Presentations - IMC 2021

Faint meteor observation by DIMS and laboratory meteor spectroscopy

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Abstract

Faint meteor observation is of important to understand the micrometeoroid flux originated from unknown populations such as very fast (> 72km/s) interstellar meteors and very slow (<12km/s) temporarily captured orbiters (TCOs), etc. Faint meteor observation carried by using the DIMS (Dark matter and Interstellar Meteoroid Study) equipped with a Canon 85mm/F1.4 lens (FoV of 24 x 16 deg, 60Hz) will be introduced. On the other, the laboratory experiment of organic meteors to simulate interstellar materials were conducted to examine C 2 Swan bands in the visible spectrum of the meteor wake.

Semi-Automated Meteorite Recovery with Drones, Machine Learning and Mixed Reality

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Abstract

The Desert Fireball Network which extends across Western and South Australia, observers hundreds of fireball events per year, some of which result in a meteorite surviving to the ground (Bland et al. 2012). Traditionally, searching for these meteorites consists of individuals walking in a line, sweeping a fall site until the area has been covered, or the meteorite is found. While this approach has enabled the recovery of many meteorite falls, it is labor intensive and time consuming. We have devised a new methodology to use when searching for meteorites, which utilizes automated drones to survey a fall site, and a machine learning algorithm to process the images and identify meteorite candidates (Anderson et al. 2020). Our strategy uses images of the local terrain to train a neural network, and minimize the number of false positives. This approach also includes human factors psychology techniques to sort through possible meteorite candidates efficiently and accurately. In this presentation we also preview our prototype mixed-reality vision system. This head-mounted device acts as a virtual reality monocle, offering one eye unobstructed vision, while the other is presented with a enclosed screen. The device which we call the SVR (Semi-Virtual Reality), has three modes: image/video capture, live map, and live view/inference.

Comparison of Atmospheric Entry Models of Meteoroids

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Abstract

The physics behind atmospheric entry of meteoroids is surprisingly complex. More advanced models lead to differential equations that can be in general only solved by numerical methods. We are developing a high-performance simulator of meteoroid flight in C++. With its help we examine multiple models of meteoroid flight dynamics; which comprise models of the Earth, correlations for atmospheric drag in multiple flight regimes spanning a wide range of Knudsen and Mach numbers, and several models of atmosphere. We also investigate the implications of employing various models of heat transfer, ablation and fragmentation. Finally, we study how they affect the light curve of the resulting meteor and the final fate of the simulated particle.

Meteor observation with the DIMS project: sensor calibration and first results

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Abstract

In addition to meteors coming from the Solar System, fast- and straight-moving luminous events of exotic origin could theoretically be observed in the Earth's atmosphere at night. For example, "nuclearites"are strange quark matter nuggets that are hypothesized as possible candidates of macroscopic dark matter. If they exist, they should collide with the atmosphere and generate luminous events similar to meteors. However, they could be recognizable mainly by their lower altitude from ground (10 km) and their very high expected speed (250 km/s). Also for meteoroids of interstellar origin, the boundary value of 72 km/s may be exceeded but only by several kilometers per second. The DIMS (Dark matter and Interstellar Meteoroid Study) experiment was born in 2017 aiming to search for fast-moving objects by observing the sky with wide-field and high-sensitivity CMOS cameras. The DIMS collaboration carried out several observational campaigns, mainly from Japan and at the Telescope Array site in Utah, to test and develop the system and observed few thousands of meteors. We derived the calibration of the DIMS sensors by astrometry and photometry techniques applied to observed stars in the FoV (57°x 34°) and assessed the achieved positional precision and sensitivity levels. DIMS cameras observe in a wide bandpass (300-1000 nm) and we estimated

a limiting magnitude for meteors of about +6. By triangulation between two DIMS cameras, we derived the dynamics of observed events from our observational campaigns. At present time, none of the analyzed events shows indisputable features indicating non-meteor origin. In this contribution, we will present the current status of this work.

Tests with a simple ablation and dark flight calculator

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Abstract

At the 2019 IMC we presented a simple Python ablation and dark flight calculator. Based on real data from the Flens fireball and meteorite fall, we test the performance of the software, and compare results.

Estimating luminous efficiency from simultaneous radar-optical measurements of shower meteors

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Abstract

To establish an estimate for luminous efficiency and its variation with speed and radiant power, we report a series of simultaneous optical and specular echo radar measurements of shower meteors. Optical measurements were performed with two pairs of autonomously operated electron-multiplied charge coupled device cameras (EMCCDs) co-located with the multi-frequency Canadian Meteor Orbit Radar (CMOR). Using the timing and geometry of individual meteors measured by both the radar and multi-station EMCCD systems, the portion of the optical lightcurve corresponding to each specular radar echo is measured and the received echo power used to estimate an electron line density. We also model each event using an erosion-type ablation model to constrain the overall meteoroid mass. We focus on shower meteors to measure the variation of luminous efficiency within a semi-homogenous population of meteoroids moving at the same speed. The variance in luminous efficiency per shower provides an independent estimate for the accuracy of our model assumptions. For each shower we investigate the change in luminous efficiency as a function of brightness.

MOMSTER: developing a Meteor Education Kit as a resource for STEAM teachers in secondary schools

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Abstract

MOMSTER aims at developing a Meteor Education Kit as a resource for STEAM (Science, Technology, Engineering, Arts, Mathematics) teachers in secondary schools. The kit includes a mobile radio meteor station consisting of a dedicated antenna and radio receiver, as well as an educational package to learn all about meteors and their detection methods, while at the same time conveying a fascination for the ephemeral beauty and complexity of these natural light shows. The project goals are stimulating STEAM (ultimately resulting in nudging future career choices towards science or engineering career paths) and the use of citizen science (especially the Radio Meteor Zoo initiative on the online citizen science platform Zooniverse) at schools, and reaching the general public. The development of educational resources builds upon preliminary experiences we gained by participating in an Erasmus+ project called BRITEC (Bringing Research into ThE Classroom), in which teachers and pupils participated in the Radio Meteor Zoo activity. We are presently in a pilot phase where three Belgian schools (two Dutch speaking and one French speaking) test the mobile radio meteor station and the educational resources, and give their feedback. We are using

STEAM-education as an approach to broaden our target group towards less scientifically oriented students. We do this by developing an educational resource on visual (science) communication. We also organized an art &design competition for high school students with more than 30 submissions. The best piece of art will decorate the 'MOMSTER boxes'we use for transport of the radio receivers. This project receives a grant from the Europlanet Society to engage the public with planetary science.

FRIPON network last results and data access

Colas[1], F and the FRIPON team

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Abstract

tbd

From D-criteria to chaos map

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Abstract

Today there is more than 10001 meteor showers listed by the IAU, which would mean a similarly large number of parent bodies in the vicinity of the Earth in the near past (1-100kyrs). This casts a doubt on methods used to find new meteor showers. If we name "meteor group" several meteors forming what looks like a meteor shower, orbit dissimilarity criteria (D-criteria) are usually used to distinguish between meteor groups and actual meteor showers. However, we will recall here how those D-criteria are not as reliable as first hoped. For example, the widely used DSH criterion (Southworth and Hawkins, 1963) exhibits mathematical, physical and statistical problems. Furthermore, many physically sound criteria would benefit from more thorough robustness tests. Instead of defining a new criterion, a new tool is proposed here to complete information from D-criteria : a chaos map. The utility of this tool will be shown, along with some first results on the stability of meteoroids streams, linked with well-know meteor showers.

"MoMet": A mobile case for improved meteor observations

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Abstract

Meteor outbursts happen every year. Despite the spread of meteor observation camera networks, such outburst might not always be observed in optimal conditions (orbital geometry, spectroscopy camera grating orientation, ...). For these reasons, we have developed a Mobile Meteor observation facility called "MoMet". The goal is to ease the deployment, installation and usage of 5 meteor cameras, embedded in an airplane cabin-compatible suitcase. The design and making was performed by Paris Observatory (IMCCE &GEPI). The hardware is composed of Basler and DMK cameras, operated by Odroid and RaspBerry-Pi 4 onboard computers. The acquisition and detection software is RMS. The configuration interface is written in NodeJs and is accessible by the user through a web browser once the computer is connected to the case by an Ethernet cable. The RMS configuration is applied thanks to a python software running on all onboard computers. Time is kept updated thanks to a local NTP server that transmits time to each onboard computer and a GPS receiver acts as a time reference for the NTP server. The design, making and first results will be presented.

Broadband radio emission from meteor trails observed with LOFAR

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Abstract

The LOFAR telescope observed the Perseid and Geminid meteor showers in 2020, and the Quadrantid meteor shower in 2021. Using the AARTFAAC All Sky Monitor we created high resolution all sky images at frequencies between 30 and 70 MHz. In our images, clear broadband meteor trails are visible, some of which persist up to minutes. For one night of the Perseids, we matched 200 meteor trails to optical detections of the CAMS BeNeLux network. During the Quadrantid and Geminid meteor showers, significantly fewer radio meteor trails were detected (without optical measurements due to clouds). As a possible explanation, we propose that the broadband meteor emission is not intrinsic, but reflected emission from the Galactic center, which was only up during the Perseids.

Detection of meteors in shuttered photography with IA and mathematical morphology

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Abstract

The CABERNET project aims to measure accurate trajectories and orbits of meteors, by implementing three photographic stations equipped with a 100Hz electronic shutter. Meteors appear as elongated chopped lines. Artificial satellites also appear as elongated lines. Up to now, the detection of meteors was performed by image difference and a manual inspection of the data. In this paper we present a new approach based on mathematical morphology and IA. The principle is first to detect an event on a frame. This event appears on the image difference as a bright amount of pixels when it is a meteor, bright and dark for a satellite (bright is the satellite in the image t, dark is the satellite in the image t-1). We developed an algorithm to detect these events using mathematical morphology on the original images and statistical change tests on the image difference. Once an event is considered as a potential candidate, we classify it into 3 classes: 'meteor', 'satellite'or 'trash'. In this last class, we can find planes, incomplete satellites, some clouds, the negative part of a meteor etc. The classification is performed using an Random Forest classifier with 12 features, on a database of 4000 'trash', 1700 'satellite'and 600 'meteors'. The results reached 97

Subspace Based Meteor Detection Using SLIDE

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Abstract

A feasibility study was performed using an alternative meteor detection algorithm called subspace based line detection (SLIDE). The method is discussed in the context of existing state-of-the-art, low-light meteor detection algorithms, with the focus on SLIDE's advantages, short-comings, and performance results.

AllSky7 Fireball Network Europe

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Abstract

Since the 2020 IMC, the size of the AllSky7 Fireball Network Europe has more than doubled, with currently nearly 50 stations active in 12 European countries. The lecture will discuss the organization of the network, describe recent progress and present some of the highlights of the past 12 months.

Micrometeorites trajectories in the atmosphere from fireball fragmentations

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Abstract

We will present our own software for meteorites and micrometeorites trajectories with particle concetration in the atmosphere at specific times after fragmentation. We will focus on specific fireball fragmentations like Košice case and others, originating from the AMOS all-sky camera osbervations

Lunar impact flashes - almost like meteors

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Abstract

Meteoroids do not only enter the Earth's atmosphere, they also hit the Lunar surface where they generate a light flash upon impact. Since the end of the last millenium, people have been observing these lunar impact flashes. I have been involved in this topic for many years from a scientific point of view; since early 2021 I have been observing the dark side of the Moon (yes, the dark side!) myself. In this presentation I will give an introduction what these observations can contribute to our 'meteor' topic. I will also share my observational experiences which I will have hopefully accumulated until the conference.

Reconstructing meteoroid trajectories using BRAMS data

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Abstract

BRAMS (Belgian RAdio Meteor Stations) is a Belgian network of radio stations using forward scattering of radio waves on ionized meteor trails to detect and characterize meteoroids. One of the long-standing problem is the reconstruction of individual meteoroid trajectories from multi-stations observations of the same object. In this talk, we will present the status of 3 methods : 1) one using only time-delays measured between meteor echoes recorded at >=6 receiving stations, 2) one using data from our interferometer in Humain + time-delays measured between meteor echoes in Humain and 3 other receiving stations, 3) one assuming we can determine the total range traveled by the radio wave (something currently not possible with the BRAMS network as it is but could be considered in the future). In the latter case, only time-delays measured between 3 receiving stations are enough.

Meteorix A new processing chain for real-time detection and tracking of meteors from space

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Abstract

Meteorix is a Universitary CubeSat project from Sorbonne University. Its main objective is the detection and characterization of meteors and space debris. Processing chains used on Earth work with stationary cameras and different image-processing techniques which add or subtract several frames together to detect celestial objects. In the case of a nanosatellite, the camera is no longer stationary due to its orbit which causes to many differences between each frame to use the previous techniques. This is why we propose in this work a new and space-specific processing chain for meteor detection.

Hunting for short-duration meteor showers

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Abstract

The IMO Video Meteor Database has been search for meteors showers numerous times, first starting 2006 with a database size of nearly 200,000 meteors, and last time in 2012, when the number had grown to over a million meteors. Over a hundred meteor showers could be detected automatically, and confirmed in this analysis. By the time of the 20th anniversary of the IMO Video Meteor Network in 2019, when the database size had grown by a factor of four again. This time, we did not simply want to repeat the analysis and detect even fainter showers, but focus particularly on short duration meteor showers, which may have slipped past meteor showers searches by IMO and other meteor networks. The result of this search will be presented.

Simultaneous observation of faint meteor using MU radar and Tomo-e Gozen Schmidt telescope

Kouki Nonaka[1], Kohei Morita, Shinsuke Abe (Nihon University) Ryou Ohsawa, Shigeyuki Sako (University of Tokyo) Daniel Kastinen, Johan Kero (Swedish Institute of Space Physics) MU-Tomo-e observing team

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Abstract

Since 2018 we have been conducting simultaneous observations of faint sporadic meteors using the Middle and Upper atmosphere radar (MU radar) at Kyoto University's Shigaraki observatory (34.9N,136.1S) and the Schmidt telescope equipped with Tomo-e Gozen Camera at University of Tokyo's Kiso observatory (35.8N,137.6). In this presentation, updated results including 2020 Geminids campaign will be discussed.

Collection of micrometeorites in the stratosphere

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Abstract

A stratospheric balloon was launched to collect micrometeorites up to 35 km. For this mission, a collector was specially designed and is being improved for future missions. The collected particles were analysed using various techniques, such as SEM, SIMS, and EDX. An attempt at classification was made according to The classification of micrometeorites by Genge et al. (2008).

Minimizing biases of luminous efficiency determinations based on FRIPON data

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Abstract

The French fireball network FRIPON (Fireball Recovery and InterPlanetary Observation Network) collected 3871 confirmed events between April 2016 and June 2020. Of those, a subset of data with physically realistic results and good light curve quality was chosen. For these 281 meteors, the luminous efficiencies τ were computed. Based on this subset,relations of τ and the pre-atmospheric meteoroid velocity, and mass, were examined. Aspects which could cause inaccuracies, influence the results, or render the method less validwere considered. These include the assumed density based on stream associations, the possibility of an observational bias due to missing parts of the trajectory, the final height, the deceleration, and flow regime. 54 well-recorded events could be obtained from the discovered individual biases and constraints. These events have τ-values in the range between 0.012% and 1.1%. It would appear that the derived luminous efficiency of meteoroids is dependenton the assumed material density. By using the subset the results provide evidence that applying a debiasing method improves the analysis of decelerated meteoroids with the underlying method being only valid for meteors in the continuum-flow regime. In general, these events feature low end heights, large masses, and high deceleration.

Fireball Report: two new APIs to share your camera observations

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Abstract

The American Meteor Society (AMS) and the International Meteor Organization (IMO) accept online reports of suspected fireballs from the general public through an online form. Eye-witness reports are combined and presented on publicly accessible "event pages"where an estimate of the trajectory of the fireball and other data are presented. We implemented a new API that allows camera networks to enhance the event pages with their own data (trajectory, location of the cameras involved in the detection and any other data they are willing to make public). This API is an opportunity for the camera networks to compare their results and to promote their work via links back to their own websites. A second new API allows camera operators to share their observations (azimuth, elevations…) as well as their media (photos &videos) just like the eye witnesses do.

A survey of hydrogen emission in meteors

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Abstract

A particularly interesting area of study of meteor spectra is atomic hydrogen emission as it may be the only readily observable signature of organic matter and hydrogen-containing minerals in meteoroids. In this talk, we will present the results of our analysis of the H emission in a large sample of meteor spectra from ablating mm-dm-sized meteoroids. We analysed the variations of H emission among meteoroids from different dynamical sources and studied the link between H intensity and specific physical and orbital parameters.

Meteorix camera tests for space-based meteor observations

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Abstract

Meteorix is a Universitary CubeSat project and it aims to detect meteors and space debris from space by boarding a dedicated meteor detection camera onboard a nano-satellite. Usually, CubeSat's camera are used for daylight observations. In this work, we present some tests realized with the 3DCM734 camera, which is also used in the martian rovers for imagery purposes. In-lab tests were conducted to measure the quantum efficiency. First on sky images were performed during the 2020 Geminids from the Paris area. Follow-up tests were performed from Observatoire de Haute-Provence during the 2021 eta-Aquariids meteor shower. Capabilities and needed modifications for meteor detection were identified. The first meteor detected with Meteorix camera will be presented.

Calibration of visual meteor observations

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Abstract

Observations under various conditions allow us to derive information about the calibrations used to calculate the ZHR or flux density.This is necessary to obtain results also from moonlit returns of showers. Different observing conditions as well as intrinsic meteoroid stream parameters determine the size range which is observed and need to be specified when comparing different streams.

Observations (from 2016 to 2020) of the Geminids from different regions of Russia by an amateur astronomer

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Abstract

I present the results of my observations (visual and photographic) of the Geminid meteor shower in 2016, 2018, 2019 and 2020. I observed meteors from different regions (Moscow and Primorsky Krai) of Russia, under different observation conditions: light pollution, Moon phases and weather. I used a DSLR camera Canon EOS 60D with 18-135mm f/3.5-5.6 lens to photograph meteor tracks.

What just happened? Facilitating cooperation between Fireball networks

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Abstract

The UK has six fireball or meteor networks using five different camera systems. Similar overlaps occur in Germany, France, Morocco and the United States. We report here on two innovations which help overlapping or neighbouring networks compare observations and exchange data. These are:

1. The Event Log format. This is how a meteor network can disclose the timing and approximate observing location of each meteor that it has detected, to enable the other network to check for matching meteor observations. This solution arose from a 15-way email discussion initiated by LubošNeslušan following the Europlanet Virtual Fireballs Conference in June. After much discussion about existing meteor databases and communication protocols, Mike Hankey of the American Meteor Society proposed an elegant, peer to peer solution that is very easy to implement. This solution will be described in the presentation.

2. The Global Fireball Exchange format. This is how a meteor network can easily send or receive a detailed single-station observation of a fireball event. This enables each network to swap observations with its neighbours, so that each can run their own trajectory and dark flight models using a mix of their own data and data from other networks. This solution arose from detailed work presented to Europlanet in 2020, in which eight existing single-station fireball data formats were compared and evaluated, and the format used by the Australian Desert Fireball Network was found to be the best. The Global Fireball Exchange (GFE) Format has been (or is being) implemented by five different networks and was used to exchange data during the analysis of the Winchcombe meteorite fall.

These tools allow neighbouring networks to quickly determine whether they both captured the same event of interest, then to exchange observations of that event. This should lead to quicker recovery of meteorites and better initial strewn field calculations. https://drive.google.com/

Status of the IAU Meteor Data Center

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Abstract

In 2006 Commission 22 of the International Astronomical Union (IAU) established a Task Group for Meteor Shower Nomenclature. In the following year the meteor shower database was created as part of the IAU Meteor Data Centre (IAU MDC), and two years later 64 meteor showers were officially named by the IAU. Since 2019, new rules have been established for the introduction and removal of meteoroid streams from the IAU Meteor Data Center (IAU MDC).

Within the "Shower database", the MDC is responsible for: the designation of meteor showers, in conjunction with the Working Group on Meteor Shower Nomenclature of IAU Commission F1 (Meteors, Meteorites, and Interplanetary Dust) and it acts as a central list of all meteor showers. Simultaneously, at the "Orbital database"part, the MDC is in charge of the efficient collection, (computation,) checking and dissemination of trajectory observations and orbits of meteors, and it also acts as a central depository for meteor orbits obtained by photographic, video and radar techniques. This presentation will give a concise description of the IAU Meteor Data Center database, its origin, structure and, in particular, the current requirements for the introduction of new data, unknown as well as known meteor showers.

The Fruits of Failure, Frustration and Fortune

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Abstract

So, I would like to present - lost opportunities of meteor observations from winter 2019 to fall 2021 with analysis of the reasons for the failure - the hunt for Quadrantid moon impacts 2020 and why it failed - project “3APES”, a 3-camera Astronomical Particle Examination Sensor, made of three video cameras as in situ detector for cosmics, and why it turned out to be quark - last but not least some meteor observations that were successful just by fortune: Geminids 2020, Quadrantids 2020, Lyrids 2020…- at last, if it is accepted, my movie of the ISS fly by over Munich in fall 2020, shot with 0.8m telescope of the Munich public observatory and a professional movie camera.

It would be more a kind of parforce ride with many images than a presentation to just one scientific subject. But with a certain humour…

Transverse scatter reflection coefficients from different plasma distributions and comparison to triple-frequency meteor radar observations

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Abstract

Transverse scatter meteor observations have been conducted for more than 7 decades to estimate winds and temperatures at the mesosphere and lower thermosphere or to perform astronomical observations of the meteor earth environment collecting information about the meteor flux, orbit characteristics, entry velocity and the mass/size distribution of the extraterrestrial particles. Meteoroids entering the Earths atmosphere are decelerated and heating by collision with the ambient atmospheric molecules and depending on their kinetic energy, they form an ambipolar diffusing cylindrical plasma trail. Until today a comprehensive description of the radial plasma distribution and their evolution in time is missing. Here we present theoretical results of reflection coefficients for 4 different plasma distributions derived from a full wave scattering model to obtain a quantified description of the observed signals in terms of their initial trail radius, the electron line density and ambipolar diffusion coefficient. Furthermore, we fitted the theoretical reflection coefficients to the triple frequency meteor radar observations to determine physical consistent electron line densities, initial trail radii and diffusion coefficients. The observations confirmed that the signal morphology depends on the polarization of the emitted radiowave and its alignment to the meteor trajectory.

AMOS update and status

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Abstract

We will provide an update and status of AMOS global meteor network, new stations, technical updates and examples of interesting observations of meteors, both all-sky and spectral.

MALBEC : Feasibility of double-stratospheric ballon observation

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Abstract

The "Meteor Automated Light Balloon Experimental Camera" (MALBEC) project aims to observe meteors from a double-stratospheric balloon stations. Theoretical considerations explore the possibilities of such mobile observations, given the practical constrains and the scientific goal. In particular, the expected number of detected meteors is computed and compared to past observations campaigns. We find quite challenging to compare ground based visual meteor counts and stratospheric camera observations. In addition, theoretical and wind tunnel experiments explore what mid-infrared observation could bring to meteor science.

Spectral Calibration of Meteors: On The Altitude-Dependent Atmospheric Correction

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Abstract

By analysing the spectra of meteors ablating in the Earth's atmosphere, one can acquire valuable information about the composition of their parent bodies, asteroids and comets. Discoveries about space bodies'compositions support different research areas, including Solar System evolution, astrobiology and planetary defense. In meteor spectral analysis, the spectral features observed during a meteor's ablation in the atmosphere can be broken down into components belonging to the meteoroid and those of atmospheric origin. A challenge for accurate meteoroid composition inference from meteor spectra comes from the correction for the Earth's atmosphere extinction; its dependence on the altitude of the meteor is particularly challenging, though often not considered in the calibration chains. This paper discusses the procedure developed in this project for atmospheric correction of meteor spectra and the realization of altitude-dependent spectral response curves. The research is done within the framework of ESA's Meteor Research Group (MRG) and uses as main data source ground-based observations collected from optical cameras in CILBO observatory. Areas of the research presented in this paper tackle the characterisation of the instrument spectral response, used for sensitivity calibration of meteor spectra, and the altitude-dependent correction for the extinction by the Earth's atmosphere on meteor spectra. Main focus is on the atmospheric calibration. Calibration chains are generally based on a spectral response curve, obtained for the instrument by on-ground calibration or derived from bright star

observations. In this project, the instrument spectral response is built by using first-order observations of Vega (-Lyrae) from CILBO. To compensate for the impact of the atmospheric extinction on the star's radiation observed from CILBO's camera, we consider the direction of the incoming radiation and the scattering optical thickness of aerosols and gas molecules in the atmosphere. The resulting atmospheric-calibrated spectra are radiometric calibrated, correcting for dark current and flat-field, and then divided by Vega's first-order spectrum observed by Hubble's STIS instrument. Finally, a spline-fitting algorithm is applied to smoothen the resulting spectral response curve, followed by a normalisation. For a typical meteor event extracted from CILBO, a total of around 30-50 frames is observed, with frame rate 25 FPS. Between consecutive frames, the meteor could have gone through more than 1 km in the atmosphere. To correct for the different extinction during a meteor's path in the atmosphere, the instrument spectral response curve is multiplied by a correction factor which depends on the meteor's altitude at the time of observation. This resulting instrument spectral response is finally multiplied to the observed spectra from CILBO, this way obtain the spectral calibrated data products. This paper aims to demonstrate the improvement on meteor spectra analysis deriving from the presented methodology, using one characteristic example. Results show the impact of the calibration procedures on the meteoroid's composition inference.

Trajectory, photometry, and fragmentation of the Winchcombe meteorite fall reconstructed using a multi-network data set

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Abstract

Six meteor networks operate a variety of diverse optical cameras in the United Kingdom, ranging from all-sky to narrow-field systems. The networks use different hardware, software, and mutually-incompatible data formats. The Winchcombe meteorite fall which occurred on February 28, 2021 was observed by all of the networks in the UK, and in this work we analyze the fireball using that diverse data set. We discuss the key quality criteria that data need to meet, best practices of data reduction to achieve maximum accuracy, and describe procedures used to derive the photometry and the fragmentation behaviour of the fireball. Finally, we give a set of recommendations which may help amateur astronomers deploy systems that produce data that can be used in a scientific analysis.

Recent results from the Kilwinning Spectroscopic Survey for Meteors

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Abstract

A review of some bright meteor spectra captured by the KiSSMe cameras (Ursids, Quadrantids and sporadics).

Observing the Hayabusa-2 Capsule Re-entry over Australia

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Abstract

Japan Aerospace Exploration Agency's Hayabusa-2 sample return capsule came back to the Earth on the 5th December 2020 at 17:28 UTC. This was a unique opportunity to test sensors and record aspects of fireball phenomena that are hard to collect for sporadic, natural events. A scientific observation campaign was planned to observe the optical, seismo-acoustic, radio and high energy particle phenomena associated with its re-entry. A multi-institutional collaboration between Australian and Japanese universities resulted in 49 instruments deployed (total of 73 including existing, permanent sensors). The SRC re-entered the atmosphere over South Australia, visible for 53 seconds as a fireball from near the Northern Territory border, toward Woomera where it landed in the the Woomera military test range. Data collection was successful and will be used to study the effects produced by interplanetary objects impacting the Earth's atmosphere for natural objects.