*Issue No. 17* *May 2001*

# DISTANT EKOs

## *The Kuiper Belt Electronic Newsletter*

*Edited by: Joel Wm. Parker*

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## CONTENTS

# NEWS & ANNOUNCEMENTS

The discovery that 1998 WW31 is a binary TNO was announced in IAUC 7610 by Veillet and collaborators. The components differ in brightness by about 0.4 mag, and their maximum separation is at least 40,000 km. The IAU Circular is available at:

`http://cfa-www.harvard.edu/iauc/07600/07610.html`

Images and details on the data are available at:

`http://cfht.hawaii.edu/ veillet/WW31.html`

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

2000 YQ142, 2001 FU172

and 1 new Centaur/SDO discovery:

2001 FZ173

Reclassified objects:
1998 WA31 (TNO $\rightarrow$ SDO)
2000 FF8 (TNO $\rightarrow$ SDO)
2000 GV146 (SDO $\rightarrow$ TNO)
2000 GY146 (SDO $\rightarrow$ TNO)

Current number of TNOs: 368 (and Pluto & Charon)
Current number of Centaurs/SDOs: 68

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# PAPERS ACCEPTED TO JOURNALS

## The Orbit Evolution of 32 Plutinos over 100 Million Years

**X.-S. Wan[1] and T.-Y. Huang[1]**

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

The orbits of thirty two plutinos that are presently in the 3:2 mean motion resonance with Neptune have been integrated numerically and accurately to 108 years into the future. Fourteen of them are found in unstable orbits after encountering Neptune or Pluto. Six of eighteen plutinos with stable orbits are in the Kozai resonance or around its separatrix zone. No node to node, perihelion to perihelion secular resonance or the so called 1:1 super resonance are found.

**Published in: Astronomy & Astrophysics, 368, 700 (2001 March)**
*For preprints, contact* xswan@nju.edu.cn
*or on the web at*
http://www.edpsciences-usa.org/articles/aa/abs/2001/11/aah2564/aah2564.html

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## The Edge of the Solar System

**R.L. Allen[1], G.M. Bernstein[1], and R. Malhotra[2]**

[1] Department of Astronomy, University of Michigan, 830 Dennison Building, 500 Church Street, Ann Arbor, MI 48109, USA

[2] Department of Planetary Sciences, University of Arizona, 1629 East University Boulevard, Tucson, AZ 85721, USA

We have surveyed for Kuiper Belt objects (KBOs) in six fields of the ecliptic (total sky area 1.5 deg$^2$) to limiting magnitudes between $R = 24.9$ and $R = 25.9$. This is deep enough to detect KBOs of diameter 160 km at a distance of 65 AU. We detected 24 objects. None of these objects, however, is beyond 53 AU. Our survey places a 95% CL upper limit of $\Sigma < 5$ deg$^{-2}$ on the surface density of KBOs larger than 160 km beyond 55 AU. This can be compared to the surface density of 6 deg$^{-2}$ of 160 km KBOs at distances 30–50 AU determined from this survey and previous shallower surveys. The mean volume density of $D > 160$ km KBOs in the 55–65 AU region is, at greater than 95% confidence, less than the mean density in the 30–50 AU region, and at most two-thirds of the mean density from 40 to 50 AU. Thus, a substantial density increase beyond 50 AU is excluded in this model-independent estimate. A dense primordial disk could be present beyond 50 AU if it contains only smaller objects or is sufficiently thin and inclined to have escaped detection in our six survey fields.

**Published in: The Astrophysical Journal, 549, L241 (2001 March 10)**
*For preprints, contact* rhiannon@astro.lsa.umich.edu
*or on the web at*
http://www.journals.uchicago.edu/ApJ/journal/issues/ApJL/v549n2/005877/005877.html

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## Properties of the Trans-Neptunian Belt: Statistics from the CFHT Survey

**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 results of a wide-field survey designed to measure the size, inclination, and radial distributions of Kuiper Belt Objects (KBOs). The survey found 86 KBOs in 73 square degrees observed to limiting red magnitude 23.7 using the Canada-France-Hawaii Telescope and the 12k x 8k CCD Mosaic camera. For the first time, both ecliptic and off-ecliptic fields were examined to more accurately constrain the inclination distribution of the KBOs. The survey data were processed using an automatic moving object detection algorithm, allowing a careful characterization of the biases involved. In this work, we quantify fundamental parameters of the Classical KBOs (CKBOs), the most numerous objects found in our sample, using the new data and a maximum likelihood simulation. Deriving results from our best-fit model, we find that the size distribution follows a differential power law with exponent $q = 4.0^{+0.6}_{-0.5}$ ($1\sigma$, or 68.27% confidence). In addition, the CKBOs inhabit a very thick disk consistent with a Gaussian distribution of inclinations with a Half-Width of $i_{1/2} = 20^{+6}_{-4}$ deg ($1\ \sigma$). We estimate that there are $N_{\rm CKBOs}(D > 100\ {\rm km}) = 3.8^{+2.0}_{-1.5} \times 10^4$ ($1\sigma$) CKBOs larger than 100 km in diameter. We also find compelling evidence for an outer edge to the CKBOs at heliocentric distance $R = 50$ AU.

**To appear in: The Astronomical Journal (2001 July)**

*For preprints, contact* `chad@gps.caltech.edu`

*or on the web at* `http://www.gps.caltech.edu/~chad/cfhtpp/ps/cfht.ps`

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## VR Photometry of Sixteen Kuiper Belt Objects

**R. Gil-Hutton[1] and Javier Licandro[2]**

[1] Félix Aguilar Observatory, San Juan, Argentina

[2] Centro Galileo Galilei, S/C de la Palma, Tenerife, Spain

We present $V$ and $R$ photometry of 16 Kuiper belt objects from the 3.6 m Telescopio Nazionale Galileo and Complejo Astronómico El Leoncito 2.1 m telescope. We find a wide dispersion in the $(V-R)$ colors of the objects, indicating nonuniform surface properties. If we assume near constant albedos, there is not appear to be a general trend of redness with size, but the color range for classical KBOs in our sample appears to be wider than for Plutinos. Unless the albedo value is variable for different objects, 1998 $SN_{165}$ becomes the largest Plutino so far identified, apart from Pluto (diameter = 2400 km) and Charon (1200 km).

**To appear in: Icarus**

*For preprints, contact* `rgilhutton@casleo.gov.ar`

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# Thermal Evolution and Differentiation of Edgeworth-Kuiper Belt Objects

**M. Cristina De Sanctis[1], M. Teresa Capria[1], and Angioletta Coradini[1]**

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The region beyond Neptune's orbit is populated with numerous bodies with semimajor axes from 31 to 48 AU. This region, known as Kuiper Belt, should contain primitive bodies, probably among the most primitive objects of the solar system. These bodies could be remnants of the solar system formation. They seem to be dark volatile rich objects showing strong relation to comets: the Kuiper belt is probably the source of most short period comets and Centaurs. The Kuiper belt objects could still contain ices and organic compounds with the same proportion as in the epoch of their formation from the primordial solar nebula. Thermal models of bodies moving on Kuiper belt orbits have been developed with the aim to follow their evolution and differentiation and to better understand the relations between them and the short period comets and Centaurs. In these models we assume that KBOs are porous bodies composed by ices and dust. The solar energy is very low between 30 and 50 AU, and radiogenic heating can become a non-negligible source of energy for the differentiation. The radioactive elements, if they exist in sufficient quantity, may modify the original composition of cometary nuclei. In these models we have assumed that the radiogenic elements stored in the refractory component are $^{40}$K, $^{232}$Th,$^{235}$U, $^{238}$U in the same proportions as in the meteoritic abundance. In some models we have included also the short lived radionuclide $^{26}$Al.

The aim of this work is to see how an undifferentiated Kuiper Belt body can change its internal structure under the combined effect of radiogenic heating and solar irradiation. Moderate heating can permit the sublimation of the most volatile ices toward the surface. The main result is that the Kuiper Belt Objects can be strongly volatile depleted. In the upper layers, several hundred meters below the surface, the most volatile ices (like CO) are completely absent.

**Published in: The Astronomical Journal, 121, 2792 (2001 May)**

*For preprints, contact* `cristina@saturn.ias.rm.cnr.it`

*or on the web at*

`http://www.journals.uchicago.edu/AJ/journal/issues/v121n5/200483/200483.html`

# PAPERS RECENTLY SUBMITTED TO JOURNALS

## Evidence for an Extended Scattered Disk

**B. Gladman[1], M. Holman[2], T. Grav[3], J. Kavelaars[4],**
**P. Nicholson[5], K. Aksnes[3], J-M. Petit[1]**
[1]Observatoire de la Côte d'Azur, France
[2]Harvard-Smithsonian Center for Astrophysics, USA
[3]University of Oslo, Norway
[4]McMaster University, Canada
[5]Cornell University, USA
Submitted to: Icarus
*For preprints, contact* `gladman@obs-nice.fr`
*or on the web at* `http://arXiv.org/abs/astro-ph/0103435`

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# OTHER PAPERS OF INTEREST

## The Role of Chaotic Resonances in the Solar System

**N. Murray[1] and M. Holman[2]**

[1] Canadian Institute for Theoretical Astrophysics, 60 St. George Street, University of Toronto, Toronto, Ontario M5S 3H8, Canada

[2] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA

Published in: Nature, 410, 773 (2001 April 12)

*For preprints, contact* mholman@cfa.harvard.edu

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## Migration of Giant Planets in Planetesimal Discs

**A. Del Popolo[1], M. Gambera[2], and E.N. Ercan[3]**

[1] Dipartimento di Matematica, Università Statale di Bergamo, Piazza Rosate, 2 - I 24129 Bergamo, ITALY

[2] Feza Gürsey Institute, P.O. Box 6 Çengelköy, Istanbul, Turkey

[3] Boğaziçi University, Physics Department, 80815 Bebek, Istanbul, Turkey

To appear in: Monthly Notices of the Royal Astronomical Society

*For preprints, contact* adelpopolo@alpha4.ct.astro.it

*or on the web at* http://arXiv.org/abs/astro-ph/0103327

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## Study of the Anomalous Acceleration of Pioneer 10 and 11

**John D. Anderson[1], Philip A. Laing[2], Eunice L. Lau[1], Anthony S. Liu[3], Michael Martin Nieto[4], Slava G. Turyshev[1]**

[1] Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, USA

[2] The Aerospace Corporation, 2350 E. El Segundo Blvd., El Segundo, CA 90245-4691, USA

[3] Astrodynamic Sciences, 2393 Silver Ridge Ave., Los Angeles, CA 90039, USA

[4] Theoretical Division (MS-B285), Los Alamos National Laboratory, University of California, Los Alamos, NM 87545, USA

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*or on the web at* http://arXiv.org/abs/gr-qc/0104064

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.

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## Moving ... ??

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`ekonews@boulder.swri.edu`