XIII

FUTURE PROSPECTS FOR COOPERATION

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Possible Collaborative Network with Small Telescopes and a Standard CCD in Japan

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Abstract. There are two obvious ways to make a quick survey work. A: A telescope with a wide field and a large size detector. B: Many telescopes with a rather narrow field and a small size detector. In Japan, there are now 47 telescopes with diameters of 50–100 cm dedicated to public use. If we develop a simple-to-handle detector system, non-professional observers at each public observatory would have the possibility of joining a collaborative survey network. We started a test observation which is expected to extend to a survey network.

1. Introduction

A Schmidt telescope has a wide field which is usually a $5° \times 5°$ field and therefore is an effective instrument for survey work. CCD detectors developed in recent decades have sensitivities much higher than photographic plates which are used for wide field Schmidt observations. The limiting magnitude for a CCD observation is much fainter than that of a photographic observation. However, since the size of the CCD detector is far smaller than that of a Schmidt photographic plate, CCD observations are not well suited to survey work. Although there are many efforts at different observatories to produce mosaic CCD detectors, their field sizes are still smaller than for photographic plates. To overcome this difficulty, we need many telescopes.

Assuming that the size of a CCD detector relative to that of a Schmidt photographic plate is 1/10, the number of telescopes needed for a CCD survey observation would be 100 times the number of Schmidt telescopes. This number seems too large to be realized under usual budgetary and manpower conditions. In this paper, we will show that there is a possibility of doing some specific surveys using telescopes with CCD detectors.

2. 47 Small Telescopes in Japan

There are only six telescopes including the Kiso 105 cm Schmidt telescope which belong to the national organization and are used for many different kinds of astronomical observations by astronomers. With the exception of the Kiso telescope, these telescopes are not used for survey work.

The national astronomical observatory of Japan is building a large telescope with an 8 m lightweight primary mirror and an alt-azimuth mounting (Kodaira, Isobe & Kogure 1984). It is expected that first light from a star will be obtained

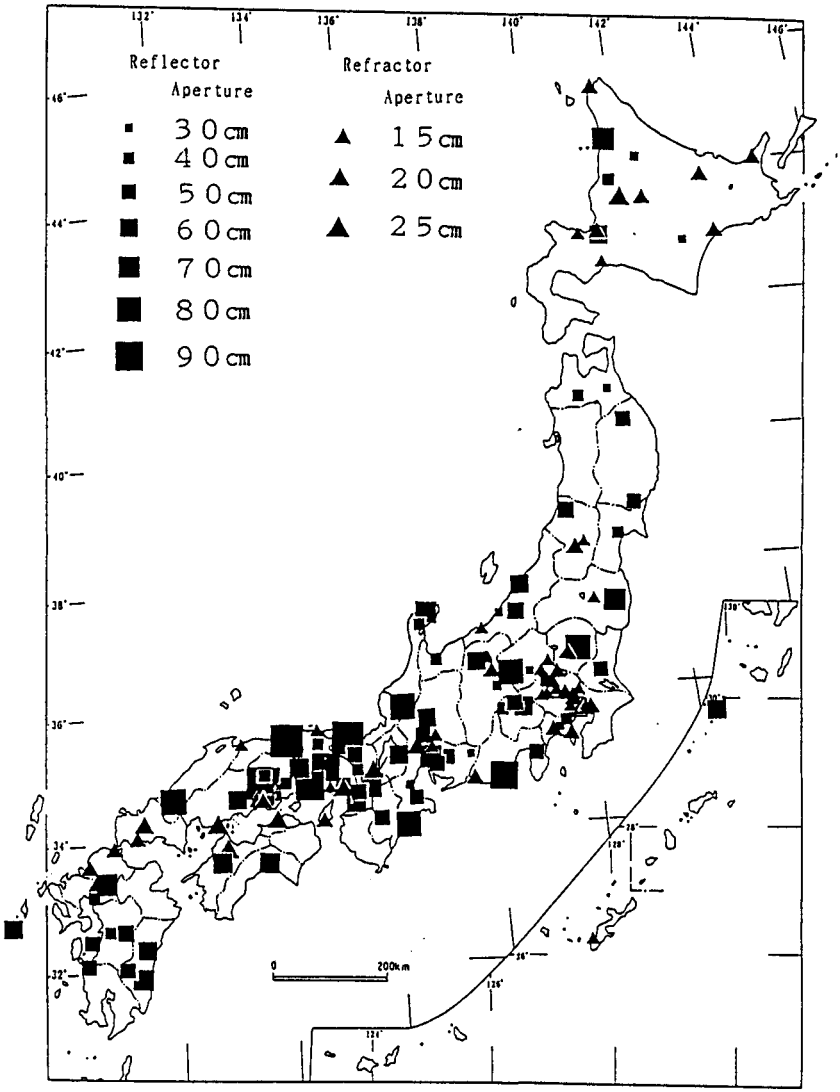

Figure 1. Distribution of public observatories with telescope(s) in Japan (by courtesy of Mr. Takehiko Kuroda at the Nishi-Harima Observatory).

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in 1999. During the development phase, I built a telescope with a 75 cm honeycomb mirror and an alt-azimuth mounting, in 1984 for the Sundai senior high school, to understand the concept of a new technology telescope (Isobe et al. 1984). After completion of this telescope, many local governments started to be interested in having a 50–100 cm telescope to show the public different celestial objects.

In 1993, we have 47 telescopes with apertures larger than 50 cm. Their distribution on a map of Japan and the increase of telescope number with time are shown in Figs 1 and 2 respectively. Nearly all of the telescopes have been built just to show some wonderful celestial objects to the public and are not used for astronomical observations. Therefore, each owner of a telescope, which in most cases is a local government, employs staff who have nearly no astronomical knowledge and work just as operators of planetariums.

A much more efficient way to popularize astronomy and astronomical observations is to prepare a collaborative survey network with a simple to use detector system for the staff at the public observatories, because they then have an opportunity to get an understanding of real astronomical observations.

3. A Survey Network to Detect Near-Earth Asteroids

We are proposing to establish a survey network for the detection of near-Earth asteroids (NEAs) which could possibly create hazardous events on Earth because of collisions (see a book edited by T. Gehrels 1994 and a paper by D. Steel in these proceedings). To detect these hazardous asteroids, three programs are running in USA and Australia, but those efforts are not enough to detect all of them.

The small telescope network proposed here is not enough to detect all the new asteroids. However, since motions of NEAs are very fast on the celestial sphere because of their short distances, a sequence of follow-up observations for the asteroids discovered in specific observatories are inevitably necessary to determine their accurate orbital elements.

We are making a test observation with a commercially available ST-6 CCD system and its software system. Three images at total light are obtained for an asteroid at three consecutive periods with a certain time interval. Using the available software system, we give each image different colours being red, yellow and blue for the first, second, and third images respectively. A reference star is selected in three images and all three images are superimposed using the star. Since all the stellar brightnesses at each exposure are same, the stellar colors on the superposed image become white. However, since the asteroid is moving relative to the stars in the field, three separate images of the asteroid with the red, yellow, and blue colors are displayed on a line (Fig. 3).

The staff at each public observatory are easily able to find three coloured images out of many white images in the field.

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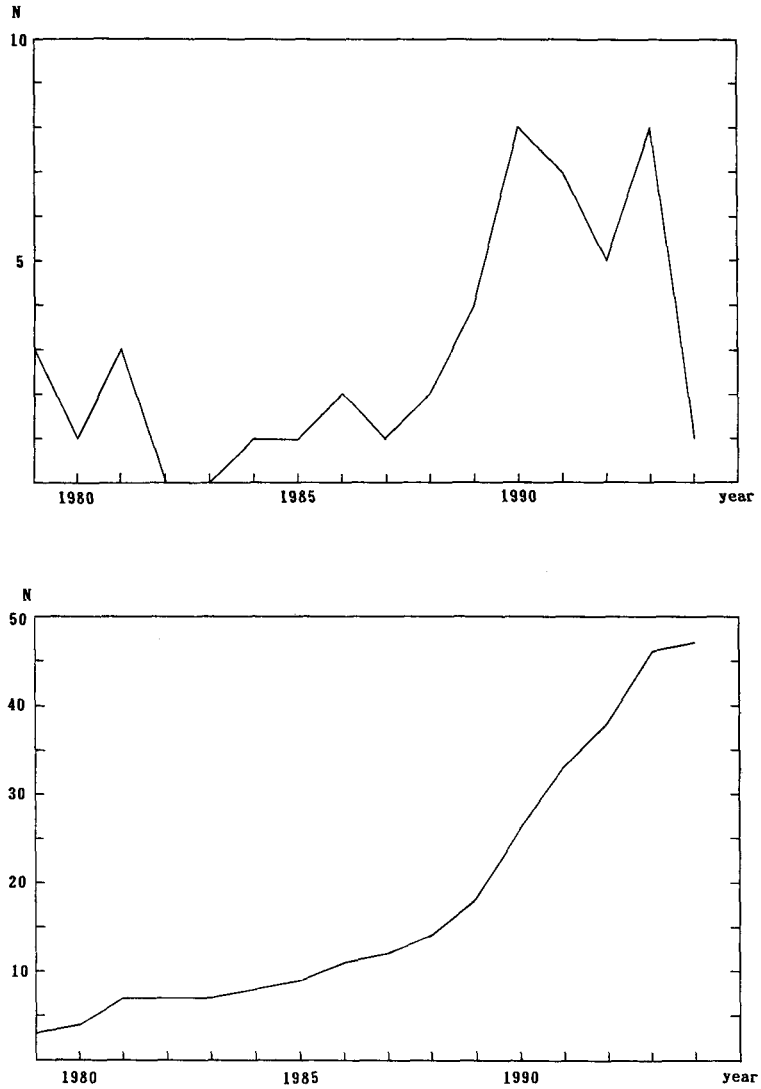

Figure 2. Number of telescopes with apertures larger than 50 cm built at each year (lower diagram) and its accumulated number (upper diagram).

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Figure 3. An image of a star field including a moving asteroid obtained as explained in the text. The asteroid shows three images with different colors while stars in the field are white.

4. Near Future

After our successful test observation we would like to organize the survey network which will, I hope, contribute to the international efforts to detect the hazardous NEAs.

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