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Near-Earth Asteroids:

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Observer Alert Network and Database Analysis

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Abstract

The Planetary Science Institute (PSI) has been funded by SERCulpr to develop a communication network to alert observers of newly discovered near-Earth asteroids (NEAs). This network is intended to encourage observers to obtain physical observations of NEAs, which are needed in order to characterize and assess the resource potential of these bodies. This network was declared operational in October, 1990 via an announcement to the asteroid observing community. PSI is also supported to develop the Near-Earth Asteroid Database (NEAD), a comprehensive database of physical and dynamical data on NEAs. In the past year we updated the database on newly discovered NEAs during 1990 and added new data on radar observations and dynamical classifications.

Introduction

Near-Earth asteroids are being discovered at an increasing rate; however, usually only a preliminary orbit and an estimate of the brightness of the asteroid is obtained during the discovery apparition. This is due to the brief interval (typically days to weeks) that the asteroid is bright enough to be observed by workers at 1-2 meter class telescopes. Unfortunately, it is usually several years before a newly discovered NEA makes another close apparition to Earth; thus little is known about the physical properties of NEAs until long after their discovery. However, as NASA is becoming increasingly interested in NEAs as potential mission targets and as a source of resources for expanded space activities, it is essential to learn more about these bodies as early as possible in order to meet the needs of the space program.

The importance of timely observations during the discovery apparition was recently emphasized by Wisniewski of the Lunar and Planetary Laboratory who found that over the next few years, roughly twice as many newly discovered NEAs will be bright enough for physical observation as there will be "old" NEAs this bright. The Planetary Science Institute established an Observer Alert Network in October, 1990; Appendix A contains the announcement letter that was sent to 111 observatories and individual observers. We have 14 observers on our active list that we communicate with whenever an appropriate NEA is discovered. We also assist in alerting observers of the need to obtain positions of newly discovered fast moving objects, both prior to and following the release of an IAU circular. In the two months following establishment of our network, we have responded to 4 requests to alert observers via the network. We plan to review the operation of the network next May to evaluate its effectiveness.

In addition to developing and operating the Observer Alert Network, we have developed the Near-Earth Asteroid Database (NEAD), which is designed to be a comprehensive catalogue of data on NEAs. NEAD will be a valuable tool in evaluating potential targets for near-Earth asteroid missions and for assessing the resource potential inherent in the NEA population. This database now exists as a dBase IV file, thus the tools of this relational database are available for analysis of data on near-Earth asteroids. In the past year, we expanded NEAD by adding radar data (cross-section and polarization ratio) and the dynamical classification scheme of Milani *et al.* for near-Earth asteroids. This classification is based on long timescale numerical integration of NEA orbits and includes the strong orbital perturbations due to close encounters with the terrestrial planets, which is omitted from the secular perturbation theories used to calculate proper elements. NEA lightcurves from the 2nd Photometric Catalogue (Lagerkvist *et al.* 1988) are scheduled to be added to the database early next year. Program documentation and additional analysis tools are being developed in dBase IV to make the data more usable for scientific users. Examples of the types of output available from NEAD are shown in Fig. 1.

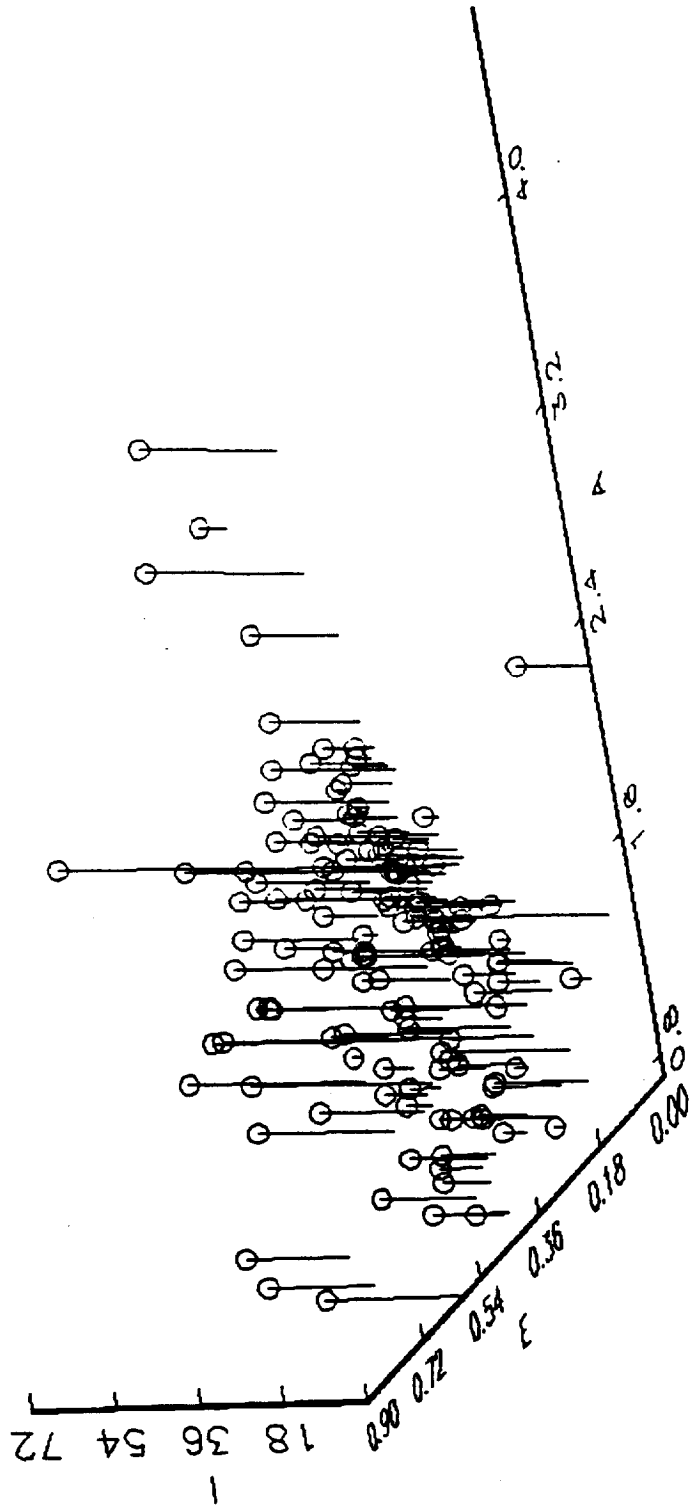


Fig. 1(a). Plot of orbital elements semimajor axis (a), eccentricity (E), and inclination (I) for all Near-Earth Asteroids.

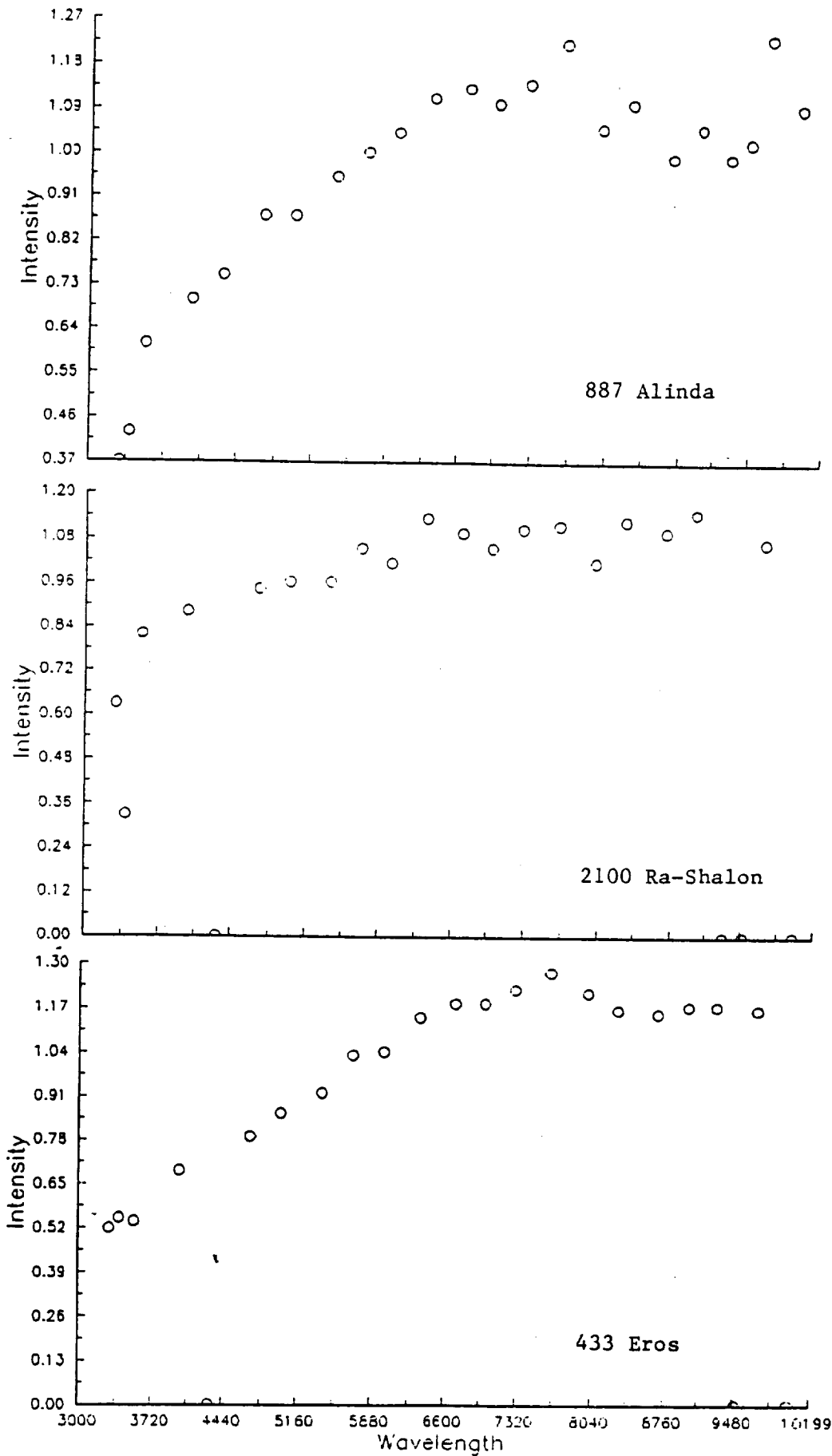


Fig. 1(b). 24-color spectrophotometry data.

REFERENCE

Lagerkvist, C.-I., *et al.* (1988). *Asteroid Photometric Catalogue: First update*. Consiglio Nazionale Delle Ricerche: Rome.

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APPENDIX A

Notification Network for Physical Observations  
of Near-Earth Asteroids

The Planetary Science Institute wishes to announce that, effective 29 October 1990, we will be operating a network designed to alert observers concerning especially interesting near-Earth asteroids for which *physical observations* are desired. The service is supported by the NASA/University of Arizona Space Engineering Research Center for the Utilization of Local Planetary Materials. The effort is headed by Dr. Donald R. Davis, with participation by Dr. Clark R. Chapman and Mr. David H. Levy.

We solicit the names and communications channels for all observers interested in being notified about important near-Earth asteroids. We will be asking them, and major observatories, to provide us with advanced observing schedules so that we will know who to contact when an important object is discovered. We will also ask the individuals who work on discovering Earth-approaching objects to notify us when particularly important objects are discovered, and we will also be regularly checking the *IAU Circulars*.

We will notify observers concerning unusually important objects for which physical observations are desired. We will give priority to those objects that (a) are likely radar targets, (b) have B brighter than 15, (c) will be well-placed for a short but adequate duration to make physical observations possible but timely notification desirable, (d) have sufficiently good orbits/ephemerides to make acquisition fairly reliable, and (e) have other unusual traits of particular interest. We anticipate, based on unofficial, partial operation of this service during the past year, that an object might meet our criteria every month or so.

The service will be an *active* supplement to the normal IAU announcements of discoveries. We encourage observers to subscribe directly to the *IAU Circulars* and to check them regularly. If you hear from us, you will know that the object is deemed to be particularly important and that an "observing campaign" is underway. We thereby hope to enhance the quantity of physical data available for these important objects that often fade so rapidly. We will be coordinating with Dr. Brian Marsden of the IAU Central Bureau to ensure that our alerts are based on sound orbits, in order to minimize wasted time at the telescope. We will be evaluating the effectiveness of the network after seven months of operation.

Our goal is to alert observers within twelve hours of when we receive notice of an important discovery (usually morning, Mountain Standard Time) but certainly within 48 hours; our response may be slower on weekends and holidays than on normal workdays. We will check *IAU Circulars* and our phone messaging service once a day, including weekends. We will send announcements out by electronic mail and telephone. While our primary goal is to alert physical observers, we will also assist when needed to alert astrometric observers about critical needs for positions.

If you have questions or suggestions about the service, or if you wish to sign up, please contact:

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2421 East Sixth Street  
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Telephone: 602/881-0332 (Logistical details can be handed by Ms. Elaine Owens at this number; during off-hours, a 24-hour message service is in operation for this telephone number.)

E-mail: PSKEY::PSKEY (on SPAN)

Fax: 602/881-0335

19 Oct 1990