36th European Symposium on Occultation Projects

ESOP XXXVI

Technical University
Bergakademie
Freiberg/ Germany
15th to 19th September
2017

International Occultation Timing Association
European Section

Proceedings of the

36th European Symposium on Occultation Projects

held in Freiberg, Germany
from the 15th to 19th of September 2017

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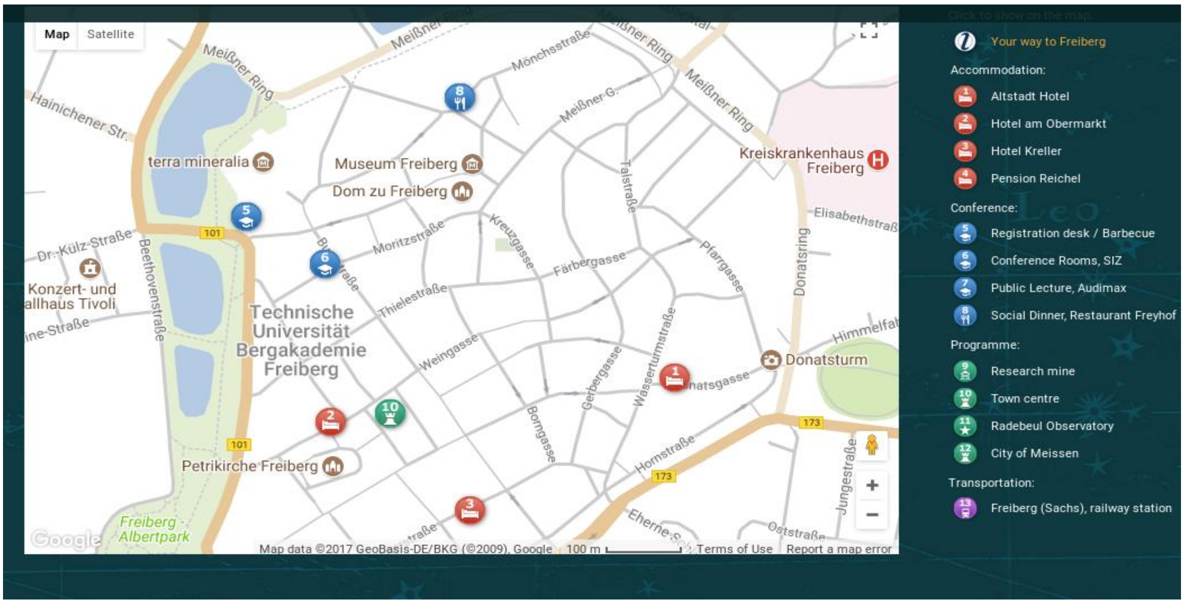
Content

Useful information

Main location of the conference:

Studien-Info-Zentrum SIZ, Prüferstr. 2, 09599 Freiberg

City map of Freiberg



WLAN Access code: Leder160

Dear Participant,

many, many conferences are being held all over the world these days. There are also several conferences being held by TU Bergakademie Freiberg each year. Since the Bergakademie is "The University of Resources. Since 1765.", we strive for a sustainable use of resources. One aspect is the reuse of conference name tags, abiding the motto "Reduce, reuse, recycle". Therefore, we kindly ask you to return the plastic part of the name tags (you may keep the paper part as a souvenir, if you wish) after the conference. Thank you for your cooperation, your help is kindly appreciated!

At the end of this volume, you will find blank pages for your personal lecture notes. This way, you have both notes and abstracts in one volume. We chose not to provide a separate notepad.

The List of participants had to be removed due to new data protection legislation.

Overview of the symposium programme

Friday, 15th September

From 16h00	Registration desk opens Krügerhaus, Schlossplatz 10
19h00 - 21h30	Barbecue, snacks and drinks Krügerhaus
21h30 till open end	Have a drink in Freiberg down town

Saturday, 16th of September, 2017

9h00 - 9h25 Opening ceremony

9h25 - 11h00 Emerging technologies. Chair: Wolfgang Beisker

30 Detlev Koschny
Kryoneri - a 1.2 m telescope with high-speed cameras

30 Karsten Schindler
Airborne Occultation Observations: Past, Present, and Future

15 Wojciech Burzynski
Do It Yourself - cheap VTI based on Arduino project

15 Eberhard Bredner
Applications of Max und Moritz

11h00 - 11h30 Coffee break

11h30 - 13h00 Asteroids

15 Atila Poro, Fatemeh Montazeri
Simulation of Asteroid's rotation

15 Zeinab S. Lesani
Introducing a new mobile application for submit and timing (Made in IOTA/ME)

20 Alexander Pratt
Occult Watcher Add-ins

20 Djunai Baba Aissa
New observations of asteroid occultations in Algeria

20 Bernd Gaehrken
Kalliope and Linus

13h00 - 14h00 Lunch

14h00 - 15h25 Lunar occultations I and previews. Chair: n.n

20 Gerhard Dangl
Observations of a grazing star occultation in daylight

30 Eberhard Bredner
Reports about recent grazing occultations

20 Dietmar Büttner
A total lunar occultation with multiple contacts

15 Oliver Kloes
Highlights of upcoming asteroidal occultations in Europe 2018

15h25 – 15h45 Coffee break

15h55 - 17h20 Lunar Occultations II Chair:

40 Leslie Morrison
Lunar Occultations and the Earth Rotation

20 Tim Haymes
Graze of 81 Tau - using GRAZPREP

25 Eberhard Riedel
GRAZPREP - features and limitations

Different Location: Audimax, Winklerstraße

18h00 - 20h00 Cosmic catastrophes – consequences and likelihood (in German)

Dr. Wolfgang Beisker: Opening introduction

Dr. Jan Michael Lange, Bergakademie
Minor planet impact – geological consequences*

Dr. D. Koschny, ESA:
Crash with a minor planet - likelihood and countermeasures*

Beisker, Lange, Koschny
Round table discussion*

20h15 - 22h15 **Social dinner** Restaurant Freyhof, Untermarkt, town centre

22h15 till open end Have a drink in Freiberg down town

*: These lectures will be held in German

Sunday, 17th of September, 2017

9h15 - 11h05 GAIA and occultation astronomy, Chair:Wolfgang Beisker

60 Stefan Jordan
The Gaia Mission - Status and Prospects

50 Bruno Sicardy
Exploring the Solar System using stellar occultations

11h05 – 11h30 Coffee break

11h30 - 13h00 Recent and future occultations Chair:Alex Pratt

15 Wolfgang Beisker
The occultation by Pluto on the 19th of July 2017

55 Mike Kretlow
The Chariklo Occultation Campaign 2017

20 Bruno Sicardy
Triton – Monitoring changes in its atmosphere

13h00 - 14h00 Lunch

14h00 - 15h20 Practical workshop Chair: Sven Anderson

80 Gerhard Dangl
Practical workshop on EXTA

15h20 - 15h35 ***Coffee break***

15h35 - 16h30 Various Chair: Wolfgang Beisker

20 Konrad Guhl, Andreas Tegtmeier, Eberhard Bredner
The solar eclipse of 21st of August 2017

20 Konrad Guhl
Observation of occultations by planets in the 19th century

10 Jan Manek
Invitation to ESOP 37 in Czech Republic

5 Closing remarks

16h30 - 18h00 extraordinary business Meeting of IOTA-ES

Abstracts of ESOP 36

Kryoneri - a 1.2 m telescope with high-speed cameras

Detlev Koschny
European Space Agency - ESA

The National Observatory of Athens owns and operates the 1.2-m Kryoneri telescope in the Peloponnese. In 2015-16, this telescope was refurbished and equipped with a camera system to observe lunar impact flashes. The project name is NELIOTA (NEO Lunar Impacts and Optical Transients). These flashes are generated when centimeter- to meter-sized meteoroids hit the lunar surface. The flux density of meteoroids in this size range is poorly constrained. Observing lunar impact flashes allows us to improve our knowledge of the flux density in this size regime.

The 1.2-m Kryoneri telescope was upgraded with new electronics and some mechanical parts. In the primary focus, a field corrector with a dichroic beam splitter with a cut-off at 730 nm was installed. Two cameras of type Andor Zyla 5.5 sCMOS record images with a frame rate of 30/s. The cameras can be read out with 12 or 16 bit. The final system has an f-ratio of f/3.1 and a field of view of 17' x 14.3'. The two cameras allow us to exclude false detections due to cosmic ray events on the detector. Due to the dichroic beam splitter, the ratio of the event brightness will allow a very rough temperature estimate of the impact flash.

The observation of lunar impact flashes was the rationale for this refurbishment. The project has funding to operate the system for 22 months during the times when the lunar phase is favorable. The setup also offers itself for observing stellar occultations by asteroids. A small number of potential occultations have been observed so far, however without any positive result. The timing accuracy of the cameras is still under refinement. Once done, the telescope will be well-suited for occultation observations, pending the availability of an observer.

Airborne Occultation Observations: Past, Present, and Future

Karsten Schindler
Deutsches SOFIA Institut, Universität Stuttgart, Germany
SOFIA Science Center, NASA Ames Research Center, Moffett Field, CA, USA

Stellar occultations have been observed from airborne platforms for more than four decades. Flying above the troposphere’s weather, clouds, and ≈75% of Earth’s atmosphere, airborne telescopes allow observations at optimal locations that are nearly unaffected by scintillation noise. This enables photometric measurements with very high precision. The Kuiper Airborne Observatory (KAO, 1971 – 1995) carried out a number of significant occultation observations that lead to key scientific discoveries. Some of them laid the foundation for scientific investigations that remained hot topics in the science community until today, in particular continued studies of Pluto, Triton, and Chiron. The Stratospheric Observatory for Infrared Astronomy (SOFIA) aims to continue this airborne occultation program, and observed two Pluto occultations in 2011 and 2015 to study the evolution of Pluto’s atmosphere. SOFIA’s next endeavor will be the upcoming Triton occultation on 5 October 2017. Flying out of Daytona Beach, Florida, SOFIA aims to intercept Triton's shadow above the mid-Atlantic, about 1500 miles off Florida's coast, right at the shadow's center to observe the “central flash”. This mission will be the first opportunity for European observers to collect data simultaneously with SOFIA, thus helping to collect essential data points at different latitudes, and contributing directly to SOFIA‘s quest to analyze the current state of Triton's atmosphere. In my talk, I will reflect about the occultation legacy of KAO, latest results from SOFIA, and our current plans to observe the Triton occultation.

Applications of Max und Moritz

Eberhard Bredner
IOTA-ES

Organizing occultation observations often means that there are participants but without the appropriate equipment. So I created Max and Moritz, now also Witwe Bolte. This are electronic-sets completely independent but fit to get precise data - the user only has to provide a telescope of sufficient power.

Do It Yourself - cheap VTI based on Arduino project

W. Burzynski
IOTA-ES

Every observer of occultation phenomena, even less experienced in electronics and computer science, can build his own video time inserter. The Arduino programming platform allows to do it quickly and simply - the device is constructed of ready-made components, literally like blocks. At the heart of the device is a simple 8-bit Atmel AVR microcontroller and its software and libraries are available on the internet as an open source. For a price even under 100 EUR you can do yourself a reliable time keeping device. In addition, the Arduino board can be the basis for the construction of other observation devices such as the sky quality meter or the cloud detector.

Simulation of asteroid rotation

Atila Poro [1], Fatemeh Montazeri Najafabadi [1]
[1] *International Occultation Timing Association Middle East Section (IOTA/ME)*

Keywords: Asteroid, Occultation, light curve, minor planet, flashing

Minor planet is any astronomical object in direct orbit around our Sun that is not a planet, dwarf planet, or a comet. Asteroids are minor planets made of stone, metal, or carbon with no atmosphere. And there are a lot of asteroid in sky but many of their properties are unknown because we can't send enough satellite and use telescopes to study them.

The physical properties of minor planets, such as rotational states and shapes, represent a portrait of both history and evolution of these small solar-system objects. Building a three dimensional shape model is possible theoretically from two dimension models; yet this has not been performed effectively with just occultation data. But many such models have been constructed from light curve inversion.

The rotational phase of the asteroid impacts the amount of observed radiation at a certain point in time; since minor planets have irregular shapes, the portion of their surface area which is both visible and illuminated will change as it rotates.

Therefore, the total amount of reflected sunlight seen by a sensor on Earth varies unless we have a pole-on view to the asteroid. A sequence of brightness measurements is important.

Occultation’s data are used to better our understanding of asteroid physiology: such as asteroid orbit, shape and size and this is the only method to understand this physiology. This method provides timings for instantaneous measurement of an asteroid part between the occulted star and the observer equally. So for enough observations, we can have two dimensional silhouette that is used in specific location in the asteroid's rotational light curve.

In some of the occultation we have twice minimum in our light curves. It means at the moment we see a large scale decrease the brightness and after that increase again because of that we called this phenomenon flashing. By observation of this phenomenon, determination of physical characteristics of asteroids will be easier. This phenomenon has a reason. It can be because of the asteroid's rings. Or also can be because of asteroid rotation with high speed. We study in this cause for flashing. If the 3d dimension of asteroid is so elliptical with large eccentricity It could be a reason that when combined with the high speediness of rotation asteroids, may be produce these flashings. So flashing doesn't occur for all asteroids. There must be some special cases for occurring this phenomenon. Most important of them is that; the asteroid must be oval, distribution of mass asteroid must be heterogeneous; generally one side has more mass than the other side. Also the distance between star and asteroid, brightness and the observation angle are also effective parameters to be and observe or not to be and not observe flashing.

Theoretical methods and simulations can help us more. So in this work; we can guess the rotational speed of asteroid that make asteroid to flashing by simulation.

Introducing a New Mobile Application for Timing

Zeinab S. Lesani [1] ; Atila Poro [1]
[1] *International Occultation Timing Association Middle East Section (IOTA/ME)*

Keywords: Timing, Asteroid, Occultation, Application

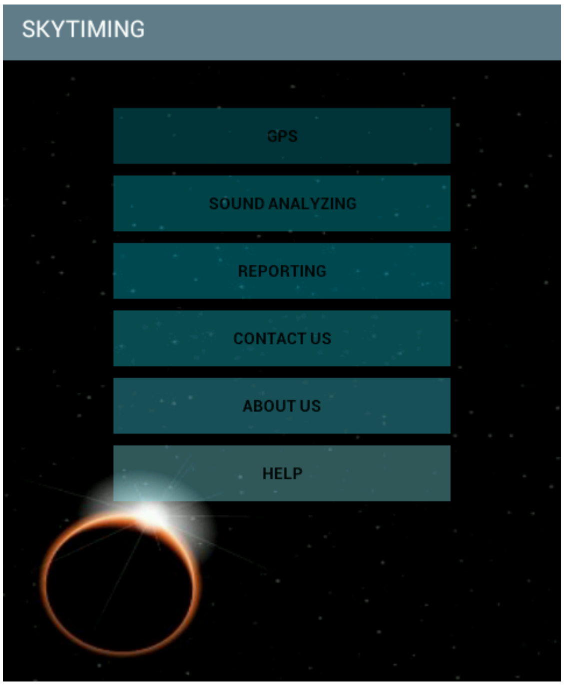
The accurate and correct timing is very important in astronomical researches.

Because, it is applied as data for future studies.

In astronomical issues, one of the main problems of amateur observers is accurate timing. Because, any minor error lead to incorrect results, and attempts of observer are not effective. Therefore, existence an accurate and accessible method is very important; so I tried to create a mobile application, called “SKYTIMING”.

“SKYTIMING” is an accurate timing application (Minimum desired accuracy is 0.01 second). It’s always available and standalone. So the observer just needs a smart phone and a telescope to have an accurate timing and send a global standard report using it.

Moreover, it eliminates the problems of other methods, including easy accessing and other, good accuracy, because of using GPS for timing, and ability to perform all steps by it “timing in an observation, calculating the exact time by GPS, recording a coded beep sound and the observer sound to determine the start and end of the event, analyzing the recorded sound, reporting and send report for check and using”.



OccultWatcher Add-ins

Alex Pratt
IOTA-ES, BAA

OccultWatcher supports and includes a number of Add-ins, which are additional modules to help the observer. The presentation will briefly introduce and discuss the Add-ins: C2A, Lunar Occultations and IOTA Reporting.

C2A is planetarium software for displaying the star field of an occultation.

The Lunar Occultations Add-in lists any occultations of close double stars from the IOTA feed.

The IOTA Reporting Add-in uses a template to auto-fill the asteroidal occultation report form. This simplifies the reporting process and reduces the risk of mistakes when entering information.

New observations of asteroidal occultations in Algeria

Djounaï BABA AISSA
Algiers's Observatory - CRAAG

Over the past few years, we created a research project to study stellar occultations by asteroids and specially Near-Earth-Asteroids in Algiers's Observatory (CRAAG). During this period, we observed positive and negative occultations by visual method.

Moreover, we also created the first Algerian Asteroidal Occultation Network in December 2016. During this astronomical event, more than thirty astronomy associations from different regions of Algeria participated to the first Algerian Training Course of Asteroidal Occultation studies. For this purpose, we will describe what we have accomplished.

Otherwise, we will discuss about the work we have done during July and August 2017.

In fact, we carried out an observation campaign to study several low probability stellar occultations by asteroids using IBEROC and IOTA data. In this context, we employed the 80 centimeters Ritchey-Chretien reflector coupled with Watec 910 HX Video Camera and IOTA VTI GPS Inserter. We will present the principal results that we obtained.

Eclipses and occultations at 22 Kalliope and the moon Linus

Bernd Gaehrken
Public Observatory, Munich

Many asteroids have moons but most of this moons are small and delivers no significant drop during an eclipse or occultation. At Kalliope and Linus the relation between the diameters is 1:6. In relation to the surface the relation is 1:36. So a drop of 0,03 mag is expected... But the shape of Kalliope is not a ball, it´s a pancake. The geometry allows also drops with higher magnitudes. The speech shows some measurements made at the during the winter 2016/17.

Grazing occultation of star Aldebaran by the Moon in the day sky (May 08, 2016)

Gerhard Dangl
IOTA-ES

The bright star Aldebaran (alpha Tauri) in the constellation Taurus is occulted again after the year 1999 in the years 2015 to 2018 several times by the moon. And after 2018 the next Aldebaran occultation will not be observable again until 2034. In addition to the full occultation by the Earth's moon, there are several grazing occultations through the mountains and valleys along the lunar edge in the period from 2015 to 2018. These grazing events can often appear spectacular by multiple occultations within a few seconds and take place both in daytime and at nighttime.

For an observation site in Austria 2016 and 2017 a total of five grazing occultations of Aldebaran will be listed by the Earth Moon. On the forenoon of the 8th of May, 2016, there was a grazing occultation of Aldebaran through the North Pole area of the Earth Moon, which was observed in Lower Austria in the southeast day-sky. The course of the calculated graze line crossed Austria from Salzburg to Lower Austria.

Observation place Ravelsbach in Lower Austria (15.8475 E, 48.5550 N)

The determination of a suitable observation site is supported by a self-designed Excel calculation sheet. It is often necessary to select the observation site within a tolerance band of a few meters in width in order to be able to measure the desired lunar profile.

The observation in Ravelsbach

The observation in Ravelsbach on day-sky was much more difficult than expected. Since the star Aldebaran transmits a large light component in the long-wave red range due to its spectral class K5 III, a planet IR Pro 807 infrared filter of astronomy was used for recording in the blue daytime sky.

Results and evaluation of the recordings

Despite difficult observation conditions, a total of six successive individual coverage events were recorded in Ravelsbach on May 08, 2016 within 76 seconds and recorded on video with GPS time insertion. Due to the extremely difficult recording conditions, a direct and automated video evaluation by software was not possible. Poor contrast and rapid movements caused by strong wind gusts were the main problem. Therefore, nearly 10,000 single video images from this grazing star occultation were manually analyzed. The measurements were sent to the IOTA graze coordinator in Japan.

http://www.dangl.at/2016/moon/moon_aldebaran_20160508_e.htm

Reports about recent grazing occultations

Eberhard Bredner
IOTA-ES

IOTA/ES has the mighty software GRAZPREP - created by Dr. Eberhard Riedel - to calculate grazing occultations. So an interested observer can "calculate" observations with high reliability regarding his opportunities/possibilities. The actual situation will be explained by some experiences.

A total lunar occultation with multiple contacts

Dietmar Büttner
IOTA-ES

While observing a total occultation of ZC 3320 at his home location in Chemnitz on 2013 November 11 the author noticed three contacts instead of the expected one disappearance.

All three contacts occurred within a time span of only 1 second. The observing site was 18 km inside the predicted northern limit line for the grazing occultation of the star.

In his talk the author describes his investigations of the things happened, concluding that this very special event was caused by an extraordinary limb profile geometry.

Profiles and Moons - Highlights of Asteroid Occultations in Europe 2018

Oliver Klös
IOTA-ES

Besides providing high precision position data of an asteroid, the main task of occultation observers is the determination of the shapes of asteroids by measuring the profiles. Observations of occultations by small moons of some minor planets are possible since video cameras with high frame rates are common for most observers. These measurements will improve the orbits of these companions and will give precise diameters.

In May 2017 Steve Preston (IOTA) provided his first predictions of occultations by asteroids for the year 2018. Observers in Europe will have the opportunity to measure the same asteroid twice, which may give different profiles that would improve the 3D shape models.

The chase for the small moons will continue while the shadows of (216) Kleopatra and its satellites will return to Europe several times.

This presentation with path maps gives a first look on some of these highlights next year based on Steve Preston's predictions with GAIA data. For the satellite predictions I have made my own calculations with ephemerides by IMCCE (Institut de mecanique celeste et de calcul des ephemerides), Paris, with Dave Herald's Occult V4 software.

Lunar Occultations and the Earth's Rotation

Leslie Morrison.
Pevensey, East Sussex, UK

Many thousands of timings of lunar occultations since AD 1623 provide the most accurate data on variations in the Earth's rotation until the introduction of the atomic timescale around 1962. Analyses of these timings reveal fluctuations in the length of the day of several milliseconds on a timescale of decades. These are largely due to core-mantle coupling which redistributes angular momentum within the Earth.

Graze of 81 Tau - using GRAZPREP

Tim Haymes
IOTA-ES

GRAZEPREP 4.03 was used to predict 14 graze contacts for 81 Tauri during a recent Hyades passages. The presentation describes site selection and recording of 13 contacts, one was non-instantaneous. A further contact (RB) was on the bright limb. There was good agreement with Occult4 preliminary analysis. Initial planing was done with Occult 4, and GRAZEPREP was used for predicting contacts in optimized locations. The video recording can be seen on YouTube. I have two recordings from mobile stations:

https://www.youtube.com/watch?v=SsZkFPbXZIc&feature=youtu.be [81 Tau 2017]

https://www.youtube.com/watch?v=MvTK6rHkX7A&feature=youtu.be [Lunar Eclipse 2015]

GRAZPREP - features and limitations

Eberhard Riedel
IOTA-ES

GRAZPREP is a freeware tool that supplies all details of grazing occultation predictions and assists in preparing successful observations as well as evaluating and reporting timings of these events. In an example of a recent observation report the possibilities as well as the present limitations of the achievable precision regarding stellar position and projected lunar limb details are explained.

The Gaia Mission - Status and Prospects

Stephan Jordan
Astronomisches Recheninstitut, Heidelberg, Germany

The astrometric satellite Gaia was launched in December 2019. After a comprehensive commissioning phase Gaia began its nominal scientific measurements in mid 2014. Gaia's main goal is the determination of precise astrometric data for more than one billion stars in our Milky Way with extremely high precision.

Gaia Data Release 1 was published in September 2016. It contains positions and magnitudes for about 1.1 billion stars. For two million stars proper motions and parallaxes could also be determined. More than 160 scientific papers based on this catalogue were published until July 2017. Gaia Data Release 2 will be available in April 2018 and will probably contain more than one billion stars with positions, proper motions and parallaxes, many having a precision of better than 0.1 milliarcsecond. Positions of more than 10000 asteroids are also expected in Gaia DR2. In order to provide accurate positions for occultations, astrometric data for several stars were published before the main data releases.

Exploring the Solar System using stellar occultations

Bruno Sicardy
Université Pierre et Marie Curie & Observatoire de Paris

The spatial resolution obtained during stellar occultations is basically limited by Fresnel diffraction scale, i.e. typically of order of km for objects beyond Neptune. Moreover, those events also permit the detection and monitoring of tenuous atmospheres at nbar level and led to the discovery of rings around small bodies.

The main limitation so far is prediction accuracy, typically 40 mas, corresponding to about 1,000 km projected on Earth. This leads to large time dedicated to astrometry, tedious logistical issues, and more often than not, mere miss of the event.

The Gaia catalog, with sub-mas accuracy, hugely improves both the star positions and ephemerides of the bodies, resulting in accuracies of ~10 km for the shadow track on Earth. Thus campaigns will be much more carefully planned, with success rate approaching 100%, weather permitting.

Scientific perspectives and recent results will be presented, e.g. central flashes caused by Pluto's atmosphere may reveal hazes and winds near its surface, grazing occultations will show topographic features on remote bodies, allowing geological studies, occultations by Chariklo's rings will unveil dynamical features such as resonances with nearby satellites or proper mode "breathing".

The occultation by Pluto on the 19th of July 2017

Wolfgang Beisker
IOTA-ES

The 14th mag star UCAC4 345-180315 was occulted by Pluto on the evening of the 19th of July, 2016. The event could be observed from large parts of Europe, middle east and northern Africa as well. A campaign had been organized with many observers and observatories throughout Europe and other countries. The scientific goal was the ongoing monitoring of Pluto's atmosphere as well as the improvement of Pluto's astrometry. Because of the increasing distance of Pluto from the sun, scientists are waiting for a possible shrinking of its atmospheric pressure. The astrometric predictions were largely done by the RIO team and Bruno Sicardy's team. A fainter star was occulted by Pluto 5 days before (14th of July). This was successfully observed and used as a "pathfinder" for the main occultation on the 19th. In a very helpful decision, the GAIA team released the star position of the target star 2 months before the GAIA DR1 catalogue was released. Together with a new ephemeris of the New Horizons team the occultation track for the 19th could be determined by this with very high precision (pre- versus post occultation calculation only differed in less than 100 km).
Because of good weather conditions for the event in large parts of Europe, observations of about 30 stations could be recorded and analyzed.

The Chariklo Occultation Campaign 2017

Mike Kretlow
IOTA-ES

(10199) Chariklo is currently the largest known Centaur. It is the first asteroid-sized object (diameter about 260 km) with a known ring system, which was discovered during a stellar occultation in 2013. For this year, three favourable occultations by Chariklo of stars brighter than ~15 mag were predicted: on April 9 and June 22 (both crossing over Southern Africa: Namibia, Botswana and South Africa), and on July 23 (crossing over South America: Brazil, Paraguay, Argentina and Chile). All three events were successfully observed by international (pro-am) teams, organized and supported by the Paris/Meudon Observatory within the ERC Lucky Star project. The author (who joined all three expeditions) gives an overview about these occultations, the main objectives of this observing campaign and presents first results.

Triton – Monitoring changes in its atmosphere

Bruno Sicardy
Université Pierre et Marie Curie & Observatoire de Paris

On October 5th/6th the satellite of Neptune, Triton, will occult a 12m4 star UCAC4 410-143659. The occultation track passes over parts of the USA and central Europe. This event is the first opportunity after 2008 to monitor the status of Triton's thin atmosphere, which consists mostly of Nitrogen, as for Pluto. In this report a preview is given on the event, its scientific rationale as well as the observational conditions and techniques necessary to record the event.

The solar eclipse of 21st of August 2017

Konrad Guhl, Andreas Tegtmeier and Eberhard Bredner
IOTA-ES

Observation of Baily beads at total and annular eclipses have been one of the main activities of IOTA and IOTA/ES for many years. The standard observations are done on the northern and southern rim of the path of totality. For the total eclipse August 21st 2017, these station are manned by Elke+Konrad Guhl (north) and Carmen+Andreas Tegtmeier (south). Due to the possibility of high speed observation and the more detailed knowledge of moon limbs by spacecraft, observation on the centerline appeared viable. So this eclipse became the first where IOTA/ES attempted such an observation. The station was manned by Dr. Eberhard Bredner. Due to the limited time between the eclipse and the symposium, no calculation based on the video tapes is ready yet. Observers will present the raw video tapes and report about obstacles and success.

Observation of occultations by planets in the 19th century

Konrad Guhl
Archenhold-Sternwarte, IOTA/ES

The main planets of our solar system have been popular objects of observation for as long as telescopes are in use. As a result, the study of planetary bodies led to the discovery of stars – often by accident, as new satellites were the main target. These stars were then monitored – to discern them from satellites – and as events progressed, occultations were observed. Soon, the possibilities for atmospheres were discussed. During the second half of the 19th century, scientists started calculating the probability of occultations and also generated the first ephemerides. All in all, 14 different occultation events were recorded in the two leading astronomical journals, the "Astronomische Nachrichten" (AN) and "Monthly Notice of the royal astronomical society" (MNRAS). Notable examples will be presented and discussed.

Here, two facsimiles of records presented in the contribution:

Notes on an Occultation of a Star by Saturn.
By the Rev. W. R. Dawes.
(*Extracts of Letters to the Astronomer Royal.*)

" Last evening, on turning my equatoreally-mounted telescope upon *Saturn*, I perceived a small fixed star on the preceding side of the planet, and almost precisely in the line of the major axis of the ring produced. Allowing for the brilliancy of *Saturn*, I estimated it be of the 9th magnitude. It was distant from the western extremity of the ring about 40″. The third satellite, *Tethys*, was very near its greatest elongation on the same side.

" As it appeared evident that an occultation must happen, I measured with the wire micrometer the difference of R.A. of the star and the western extremity of the ring; and from this, and *Saturn's* daily motion in R.A., I found that the G.M. time of occultation by the ring would be about $15^h\ 6^m$. Having also observed the difference of N.P.D. of the star and the most southerly point of the edge of the ring (considerably to the west of the southern extremity of its minor axis), I found from this and the daily motion in N.P.D., the difference of N.P.D. at the expected time of occultation. The threads of the micrometer having been set to include this difference of N.P.D., and placed equatoreally, the southern thread was made to touch the southern point of the

W.R. Dawes, Notes on an Occultation of a Star by Saturn, MNRAS vol.16 (1856) page 149

Beobachtung einer Sternbedeckung vom Mars den 20. Mai 1822. Vom Hrn. Prof. Tralles in Berlin.

Am 20. des Ab. zeigte sich ein Paar Min. vom Mars östl. ein Stern, wovon zu vermuthen war, dafs der Planet ihn etwa 2 Stunden nachher bedecken würde. Es war No. 162

♌ 7. Gr. (Bode's gr. Verz.) nach la Lande angesetzt. Bei Bradley und Piazzi kömmt er nicht vor, er schien mir fast 6. Gr. zu sein. Ich beobachtete mit einem 5f. Achromat. 3½ Zoll Oeffnung, 160mal. Vergr.

Um 11 U. 3′ 24″ (Zeit der Uhr) wurde der Abst. des ♂R. vom * dessen gröfseren Durchm. gleich geschätzt.

Um 11 U. 9′ 52″ entging der Stern der Schärfe des Auges, indem er nach und nach schwächer geworden war. Während 30″ blieb es doch zweifelhaft, ob er nicht noch

Tralles, Beobachtung einer Sternbedeckung vom Mars den 20.Mai 1822, Berliner Astronomisches Jahrbuch 1823, S. 189, Berlin 1822

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According to the SächsPresseG, this publication is not obliged to define an imprint.

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Dr. Wolfgang Beisker and Konrad Guhl
Ralph Behrend

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No animals were harmed in the production of this publication. It was, however, tested on animals. Guinea pigs were used as test subjects. They seemed unable to grasp the gravity of occultation science. However, the test print seemed tasty to at least one of the three subjects.

Steigerlied
(traditional song of miners and scholars in Freiberg)

Glück auf, Glück auf, der Steiger kommt.
|: Und er hat sein helles Licht bei der Nacht, :|
|: schon angezünd't :|

Schon angezünd't! Das gibt ein'n Schein,
|: und damit so fahren wir bei der Nacht, :|
|: ins Bergwerk ein :|

Ins Bergwerk ein, wo die Bergleut' sein,
|: die da graben das Silber und das Gold bei der Nacht, :|
|: aus Felsgestein :|

Aus Felsgestein, graben sie das Gold,
|: doch dem schwarzbraunen Mägdelein, bei der Nacht, :|
|: dem sein sie hold :|

Und kehrt er heim, zu dem Mägdelein,
|: dann erschallt des Bergmanns Gruß bei der Nacht, :|
|: Glück auf, Glück auf! :|