Issue No. 1 *September 1998*

DISTANT EKOs

The Kuiper Belt Electronic Newsletter

ekonews@boulder.swri.edu *Editor: Joel Wm. Parker*

CONTENTS

Welcome to the first issue of *Distant EKOs*, the newsletter devoted to the dissemination of research related to the Kuiper belt.

With interest in the Kuiper belt spreading to other areas of research (comets, disks and planet formation around other stars, etc.) and in the popular press, it seems timely to establish such a newsletter to facilitate communication among interested researchers. From a non-exhaustive search of references over the last decade, the annual publication rate of articles that mention the Kuiper belt (or one of its synonyms) is as follows:

Year of Publication	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Number of Articles	1	4	7	9	10	12	13	16	48	48	23

Roughly half of those articles are papers in refereed journals. In addition, there have been about 5–10 articles per year specific to Chiron, and about 10–30 per year about Pluto. It is clearly getting to a point where having a central resource for Kuiper belt publications and news will help researchers locate the most recent work available. It is my hope that this newsletter (and the associated web page which will be available "soon") will provide that service. This is not a purely altruistic endeavor; I have found such newsletters to be useful in the other areas of my research, and wished there was one for the Kuiper belt.

I appreciate the positive feedback I have received since I first suggested putting together such a newsletter. In fact, the only conflicting opinions I received were regarding nomenclature: *Kuiper belt* vs. *Edgeworth-Kuiper belt*. Certainly the most common usage is "Kuiper belt" (which leads by a factor of 10 by number of papers, with some authors varying their use of one or the other in different papers), but there is a sense of fairness in giving Edgeworth credit. As one person commented to me, is there any reason why the occupants of the Kuiper belt can't be called Edgeworth-Kuiper objects? So is born *Distant EKOs: The Kuiper Belt Electronic Newsletter*. Some may feel this is an oxymoron. I'll make a deal: I will change the name of the newsletter when everyone on the distribution list decides on what to call the region of space occupied by trans-Neptunian objects. (I don't think "TNO belt" would get many votes).

The distribution list for this first mailing has 242 subscribers, a very impressive start, and indicative of the level of interest in this topic. But more important than a large readership is a complete collection of new articles and news items. So again, I encourage all of you to send in articles and information.

Finally, I owe a large debt to other electronic newsletters that have paved the way and allowed me to steal ideas, formats, and web pages. I have pilfered from the *Magellanic Cloud*, *Dwarf Tales*, and *Hot Star* Newsletters, and the granddaddy of them all, the *Star Formation Newsletter*. Links to those newsletters and others will be available on the *Distant EKOs* web page.

jp

NEWS & ANNOUNCEMENTS

Census of Kuiper Comets: The Taiwan-America Occultation Survey

Alcock, Charles[1], Lee, Typhoon[2], and Chen, Wen-Ping[3]

[1] Lawrence Livermore National Laboratory, The Institute of Geophysics and Planetary Physics
[2] Academia Sinica, Institute of Astronomy and Astrophysics
[3] National Central University, Institute of Astronomy

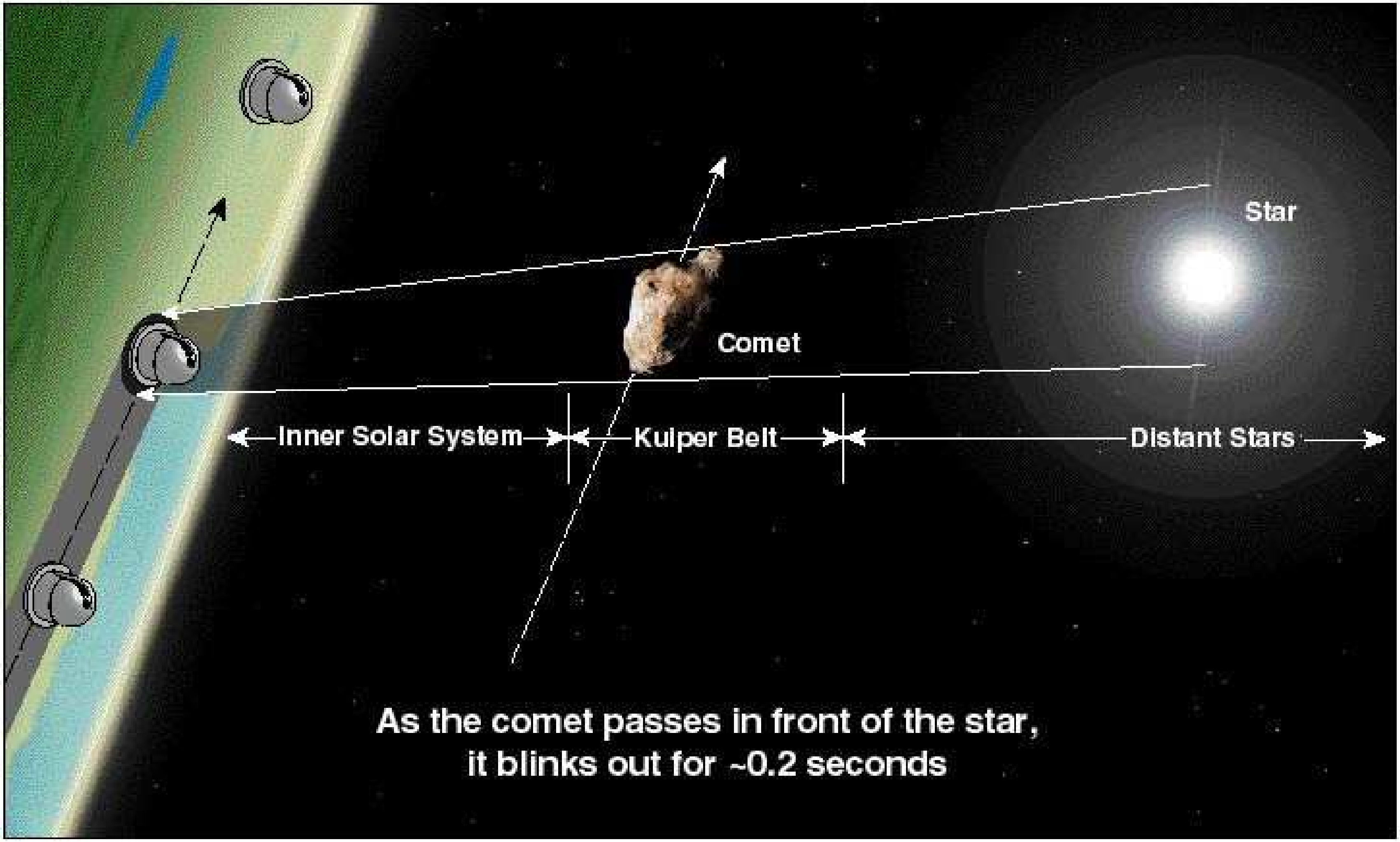
More than sixty small planetary bodies with radii > 100 km have recently been detected beyond Neptune using large telescopes. Pluto and its satellite Charon are probably the largest members of this family. The purpose of the TAOS project is to measure directly the number of these KBOs down to the typical size of cometary nuclei (a few km). A figure illustrating the proposed detection method is shown on the next page.

When a KBO moves in between the earth and a distant star it will block the starlight momentarily. A telescope monitoring the starlight will thus see it blinking. The probability of such occultation events is so low that we will need to conduct 100 billion measurements per year in order to detect the ten to four thousand such occultation events expected. The large range in this estimate reflects our ignorance in how to extrapolate from large KBOs to small ones. Evidently, there is an urgent need to conduct a census. Three small (20 inch) fast (f/1.9) wide-field (2 square degrees) robotic telescopes equipped with 2048x2048 CCD cameras will be deployed along a 7 km east-west baseline. They will operate in a coincidence mode so that the sequence and timing of the three separate blinkings can be used to distinguish real events from false alarms.

TAOS will increase our knowledge about the Kuiper Belt, the home of most short period comets that return to the inner solar system every few years. This knowledge will help us to understand the formation and evolution of comets in the early solar system as well as to estimate their flux of impacting our home planet. Lawrence Livermore National Laboratory (through its Institute of Geophysics and Planetary Physics), National Central University (Institute of Astronomy), and Academia Sinica (Institute of Earth Sciences and Institute of Astronomy and Astrophysics) will each contribute one telescope. The three partners will work together to set up the automatic observatory on peaks at 3,000 m elevation in or near the Yu-Shan (Jade Mountain) National Park in Taiwan. The current plan calls for beginning routine observation by the year 2000. The three robotic telescopes will automatically monitor 3000 stars every clear night for several years, consult among themselves to reject false events, and notify us via telecommunication when a real event is found. Follow up observations using large telescopes at major observatories around the globe attempting to detect the reflected sunlight from the KBO, hence its orbit and distance, are being organized. A fourth telescope on a north-south spur to refine the size information of occulting KBOs is also being contemplated. We also anticipate a lot of byproducts on stellar astronomy based on the large (10,000 giga-bytes/year) photometry data bank to be generated by TAOS.

For more information, go to `http://taos.asiaa.sinica.edu.tw/`

Counting Kuiper Belt objects using occultations



36723-K.Belt-001

Follow-up and Recovery of "Distant EKOs" at CFHT

C. Veillet[1]

[1] CFHT, P.O. Box 1597, Kamuela, Hawaii 96743

The observation of already discovered Trans-Neptunian Objects (TNOs) started on the Canada-France-Hawaii Telescope (CFHT) in 1997, from the availability of the author as a resident astronomer familiar with the astrometry and dynamics of faint objects in the Solar System, and from the need of follow-up or recovery at a second opposition of many TNOs in order to secure a relatively good orbit for their subsequent dynamical study.

This program is using the best configuration of the CFHT 3.6-m for this kind of observation: imaging at F/8 with a 10 arcmin field of view and an efficient STIS2 CCD with a scale of 0.44 arcsec/pixel. A magnitude of R=24 can be reached in 15 minutes in reasonable seeing conditions (1 arcsec - median seeing at CFHT is around 0.7 arcsec). Discretionary time allowed to prove that the program was feasible. Regular time has then been allocated on a joint Canadian-French proposal (D. Balam and C.Aikman at DAO, the author at CFHT). A first run in May of this year, devoted to both TNOs and Near Earth Asteroids, has been successful. Another run is planned for December, and D-time is used in between on an irregular basis. 25% of the TNOs discovered since 1996 have been reobserved at CFHT, and additional observations have been made for some older ones (including 1994 ES not observed since 1995 and recovered last May). In parallel, the images of the "Deep Wide Field Imaging Survey" undertaken with the new CFH12k detector at the prime focus will all be processed for TNOs detection, with the observation strategy optimized as much as possible for these detections.

Details on the follow-up and recovery program results, with a regular update of the observations available, can be found at `http://www.cfht.hawaii.edu/~veillet/cv_tnos.html`. Collaboration or coordination with other similar programs would be useful, and welcome!

For more information, contact `veillet@cfht.hawaii.edu`
or on the web at `http://www.cfht.hawaii.edu/~veillet/cv_tnos.html`

PAPERS ACCEPTED TO JOURNALS

Visible and Infrared Photometry of Six Centaurs

John K. Davies[1], Neil McBride[2], Sara L. Ellison[1], Simon F. Green[2], and David R. Ballantyne[1]

[1] Joint Astronomy Centre, 660 N A'ohoku Pl., Hilo, Hawaii, 96720
[2] Unit for Space Sciences & Astrophysics, University of Kent, Canterbury, CT2 7NR, UK

We present infrared (JHK) and visible (VRI) observations of the Centaurs 2060 Chiron, 5145 Pholus, 7066 Nessus, 1995 DW_2, 1995 GO and 1997 CU_{26}. These are combined whenever possible to derive relative reflectance spectra between 0.55 and 2.2μm. The extreme visible to infrared color of Pholus found in 1992 is confirmed, as is the redness of 7066 Nessus. We refine the rotation period and lightcurve of 1995 GO and resolve ambiguous determinations of its V−R color. We find that 1997 CU_{26} has V–JHK colors very similar to 1995 GO. Our data imply changes in the visible–IR color of 2060 Chiron with level of cometary activity and, aware of the difficulties of combining non-simultaneous data, we comment on the likely reality of these. We find a wide range of reflectances within the Centaur population with no obvious correlations with heliocentric distance.

To appear in: Icarus
For preprints contact `J.Davies@JACH.Hawaii.edu`
or on the web at `http://www.jach.hawaii.edu/~jkd/cv.html` and click on the link.

. . . .

Detection of Water Ice on the Centaur 1997 CU_{26}

M.E. Brown[1] and C.D. Koresko[1]

[1] Division of Geological and Planetary Sciences, Caltech, Pasadena, CA

We report the detection of the 1.5 and 2.0 μm absorption bands due to water ice in the near-infrared reflection spectrum of the Centaur 1997 CU_{26}, which is currently located just outside the heliocentric distance of Saturn. The water ice bands are weaker than those detected on the surface of any other solar system body; the spectrum is well fit with a model surface consisting predominantly of a neutral dark absorbing substance with only $\sim 3\%$ areal coverage of water ice. The spectrum thus appears very different from that of the Centaur 5140 Pholus, though both objects are of similar brightness and at similar heliocentric distances.

To appear in: Ap.J. Lett.
Preprints available on the web at `http://www.gps.caltech.edu/~mbrown/papers/pubs.html`

. . . .

Two Distinct Populations of Kuiper Belt Objects

S.C. Tegler[1] and W. Romanishin[2],

[1] Dept Physics & Astronomy, Northern Arizona University, Flagstaff, AZ 86011
[2] Dept Physics & Astronomy, University of Oklahoma, Norman, OK, 73019

The discovery of the first Kuiper belt object beyond the orbit of Neptune has initiated a revolution in our understanding of the architecture of the outer solar system. There is no longer a sharp edge to the solar system at the orbit of Pluto. About sixty Kuiper belt objects, intermediate in size between comets and planets, are known to exist on stable, circular orbits about the Sun and no doubt many more objects await discovery. Due to their recent discovery and their intrinsic faintness, little work has been done to explore the physical and chemical properties of these worlds. During the last two years we have carried out a broad band color survey of 1/4 of the known objects and found a surprising result: Kuiper belt objects exhibit two distinct color populations. One population consists of objects with surface colors only slightly redder than the color of the Sun, and the other population consists of the reddest objects in the solar system.

Published in: Nature, 392, 49-51
For preprints contact `tegler@proto.phy.nau.edu`

SUBMITTED PAPERS AND OTHER ARTICLES

The Fate of Pluto's Atmosphere

J.A. Stansberry [1] and R.V. Yelle[2]
[1] Lowell Observatory, 1400 W. Mars Hill Road, Flagstaff AZ 86001, USA
[2] Boston University, Center for Space Physics, 725 Commonwealth Ave., Boston, MA 02215, USA

Submitted to: Icarus

. . . .

Collisional and Cratering Rates in the Kuiper Belt: Applications to Surface Activation and Modification

D. D. Durda[1] and S. A. Stern[1]
[1] Southwest Research Institute, Suite 426, 1050 Walnut Street, Boulder, CO 80302, USA

Submitted to: Meeting of the Division of Planetary Sciences, AAS (to appear in BAAS)

For preprints contact `durda@boulder.swri.edu`

. . . .

Probing the Centaurs and Edgeworth-Kuiper Belt Object Populations, the Source of Short Period Comets

M. C. Festou[1], 3, M. Duncan[2], H. Levison[3], and S. A. Stern[3]
[1] Observatoire Midi-Pyrénées, Toulouse, France
[2] Queen University, Kingston, Canada,
[3] Southwest Research Institute, Boulder, CO, USA

Published in: CFHT Information Bulletin Number 37, Semester 97II

For preprints contact `festou@boulder.swri.edu`

or on the web at `http://www.cfht.hawaii.edu/bulletins/bull37/html/bulletin.htm`

REQUESTS FOR COLLABORATION

Austin Mardon is looking for collaborators in Eastern Europe, including Russia and Asia to apply for joint grants to conduct research. Please contact him at:

Austin Albert Mardon
P.O. Box 1223, Main Post Office
Edmonton, Alberta, CANADA
T5J-2M4
email: `mardon@freenet.edmonton.ab.ca`

THESES

The Resonant Dynamics in the Solar System — Application to the Motion of the Trans-Neptunian Objects

F. Thomas[1]

[1]Observatoire de la Côte d'Azur, B.P. 4229, 06304 Nice Cedex 4, France

This thesis presents a study of the resonant dynamics in the outer Solar System. The analysis consists in the determination of the properties (location and amplitude) of the mean motion, secular and Kozai resonances which could affect the orbital evolution of a little body (asteroid or comet) under the perturbations given by more massive bodies : the planets. The case of the trans-Neptunian objects is considered. Now 60 in number, they belong to a new family of big asteroids : the Kuiper belt. This system should collect, in addition to Pluto, several thousand very large bodies which should be the unused debris left after the formation of the planets.

Both analytical and numerical explorations of the resonant structure of the Kuiper belt shows that this system turns out to be made of three different parts. In the inner part (between 34 and 40 AU), order-one mean motion resonances with Neptune give phase-protections from close encounters with the resonant planet. Moreover numerical integrations reveal that these resonances are stable over a time exceeding the age of the Solar System. All the objects discovered in this part are distributed in these resonances, and mainly in the 2/3 with Neptune. Besides a non-resonant and very stable zone at small eccentricity is mysteriously unpopulated. In the intermediary region (between 40 and 42 AU) the dynamics is unstable because the secular resonances with Neptune and Uranus overlap and give big unstabilities. Theses resonances pump the eccentricity up to Neptune-crossing values so that this region is quickly depopulated. On the other hand, the dynamics in the outer part of the Kuiper belt (beyond 42 AU) is very poor : there are no secular resonances and the mean motion resonances with Neptune, being very separated from each other, have small dynamical effects. The trans-Neptunian objects detected in this region have quite big eccentricity and high inclination, and this fact cannot be explained by pure dynamics but requires the investigation of primordial mechanisms of excitation.

Dissertation directed by C. Froeschlé and A. Morbidelli
Ph.D. awarded February, 1998 from the Observatoire de Paris
Address : Observatoire de Paris, 77 avenue Denfert-Rochereau, 75014 Paris, France
Observatoire de la Côte d'Azur, B.P. 4229, 06304 Nice Cedex 04, France
E-mail address : `thomas@obs-nice.fr` *or* `thomas@orion.iagusp.usp.br`

CONFERENCE INFORMATION

Exploration of the Kuiper Belt: Where do we go from here?

Flagstaff, Arizona
September 3 and 4, 1998

`http://www.lowell.edu/research/kboconf/`

The region beyond the orbit of Neptune is home to thousands of as-yet undiscovered minor planets (and some tens of relatively recently discovered small bodies) in what is called the Kuiper Belt. The primary objective of the workshop is to define the most important observations that need to be made to characterize the Kuiper Belt and the objects in it, and to determine what operational and technological improvements are necessary in order to accelerate the pace at which we can find answers to those questions. The conclusions of the workshop will be published as a means of sparking increased and focused support from agencies and others able to augment the resources being committed to the exploration of the Kuiper Belt. The program will consist of invited reviews, contributed talks and posters, and discussion sessions.

For information/questions contact `stansber@lowell.edu`

. . . .

30th Annual Meeting of the Division for Planetary Sciences, AAS

Madison, Wisconsin
October 11–16, 1998

`http://www.ssec.wisc.edu/dps98/`

The 1998 Madison DPS meeting will consist of contributed oral talks in two parallel sessions, poster presentations in dedicated sessions, as well as invited talks and prize lectures held in plenary sessions. Posters will remain on display for the entire meeting.

[From the preliminary schedule, it appears that the Kuiper belt oral session will be on Friday morning, October 16th. —*Ed.*]

For information/questions contact `dps98@ssec.wisc.edu`

. . . .

ESO Workshop on Minor Bodies in the Outer Solar System

ESO Headquarters, D-85748 Garching near Munich, Germany
November 2–5, 1998

`http://www.eso.org/gen-fac/meetings/mboss98/`

A four-day ESO Workshop on Minor Bodies in the Outer Solar System (ESO MBOSS-98) will be held at ESO headquarters in Garching, Germany on November 2nd–5th 1998. Please note that the organisers are still accepting late registration and that there are limited funds available for assistance in attending the workshop. Interested parties should register at:
`http://www.eso.org/gen-fac/meetings/mboss98/mboss98-regist.html`

The purpose of the workshop is to review and discuss current knowledge of all minor bodies beyond the asteroid belt, as well as their origins and inter-relationships. Special emphasis will be placed on current research programmes (both observational and theoretical), and the possible uses of next-generation observational facilities such as the ESO Very Large Telescope (VLT).

A primary role of MBOSS-98 will be to pose a number of questions for debate, for which answers are required in order to advance our overall picture of the formation, evolution and interaction of these bodies. The workshop will allow observers and theoreticians to get together and discuss plans for future studies in this rapidly advancing field. As such, it is hoped that MBOSS-98 will provide a rich forum for the planning of future studies of the outer Solar system during the first years of the next millennium.

For further information, please contact:
`a.fitzsimmons@qub.ac.uk` (scientific matters)
`rwest@eso.org` (local arrangements)

. . . .

Asteroids, Comets, Meteors Conference

Cornell University
July 26–30, 1999

`http://scorpio.tn.cornell.edu/ACM/`

The next Asteroids, Comets, Meteors Conference will be held on the campus of Cornell University in the summer of 1999. This conference will be the seventh of the international ACM series. It will focus on all aspects of studies on asteroids, comets, and meteors, including observations, theories of origin and evolution, discoveries, astrometry, dynamic behavior, structure, composition, laboratory studies, classifications, and databases. Presentation and discussion of results from the Near Earth Asteroid Rendezvous (NEAR) mission are also anticipated.

The ACM program will include talks, special topics sessions, posters, round table discussions, and end-of-the-day plenary sessions. We hope to plan no more than two parallel sessions at a time, and to allow ample space and time for poster presentations.

The deadline for abstract submission will be March 26, 1999.

For information/questions contact `beth@astrosun.tn.cornell.edu`

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 also is sent out to the e-mail distribution list in the call for abstracts about a week before each issue is published. Please use that template if possible (plain ASCII text submissions also will be accepted), and send your submission to:

`ekonews@boulder.swri.edu`

The *Distant EKOs* Newsletter will be available on the World Wide Web. The URL address will be advertised in one of the next issues. Recent and back issues of the Newsletter will be archived there in various formats. The web pages also will contain other related information and links.

Moving ... ??

If you move or your e-mail address changes, please send the editor your new address. If the Newsletter bounces back from an address for three consecutive issues, the address is deleted from the mailing list. All address changes, submissions, and other correspondence should be sent to:

`ekonews@boulder.swri.edu`