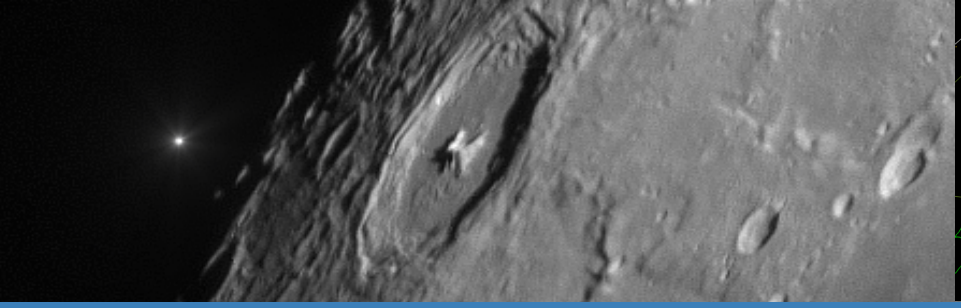
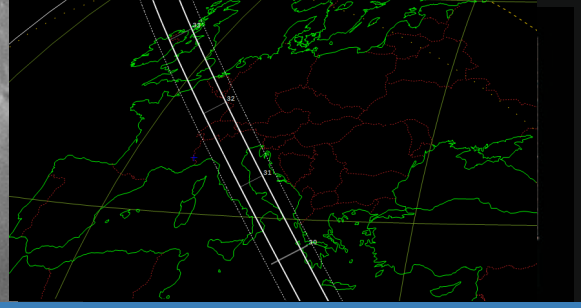
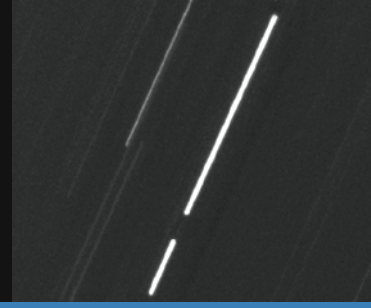





The European Section of the International Occultation Timing Association (IOTA/ES)

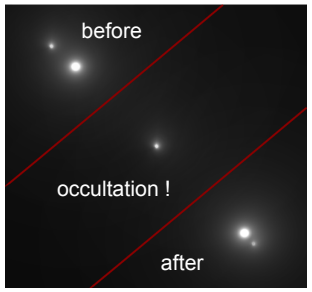
IOTA-ES is the group in Europe which provides techniques, personnel and research for all kinds of occultation astronomy, which covers occultations of stars by the Moon, by main belt asteroids, by planets as well as by bodies of the outer solar system. These occultation phenomena tell us about the shapes and possible atmospheres of the bodies, and in some cases the nature of the occulted stars.

The observer gets a fascinating insight into our solar system with an unprecedented angular resolution.

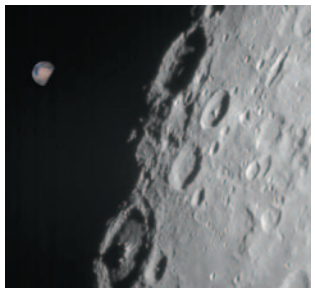
The scientific non-profit organisation IOTA/ES e.V. (registered in Hannover, Germany) is open to all people interested in occultation astronomy, either as a technology expert, observer, researcher or just a person who loves this special kind of nature in the solar system.

For an annual fee of €20 members of IOTA/ES support the English language publication "Journal for Occultation Astronomy" (JOA), which is produced in Germany for worldwide distribution. They become part of the worldwide IOTA community, which has members on all continents, all devoted to the same goal.

IOTA/ES has about 100 members (individual or corporate).



Occultation of a star by an asteroid



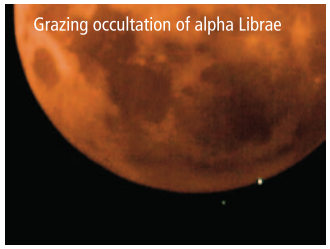
Occultation of Mars by the Moon

Every year IOTA/ES organises the European Symposium on Occultation Projects (ESOP), the annual science meeting of IOTA/ES. It generally takes place in a different European country each year at the end of August. ESOP conferences (in English) are a forum where amateur, semi-professional and professional astronomers can present and discuss new occultation observations and techniques and promote new observing campaigns. With our worldwide contacts with amateur and professional astronomers, who are working in the same subject areas, we can help all members to to work in the field of occultations and help to maintain international contacts. The online meeting places/information sources for prospective observers are the website **www.iota-es.de** and the PLANOCCULT minor planets internet list run by Belgian amateurs.

JOIN US!
Only €20
per year

Occultations of stars by the Moon

As early as the 3rd century B. C. Ptolemy observed an occultation of Spica by the Moon. This was 'only' evidence of the different distances of the two celestial bodies, yet the observation of total occultations has provided fundamental insights into many different areas.
These include, among others, selenology (the study of the Moon), star positions, determination of the geographical longitude at sea, measuring stellar diameters, double star observation and describing the Moon's orbit. Today, timings of occultations refine the Moon's edge (limb) with accuracies comparable to lunar limb data from space probes (KAGUYA, LOLA and others) and have led to the discovery of new double stars. High time resolution (in the millisecond range) can determine the diameters of stars as well. The observation of total occultations remains an impressive natural spectacle that has transferred great educational benefits from the screen. Furthermore, it trains the observer in the practical skills required when undertaking expeditions to record grazing occultations or occultations by other celestial objects.

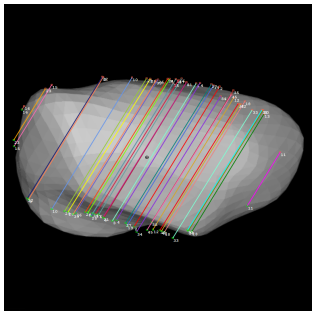


Grazing occultation of alpha Librae

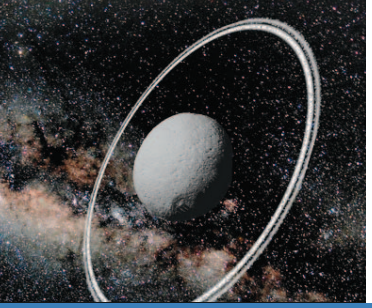
Grazing occultations by the Moon

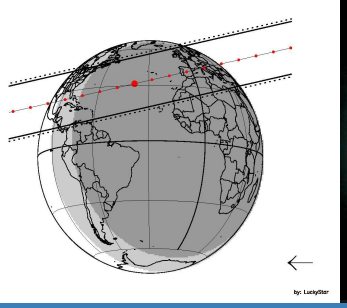
Grazing lunar occultations are among the most remarkable occultations of all. When one stands precisely on the northern or southern edge of the Moon's shadow, as projected by a star onto the Earth's surface, one can observe the star in a small telescope and watch the movement of the Moon in real time and see how many times within a few minutes the star suddenly disappears and reappears against the Moon's rugged limb. The benefits of these observations are the same as for total occultations, where measurements can be made repeatedly of the same event, but also more accurately. Erroneous star positions can be discovered in this way, and double and multiple star systems can be clearly identified on the basis of different ingress and egress angles to the limb of the Moon. IOTA/ES makes software and data available to enable successful observation of these events.

Occultations by main belt asteroids, TNOs and other objects



During its year-long orbit around the Sun an observer on Earth can see asteroids passing through star fields, hence a star can be occulted by an asteroid. This phenomenon can be observed from within the shadow path, similar to when observing a total solar eclipse. Section members try to set up observing stations within and near the shadow path to measure the duration and time of the occultation. By combining the individual observations highly accurate positions of the asteroids can be determined, as well as their diameters and shape profiles – and even satellites of asteroids have been discovered! The shadow paths must be known as accurately as possible, and in special cases the Minor Planet Center (USA) and other astrometric facilities throughout the world compute and publish new positional data a few days before the event, known as "Last-minute predictions". Using the same observing techniques as above, the diameter and shape of numerous celestial bodies can be determined, as well as of those that orbit the Sun far beyond Neptune (Trans-Neptunian Objects = TNOs).



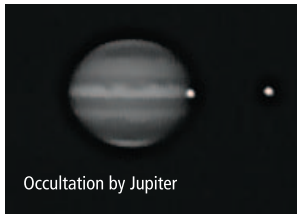


Solar eclipse 2006

Occultation by Saturn

This is an exciting field for international collaboration between professional and amateur astronomers (PRO-AM), with the aim of exploring these very distant objects at the edge of our planetary system. An important result in recent years was, for example, the discovery of a ring system around the Centaur Chariklo. The Gaia space mission with its astrometric catalogues Gaia-DR2 has largely improved the prediction quality for such occultations.

Atmospheric physics from occultations

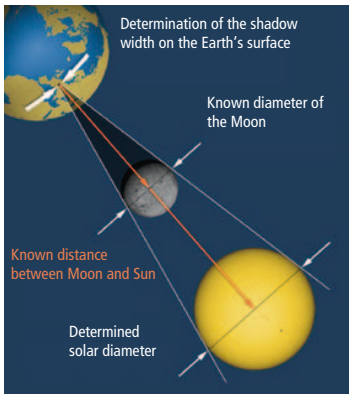


Occultation by Jupiter

Almost all of the planets, some of their satellites, as well as some of the Trans-Neptunian Objects (TNOs) may have gaseous atmospheres. During an occultation the starlight can be disrupted and/or absorbed by the gaseous envelope. This allows us to determine pressure, temperature and in some cases also chemical composition and winds of the atmosphere. Highlights in recent years in which IOTA members were involved in this work were studies of the atmospheres of Pluto and Triton.

Technical equipment for observing stellar occultations

In order to obtain scientifically useful results from occultation timings and lightcurves, one requires a sufficiently large enough telescope on a stable mount. To see events from locations, where no fixed site observatory can be found, the telescope and other equipment must be portable. Whilst for observing lunar occultations of brighter stars an aperture of 10 cm is often sufficient, a larger aperture is recommended for asteroidal occultations and certainly needed for TNO events, because the target star is often much fainter than 10th magnitude. Telescopes from 8-inch (20 cm) aperture upwards offer a great variety of observing possibilities. Additionally, knowledge of the exact observing position on the Earth and accurate time measurement are required. Affordable GPS receivers deliver both of these measurements, provided they utilise 1-pulse-per-second signal (1PPS) timing synchronisation. Internet time standards, such as distributed by the Physikalisch-Technischen Bundesanstalt in Braunschweig (PTB), are also suitable. In Europe a radio time signal (provided by the PTB) is also available on 77.5 kHz, broadcast near to Frankfurt/Main. A further requirement is to record the occultation event using video or digital cameras. Visual observations of lunar occultations are now of very limited value because of their inaccuracies. Recordings with timing resolutions of up to 1/50th second can be made using a highly sensitive video camera mounted at the focus of the telescope. Electronic accessories, such as the so-called time inserter, embed the time signal received from the connected GPS antenna and the geographical location into the video images. Modern high-sensitivity CCD cameras can operate at even significantly higher time resolutions, with which close double stars, stellar diameters and the smallest lunar limb details can be determined. A computer can also serve as the recording device. Less demanding timing accuracy is required when measuring the diameters of asteroids or even TNOs. If we assume an average motion of a TNO of 20 km/sec relative to the observer, even with 1 second time resolution an unprecedented accuracy is possible for objects about 40 astronomical units away.



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Application for Membership available on our website

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