

Abstracts Received

Nicolas Biver The composition of comets	The composition of cometary nuclei has been investigated by remote sensing of its coma from UV to radio-wavelengths for decades. In-situ monitoring of a comet by the Rosetta mission has brought us more extensive information on a specific comet, 67P/Churyumov-Gerasimenko. I will review both our general knowledge of the composition, from solid to most volatile ice phase, of cometary material and also the large compositional diversity we observe among comets. I will also highlight a few techniques (e.g. spectroscopy, AFRHO) accessible to amateurs where they can provide valuable information to research studies on comet composition.
Walter Harris Characterization of cometary mission targets from concept development to encounter phase	This presentation will discuss how ground based characterization (activity patterns, outbursts, occultations) of comets is of high value for development of concepts and flight implementation. Remote sensing of nucleus size and dust/gas production are essential for planning encounter operations and provide valuable global context during active missions. Time domain coverage is also important for determining evolutionary processes over multiple apparitions and for detection and monitoring of outbursts. Most potential mission targets are accessible to amateurs and small aperture observatories where campaigns and long duration monitoring are possible. This valuable resource has operated synergistically with missions and targeted studies at larger observatory in the past, and should continue to be coordinated in the future.
Cecilia Tubiana Rosetta to Comet Interceptor	I will present an overview of the Rosetta mission to comet 67P, with some of its results and open points, and the Comet Interceptor mission to a long period comet.
Oleksandra Ivanova Spectrophotopolarimetry as a tool for characterizing active small	The comprehensive study of the physical, chemical, and dynamical properties of comets of different dynamic classes, active asteroids, and centaurs, using the results of photometric, polarimetric, and spectral

bodies surfaces, atmospheres, and dust particles.	observations and numerical modelling is very important to reveal features related to different regions of their formation in the Solar system or different evolution. In general, the genetic link between comets, asteroids, and satellites of the planets is currently extremely important. After all, sometimes it is difficult to determine to which class of Small Bodies of the Solar system this or that object belongs. For example, quite a few satellites of planets that have retrograde orbits are more like captured asteroids than other planetary satellites that rotate in the plane of the equator in circular orbits. To obtain the observational material, propose a complex approach. It consists, in particular, of a combination of the observational methods (quasi-simultaneous photometric, polarimetric, spectropolarimetric, and spectral observations), the use of large telescopes, and monitoring observations to obtain long series of data.
Charles Galdies Pro-Am challenges in photometric observation of minor planets and asteroids.	Observation of Near Earth Objects and comets is important. Primary objectives include the identification, tracking, cataloguing and characterization of their physical characteristics. This objectives indeed provides a great Pro-Am collaborative opportunity. Similar to other Pro-Am initiatives (such as Home aavso and BHTOM Home (astrolabs.pl)) the information that citizen science can generate can become highly useful for future analysis, including orbital risks to Earth. This is because of their free telescope time and high temporal, photometric time-series acquisition us that is now becoming so valuable. Indeed, citizen science has now become a well-recognized and important tool in astronomy research. We can indeed contribute much to this research by identifying and classifying minor planets, asteroids and comets in space. Further technical support is therefore called for in order to further solidify this important collaboration through the provision of appropriate supportive technical, processing and training programmes.
Marek Husarik Unpredictable active asteroids.	To show recent results from own observations of Phaethon and 2005 UD, Gault, and 2005 QN173.
Giannantonio Milani CCD Af[rho] photometry and the CARA approach	History of the project, method, goals and results. What is Af[rho] and what you can get from it and what you can't
Joseph N. Marcus	The total visual magnitude, m_1 , of the cometary coma is governed by contrast detection by the human visual

Psychophysical Artifacts in Visual m1 Magnitude Estimates	nervous system. The coma outer edge represents the liminal detection of gradient contrast, and its physical radial location is affected by magnification as well as by the coma's intrinsic surface brightness. Higher powers -- whether by eyepiece magnification or nearer earth distance -- paradoxically shrink the perceived physical coma radius, giving rise, respectively, to so-called "aperture" and "delta" effects, in which m1 is artifactually underestimated. A lesser-recognized, but more important artefact -- from the same psychophysics -- is the long-vexing disproportionation between m1 estimates and species production rates Q, which I call the "m-Q anomaly." Here, k in the relation $\log Q = k * m1$ is observed to be close to $k = -0.27$ rather than to the expected canonical $k = -0.4$. My psychophysical model accounts for these and other artifacts in m1 and coma diameter estimates, and can be used to improve visually-estimated cometary m1 light curves.
Youssef Moulane The TRAPPIST comet survey	We present in this work the TRAPPIST, a set of two twins robotic telescopes with a diameter of 60 cm. TRAPPIST-South at La Silla ESO Observatory (Chile, 2010), and TRAPPIST-North at the Oukaimeden Observatory (Morocco, 2016) [1]. The TRAPPIST telescopes are entirely robotic, equipped with a sensitive CCD camera and a complete set of narrow and broad-band filters [2]. Those two robotic telescopes are dedicated to the detection and characterization of exoplanets and the study of comets and other small bodies in our solar system. In this talk, we will show the techniques and strategy for observations and monitoring of comets activity using a set of HB cometary narrowband filters. We will present a summary of data collection for more than 60 comets observed with the two telescopes over the last decade (2011-2021) [3,4]. I will end my talk with the outreach activities we have organized using TRAPPIST as well as the collaborative activities with amateur astronomers. References: [1] E. Jehin et al. 2011, The Messenger, 145-2, [2] T.L. Farnham et al. 2000, Icarus 147, 180, [3] C. Opitom. Monitoring of the chemical composition of comets in the framework of the TRAPPIST survey, Thesis, 2016., [4] Y. Moulane. Monitoring the activity and composition of comets with TRAPPIST telescopes, Thesis, 2021.

Josep M. Trigo-Rodríguez Photometric Follow-up of interstellar comet Borisov	We will present an overview of a 4-months coverage made with m-sized telescopes of the inbound orbit of comet Borisov from the Northern hemisphere, explaining the relevance of pro-am teams to perform these observations
Ignacio Ferrín "Secular Light Curves of Comets (SLCs)"	The Secular Light Curves (SLCs) formalism (Ferrín, 2010) has been very powerful in creating a depiction of the long term behaviour of comets. The SLC is capable of detecting objects with very small cometary activity. The work of amateur astronomers is of great importance in this regard, because the system eye-brain is capable of extracting the whole flux from the cometary coma, while CCDs can't. We will present examples of the information retrieved, the importance of this information for cometary science, and examples of interesting objects that should be observed in the coming years.

Carrie Holt Distant Activity of Long-Period Comets	Since August 2020, we have been monitoring newly discovered distant long-period comets using 1-m telescopes from our Las Cumbres Observatory (LCO) Outbursting Objects Key project and the 4-m SOAR telescope. By consistent monitoring at large distances, we will be able to better understand the processes driving distant cometary activity and make better predictions of the brightness evolution of future discoveries. We will present our preliminary results.
Jacques Crovisier The outbursts of comet C/2021 A1 (Leonard)	The outbursts of comet C/2021 A1 (Leonard) J. Crovisier, N. Biver, D. Bockelée-Morvan LÉSIA, Observatoire de Paris Comet C/2021 A1 (Leonard) was observed with the Nançay radio telescope (NRT) from 1st October 2021 to 15 February 2022. The 18-cm lines of the OH radical were measured in order to monitor the water outgassing from the comet. The December pre-perihelion period showed favourable observing conditions, with the comet approaching the Earth at 0.23 au (12 December) and a high inversion of the OH maser. A sudden increase of activity was observed from the OH lines as soon as 13 December, before it was spotted on 15 December from total visual magnitudes. Then a series of outbursts were observed, both from the OH lines and from the total visual magnitudes. As an example of the synergy between amateur and professional astronomers, we will present an analysis of the comet outgassing evolution in correlation with the comet total visual magnitude during these outbursts.
Richard MILES Amateur observations of Centaur comet 29P/Schwassmann-Wachmann: What we now know	Eight years of high-cadence observations by amateurs have revealed several new discoveries. A summary of these will be presented.
Anhelina Voitko	Comet 29P/Schwassmann-Wachmann 1 (hereafter 29P) is famous by its continuous activity and unpredictable outbursts.

Monitoring of Color Variations in Comet 29P/Schwassmann-Wachmann 1	We have been measuring photometric color of 29P during the monitoring in August-October of 2018 (nine epochs) using the 61-cm telescope at the Skalnaté Pleso observatory equipped with the V and R broadband filters from the Johnson-Cousins photometric system. Color of a comet gives clues to the microphysical properties of dust particles in the coma. We have found variations of color slope on October 11. Further, the modelling of the extreme values was performed using agglomerated debris particles. It was therefore found that the reddest color suggests the Fe-Mg silicate and/or organic composition of dust particles, while the bluest color can be explained by the water-ice and/or Mg-rich silicate.
Daniel Gardener Searching for Outbursts in Ground-Based Photometry of 67P/Churyumov-Gerasimenko	Comets are the primitive building blocks of the Solar System. In order to understand the extent of the pristine nature of comets, we must understand the mechanisms that affect their surfaces and comae - their activity. The most obvious sign of activity is the production of comae and tails, caused by escaping gas and dust lifted off the surface of the comet. Other signs of activity include outbursts, where material is suddenly ejected into the coma, causing an immediate and rapid brightening in telescopic observation. 67P/Churyumov-Gerasimenko is a Jupiter family comet that was the target of the Rosetta mission, the first mission to successfully orbit and land a probe on a comet, and this mission was accompanied by a large ground-based observing campaign. The photometry from this campaign has been previously calibrated approximately but we present a more accurate calibration using background stars. We have developed a pipeline incorporating Astrometry.net, SExtractor and calviacat to calibrate and measure photometry of comet 67P during its 2016 perihelion passage, making use of all visible broadband wavelength imaging collected across a wide and disparate range of facilities. The pipeline calibrates the brightness to a common photometric system (Pan-STARRS 1) using background stars in the field. Preliminary results follow predictions based on observations in previous orbits and show no obvious deviations in activity, indicating that 67P doesn't show significant changes due to ageing from orbit-to-orbit. All processes that physically and chemically alter a cometary nucleus can be regarded as ageing. We are searching for small-scale variation in activity that can be related to outbursts measured in situ by the spacecraft, with the goal to place constraints on these outbursts and their detectability from Earth-based observations. This will help us constrain how well global activity measures relate to local changes on the comet nucleus. The lessons learned from Rosetta can then be applied

	to the wider comet population, the majority of which will never be visited directly and only ever observed from the ground.
Jakub Černý Software for comet observers - KOPR	Visual and CCD observing of comets is a very challenging. The process itself brings a lot difficulties on its way. That's why I started to programming a new software for comet observers, which make process easier and helping observers to avoid as much mistakes as possible. It also generate a standardised output which can be uploaded directly to main databases of photometric data.
Thomas Lehmann AIRTOOLS	The AIRTOOLS software has been used to analyze large and small aperture photometry of comets. Emphasis is given on high quality calibrations to obtain consistent photometric measurements as qualified by example lightcurves. Small aperture photometry complements large aperture measurements and allows to monitor inner coma activity. Preliminary results suggest different probability of such transient outbursts on dynamically old and new comets.
Nick James Comet photometry using the comphot tool	I am the author of comphot which is a tool which allows simplified total magnitude and coma diameter estimation for comets. I would like to discuss how it might be used by observers.
Geraint Jones Ion Tails	Overview of Solar Windssocks project, which can convert amateur and professional images of ion tails into estimates of solar wind speeds. I can also provide an overview of the Comet Interceptor mission.
Uwe Pilz Parameters of comet Leonard from amateur photographs	I used Michael Jägers' photographs of C/2121A1 for calculating some of the parameters of the come: rotation period of the nucleus, rotation axis and expansion velocity of the dust shell. velocity of ionized gases, Beside this, I tried estimating the size of the nucleus from brightness measurings.
Qasim Afghan Structural analysis of the dust tail of Comet NEOWISE (C/2020 F3)	Comet NEOWISE (C/2020 F3) displayed a highly structured dust tail, exhibiting the most visible dust tail features from Earth since Comet McNaught (C/2006 P1) in the Southern Hemisphere and Comet Hale-Bopp (C/1995 O1) in the Northern Hemisphere. Using images taken by the amateur astronomer community, this dust tail was analysed using the Finson-Probstein model. The comet's position in the sky in amateur images is calculated using an open source algorithm [1], the position and exact time then calculated, and the dust tail is simulated. This modelled dust tail structure is then projected and overlaid onto the comet image to directly compare and identify similarities and discrepancies between the model and the image. Using the novel analysis method of mapping the image to a plot of dust grain beta against ejection time[2], tail structures can be more easily identified, analysed

	and tracked over time (where beta is the ratio of force due to solar radiation pressure and that due to the sun's gravity). Dust tail structures such as syndynic bands and striae have been identified and characterised in terms of dust ejection time and dust beta values. These structures are tracked over time, and compared to the analysis of similar structures seen in C/2006 P1 (McNaught) [2]. There are some clear differences between the two comets, particularly in the alignment and arrangement of their striae, most likely due to different heliospheric conditions during each comet's perihelion passage. These results, all based on amateur observations, provide a thorough description of Comet NEOWISE's dust tail to contribute to the collection of cometary dust tail profiles currently available. This will enable convenient comparison between comets in the future, and eventually enable population studies on cometary dust tails and their features. The atomic Sodium tail has been parameterised in this work, with an estimated ionization lifetime of the Sodium atoms at 17 hours $\pm$ 2 hours. [1] Lang, Dustin, David W. Hogg, Keir Mierle, Michael Blanton, and Sam Roweis. 2010. "ASTROMETRY.NET: BLIND ASTROMETRIC CALIBRATION OF ARBITRARY ASTRONOMICAL IMAGES". The Astronomical Journal 139 (5): 1782-1800. doi:10.1088/0004-6256/139/5/1782. [2] Price, Oliver, Geraint H. Jones, Jeff Morrill, Mathew Owens, Karl Battams, Huw Morgan, Miloslav Drückmüller, and Sebastian Deiries. 2019. "Fine-Scale Structure In Cometary Dust Tails I: Analysis Of Striae In Comet C/2006 P1 (Mcnaught) Through Temporal Mapping". Icarus 319: 540-557. doi:10.1016/j.icarus.2018.09.013.
Olena Shubina Photometrical and polarimetric Data bases for asteroids and comets: contents and practical use	Nowadays, astronomy is a huge amount of data observed with different equipment at both ground base telescopes and spacecraft. Small celestial bodies are not an exception. A lot of information obtained by photometry, polarimetry, and spectral methods collects in databases. They include and organize specific data (raw observations, processed results, additional information) about different groups/classes of asteroids or comets. But often, only a limited audience knows about these databases. Thus it is important to popularize them among professional astronomers and amateurs, in particular photometrical and polarimetric databases of asteroids and comets (their structure, access, and what one can obtain from their analysis).

Jure Zakrajsek COBS	Details of the Comet Observation (COBS) database and associated website functionality
Helen Usher Proposals for a FITS Archive	I will outline some options for the development an archive to store raw fits data in a consistent format, along with robust observation metadata. Currently there are databases which store either processed data, or images. For some purposes it is necessary to have complete control over the processing of raw data, and so having access to unprocessed observations is needed. Additionally, there is a need to ensure FITs heading information is in a standard format and has been validated. An archive would ensure that valuable observations by amateurs are easily available to professional and amateur researchers now and in to the future. Archive observations could be revisited as analysis techniques improve over time. Processing tools could also form part of the archive website.
Stéphane Erard Sharing observational data in VESPA	VESPA (Virtual European Solar and Planetary Access) is a part of the Europlanet 2024 RI programme. It is an infrastructure to publish data in the field of Solar System studies, and to easily search specific configurations in existing databases. VESPA relies on a uniform vocabulary describing instrumental and observational conditions, and standards of the Virtual Observatory (VO) - a very mature infrastructure to access data in Astronomy. VESPA also provides a dedicated interface allowing cross-searches in databases, and is particularly fit to support coordinated observation programmes. Finally, VESPA connects standards VO tools to visualize and process the data. A standard procedure is proposed for data providers to publish their data and make them accessible to the community, according to the standards of Open Science.

Wendy Clark An Amateur Journey with Remote Cometary Observations	How I accidentally become involved with remote observations, learning the processes and contributing my data to a live ProAm campaign for Comet 67p Churyumov Gerasimenko
Alain Maury The MAP program, discovering NEOs and comets as amateurs in 2022	In the era of NASA sponsored programs using large telescopes and large detectors in order to search for Near Earth Asteroids and comets, it has become more and more difficult for amateurs to make discoveries in this field. But using a combination of high performance wide field telescopes and CMOS cameras as well as innovative software and powerful computers, the MAP program has made significant discoveries since the beginning of 2021. In fact, of the 6 comets discovered by amateurs since 2021, 4 were discovered by our program. Of the 79 NEOs discovered in 2021 by amateurs, 56 (i.e. 70%) were discovered by MAP. The talk will describe the hardware and software used and the results obtained.
Gunter Kargl and Colin Snodgrass The Europlanet Telescope Network	We will outline the opportunities for amateurs and professionals to access professional telescopes through the Europlanet Telescope Network, to make comet observations.
Paweł Szewczyk Introducing students to astronomical observations	Since 1983 our association, Almukantarat Astronomy Club, has been organising science camps for high school students from Poland. Each year we reach more than 100 students interested in astronomy and other fields of science. During our camps we introduce participants to astronomical observations using amateur equipment. I will present our model of working with young people and discuss the challenges we face during our observational campaigns. I will show how we approach education of young generation of observers.
Helen Usher, Paul Roche, Tony Angel, Richard Miles, Ben Wooding, Cai Stoddard-Jones Comet Chasers - using cometary research as an Education and Outreach Tool	The 'Comet Chasers' project, working with primary schools in South Wales, is designed to use comets as the focal point for practical activities to teach scientific method, and elements of the STEM and broader curriculum in a fun and engaging way. It also seeks to change attitudes and aspirations with regard to science and careers. It is an innovative project which links international researchers, amateur astronomers and educators. We will report the results so far, including two research papers that have been submitted which include observations made by school children. We also explore how such a model might work on a larger scale - using the expertise of amateur astronomers across the world to enthuse, inspire and guide our next generations of observers and scientists.

