Occultations of compact radio sources by asteroids.

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Observations of occultations of stars by asteroids at visual wavelengths is an important method to specify the size and shape of asteroids and to revise their orbital parameters. Also rings around asteroids have been found via the occultation method [1,2]. We have initiated a project to observe occultations of compact radio sources at radio frequencies.

At visual wavelengths, a shadow of a main-belt asteroid on the Earth during an occultation closely resembles its true shape and size. However, at radio wavelengths, a shadow is dominated by interference fringes, it is larger than the asteroid, and nearly independent of the shape of the asteroid. So far, we have made two successful radio observations of occultations by asteroids; the occultation by asteroid Thyra in March 2015 and by asteroid Palma in May 2017.

The occultation by Thyra was observed with the Effelsberg 100m radio telescope at ~5 GHz [3]. We showed, for the first time, that a single observation of an occultation of a compact radio source at radio frequencies can be used to derive the effective size of the occulting object and to derive the distance between the observer and the center of the occultation path on the Earth. While the main features of the observed light curve can be explained with the Fresnel-Kirchhoff diffraction law, there are some discrepancies that require further modelling.

The occultation by Palma was observed with 6 telescopes of the VLBA (Very Long Baseline Array, operated by Long Baseline Observatory (LBO)) interferometer array at ~7GHz. Only the telescope at Brewster was within the shadow of Palma. Using an interferometer array offers an exciting possibility to observe changes of signal *phase* during an occultation, something that has never been observed. We have five antenna pairs which are used to derive profiles of intensity and phase during the occultation. Theoretical models for intensity and phase, in the case of the occultation by Palma, are shown in Fig. 1.

As a spin-off of this project, we propose that radio observations of occultations are used to search for and study Kuiper belt objects.

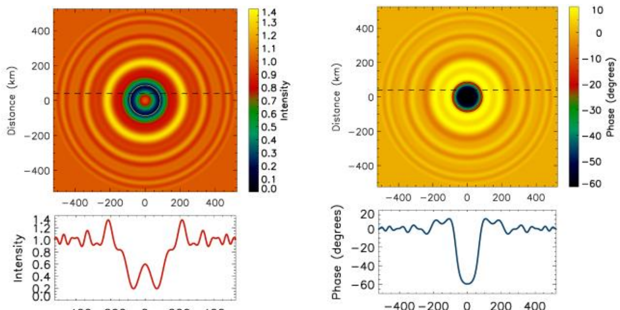

Figure 1. Theoretical models for intensity (left) and phase (right) of the occulted radio source, in the case of the occultation by Palma, based on the Fresnel-Kirchhoff diffraction law.

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