M(1,1)$ tend to be redder than the others, while Plutinos present the opposite trend.

The color distribution of the various MBOSS classes are analyzed and compared using generic statistic tools. The comets were found to be significantly bluer than the other MBOSSes.

Finally, we compare the various 1D and 2D color distributions to simple models, in order to throw some light on the question of the bimodality of MBOSS color distributions. It is found that with the current data set, all color distributions are compatible with simple, continuous distribution models, while some color distributions are not compatible with simple bimodal distribution models. The tables and complete set of figures corresponding the up-to-date database are available on the web at `http://www.sc.eso.org/~ohainaut/MBOSS`

To appear in: Astronomy and Astrophysics

For preprints, contact `ohainaut@eso.org`

or on the web at `http://www.sc.eso.org/~ohainaut/MBOSS`

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Bicolour lightcurve of TNO 1996 TO_{66} with the ESO-VLT

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We performed high resolution imaging of 1996 TO_{66} in V and R bands to verify and monitor the lightcurve change, to address a colour change over a rotation and to search for a cometary activity. No activity was detected at the 29 mag/sq.arcsec level with 5400 s integration time with the ESO-VLT. Combining the data in Nov. and Dec. 1999, we obtained a complete rotation period coverage. The lightcurve was a single-peaked, with an amplitude of 0.21 mag in R. The $(V-R)$ colour displays the inhomogeneity of TNO surface. TNO's patchy surface may be cause the intensity change of water absorption feature in near-IR spectra. These observations can be the starting points for a challenging work of surface mapping of TNOs.

Published in: Astronomy & Astrophysics, 385, 281 (2002 April)

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Infrared Spectroscopy of the Largest Known Trans-Neptunian Object 2001 KX_{76}

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We report complete near-infrared (0.9–2.4 μm) spectral observations of the largest know trans-neptunian objects (TNO) 28976 = 2001 KX_{76} taken in two different nights using the new Near Infrared Camera Spectrometer (NICS) attached to the 3.56m Telescopio Nazionale Galileo (TNG). The spectra are featureless and correspond to a neutral colored object. Our observations indicate that the surface of 2001 KX_{76} is probably highly evolved due to long term irradiation, and that collisional resurfacing processes have not played an important role in its evolution.

To appear in: Astronomy & Astrophysics

Preprint by e-mail to `licandro@tng.iac.es`
or on the web at `http://xxx.lanl.gov/abs/astro-ph/0204104`

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The Binary Kuiper Belt Object 1998 WW31

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The recent discovery of a binary asteroid during a spacecraft fly-by generated keen interest, because the orbital parameters of binaries can provide measures of the masses, and mutual eclipses could allow us to determine individual sizes and bulk densities. Several binary near-Earth, main-belt and Trojan asteroids have subsequently been discovered. The Kuiper belt—the region of space extending from Neptune (at 30 astronomical units) to well over 100 AU and believed to be the source of new short-period comets—has become a fascinating new window onto the formation of our Solar System since the first member object, not counting Pluto, was discovered in 1992. Here we report that the Kuiper-belt object 1998 WW31 is binary with a highly eccentric orbit (eccentricity $e \approx 0.8$) and a long period (about 570 days), very different from the Pluto/Charon system, which was hitherto the only previously known binary in the Kuiper belt. Assuming a density in the range of 1 to 2 g cm^{-3}, the albedo of the binary components is between 0.05 and 0.08, close to the value of 0.04 generally assumed for Kuiper-belt objects.

Published in: Nature, 416, 711 (2002 April 18)

For preprints, contact `veillet@cfht.hawaii.edu`

or on the web at `http://oposite.stsci.edu/pubinfo/pr/2002/04/`

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Pluto and Charon: Formation, Seasons, Composition

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Pluto and Charon, once thought to be a singular system in an odd orbit at the edge of the solar system, are now known as members of a vast population of icy bodies beyond Neptune. Models for the occurrence of the odd orbit and formation of these bodies in the context of the total population are reviewed. Pluto's orbital characteristics, coupled with the existence of volatiles on the surface, suggest that large scale seasonal change should occur on the surface. Models of seasonal variability are discussed, past and current observations are examined for evidence of variability, and a strawman model of seasonal changes is proposed. Finally, recent observations of the surface composition of Charon are discussed and compared to observations of other similarly-sized icy bodies in the outer solar system.

Published in: Annual Review of Earth and Planetary Science, 30, 307 (2002)

Preprints on the web at `http://www.gps.caltech.edu/~mbrown/papers`

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Migration of Giant Planets in a Time-dependent Planetesimal Accretion Disc

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In this paper, we further develop the model for the migration of planets introduced in Del Popolo et al. (2001). We first model the protoplanetary nebula as a time-dependent accretion disc and find self-similar solutions to the equations of the accretion disc that give to us explicit formulas for the spatial structure and the temporal evolution of the nebula. These equations are then used to obtain the migration rate of the planet in the planetesimal disc and to study how the migration rate depends on the disc mass, on its time evolution and on some values of the dimensionless viscosity parameter α. We find that planets that are embedded in planetesimal discs, having total mass of $10^{-4} - 10^{-1}\ M_{\odot}$, can migrate inward a large distance for low values of α (e.g., $\alpha \simeq 10^{-3} - 10^{-2}$) and/or large disc mass and can survive only if the inner disc is truncated or because of tidal interaction with the star. Orbits with larger a are obtained for smaller value of the disc mass and/or for larger values of α. This model may explain several orbital features of the recently discovered giant planets orbiting nearby stars.

Published in: Monthly Notices of the Royal Astronomical Society, 332, 485

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Modern Integrations of Solar System Dynamics

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Until the early 1990s, numerical simulations of Solar System dynamics were done using accurate but slow integrators. The typical timescales were on the order of a million years, apart from exceptions achieved by considering averaged equations or using specifically designed supercomputers. In the last decade, new numerical integration methods for Solar System dynamics have been introduced. The mixed variable symplectic method (Wisdom & Holman 1991) has permitted the study, in the absence of close encounters, of the evolution of planets and small bodies on timescales comparable to the age of the Solar System. The regularized mixed variable scheme (Levison & Duncan 1994) has allowed the compilation of statistics on the evolution of thousands of near-Earth asteroids and comets, from their source regions to their dynamical elimination. The Symba and the Mercury codes (Duncan et al. 1998, Chambers 1999), which treat close encounters between massive bodies in a symplectic way, have permitted the simulations of planetary accretion and of the early phase of the highly chaotic evolution of the Solar System. This paper reviews the most exciting results obtained with these new integrators. Emphasis is given to the conceptual steps that these works represent in our understanding of Solar System dynamics.

Published in: Annual Review of Earth and Planetary Science, 30, 89 (2002)

For preprints, contact `morby@obs-nice.fr`

PAPERS RECENTLY SUBMITTED TO JOURNALS

A Collisional Family in the Classical Kuiper Belt

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Submitted to: The Astrophysical Journal Letters

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CONFERENCE CONTRIBUTIONS

Kuiper Belt Dust: Spatial Distribution and Spectral Energy Distribution

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To appear in: ASP Conference Series (Debris Disks and the Formation of Planets: A Symposium in Memory of Fred Gillet)

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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`

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