

NEGATIVE REPORT OF OCCULTATION BY THE D-TYPE ASTEROID  
(773) IRMINTRAUD

*By Apostolos Christou and Mark Bailey  
Armagh Observatory*

An unusual negative observation is reported of the predicted occultation of the star HIP 186 by (773) Irmintraud on the morning of 21 July 2004.

*Introduction*

Stellar occultations by solar system objects (asteroids and satellites) constitute a method of determining the sizes and shapes of large samples of these bodies using small-aperture instruments to a level only otherwise achievable, in some cases, by a few large-aperture ground-based adaptive optics facilities or the Hubble Space Telescope<sup>1</sup>. They are also a means of testing the astrometric precision of their ephemerides<sup>2</sup> and the physical properties of their extant atmospheres<sup>3</sup>. During an occultation, which is a time-critical phenomenon, the asteroid-to-star geometry projects a narrow, roughly cylindrical shadow track on to the surface of the Earth, within which the star is briefly occulted.

An observing team of twelve staff and students, including summer students, was divided into three groups: John McFarland, Bebe Ishak, Anne O’Leary, Mark Purver; Apostolos Christou, David Asher, Chia-Hsien Lin, Eleanor Nolan; and Mark Bailey, Jonathan McAuliffe, Sharon McClure, Ciara Quinn. On the evening of 2004 July 20, they travelled approximately 100 miles west of Armagh to observing locations west of Sligo, Ireland, each close to the centre of the predicted shadow track, and separated from each other by a few miles. The aim was to observe, using small telescopes and binoculars, the predicted occultation of the magnitude 6.5 star HIP 186 in Pisces by the D-type minor planet (773) Irmintraud (diameter c.95 km) at approximately 01:19:22 UT on 2004 July 21. Not just was this a rare occultation of a fairly bright star, but it has been suggested<sup>4</sup> that Irmintraud could be a representative of a rare class of meteorite parent body similar to that which produced the extremely primitive Tagish Lake meteorite<sup>5</sup>.

*Results*

Despite extremely unfavourable weather (heavy rain and wind), the clouds dispersed shortly before the predicted time of the occultation, to leave both stars and the Milky Way visible through what appeared to be a ‘watery’ sky with high-level haze. Around the time of the predicted event, two of the three groups reported what seemed at first to be a rare grazing occultation, in which the star appeared to ‘blink’ off and on several times within 10–60 seconds of the predicted time of the event. It was initially thought that this could be due to passage past the star of uneven topographic features near the limb of the asteroid.

Subsequent careful timing analysis, however, showed that in addition to these events, approximately 6 further ‘blinks’ of the star were observed, each lasting of the order of a second or less, during a total observing period lasting approximately 4 minutes around the time of the predicted occultation. It is most unlikely that the entire sequence of disappearances can be attributed to any physical phenomenon associated with this unusually dark main-belt object, and it is therefore concluded that the sequence of ‘blinks’ of HIP 186 was caused by exceptionally poor atmospheric ‘seeing’ in the wake of the passing active weather system.

This result highlights an unexpected difficulty with the interpretation of visual occultation data with no video record. The experience was nevertheless valuable (and worthy of report) in

underlining how small groups of observers, using quite small instruments and simple equipment, can potentially make significant contributions to knowledge in this rapidly advancing field.

The Armagh Occultation Team's report strongly suggests that the central axis of the occultation track was at least one asteroid radius away from predictions<sup>6,7</sup>, approximately 0.03 arcseconds projected on the sky plane, or less if the asteroid is smaller than the best current estimate. This provides a constraint on the asteroid's position at the time of the event. Had the asteroid been seen from different sites to occult the star, milliarcsecond astrometry and shape determination would have been possible, as in the case of (345) Tercidina<sup>8</sup> in 2002 September.

### *Discussion*

Owing to the poor weather, the Armagh team was the only group on the island of Ireland able in principle to observe the event. Negative results were reported by observers in Spain, Italy and France<sup>9</sup>, again suggesting that the asteroid was probably quite far from its predicted path. This indicates that the ephemeris for this asteroid is not as accurate as that of the majority of large asteroids with observed occultations and/or that its physical size is smaller than the current best estimate, which may have implications for its albedo and related physical properties.

### *Acknowledgements*

We thank members of the Armagh Occultation Team for their assistance, Martin Murphy for helpful comments, two anonymous referees for encouraging remarks, and Jan Manek for coordinating European occultation reports.

### *References*

- (1) R. L. Millis, D. W. Dunham, "Precise measurements of asteroid sizes and shapes from occultations". In: Asteroids II (Binzel, R. P., Gehrels, T., Matthews, M. S., eds), p148–170, University of Arizona Press, Tucson, 1989.
- (2) B. Sicardy, et al. "The occultation of HIP 106829 by Titania". Bull. Amer. Astron. Soc. 33, 1130, 2001.
- (3) J. L. Elliot, "Stellar occultation studies of the solar system". Ann. Rev. Astron. Astrophys. 17, 445–475, 1979.
- (4) A. Kanno, T. Hiroi, R. Nakamura, M. Abe, M. Ishiguro, S. Hasegawa, S. Miyasaka, T. Sekiguchi, H. Terada, G. Igarashi, "The first detection of water absorption on a D type asteroid", Geophysical Research Letters, 30, 17, PLA 2-1–PLA 2-4, 2003.
- (5) H. Y. McSween Jr, "Identifying cosmic muck", Nature, 407, 843–844, 2000.
- (6) <http://mpocc.astro.cz/updates/2004/0721irm.html>
- (7) [http://www.asteroidoccultation.com/2004\\_07/0721\\_773\\_1842.htm](http://www.asteroidoccultation.com/2004_07/0721_773_1842.htm)
- (8) <http://www.euraster.net/results/2002/20020917-Tercidina.html>
- (9) J. Manek, personal communication.