Issue No. 9 *January 2000*

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

For the numerology-inclined, the number of EKOs has passed 200 in time for the year 2000. A total of 105 EKOs and 6 Centaurs have been discovered in 1999, nearly doubling the number found in all previous years combined (and a few more 1999 discovery reports will likely trickle in during the next month or so). It is encouraging that more observing time also is being dedicated to recoveries in attempts to keep up with this phenomenal discovery rate.

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There were 19 new EKO discoveries announced since the previous issue of the *Distant EKOs* Newsletter:

1999 OG4, 1999 OH4, 1999 OJ4, 1999 OK4, 1999 OL4, 1999 OM4, 1999 ON4, 1999 OO4,
1999 RS214, 1999 RT214, 1999 RU214, 1999 RV214, 1999 TC36, 1999 XY143, 1999 RW214,
1999 RX214,1999 RY214, 1999 RZ214, 1999 RA215

And 1 new Centaur:

1999 XX143

Current number of EKOs: 216 (and Pluto & Charon)

Current number of Centaurs: 17

PAPERS ACCEPTED TO JOURNALS

A Laboratory Impact Study of Simulated Edgeworth-Kuiper Belt Objects

A. Eileen V. Ryan[1], B. Donald R. Davis[2], and C. Ian Giblin[2]

[1] New Mexico Highlands University, Department of Physics, Las Vegas, New Mexico 87701

[2] Planetary Science Institute, 620 North Sixth Avenue, Tucson, Arizona 85705

This paper reports on a series of laboratory impact experiments designed to provide basic data on how simulated Edgeworth-Kuiper belt objects (EKOs) fragment in an impact event. In September–October 1997 we carried out 20 low-velocity airgun shots at the Ames Vertical Gun Range into porous and homogeneous ice spheres using aluminum, fractured ice, and solid ice projectiles. We found that the porous ice targets behaved as strongly as solid ice in collision. Energy is apparently well dissipated by the void spaces within the target, such that these fragile ice structures respond as if they were strong in impacts. Therefore, it would appear that if EKOs are porous, they are not collisionally weak.

Also, our data show that collisional outcomes for low-velocity impacts into ice targets depend on the type of projectile used as well as the properties of the target. We observed that the degree of fragmentation for any given type of target increases as the strength of the projectile increases. Aluminum projectiles are far more damaging to the target at the same collisional energy than solid ice projectiles, which in turn, are more damaging than fractured ice projectiles. One possible explanation for this behavior is the variable depth of penetration of the projectile for different cases—stronger projectiles penetrate more deeply and couple more energy into the target than do weak projectiles. Based on this, if we assume that there has not been significant heating or differentiation in the Edgeworth-Kuiper (E-K) belt, the most applicable impact strength for the low-velocity E-K belt collisions is likely to be that derived from similar target/projectile materials impacting each other. The laboratory data from this analysis indicate that a value for impact strength $> 5 \times 10^5$ ergs/cm^3 is appropriate for porous ice targets impacted with solid/porous ice projectiles.

Published in: Icarus 142, 56 (1999 November)

For preprints, contact `eryan@physics.nmhu.edu`

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Collision Rates in the Present-Day Kuiper Belt and Centaur Regions: Applications to Surface Activation and Modification On Comets, Kuiper Belt Objects, Centaurs, and Pluto-Charon

D. D. Durda[1] & S. A. Stern[1]

[1] Department of Space Studies, Southwest Research Institute, #426, 1050 Walnut Street, Boulder, CO 80302, USA

We present results from our model of collision rates in the present-day Edgeworth-Kuiper Belt and Centaur region. We have updated previous results to allow for new estimates of the total disk population, in order to examine surface activation and modification time scales due to cratering impacts. We extend previous results showing that the surfaces of Edgeworth-Kuiper Belt objects are not primordial and have been moderately to heavily reworked by collisions. Objects smaller than

about $r = 2.5$ km have collisional disruption lifetimes less than 3.5 Gyr in the present-day collisional environment and have probably been heavily damaged in their interiors by large collisions. In the 30–50 AU region, impacts of 1 km radius comets onto individual 100 km radius objects occur on 7×10^7–4×10^8 yr time scales, cratering the surfaces of the larger objects with ∼8–54 craters 6 km in diameter over a 3.5 Gyr period. Collision time scales for impacts of 4 meter radius projectiles onto 1 km radius comets range from 3–5 $\times 10^7$ yr. The cumulative fraction of the surface area of 1 and 100 km radius objects cratered by projectiles with radii larger than 4 m ranges from a few to a few tens percent over 3.5 Gyr. The flux of Edgeworth-Kuiper Belt projectiles onto Pluto and Charon is also calculated and is found to be ∼3–5 times that of previous estimates. Our impact model is also applied to Centaur objects in the 5–30 AU region. We find that during their dynamical lifetimes within the Centaur region, objects undergo very little collisional evolution. Therefore, the collisional/cratering histories of Centaurs are dominated by the time spent in the Edgeworth-Kuiper Belt rather than the time spent on planet-crossing orbits. Further, we find that the predominant surface activity of Centaur objects like Chiron is most likely not impact-induced.

To appear in: Icarus
For preprints, contact `durda@boulder.swri.edu`

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Population of the Scattered Kuiper Belt

C. A. Trujillo[1], D. C. Jewitt[1], and J. X. Luu[2]

[1] Institute for Astronomy, 2680 Woodlawn Drive, Honolulu, HI 96822, USA

[2] Leiden Observatory, PO Box 9513, 2300 RA Leiden, The Netherlands

We present the discovery of three new Scattered Kuiper Belt Objects (SKBOs) from a wide-field survey of the ecliptic. This continuing survey has to date covered 20.2 square degrees to a limiting red magnitude of 23.6. We combine the data from this new survey with an existing survey conducted at the University of Hawaii 2.2m telescope to constrain the number and mass of the SKBOs. The SKBOs are characterized by large eccentricities, perihelia near 35 AU, and semi-major axes > 50 AU. Using a maximum-likelihood model, we estimate the total number of SKBOs larger than 100 km in diameter to be $N = (3.1^{+1.9}_{-1.3}) \times 10^4$ (1σ errors) and the total mass of SKBOs to be $M \sim 0.05 M_{\oplus}$, demonstrating that the SKBOs are similar in number and mass to the Kuiper Belt inside 50 AU.

To appear in: Astrophysical Journal Letters, 529 (2000 February 1)
For preprints, contact `chad@ifa.hawaii.edu`
or by anonymous ftp to `ftp://hubble.ifa.hawaii.edu/OUTGOING/chad/skbos/`
or on the web at `http://www.ifa.hawaii.edu/~chad/skbos/`

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Infrared Spectroscopy of Centaurs and Irregular Satellites

M.E. Brown[1]

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

We have obtained near infrared spectra of the 4 brightest known Centaurs and of 5 irregular satellites of giant planets. Many of these objects show 1.5 and 2.0 μm absorption bands indicative of water ice, including 1997 CU_{26}, Pholus, Phoebe (S9), and Nereid (N2). The satellites of Jupiter – Elara, Himalia, and Pasaphae (J6, J7, J8) – appear spectrally featureless, consistent with asteroidal origins for these bodies. Phoebe's surface water ice indicates that it formed as an icy planetesimal rather than as an asteroid.

To appear in: The Astrophysical Journal (2000 February)

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

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Evidence for Crystalline Water and Ammonia Ices on Pluto's Satellite Charon

M.E. Brown[1] **and W.M. Calvin**[2]

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

[2] University of Nevada – Reno, NV, USA

Observations have resolved the satellite Charon from its parent planet Pluto, giving separate spectra of the two objects over from 1.0 to 2.5 μm. The spectrum of Charon is found to be different from that of Pluto, with water ice in crystalline form covering most of the surface of the satellite. In addition, an absorption feature in Charon's spectrum suggests the presence of ammonia ices. Ammonia ice - water ice mixtures have been proposed as the cause of flow-like features observed on the surfaces of many icy satellites. The existence of such ices on Charon may indicate geological activity in the satellite's past.

Published in: Science, 287, 107 (2000 January 7)

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

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Detection of Water Ice on 2060 Chiron

Michael J. Foster[1], **Simon F. Green**[1], **Neil McBride**[1], **and John K. Davies**[2]

[1] Unit for Space Sciences and Astrophysics, School of Physical Sciences, University of Kent, Canterbury, UK

[2] Joint Astronomy Centre, 660 N A'ohoku Place, Hilo, Hawaii, 96720, USA

We present a reflectance spectrum of 2060 Chiron over the wavelength range 1.6-2.2 μm. The 2-μm water ice absorption feature seen in several other Centaurs at λ=2.03 μm is identified at the 5% level below the continuum.

Published in: Icarus, 141, 408 (1999 October)

For reprints, contact `S.F.Green@ukc.ac.uk`

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On the Detectability of Satellites of Small Bodies Orbiting the Sun in the Inner Region of the Edgeworth-Kuiper Belt

I. Toth[1]

[1] Konkoly Observatory, P.O. Box 67, Budapest H-1525, Hungary

The detection and observation of satellites of the small bodies orbiting the Sun in the outer Solar System is extremely important in order to determine the orbit and masses of the components in the binary system as well as to know their sizes to derive their mean bulk density. This note provides a formal estimation of the possible separation distances, orbital periods, and apparent brightnesses of possible satellites of the objects in the inner region of the Edgeworth-Kuiper Belt.

Published in: Icarus, 141, 420 (1999 October)

For preprints, contact tothi@konkoly.hu

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Periodic Orbits in the 3:2 Orbital Resonance and Their Stability

F. Varadi[1]

[1] Institute of Geophysics and Planetary Physics, UCLA, 405 Hilgard Avenue, Los Angeles, CA 90095-1567, USA

Periodic orbits in the external 3:2 orbital resonance are investigated in the context of the planar, elliptic restricted three-body problem. Differential continuation is employed to determine the location of such orbits. Their stability and periods of libration around them are also computed. Stable, nearly circular orbits for hypothetical small bodies are found in extrasolar planetary systems having a giant planet on a very eccentric orbit. These orbits cross the orbit of the giant planet, but the 3:2 orbital resonance keeps them safely apart in a configuration analogous to that of Neptune and Pluto.

Published in: The Astronomical Journal, 118, 2526 (1999 November)

For preprints, contact varadi@ucla.edu

PAPERS RECENTLY SUBMITTED TO JOURNALS

A Detection Method for the Small Kuiper Belt Objects: The Statistical Stellar Occultations

F. Roques[1], M. Moncuquet[1]

[1] DESPA, Observatoire de Paris, 92195 Meudon, France

Submitted to: Icarus

For preprints, contact `roques@obspm.fr`

OTHER PAPERS

Charon's First Detailed Spectra Hold Many Surprises

Eliot Young[1]

[1] Southwest Research Institute, Suite 426, 1050 Walnut Street, Boulder, CO, 80302, USA

Published in: Science, 287, 53 (2000 January 7)

For preprints, contact `efy@boulder.swri.edu`

CONFERENCE CONTRIBUTIONS

The American Astronomical Society's 195th annual meeting will be held January 11–15 in Atlanta, Georgia. The full list of sessions can be found at:
`http://www.aas.org/publications/baas/v31n5/aas195/SL.htm`
Below I list some Kuiper Belt-related papers to be presented at the meeting:

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Astrometric Observations of Kuiper Belt Objects

C.M. Ernst, M.J. Holman

`http://www.aas.org/publications/baas/v31n5/aas195/667.htm`

To appear in: BAAS: AAS meeting #195, paper 108.02

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Modeling Resonant Structure in the Kuiper Belt

E.K. Holmes, S.F. Dermott, K. Grogan

`http://www.aas.org/publications/baas/v31n5/aas195/474.htm`

To appear in: BAAS: AAS meeting #195, paper 108.03

CONFERENCE INFORMATION

31st International Geological Congress

2000 August 6-17
Rio de Janeiro, Brazil

http://www.31igc.org

This meeting has numerous symposia covering primarily Earth geology, but of particular interest to Kuiper belt studies are the Comparative Planetology symposia, which are listed at: http://www.31igc.org/first/scientif/general3.htm#25.

For information about symposium 25.2: "Geoscientific Research of the Outer Planets and their Satellites", contact Jeffrey S. Kargel (jkargel@flagmail.wr.usgs.gov) or Christophe Sotin (sotin@chimie.univ-nantes.fr).

For information about symposium 25.4: "Meteorites, Asteroids, Comets, and Cosmic Dust" contact Gerhard Schwehm (gschwehm@estec.esa.nl) or Celso de Barros Gomes (marciacm@usp.br).

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 ... ??

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`ekonews@boulder.swri.edu`