Near-Earth Asteroids:

Observer Alert Network and Physical Observations

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Abstract

This project strives to obtain physical observations on newly discovered Near-Earth Objects (NEOs) in order to provide fundamental data needed to assess the resources available in the population. We have the goal of acquiring data on all objects brighter than magnitude V=17.0. To accomplish this, we have established an electronic mail alert and observer information service that informs observers around the world as to the status of physical observations on currently observable NEOs. We also acquire such data ourselves through a cooperative program with European colleagues that uses telescopes on La Palma to obtain spectra of NEOs and through observations made from a local telescope on Tumamoc Hill. This latter telescope has the advantage that large amounts of observing time are available, so that whenever a new NEO is discovered, we can be assured of getting time to observe it.

Near-Earth Objects: Observer Alert Network and Physical Observations

Progress Report and Proposed Research:

Near-Earth objects (NEOs) 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 or many years before a newly discovered NEO makes another close approach to Earth; thus little is known about the physical properties of NEOs until long after their discovery and no physical data at all exists for most NEOs. However, as NASA is becoming increasingly interested in NEOs 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 NEOs will be bright enough for physical observation as there will be "old" NEOs this bright. In order to stimulate awareness of the need for NEO observations, the Planetary Science Institute established an Observer Alert Network in October, 1990. We have twenty observers on our active list that we communicate with whenever an appropriate NEO is discovered. We also assist in alerting observers of the need to obtain positions of high priority newly discovered fast moving objects, both prior to and following the release of an IAU circular.

In the past year, we have expanded this Network to include an Observer Information File that provides current information about physical observations, both accomplished and planned, for NEOs that are currently observable. The contents of the current file are given in Appendix A. This file is updated every working day and is available over Internet to the global community of NEO observers. Use of this information will enable the observer community to plan observations so as not to duplicate those already acquired by others and to fill in "holes" in the data before the NEO fades to unobservability.

We propose to continue our information and alert service to the community as a way of maximizing the value of physical observations of NEOs. As can be seen from Appendix A, the community has been doing a fairly good job in recent months in acquiring physical observations and through our service we plan to keep emphasis focussed on these important objects.

We have also progressed on our program to acquire physical observation of NEOs both from Tumamoc Hill and in association with Dr. Alan Fitzsimmons (University of Dublin) from La Palma Observatory. Our program to acquire spectra using service observers on the 4.2m and 2.4m telescope resulted in successful observations of four NEOs. *Figure 1* gives the spectra for three of these, while the fourth one, 1992KD, has not yet been reduced. We are proposing to continue this program, one of only two programs in the world that is able to get spectra in the range from 0.4-1.0 microns on a fairly regular basis. We anticipate that we will be able to get 3-4 service nights per year and would expect to observe between 4-6 asteroids per year under this program. If newly discovered NEOs are not available when service nights are offered, then we will apply to obtain spectra of previously discovered NEOs for which no compositional information now exists.

We also propose to continue our observing program using the Tumamoc Hill Observatory a potentially usable site for obtaining physical observations for many NEOs. This 20" telescope has been used only sporadically in the past due to the lack of instrumentation, the poor state of the tracking and acquisition system, and the bright sky at the observatory which is located at the western edge of the city of Tucson. However, many of the difficulties have been corrected in the past year: 1) Photometric Corporation, Ltd., has loaned a CCD camera and controller to the Observatory and this instrument is now permanently mounted on the telescope. 2) The University of Arizona (S. Larson) provided a computer for data acquisition and storage. 3) Encoders are being added to the drive to aid in pointing the telescope and in acquiring faint objects. 4) The Planetary Science Institute provided a rack and pinion dome drive. All of these improvements are either in place or will be in place in the next few weeks. Tests by S. Larson have already established that a 19th magnitude (V) star can be detected with this CCD/telescope using a two-minute integration time.

In the past several months, we have continued to develop this observatory for carrying out physical observations. A problem occurred when the pointing system on the telescope was tested earlier this summer and it was discovered that the drive stepper-motors produced excessive vibration and caused drift in the tracking system. This required that a new set of stepper motors be installed, which has been done. Currently, R. Tucker is reprogramming the pointing system to give us basic pointing capability. As soon as this is completed, currently expected to be by the end of September, then we can start to use the observatory for physical observations. Other problems have been successfully addressed in the past several months. Software has been acquired at PSI so that we can read the data images generated by the MacIntosh system at the telescope, thus we can use

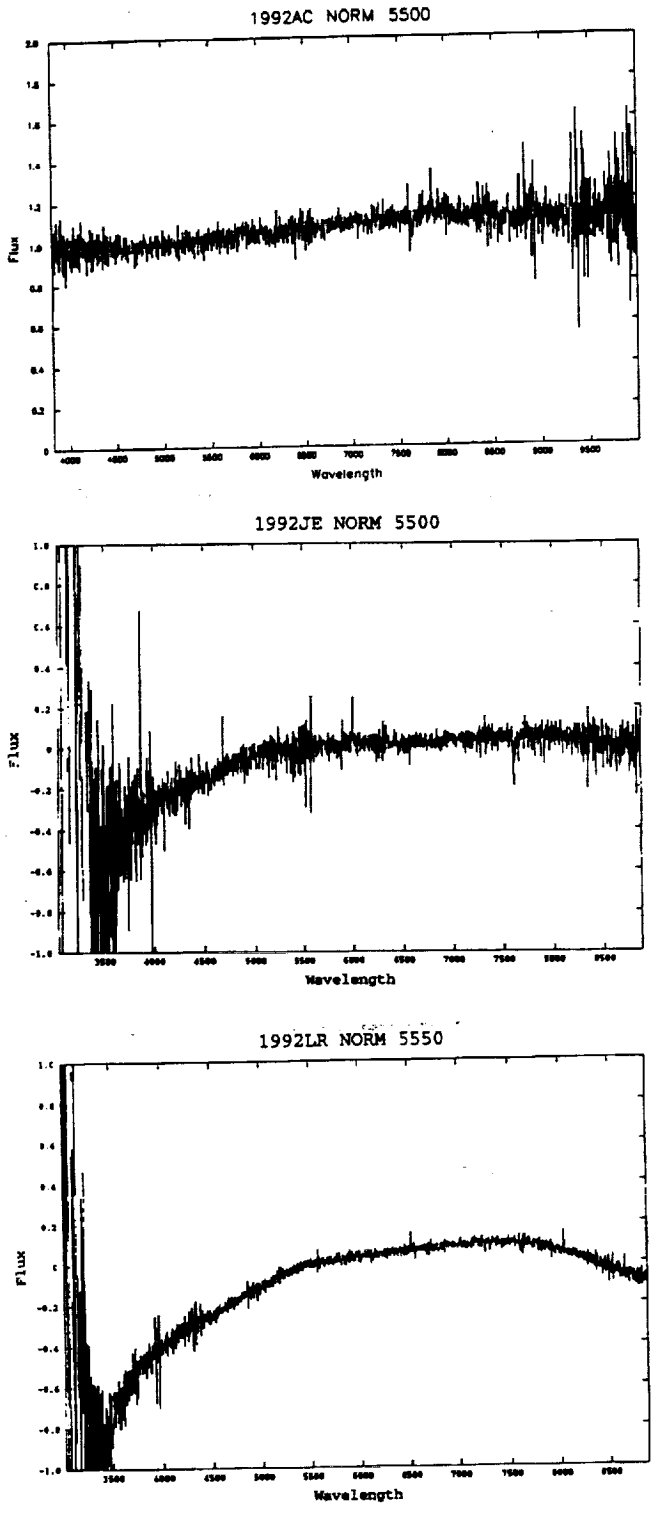

Figure 1. Spectra of 3 NEOs obtained using the 4.2m Herschel telescope on La Palma. As seen in part (a), 1992AC shows the characteristically flat spectra for an EMP type, while 1992JE, part (b), has the slightly more curved signature of the C-type asteroid. 1992LR, part (c), shows the flattening toward the red end of the spectrum characteristic of an S-type asteroid.

IRAF on our in-house Sun SPARC for data reduction. Also, we now have in-house software to produce ephemerides using the J2000.0 coordinate system, which is the system that B. Marsden uses to report newly discovered NEOs. In addition, we have hired a part-time observing assistant, Dr. Carol Neese, who will be responsible for acquiring most of the data once procedures and techniques have been established. We, as part of a consortium of scientists that is developing the Tumamoc Observatory -- the Tumamoc Hill Users Group, otherwise known by the acronym THUG -- have written a successful proposal for a small grant from the American Astronomical Society to purchase a Digital Audio Tape system, which will enable us to transfer and archive images that are taken at Tumamoc. Currently, images have to be written to a floppy disk which only holds at most 2-3 images, so if 100-200 images are acquired in a night, it takes a lot of disks as well as a lot of time to transfer them to the home institution. With this new system, a single tape will hold several hundred images.

We propose to use the Tumamoc Observatory on a regular basis to acquire physical observations of brighter NEOs. The exact limiting magnitude remains to be determined but it will be in the range of 15-17 (V), depending on how fast the object is moving and where it is located in the sky. But having access to an available telescope is essential to a program to observe newly discovered NEOs and to the goal of this program of acquiring physical observation of all such objects brighter than V = 18.0.

APPENDIX A

Example of the NEO Observer Information File

Welcome to the Near-Earth Asteroid Observer Information Network. Here follows information concerning physical observations, both accomplished and planned, for all newly discovered NEO's brighter than V=18.5. All observers are strongly encouraged to report to the network their observing plans and the outcome of those plans so that they can be added to the list. Please send information to Don Davis or Elaine Owens at 5470::PSIKEY, fax 602/881-0335, or telephone 602/881-0332.

This file was last updated on 09/11/92.

92QN discovered on IAUC 5602 on 09/03/92.
V magnitudes from Circular:

08/26/92 15.7
09/15/92 16.7
10/05/92 17.8

Observer	Data Type	Telescope	Dates	Results

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92NA discovered on IAUC 5556 on 07/05/92.
Updated on IAUC 5582.
Improved orbital elements from MPC 20647.
V magnitudes from Circular:
08/20/92 13.5
08/30/92 13.1
09/15/92 14.1

Observer	Data Type	Telescope	Dates	Results
W. Wiesniewski	lightcurve, colors	60" UA/Mt. Lemm.	08/26-30/92	u,b,v,w,x filters C type V=12.90
R. Binzel	spectra	McGHill/Kitt Pk. MDM 2.4	09/05-12/92	C type 0.4-1 um spectra 1992Sep9 UT

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92LR discovered on IAUC 5548 on 06/22/92.
Updated on IAUC 5560 and 5581.
Improved orbital elements from MPC 20646.
V magnitudes from Circular:
08/20/92 14.2
08/30/29 14.8
09/11/92 15.5

Observer	Data Type	Telescope	Dates	Results
S. Larson	colors	61" Catal. Sta.	06/26-27/92	B,V,R filters
A. Fitzsimmons	spectra	4.2m La Palma	07/21/92	spectra (.35-.9) probable S type
W. Wiesniewski	lightcurve, colors	60" UA/Mt. Lemm.	08/26-30/92	P=7h17m A=0.45m(V) Max V=14.67 u,b,v,w,x filters S type

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92JE discovered on IAUC 5515 on 05/07/92.
Updated on IAUC 5542.
Improved orbital elements from MPC 20644.
Updated on V magnitudes from Circular:
08/16/92 16.7
07/26/92 16.8
09/15/92 16.9

Observer	Data Type	Telescope	Dates	Results
S. Larson	colors	61" Catal. Sta.	06/26-27/92	B,V,R filters
W. Wisniewski	lightcurve, colors	90" UA Kitt Pk.	06/??/92	
A. Fitzsimmons	spectra	4m. La Palma	07/21/92	spectra (.4-.9) probable C type
W. Wiesniewski	lightcurve	60" UA/Mt. Lemm.	06/26-30/92	

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92HE reported on IAUC 5559 on 07/08/92.
Improved orbital elements from MPC 20644.
V magnitudes from Circular:
08/16/92 15.9
08/26/92 15.9
09/05/92 15.7

Observer	Data Type	Telescope	Dates	Results
S. Larson	colors	61" Catal. Sta.	06/26-27/92	B,V,R colors
W. Wiesniewski	lightcurve	60" UA/Mt. Lemm.	06/26-30/92	
R. Binzel	spectra	McGHill/Kitt Pk.	09/05-12/92	

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You may ftp this file to your location if you wish. Simply ftp and use the "put" command. The file name is neo.txt.