Physical studies of asteroids at the Yunnan Observatories

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The Yunnan observatories are among the major astronomical observatories in China. There are three sites for the Yunnan observatories: Kunming, Lijiang, and Fuxian lake. There is a 1.0-m telescope at the Kunming site and a 2.4-m telescope at the Lijiang site; these are usually used for asteroid studies and are thus discussed here. Asteroids are thought to be remnants of planetesimals in the Solar System. Their physical properties, such as their spins and shapes, can provide important constraints on the formation and evolution of the entire Solar System as well as the individual small bodies themselves. Because the two telescopes are located at low latitudes (of about 25 degrees), they are useful for the observation of small Solar System bodies. With the photometric data obtained by the two telescopes, we have carried out studies on the determination of physical parameters for selected asteroids, e.g., the spin parameters and the convex shape. We analyze the surface characteristics of asteroids with the help of the spectral data from the 2.4-m telescope.

For the determination of the spin parameters and the convex shape, several inversion methods have been developed [1,2; also, Muinonen et al., present meeting], e.g., the convex inversion method [3,4]. Under the frame of a collaboration between the Yunnan Observatories and the University of Helsinki, we carried out studies on lightcurve inversion. Here, with the virtual-photometry Monte Carlo method (cf., [5]), we investigate the relationship between the uncertainties of the solutions of the convex inversion and the photometric data for some selected asteroids with different orbital inclinations. For the spin parameters and parameters related to the scattering law of the surface, uncertainties are estimated from the distributions of the parameter values derived from the virtual photometric data. As for the modeled shape, the corresponding virtual shapes are compared with a best-fit shape. The reliability of the modeled shape is investigated by the percentage of the virtual shapes which are similar to the reference shape with a probability of 0.95. Furthermore, we try to understand the relationship between the reliability of the modeled shape and the uncertainties of the spin parameters, and figure out the true pole from a pair of pole candidates, or even more numerous pole candidates.

In the near future, an 18-inch optical telescope, intended for the physical studies of asteroids, will be installed at the Lijiang site of the Yunnan Observatories. Together with the 1.0-m and 2.4-m telescopes, research on the spin parameters, convex shapes, and reflectance characteristics surfaces for special main-belt and near-Earth asteroids will be continued and extended.

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