IMC 2020
Abstracts

Another Daylight Fireball over The Netherlands: the event of August, 25, 2020
F. Bettonvil *(Leiden University)*

In an earlier contribution to the IMC, focusing on the increased number of reports on daylight fireballs, another one occurred quite recently. I will report on the obtained observations, the analysis, and involvement of the public for this particular event.

Meteor Shower as key for Astronomy Outreach in Nepal
S. Bhattarai *(Nepal Astronomical Society), M. Dwa, R. Shah*

The first official program conducted by Nepal Astronomical Society (NASO) in August was a talk program followed by the observation program on Perseid Meteor Shower. This meteor shower started our outreach journey collaborating with Nepal Academy of Science and Technology (NAST) and the different media to reach more people in Nepal. Today, people in Nepal are aware of the difference between meteor shower and heavy rain as both has same name in Nepali.

Moreover, as meteor showers can be observed from across the country and need no telescopes for the observation, it has become an opportunity to promote our astronomy outreach through strategic media outreach to reach people with astronomical information. Now, meteor shower is one of the most covered topics on science in Nepali media and it never failed to fascinate people to call us for more information during several meteor showers. In this paper, I will be sharing some of our practices on how we are using meteor shower as one of our key for astronomy outreach in Nepal. It will also share on how we use landscape astrophotography to promote meteor shower observation in Nepal.

Meteor Research at Western University
P. Brown *(University of Western Ontario)*

In this talk I will highlight projects underway or completed within the Western Meteor Physics Lab (WMPL). The research program of WMPL focuses on multi-technique detection of meteors using optical, radar, infrasound and VLF instruments coupled with modelling. Recent results will be summarized and projects available for graduate students will be highlighted.

A renewed discussion: The Hyperbolic Meteors and its Interestellar Origin

M. De Cicco *(Exoss project, National Observatory), P. Gural*

After the discovery of the two confirmed extrasolar object crossing our Solar System, 1I/2017 U1 ('Oumuamua), on 2017 [5] and 2I/Borisov comet ON 2019 [4] the discussion about meteors from extrasolar origin was renewed about their existence. Tipically an eventual interestellar meteor should have a hyperbolic orbit, as they could be a subset of meteoroids encountering the Earth's atmosphere, characterized by orbital elements possessing a<0 and e>1. Hyperbolics meteors have been identified in many meteors surveys [1,3,4]. Hajduková et.al [1] calculated a total number of 484 hyperbolic orbits from 64,650 meteors within the SONOTACO catalogue [1,3], representing 3.28% of all orbits.There are often significant errors when estimating heliocentric velocities of a meteor due to inaccuracy of measurements, pertubation from recent close planetary encounters, and solar radiation that could generate false hyperbolic orbits in the parameters estimated, but there still remains a small fraction of hyperbolic solutions that could still be interstellar meteoroids Hajduková et al. [4] with an upper frequency limit of 1 in 1000 meteors. So, we followed the methods of Hadjukova and three meteor orbit data sets from Edmond, Sonotaco and Exoss were analyzed to try identify interestellar meteors. [1] Hajduková, M., Kornoš, L., and Tóth, J. (2014). Frequency of hyperbolic and interstellar meteoroids. Meteoritics and Planetary Science, 49:63–68.[2] Meech, K.J., Weryck, R., Micheli, M., et al. (2017). A brief visit from a red and extremely elongated interstellar asteroid.Nature, 552:378.[3] SonotaCo. (2009). A meteor shower catalogue based on video observations in 2007–2008. WGN 37:55–62. [4] Hajduková,M.,Kornoš,J.R.Leonard,Toth,Juraj (2013). Frequency of hyperbolic and interstellar meteoroids. Meteorit.Planet.Sci.,1–6.[5] Guzik, P., Drahus, M., Rusek, K. et al. Initial characterization of interstellar comet 2I/Borisov. Nat Astron 4, 53–57 (2020).

The luminous efficiency determination and its difficulties

E. Drolshagen, T. Ott, (*CvO Universität Oldenburg, Germany*) D. Koschny, G. Drolshagen, J. Vaubaillon, F. Colas, and B. Poppe

The luminous efficiency τ describes the fraction of lost kinetic energy of the entering object converted to brightness. This parameter is used to calculate a meteoroid's mass from its observed brightness. Presently, the luminous efficiency is part of current research and its determination based on different assumptions. Amongst others different meteor parameters have to be assumed. They range from the shape of the meteoroid, which changes during the flight through the atmosphere, and a possible fragmentation, over the composition of the meteoroid as well as of the atmosphere, to aspects of the detection themselves.

The data of FRIPON, the Fireball Recovery and InterPlanetary Observation Network, was used to calculate the luminous efficiencies of the recorded meteors. First, deceleration-based formulas for the mass computation of the corresponding meteoroids were used. Then, the recorded light curves were investigated to determine the luminous efficiencies. We found τ-values in the range of $10^{-4}\ \% - 100\ \%$ and a dependence of τ on the velocity of the meteor, as it can be found in literature. Additionally, a dependence of τ on the initial meteoroid mass with negative behaviour was found. This points to the fact that smaller meteoroids radiate more efficiently.

In this talk we will show the process of obtaining these values and point out its difficulties.

Upcoming Eta-Aquariid outbursts

A. Egal *(University of Western Ontario), P. Brown, P. Wiegert, J. Rendtel, M. Campbell-Brown, D. Vida*

We present the results of a new and complete numerical model of the meteoroid streams associated with comet 1P/Halley. Through the simulation of more than 5 million meteoroids and a careful analysis, we investigate the origin, variability and characteristics of the Halleyids meteor showers, i.e. the eta-Aquariids and the Orionids. Our model was validated on 35 years of meteor observations of the Halleyids, provided by the International Meteor Organization (IMO) Visual Meteor DataBase, the IMO Video Meteor Network and the Canadian Meteor Orbit Radar. Our simulations reproduce the main characteristics of the Halleyids showers since 2002, including their activity profiles, radiants, and year to year variations. For the first time to our knowledge, realistic mass distributions of the meteor showers were derived from a numerical stream model. The extension of our analysis until 2050 predicts four potential eta-Aquariid outbursts in 2023, 2024, 2045 and 2046. In particular, we expect most of the 2024 activity to originate from particles trapped into the 1:6 mean motion resonance (MMR) with Jupiter, known to be responsible for most of the major Halleyid outbursts. If we do not predict any significant Orionid outburst between 2020 and 2050, we find the 1:6 MMR to induce a ~12 years cycle in the activity of the shower. Observations of the Orionids and especially the eta-Aquariids are strongly encouraged to refine the accuracy of the forecast.

Filtering False Positives from Meteor Surveillance Images with Deep Learning

Y. O. Galino *(Computer Science at Unifesp - Federal University of São Paulo, Brazil)*

The EXOSS initiative monitors the Brazilian sky with cameras in order to identify meteors, leading to a great quantity of non-meteor captures that must be filtered. We approach the task of automatically distinguishing between meteor and non-meteor images with the use of pre-trained convolutional neural networks. Our main contributions are the revision of the methodology for evaluating models on this task, showing that the previous methodology may lead to an overestimation of the expected performance for future data; and the application of probability calibration in order to select the most confident predictions. Our method achieves 98% accuracy predicting on 60% of the images, improving upon the performance of the uncalibrated model of 94% accuracy predicting on 70% of the images.

Impact of Starlink on meteor detection algorithms

P. Gural *(Gural Software and Analysis LLC)*

The Starlink constellation of satellites has heightened awareness of the huge proliferation of night sky moving objects that while they can bright enough in meteor cameras, are actually mostly detection mitigated through simple algorithmic adjustments.

Update on the ongoing chi Cygnid meteor shower

P. Jenniskens *(SETI Institute)*

In late August 2020, the CAMS meteor shower survey detected the chi Cygnid meteor shower, last seen in 2015. The meteors had a radiant in between the constellations of Delphinus and Aquila. Since that time, the shower has continued to be detected until at least the most recent night of September 5, with the radiant rising higher in the northern sky towards Cygnus. This presentation aims to encourage further observations by giving a brief summary of past observations and discuss possible parent bodies. Based on the 2015 return, the shower is expected to peak in the week following the International Meteor Conference 2020.

Connecting ionospheric, optical, infrasound and seismic data from meteors in Hungary

A. Kereszturi *(Konkoly Observatory, Research Centre for Astronomy and Earth Sciences), V Barta., I. Bondár, Cs. Czanik, A. Igaz, P. Mónus, B. Pál*

Example case studies made in Hungary to demonstrate the benefits and knowledge gaps, how different observational types of meteors could be connected to each other. The ionospheric effects of a leonid and a geminid meteors could be identified, while linking of infrasounds and the generated seismic effects of a daytime fireball was also possible.

Status of ESA's Meteor Research Group

D. Koschny *(European Space Agency), T. Albin, E. Drolshagen, G. Drolshagen, S. Joiret, J. Marin, R. Moissl, T. Ott, A. Rietze, C. v. d. Luijt, B. Poppe, R. Rudawska, K. Schmidt, H. Smit, H. Svedhem, A. Toni, O. Witasse, J. Zender*

ESA has been operating a double-station meteor camera setup in the Canary Islands, called CILBO, since 2012. Since a few years, we are supporting the expansion of the FRIPON fireball camera network in the Netherlands. We are working closely together with the Planetary Defence Office of our Space Safety Programme, in which we set up a long-term archive for the data of the 'European Network' of fireball observations. Our scientific work deals with understanding flux densities of meteoroids in all size ranges and all related aspects. These are e.g. constraining the luminous efficiency, and understanding observation biases. This presentation will give a short overview on the work we have performed over the last year.

Meteor Energy Obtainable from Acoustic Data

L. McFadden *(University of Western Ontario, Dept. of Physics and Astronomy), P. Brown, D. Vida, P. Spurný*

Near-field acoustic signals from fireballs (ranges < 200 km), when detected by dense seismic/infrasound networks, may be used to estimate parameters of the event, through analysis of the meteor-source waveforms at these stations. Specifically, energy estimates may be determined by the overpressure measured at an infrasound station by modelling the attenuation of the acoustic waves through a Monte-Carlo perturbed atmosphere. Using the Stubenberg meteor as a case study, it was found acoustically that the total fragmentation energy was 1.47+0.28-0.12 × 1010 J, about one-third of the total energy of the meteor.

The AllSky7 Fireball Network Germany

S. Molau *(AKM)*

An update will be given on the status of the AllSky7 fireball network in Germany and our achievements since the last IMC. The network has not only expanded significantly, but we also improved the cameras as such with an upgrade from AS6 to AS7, better heat and strew light protection and other details. We have created an online presence that gives detailed information about each station, it's status, a live view an archive of the most spectacular events. Among others, we have recorded the daylight fireball of April 6, 2020, and a number of other interesting events like sprites or starlink satellite chains. Last but not least we have finally established a scheme that allows for the delivery of further AS7 cameras to interested parties in the EU.

Monitor Exoss: Dashboard Panel for Meteor Monitoring Network On Time

G. Rescigno, ***G. Negri*** *(Exoss Citizen Science), W. Souza, M. Mastria, M. De Cicco, Exoss Team*

The EXOSS Citizen Science meteor network operates with two video capture systems: Suite SonotaCo and CAMS / NASA software. Due to necessity for obtain the station´s real time status for both systems, a monitoring tool - Monitor Exoss - was developed in Python script adapted for a "dashboard panel" at Grafana environment , encompassing , as well as all meteor capture inputs stored in mysql database for further analysis and research. Information from computer performance during capture processing is collected on time to obtain a complete individual station diagnosis in order to keep network calibration standards.

A study on latitudinal and altitudinal asymmetry in diurnal variation of sporadic meteor flux

*B. Premkumar, **C. Reddy Kammadhanam** (Department of Astronomy, Osmania University, Hyderabad)*

Understanding the latitudinal and altitudinal variation of diurnal meteor flux is essential for better estimate of annual sporadic meteor mass flux into the earth's atmosphere. The present study focus on the distribution of sporadic meteor flux at different altitudes of radars located at different latitudes. This study is based on archival data collected from six identical all-sky SKiYMET meteor radars located at different geographical latitudes, two of them are located at equatorial region, Kototabang (KTB: 0.2◦S, 100.3◦E) and Biak (BIK: 1.2◦S, 136.1◦E), two are located at northern hemisphere, Bear Lake observatory (BLO: 41.9◦N, 111.4◦W) and Esrange (ESR: 67.9◦N, 21.1◦W) and the other two are located at southern hemisphere, King Edward Point (KEP: 54.3◦S, 36.5◦E) and Rothera (ROT: 67.5◦S, 68.0◦W). The study reveals that there is a strong latitudinal as well as altitudinal asymmetry in meteor flux occurrence rate, which is a result of observing geometry of major sporadic meteor sources at a given latitude. An interesting result is occurrence of diurnal primary peak at different altitudes, particularly at north hemisphere, however, no such peak observed at south hemisphere. We discuss the mechanism responsible for such distribution.

Enhanced Aurigid activity 2019 and predictions for 2021

J. Rendtel (IMO), E. Lyytinen, J. Vaubaillon

In 2019 the Aurigids reached a maximum ZHR of 62+-12 onAugust 31 at 21:22 UT which significantly above theaverage ZHR. The population index did not deviate fromthe long-term average value of r=2.50. A possible explanationfor this activity is a very elongated 1-revolutiontrail released from the parent an orbit earlier than 1935.Enhanced rates are expected to occur during the 2021 returnclose to August 31, 21:35 UT.

MALBEC: Optimization of mobile double station meteor observation

*J. Vaubaillon, **A. Rietze** (IMCCE / Observatoire de Paris / PSL, University of Oldenburg), D. Zilkova*

The Meteor Automated Light Balloon Experimental Camera (MALBEC) aims to observe meteors from two mobile stratospheric platforms. Such a setup allows the success of any observation run, since the two stabilized cameras are located above the clouds and the observation is therefore independent from the weather. This work presents the optimization of the mobile double-station setup. Constraints are defined in terms of angular separation between the camera boresight and the radiant, the Moon and the Sun, since at stratospheric altitude the nacelle is lighted by the Sun sooner than on the ground. The surveyed volume of the atmosphere is examined as a function of time, azimuth and camera roll offsets. The expected number of double station meteors can be assessed given the camera, lens and geometry specifications.

Fake news vs Fake Fireballs

R. Rudawska *(ESA/ESTEC)*

The NEar real-time MOnitoring system (NEMO) uses an alert system based on social media providing near real-time information about new fireball events. The follow-up collection of supportive information covers various data sources, ranging from meteor networks to infrasound data. Since 2019 NEMO is maintained at the European Space Agency. In this talk, we will give an overview of the system and present some peculiar cases of meteors/fireballs that caught social media interest in the past year.

Noctilucent clouds over Munich in July 2020

P. Slansky *(University for Telvision and Film; Department II Technology)*

In early July 2020 bright and colorful noctilucent clouds could be observed from Munich city center in the South of Germany. The author could make photo series which were edited to a time-lapse video. Using simple triangulation, the images reveal both the size and structure of the NLCs and their - complex - motion. The phenomenon of the NLCs is recently related to the illumination of meteors in the Earth's atmosphere

Year-to-year comparison of BRAMS forward scatter observations of selected meteor showers

C. Verbeeck *(International Meteor Organization, Royal Observatory of Belgium), H. Lamy, S. Calders, A. M. Picar, A. Calegaro, M. Anciaux*

The BRAMS network consists of a dedicated forward scatter beacon and about 25 forward scatter receiving stations located in or near Belgium. Though these stations perform observations all year round, we still need the help of citizen scientists from the Radio Meteor Zoo for accurate detection of complex overdense meteor echoes observed during meteor showers. From 2016 onwards, we organized Radio Meteor Zoo campaigns for the major showers. Here, we perform a year-to-year comparison of BRAMS activity curves for selected showers in the years 2016-2020.

The Global Meteor Network – overview

D. Vida *(University of Western Ontario), D. Segon, M. Mazur, A. Merlak, and the Global Meteor Network Team*

The Global Meteor Network (GMN) is a world-wide video meteor network with more than 250 stations in over 20 countries. The stations consist of highly-sensitive CMOS-based cameras and Raspberry Pi single-board computers, and the software is open source. This brings the cost of a single station down to only several hundreds of EUR/USD. The network growth is reliant on citizen scientists and amateur astronomers who obtain their cameras from GMN's private industry partner. The data pipeline is fully automated and orbits of observed multi-station meteors are publicly reported in near-real time. In this work, we present the methodology and the first science results.

Poster

Using a night vision device for video recording Perseid 2019

O. Tarasov *(School of Physics and Mathematics of Tyumen Region), K. Moskvin*

Lyrids 2020 observations by AMOS, spectral, visual and photographic methods

J. Tóth *(Faculty of Mathematics, Physics and Informatics, Comenius University in Bratislava), P. Matlovič, P. Zigo, L. Kornoš, J. Šimon, T. Paulech, M. Baláž, A. Pisarčíková, D. Žilinská, D. Bartková, J. Dudík and S. Kaniansky*