Program of the 34th International Meteor Conference

Mistelbach , 27–30 August, 2015

Thursday, 27 August, 2015

14:00 – 19:00	Arrival and registration IMC participants at the Fachschule in Mistelbach, (for the residents of hotel Klaus the registration desk is at the hotel in Wolkersdorf).
19:00 – 19:30	Opening and welcome speeches. • Opening of the 34th IMC by *Cis Verbeeck*; • Welcome speech by *Thomas Weiland*, Chairman of the IMC-LOC; • Welcome speech by *Alexander Pikhard*, President of the Wiener Arbeitsgemeinschaft für Astronomie; • Practical announcements by Anneliese Haika.
20:00 – 21:00	Dinner *(MAMUZ Museum - M-Zone).*
21:00 – 22:00	*Galina Ryabova*. "MetLib Workshop" (*Fachschule Mistelbach).*
21:00 – …	Informal socializing (*IMC bar – Fachschule Mistelbach*).
	A shuttle service is available for residents of hotel Klaus, departure see at the entrance IMC-bar.

Friday, 28 August, 2015

07:30 – 08:30	Breakfast.
	Session 1 Observing and analyzing techniques *(MAMUZ Museum - Kapelle).* (Chair: *Megan Argo*).
09:00 – 09:25	*Sirko Molau*. "Population index reloaded".
09:25 – 09:45	*Pete Gural*. "The American Meteor Society's filter bank spectroscopy project".
09:45 – 10:00	*Denis Vida.* "Video meteor detection filtering using soft computing methods".
10:00 – 10:15	*Kristina Veljković*. "Improvement of software for analysis of visual meteor data ".
10:15 – 10:30	*Richard Fleet.* "Correlating video meteors with GRAVES radio detections from the UK".
10:30 – 10:45	*Debora Pavela & Miroslav Živanović*. "The effective number of shower meteors in a reduced field of view".
10:45 – 11:15	Coffee break & Poster Session.
	Session 2 Status of meteor camera networks. *(MAMUZ Museum - Kapelle).* (Chair: *Felix Bettonvil*).
11:15 – 11:30	*François Colas*. "Installation and extension of the FRIPON project".
11:30 – 11:45	*Paul Roggemans*. "Status of the Benelux CAMS network".
11:45 – 12:05	*Damir Šegon*. "Croatian Meteor Network: ongoing work 2014-2015".
12:05 – 12:25	*Przemysław Żołądek*. "Recent fireballs registered by the Polish Fireball Network".
12:25 – 12:40	*Mariusz Wiśniewski*. "Latest developments in the Polish Fireball Network".
12:40 – 12:55	*Juraj Toth*. "1/2 year of AMOS at Canary Islands".
13:00 – 14:00	Lunch – *(MAMUZ Museum - M-Zone).*

Session 3 Meteor streams *(MAMUZ Museum - Kapelle).*
(Chair: *Ana Georgescu*).

14:00 – 14:15 *Rachel Halina Soja*. "Meteor showers with the IMEX model".

14:15 – 14:35 *Jürgen Rendtel*. "Daytime meteor shower project".

14:35 – 14:50 *Christian Steyaert.* "The 2015 February 5 event".

14:50 – 15:10 *Felix Bettonvil*. "CHIPOlaTA high precision orbits of Geminids and Perseids".

15:10 – 15:25 *Galina Ryabova*. "Could the Geminid meteoroid stream be the result of long-term thermal fracture?".

15:25 – 15:40 *Sang-Hyeon Ahn*. "Precession of parent bodies from historical meteor outbursts".

15:45 – 16:15 Coffee break & Poster Session.

Session 4 Meteor cameras *(MAMUZ Museum - Kapelle).*
(Chair: *Kristina Veljković*).

16:15 – 16:30 *Matej Korec*. "QHY CCD camera for video meteor observation".

16:30 – 16:45 *Jakub Koukal & Jiri Srba*. "NFC - Narrow Field Camera".

16:45 – 17:00 *Dario Zubovic*. "Advances in the development of a low-cost video meteor station".

17:00 – 1715 *Ana Georgescu*. "A calibration unit for meteor camera".

17:15 – 17:30 *Leonard Kornos*. "Astrometric precision of all-sky observations with AMOS and meteor orbit determination".

17:30 – 17:45 *Pavol Matlovič*. "Meteor spectra from AMOS video system".

17:45 – 18:00 *Roman Piffl*. "3.000.000 meteor light curves in EDMOND database".

18:00 – 19:00 **Poster session and introduction of all poster authors**

01. *Eduard Pittich & Nina Solovaya*. "On the structure of hyperbolic and near-parabolic dust streams".

02. *Bill Ward*. "Video meteor spectroscopy".

03. *Abderrahmane Ibhi*. "The meteorite falls in Africa".

04. *Stanislav Kaniansky*. "A new analysis of Monturaqui meteorites".

05. *Peter Dolinsky*. "Radio observation of meteors at the Central Slovak Observatory in Hurbanovo".

06. *Song In-Ok, Kim Tae -gi, Kim Kyung mo, Hong Jin young and Cho Mingyu*. "Meteor observations of forward-scattered FM-radio echo in Busan (Korea) in 2015".

07. *I-Ching Yang*. "The beginning height of four meteor showers by TWEET's data".

08. *Tibor Hegedüs, Szilárd Csizmadia, Zoltán Zelkó, Zsolt Kereszty, Zsófia Bíró*. "2015 Easter bolid over North Hungary".

09. *Juraj Toth.* "Ursids 2014 by all-sky cameras AMOS and EDMOND".

10. *Roman Piffl*. "A simple method to increase the efficiency of MetRec and UFO Capture".

11. *Felix Bettonvil*. "Status report HHEBBES! / ASSN All sky camera".

12. *Dario Zubovic*. "Advances in the development of a low-cost video meteor station".

13. *Zbigniew Tymiński*. "Search campaigns of the Polish Fireball Network".

14. *Debora Pavela & Miroslav Živanović*. "The effective number of shower meteors in a reduced field of view".

15. *Anna Kartashova*. "Double-station observation at INASAN".

16. *Jakub Koukal, Sylvie Gorková, Jiří Srba, Carlos Augusto di Pietro*. "Meteor spectra in the EDMOND database".

17. *Ana Georgescu*. "ROAN 2015".

18. *Andrey Murtazov.* "Assessing risk from dangerous meteoroids in main meteor showers".

19. *Jakub Kakona*. "Czech Bolidozor radio meteor detection network".

19:00 – 20:00 Dinner *(MAMUZ Museum - M-Zone).*

20:00 – 20:45 27th IMO General Assembly *(MAMUZ Museum – Kapelle).*

Informal socializing (*IMC bar – Fachschule Mistelbach*).

Saturday, 29 August 2015

07:30 – 08:30	Breakfast.
	Session 5 Radio techniques *(MAMUZ Museum - Kapelle).* (Chair: *Ferat Özeren*).
09:00 – 09:15	*Giancarlo Tomezzoli*. "No sign of the 2014 Daytime Sextantids and mass indexes determination from radio observations".
09:15 – 09:30	*Hervé Lamy*. "Recent advances in the BRAMS network".
09:30 – 09:45	*Stijn Calders*. "The BRAMS Zoo, a citizen science project".
09:45 – 10:00	*Antonio Martinez Picar*. "Directional pattern measurement of the BRAMS beacon antenna system".
	Session 6 Ongoing meteor work *(MAMUZ Museum - Kapelle).* (Chair: *Galina Ryabova*).
10:00 – 10:15	*Denis Vida*. "Low-cost meteor radiometer".
10:15 – 10:30	*Regina Rudawska*. "Independent identification method applied to EDMOND and SonotaCo databases".
10:30 – 11:00	Coffee break & Poster Session.
11:00 – 11:15	*Auriane Egal*. "Analysis and development of meteor's trajectories reconstruction methods".
11:15 – 11:35	*Francisco Ocaña*. "On the frequency of the superfireballs: 250 years of reports".
11:35 – 11:50	*Mike Hankey and Vincent Perlerin*. "IMO Fireball report form: results and prospects".
11:50 – 12:00	*Nedim Mujic*. "Bosnian Meteor Network, first results".
12:00 – 12:15	*Jérémie Vaubaillon*. "Phenomenologic approach of the meteor phenomenon".
12:30 – 13:30	Lunch (MAMUZ Museum - M-Zone).
13:45	Departure for excursion to Vienna by bus at *MAMUZ Museum*.
15:00 – 17:30	Guided tour at Naturhistorisches Museum (NHM), Wien.
17:45 – 18:45	By bus to the Heurigen Winzerhof Rieder "Eisenhuthaus", Oberer Markt 10, Poysdorf.
19:00 – 22:30	Closing dinner, cold and warm buffet with local wine ("Heurigen" is a typical wine restaurant).
23:00 – ...	Last night of the IMC, free entertainment and informal chat. (*IMC bar – Fachschule Mistelbach*).

Sunday, 30 August 2015

09:00 – 10:00	Breakfast.
10:00 – 10:30	Coffee break & Poster Session.
	Session 7 Ongoing meteor projects *(MAMUZ Museum - Kapelle).* (Chair: *Jürgen Rendtel*).
10:30 – 10:45	*Detlef Koschny*. "Current activities at the ESA/ESTEC Meteor Research Group".
10:45 – 11:05	*Jana Kretschmer*. "De-biasing CILBO meteor observational data to mass fluxes".
11:05 – 11:20	*Thomas Albin*. "De-biasing of the velocity determination for double station meteor observations from CILBO".
11:20 – 11:35	*Sandra Drolshagen*. "Mass accumulation of Earth from interplanetary dust, meteoroids, asteroids and comets".
11:35 – 11:50	*Thomas Abin: "*Influence of the pointing direction and detector sensitivity variations on the detection rate of a double station meteor camera".
11:50 – 12:10	*All session chairmen*. "Conference summary".
12:10 – 12:15	Closing of the 34th IMC by Jürgen Rendtel.
12:30 – 13:30	Lunch (MAMUZ Museum - M-Zone).
	Departure of participants.

The IMC program and the abstracts list the names of the speakers only. The names of co-authors will appear in the Proceedings. Most abstracts are preliminary versions as most papers aren't yet delivered (2015 August 8).

Friday 28 August 2015

Session 1: Observing and analyzing techniques

Chair Megan Argo

Population index reloaded

Sirko Molau

At the 2014 IMC a novel approach to compute population indices from video observations of meteors was presented. It was meanwhile applied to a number of meteor showers and provided interesting insight into their brightness distribution. However, the algorithm leads sometimes to significant outliers which cannot be explained easily and question the reliability of the results. The talk will present a number of findings and ideas that were gained during the search of the root cause for these outliers.

The American Meteor Society's filter bank spectroscopy project

Peter Gural

The AMS has sponsored the development of an alternative method of meteor spectroscopy that relies on a set of eight very narrow band wavelength filters. The interference filters used are tuned to the dominant meteoric emission lines of Ca+, two Fe line regions, Mg, Na, Si+, the forbidden O line, and atmospheric O. Discussion will include the design trade-offs, construction of the instrument, first light testing, and initial results.

Video meteor detection filtering using soft computing methods

Denis Vida

In this paper we present the current progress and results of filtering Croatian Meteor Network video meteor detections using soft computing methods such as neural networks and support vector machines (SVMs). The goal is to minimize the number of false-positives while preserving the real meteor detections. This is achieved by pre-processing the data to extract meteor movement parameters and recognizing patterns distinct to meteors. The input data format is fully compliant with the CAMS meteor data standard, and as such the proposed method could be utilized by other meteor networks of the same kind.

Improvement of software for analysis of visual meteor data

Kristina Veljkovic

In this paper, we present improvements made on our software for analysis of visual meteor data. R package MetFns received major updates. Selection filters and algorithms for calculation of zenithal hourly rate and population index, as well as accompanying graphics, are corrected and their performance is improved.
Web application MetRApp contains completely remodeled data layer, new REST API and user interface. Also, calculation performances are optimized.

Correlating video meteors with GRAVES radio detections from the UK

Richard Fleet

The area of meteor ablation layer illuminated by the GRAVES radar is low on the horizon from southern UK. A number of simultaneous video meteor and radio detections suggested that it was possible to record common events despite the unfavorable relative positions. This was investigated further to see what the constraints are and whether there is any prospect of obtaining useful data.

The effective number of shower meteors in a reduced field of view

Debora Pavela and Miroslav Živanović

Constricted and reduced field of view, such as in telescopic observations, significantly changes the relationship between the size of effective and geometric field of view. We simulated telescopic observations of a meteor shower, approximating sky as a two dimensional plane. Three parameters have been varied: ratio of the meteors length and its distance to the radiant, distance between the radiant and the center of the field of view and the radius of the field of view. Given that the observer does not know about each meteor seen, whether its center is in the field of view or outside of it, the number of meteors with centers inside of the field of view can be assumed by introducing corrections for each class of the meteors seen. Observed meteors are sorted in four classes, depending on which part of the meteor is in the field of view. We proposed a function that relates the size of the effective field of view with the mentioned three parameters.

Session 2: Status of Meteor Camera Networks

Chair Felix Bettonvil

Installation and extension of the FRIPON project

François Colas

The aim of the FRIPON project is to cover FRANCE with 100 cameras to detect fireballs in order to recover meteorites and to compute accurate orbits to identify families and parent bodies. Last year was dedicated to make technical tests; in 2015 we installed all the cameras with our dedicated observation and reduction pipe line. We will show how our network works and its possible extension outside France.

Status of the Benelux CAMS network

Paul Roggemans

The Benelux CAMS network uses single CAMS and is a part of the main CAMS project managed by Dr Peter Jenniskens. It currently contributes about 10% of all orbital data to the global CAMS project. In July 2015 the network had expanded to 47 cameras installed at 14 sites, which all together yielded over 24.000 accurate meteor orbits since the first couple of cameras started in March 2012. The global CAMS project is still accumulating orbital data while it exceeded its initial aim to obtain at least 300 accurate orbits for each solar longitude. This paper sketches the evolution of the Benelux CAMS network which is likely to achieve the initial global target on its own, to accumulate at least 300 orbits per solar longitude within several years. Some results of the past 12 months are highlighted such as the κ-Cygnids of 2014, the Quadrantids of 2015 and the Lyrids of 2015 as well as some minor shower occurrences.

Croatian Meteor Network: ongoing work 2014-2015

Damir Šegon

A walkthrough activities and results during the period between two IMCs, and some notes on future plans.

Recent fireballs registered by the Polish Fireball Network

Przemysław Żołądek

A brief description of the most interesting fireballs observed by Polish Fireball Network in 2014 and 2015.

Latest developments in the Polish Fireball Network

Mariusz Wiśniewski

Since 2004 the Polish sky has been patrolled by cameras of the Polish Fireball Network (PFN). Most of PFN observers are amateurs, members of Comets and Meteors Workshop and perform observations at their homes. We use mainly continuously working stations with sensitive CCTV video cameras and a few DSLR cameras. A new system with "Meteor Digital Cameras" (MDC) cameras, based on sensitive digital cameras with wide or fish eye lenses will be presented.

1/2 year of AMOS at the Canary Islands

Juraj Toth

We will present the first experience and results from the all-sky double-station meteor project AMOS. The magnitude range and field of view coverage is complementary to the existing CILBO project. Overall statistics, meteor showers analyses and possible meteorite falls will be presented.

Session 3: Meteor streams

Chair Ana Georgescu

Meteor showers with the IMEX model

Rachel Soja

The Interplanetary Meteoroid Environment for EXploration now offers an unprecedented database of pre-calculated meteoroid streams created by recently-released dust from 400+ comets in the inner solar system. It can be used to instantaneously map the heliocentric or planet-centered distribution of particles from a given comet, and to calculate the flux of meteoroids at an object. Additionally, it can be used to map meteor storm activity along the orbit of any planet or object in the inner solar system. The capabilities and limitations of the model are demonstrated through various examples.

Daytime meteor shower project

Jürgen Rendtel

A first summary of data collected from the Daytime Arietids (171 ARI) and Daytime Sextantids (221 DSX) applying different observing methods is given.

The 2015 February 5 event

Christian Steyaert

A short (radio) outburst was observed on Feb 5, 10-10^{h} UT. Combining global amateur radio, radar, and video observations a candidate stream is identified.

CHIPOlaTA High precision orbits of Geminids and Perseids

Felix Bettonvil

Based on the development of CHIPOlaTA, an optical meteor camera based on high speed optical shutters, in both 2014 and 2015 Geminid and Perseid observing campaigns were run, which did result in a set of precise meteor trails. In this paper results will be discussed.

Could the Geminid meteoroid stream result from long-term thermal fracture?

Galina Ryabova

The previous models by Ryabova have shown that the Geminid meteoroid stream has cometary origin, so asteroid (3200) Phaethon (the Geminid's parent body) is probably a dead comet. Recently (in 2009 and 2012) some week activity was observed (see Jewitt & Li, 2010, AJ, 140), but it was not the cometary activity. Recurrent brightening of Phaethon in perihelion could be the result of thermal fracture and decomposition. In this study we model the long term dust release from Phaethon based on this mechanism.

Precession of parent bodies from historical meteor outbursts

Sang-Hyeon Ahn

We collect records of meteor outbursts from world-wide historical archives, and analyzed them to see which meteor outbursts have existed during the last two millennia. We calculate the dates of occurrence within the sidereal year for each record, and find four prominent major meteor streams having existed continuously. The prominent and continuous meteor streams are the Lyrids, the Perseids, the Leonids, and the Eta-Aquariids/Orionids pair. We also check the regression of nodal points of these streams, and find that both the Leonids and the Eta-Aquariids/Orionids pair have relatively large precession rates, while the other streams have small rates. We discuss that the near-type outbursts have occurred more frequently than the far-type outbursts.

Session 4: Meteor Cameras

Chair Kristina Veljković

QHY CCD camera for video meteor observation

Matej Korec

The possibilities of the QHY 5L CCD camera are presented for video meteor observations.

NFC - Narrow Field Camera

Jakub Koukal and Jiří Srba

We are introducing a low-cost CCTV video system for faint meteors monitoring and first results from 4 months of two-station operations. Our system called NFC (Narrow Field Camera) with a meteor limiting magnitude around +6.5 mag allows research on trajectories of less massive meteoroids within individual parent meteor showers, or the sporadic background. At present 4 stations (2 pairs with coordinated field of view) of NFC system are operated in the frame of CEMENT (Central European Meteor Network). The heart of each NEC station is a sensitive CCTV camera Watec 902 H2 and a fast cinematographic lens Meopta Meostigmat 1/50 - 52.5 mm (50 mm focal length and fixed aperture f/1.0). In this paper we present the first results based on 1020 individual meteors, from which 214 were recorded from two stations simultaneously. This data set allows the first empirical verification of the theoretical assumptions for NEC system capabilities (stellar and meteor limiting, apparent meteor brightness distribution and accuracy of single station measurements) and the first low mass meteoroid trajectory calculations. Our experimental data clearly showed capabilities of a proposed system for low mass meteor registration and significant refinement in low mass meteoroids orbital elements calculations based on NFC data.

Advances in the development of a low-cost video meteor station

Dario Zubovic

Recent advances in the field of single board computers have enabled development of a low-cost video meteor station with real-time processing capabilities. In this presentation, an overview of different capture and computing hardware is given. Furthermore, we present a current state of new open-source software for processing efficient capture, detection and compression, compatible with existing Croatian Meteor Network software stack.

A calibration unit for meteor camera

Ana Georgescu

All sky project.

Astrometric precision of all-sky observations with AMOS and meteor orbit determination

Leonard Kornos

The astrometric precision of the new version of the all-sky AMOS camera will be evaluated. Also a new program for meteor orbit determination together with uncertainty of orbital parameters will be presented.

Meteor spectra from AMOS video system

Pavol Matlovič

In our talk we demonstrate the capability of the updated All-Sky Meteor Orbit System (AMOS) (called AMOS-Spec) to measure the main element abundances of meteors. The AMOS-Spec program has been created with the intention of carrying out regular systematic spectroscopic observations. At the same time, the meteoroid trajectory and pre-atmospheric orbit are independently measured from data collected by the AMOS camera network. This, together with the spectral information, allows us to find the link between the meteoroid and its parent body, from both dynamical and physical consideration. Here we report results for 35 selected cases.

3.000.000 meteor light curves in EDMOND database

Roman Piffl

There are about 3 million meteor light curves hidden in the European viDeo MeteOr Network Database. We would like to process these light curves, to sort them and to show the differences between the typical light curves of individual showers. These data can also show us independently the physical properties of individual particles of know meteor showers.

Poster Session

On the structure of hyperbolic and near-parabolic dust streams

Eduard Pittich and Nina Solovaya

The only type of concentration of cometary dust with a reasonable probability of being detected by cosmic probes, are the dust tails emanating from passing comets. Essentially all the dust released from long-period comets leaves the solar system on hyperbolic orbits, because the radiation pressure limit is high. For short-period comets the dynamical conditions for retention of emitted particles within the solar system are much more favorable. But those which remain in circumsolar orbits tend to disperse rather rapidly.

Video meteor spectroscopy

Bill Ward

Video meteor spectra taken by the Kilwinning Spectroscopic Survey for Meteors (KiSSMe) in the preceding year.

The meteorite falls in Africa

Abderrahmane Ibhi

152 observed meteorite falls were recorded since 1800, the date when they were recognized as objects falling from the sky. They are totaling a mass of 2024.24 kg, of which 80% were recovered during the period 1920-2014 with an average of 20 falls every 15 years. The average rate of falls is low in Africa with only 0.023 per million km^2 per year. The oldest meteorite fall (L6, 22 grams) was in 1801 in Mauritius. The most recent, dated July 9, 2014, is an Eucrite fragment of more than 10 kg which has exploded in the Tighirt region in southeastern Morocco.

This rate is variable in time and in space with privileged regions namely those bordered by the Sahara and southern Africa. Other factors are also involved in the spatial variation of those falls' number: the population, its density, the percentage of forest cover, and the level of awareness about meteorites. As in the worldwide falls, these meteorites are dominated by chondrites (76%).

A new analysis of Monturaqui meteorites

Stanislav Kaniansky

A new analysis of Monturaqui meteorites.

Radio observation of meteors at the Central Slovak Observatory in Hurbanovo

Peter Dolinsky

From 4 November 2014 we started registration of meteors using radio waves at the Central Slovak Observatory in Hurbanovo. System records meteoric echoes of the TV transmitter Lviv 49.739583 MHz (N49.8480° E24.0369°, Ukraine) using a 4 element Yagi antenna with horizontal polarization (elevation of 0° and azimuth of 60°), receiver ICOM R-75 in the CW mode, and a computer with registration using HROFFT v1.0.0f.
Received data were statistically processed and compared with shower activity. Data were also reduced for background echoes. Not all echoes are caused by meteors, but also by the ionospheric Es layer. Registrations are disturbed by lightning also.

Meteor observations of forward-scattered FM-radio echo in Busan (Korea) in 2015

Kyoung-Mo Kim, Mingyu Cho, Taegi Kim, Jinyoung Hong, Yong-Woo Kang,

Sang-Hyeon Ahn, Sang-Hyun Lee and In-Ok Song

The detection system of forward-scattered FM-radio signal has been newly set up at the Korea Science Academy of KAIST in Busan, Korea. The meteor observations using a 2.5m-long Yagi antenna have been carried out since June, 2015. The radio station we used is the NHK broadcasting station (85.20MHz) in Hokkaido, Japan which is approximately 1400km away from Busan and is well below the local horizon. The detection is successfully running, and we examine the observed data in terms of number counts observed by contemporary Japanese observers, existence of diurnal pattern, and existence of underdense and overdense signals. The second observing station starts up in the nearby city Ulsan to make a cross-check. We analyze the results to find the annual and diurnal variation of meteor rates. We are planning to keep the observation for long-term as a student's education project.

The beginning height of four meteor showers by TWEET's data

Yang I-Ching

On the basis of 202 meteor shower trajectories of TWEET (TaiWan Elegant Meteor and TLE Network) in 2013, in which 91 from Perseids, 40 from Southern Delta Aquariids, 34 from Orionids and 37 from Southern Taurids, we obtain the beginning height distributions and geocentric velocity distribution of the above mentioned four meteor showers. Using p-value of t-test, we would divide 4 meteor shower into two groups: (a) Perseids and Orionids, and (b) Southern Delta Aquariids and Southern Taurids. And the average of beginning height distributions and geocentric velocity distribution in group (a) is greater than group (b).

2015 Easter bolide over North Hungary

Tibor Hegedüs, Szilárd Csizmadia, Zoltán Zelkó, Zsolt Kereszty and Zsófia Bíró

On Easter Monday, on April 6, 2015, at UTC $17^h31^m01^s$ (near sunset) there were a bright bolid having sonic boom over North Hungary, close to Miskolc, above the Bükk mountains. The event has been witnessed by many people,

and recorded with several car cameras between Budapest and Kosice, as well as with some meteorological and astronomical cameras. Unfortunately, Since the event was minutes after sunset, the sky was not dark enough and therefore the Hungarian Video meteor network cameras did not start to operate yet at that time. Our team had collected and re-calibrated as many video and photo materials as possible. Since there were very few direct images of the bolide itself, but much more photos and videos on the remainder dust trail, we utilized also these latter recordings in our calculations in some specific way. The accepted final atmospheric path and heliocentric orbit are presented. The estimation of the errors and the properties of the meteor body are discussed.

Ursids 2014 by all-sky cameras AMOS and EDMOND

Juraj Toth

The Ursids meteor shower exhibited higher activity in 2014 at a level of about 50 as ZHR. The observation by different video techniques by AMOS cameras in Slovakia and other video cameras in the EDMONd network will be presented.

A simple method to increase the efficiency of MetRec and UFO Capture

Roman Piffl

The algorithm for recording meteors by MetRec, UFO programs often have a low efficiency, especially in the case of faint or very bright and slow meteors. Using a simple device and the smart utility we can increase the efficiency up to values close to 100%.

Status report HHEBBES! / ASSN All sky camera

Felix Bettonvil

It is now 4 years since the automatic HHEBBES! All-sky camera became operational. This contribution aims at giving a status report and the roll-out of a HHEBBES! camera network. Discussed will be a) motivation b) technical improvements c) obtained results so far.

Advances in the development of a low-cost video meteor station

Dario Zubovic

Recent advances in the field of single board computers have enabled the development of a low-cost video meteor station with real-time processing capabilities. In this presentation, an overview of different capture and computing hardware is given. Furthermore, we present the current state of new open-source software for processing efficient capture, detection and compression, compatible with the existing Croatian Meteor Network software stack.

Search campaigns of the Polish Fireball Network

Zbigniew Tymiński

We present the campaigns organized by the Meteoritical Section of the Polish Fireball Network in the latest years conducted on some old and new meteorite strewn fields. The hunting for meteorites was realized mainly in Europe but the research in Africa is also presented. Some of our research resulted with spectacular meteorite finds and stories.

The effective number of shower meteors in a reduced field of view

Debora Pavela and Miroslav Živanović

A constricted and reduced field of view, such as in telescopic observations, significantly changes the relationship between the size of effective and geometric field of view. We simulated telescopic observations of meteor showers, approximating sky as a two dimensional plane. Three parameters have been varied: the ratio of meteors length and its distance to the radiant, the distance between the radiant and the center of the field of view and the radius of field of view. Given that the observer does not know about each meteor seen, whether its center is in the field of view or outside of it, the number of meteors with centers inside of the field of view can be assumed by introducing corrections for each class of meteors seen. Observed meteors are sorted in four classes, depending on which part of the meteor is in the field of view. We proposed the function that relates the size of the effective field of view with the mentioned three parameters.

Double-station observation at INASAN

Anna Kartashova and Galina Bolgova

The results of double-station meteor observation at INASAN are presented.
Television systems (Watec LCL-902HS camera and a Computar 6/0.8 optics) with fields of view of 50°x40° and a limiting magnitude (for stars) of +5.5 m were used for wide field of view observation. Double-station observations were started from 2011 at INASAN (at the Zvenigorod observatory and "Istra" station at a distance of 20 km). Multi-station observations were carried out from 3 stations in 2014. More than 5000 meteors were detected in four years of observations. Results of these observations are presented.

Meteor Spectra in the EDMOND database

Jakub Koukal, Sylvie Gorková, Jiří Srba, Carlos Augusto di Pietro

One of our research goals is to better understand the physical and chemical properties of meteoroids by using simultaneous video and spectral observations of meteors compared with laboratory spectra of meteoritic material. Spectral observations of meteors are now obtained via fixed (at Valašské Meziříčí observatory) and mobile spectroscopic CCTV systems. All records of meteors and processing data (orbital elements, speed of deceleration, etc.) are entered into the EDMOND database (European viDeo MeteOr Network Database) together with the spectral information. Another very valuable source of the physical and chemical properties of meteoroids are spectra taken in BRAMON (BRAzilian Meteor Observation Network). This network covers the southern hemisphere and is a source of information about the little-known southern meteor showers.
Simultaneously, our target is systematization of spectroscopic emission lines for the comparative analysis of meteor spectra. The solids will be irradiated using excimer and PALS lasers (Na, Ti, Mg, Al, Si, Fe, and Ca, their simple binary oxides, sulfides, minerals and real sample of meteorites). The LIDB (laser-induced dielectric breakdown) in a gas media representing the atmospheres (O2, N2, Ar, and CO2) will also be spectroscopically characterized. These spectra will be recorded in situ on the discharges and excimer laser ablations using Fourier time resolved high resolution spectrometer Bruker, high resolution Echelle spectrograph LLA and CCD spectrograph Ocean Optics. Complying data will allow for not only qualitative determinations of the impacting body composition but also the assignment of spectral lines for products from the meteorite alterations and plasma interactions in atmosphere.

ROAN 2015

Ana Georgescu

The evolution of the ROAN project in 2015.

Assessing risk from dangerous meteoroids in main meteor showers

Andrey Murtazov

We calculated the dangerous meteoroid flux and the number of collisions for the main meteor showers: Quadrantids-2014, Eta Aquariids-2013, Perseids 2014 and Geminids-2014.

Czech Bolidozor radio meteor detection network

Jakub Kákona

Session 5: Radio techniques

Chair Ferhat Fikri Özeren

No sign of the 2014 Daytime Sextantids and mass indexes determination from radio observations

Giancarlo Tomezzoli

In reply to the invitation made by Rendtel at the IMC 2014 in Giron (France) to observe the Daytime Sextantids (DSX 221) by any possible means, the EurAstro Radio Station (EARS) in Munich performed radio observations in the recording period 30/09/2014, 07:00 UT – 05/10/2014, 16:00 UT. This paper presents the results of the EARS radio observation and the data reduction method used for determining the mass index of both sporadic meteors alone and DSX 221 plus sporadic meteors in said recording period.

Recent advances in the BRAMS network

Hervé Lamy

BRAMS is a radio network using forward scattering techniques to detect and characterize meteoroids falling into the Earth's atmosphere, roughly above Belgium. It consists in a dedicated transmitter and about 25 receiving stations located in Belgium. During this talk the most recent advances in the BRAMS network or using BRAMS data will be presented. First, a calibrator that has been added to all receiving stations will be described. It aims at providing a reference for both amplitude and frequency. The importance of this calibrator in future data analysis will be explained. Second, a description of the interferometer in Humain will be provided and some examples of preliminary analysis of phase data will be given. Calibration of the interferometer algorithm with the use of a UAV will also be explained. Third, a summary of recent advances in automatic detection of meteor echoes in BRAMS data will be discussed.

The BRAMS Zoo, a citizen science project

Stijn Calders

Currently, the BRAMS network comprises around 30 receiving stations, and each station collects 24 hours of data per day. With such a large number of raw data, automatic detection of meteor echoes is mandatory. Several algorithms have been developed, using different techniques. (They are discussed in the Proceedings of IMC 2014.) This task is complicated because of the presence of parasitic signals (mostly airplane echoes) on one hand and the fact that some meteor echoes (overdense) exhibit complex shapes that are hard to recognize on the other hand. Currently, none of the algorithms can perfectly mimic the human eye which stays the best detector. Therefore we plan to collaborate with Citizen Science in order to create a "BRAMS zoo". The idea is to ask their

very large community of users to draw boxes around meteor echoes in spectrograms. The results will be used to assess the accuracy of the automatic detection algorithms on a large data set. We will focus on a few selected meteor showers which are always more fascinating for the large public than the sporadic background. Moreover, during meteor showers, many more complex overdense echoes are observed for which current automatic detection methods might fail. Finally, the dataset of manually detected meteors can also be useful e.g. for IMCCE to study the dynamic evolution of cometary dust.

Directional pattern measurement of the BRAMS beacon antenna system

Antonio Martinez Picar

The typical methods for measuring antenna characteristics are mostly based on the use of remote transmitters or receivers. For antennas used in radio communications, calibrations are usually done on an antenna test stand using transmitters with known power output. In order to minimize the ground effects while performing measurements, it is necessary to place the transmitter or receiver high above ground with the aid of aircrafts. It is, however, necessary to determine precisely the coordinates of the airborne devices as well as to maintain high stability. This used to be excessively difficult to carry out, but recent advances in Unmanned Aerial Vehicle (UAV) technologies have brought a feasible option. In this talk, the results of using a low‐cost system for measuring the directional pattern of BRAMS beacon antenna system based on an UAV are presented.

Session 6: Ongoing meteor work

Chair Galina Ryabova

Low-cost meteor radiometer

Denis Vida

In this paper we discuss possibilities of building a low-cost system for radiometric observations of meteors. As the radiometers have proven to be an invaluable source of data during the fireball fragmentation modelling, and yet there are so few radiometers operational, we propose using inexpensive photodiodes, operational amplifiers and microcontroller boards. A prototype of such a system is presented and the testing results are discussed.

An independent identification method applied to EDMOND and SonotaCo databases

Regina Rudawska

Recently in Rudawska et al. (2014) the authors introduced an independent identification method. We applied it to the EDMOND database (Kornos et al. 2014a, 2014b) with SonotaCo database (SonotaCo 2009) together, in order to identify existing meteor showers in both databases. In the first step of the method we use a criterion based on orbital parameters to find groups around each meteoroid within the similarity threshold. Weighted mean parameters of the groups are calculated, and compared using a new function based on geocentric parameters. Similar groups are merged into final clusters (meteor showers), and compared with the IAUMDC list of meteor showers.

Analysis and development of meteor's trajectories reconstruction methods.

Auriane Egal

On the frequency of the super fireballs: 250 years of reports

Francisco Ocaña

Super fireballs are rare phenomena for what the reports are scarce and the estimation of its abundance has a huge margin of uncertainty. As a citizen science project we have gathered >500 reports from newspapers in the 1850-2000 period. This database shows how super fireball rate is constant during the period, though the sources have changed in the last two centuries. We have tentatively related some sources to well-known meteor showers (Perseids, Geminids, Leonids), while others are related to minor or unknown showers, probably of asteroidal origin.

IMO Fireball report form: results and prospects

Mike Hankey and Vincent Perlerin

At the 2014 IMC, we presented the IMO online Fireball report. This form has been translated in 27 languages and 12 organizations have asked for a custom version. In this talk, we will present the preliminary results and we will give tips to improve the online presence of the local organizations in order to increase the number of reports. We will also highlight the procedures to be followed by local organizations to get a custom version of the form.

Bosnian Meteor Network, first results

Nedim Mujic

Modeled on similar networks in the region, since the spring of 2013, in Bosnia and Herzegovina an operation of video meteor network began which currently includes eight stations. Expansion of the network is in preparation by setting up another 2 stations. The Network is jointly managed by Astronomical Society Orion Sarajevo and the Federal Hydrometeorological Institute in Sarajevo whose meteorological stations were used for the installation of cameras. By mid-June 2015, cameras of the BH meteor network recorded over the 10000 meteors and we calculated more than 3000 orbits. In this paper we present the results of the first two years of operation of our meteor network.

Phenomenologic approach of the meteor phenomenon

Jérémie Vaubaillon

Session 7: Ongoing meteor projects

Chair Jürgen Rendtel

Current activities at the ESA/ESTEC Meteor Research Group

Detlef Koschny

The Meteor Research Group of ESA/ESTEC has been active in the field of meteor research since the year 2008. Currently we are focusing on several activities:
- Data analysis of the double-station data of our CILBO setup (Canary Island Long-Baseline Observatory). In particular we are working on using the data for determining the flux density of meteoroids, comparing it to other data sources, and determining whether the optical data can be used to constrain meteoroid models. We are also testing the quality of the orbits computed from these cameras and are working on a processing pipeline for the analysis of meteor spectra.

- Expansion of the CILBO setup with wider-angle cameras which are better suited for the flux measurements. We modify existing cameras to be robust enough to survive the environmental conditions on the Canary Islands and install them in the existing CILBO hut.
- We are supporting studies for lunar impact flash observations on the Moon, both ground-based and possibly space-based.
- The meteor data archiving system at ESTEC is being upgraded to be conforming to modern network security standards.

This presentation will give an overview of the activities, with detailed presentations by several of the co-authors giving technical details.

De-biasing CILBO meteor observational data to mass fluxes

Jana Kretschmer

The goal of this paper is to estimate for different mass ranges the percentage of meteors that are not detected by video observations and to derive un-biased mass fluxes.

The work is based on the data from the Canary Island Long-Baseline Observatory (CILBO), which is a double-station camera setup for meteor observations and a project by Detlef Koschny at the European Space Agency. Moreover the work by Drolshagen and Ott (2014) on the meteor observational data by the CILBO is used. Meteoroids need to have a certain impact energy when entering the Earth atmosphere to form a visible meteor trail and be detectable on camera. As a consequence the measured CILBO data are heavily biased towards fast and big meteoroids. In a paper presented at the IMC 2014 Drolshagen and Ott used a formula by Verniani (1973) to determine the mass of the detected meteoroids and plotted the velocity distribution for big meteoroids only. They found that it fits the reference velocity distribution from the ECSS (European Cooperation for Space Standardization) Space Environment Standard which indicates that it is a realistic model.

The data set that Drolshagen and Ott were using (1 June 2013 – 31 May 2014) was expanded to a longer time range and the mass of each meteoroid detected by the CILBO was calculated applying the formula by Verniani. Afterwards the velocity distribution of the CILBO data was plotted for different mass ranges and compared to the ECSS velocity distribution to estimate the missing percentage for different meteoroid mass ranges. As the detection of the meteors strongly depends on the impact energy of the objects, the fraction of non-detections increases with decreasing mass and velocity. Therefore it was found that for the smallest masses a very large fraction of the meteoroids were not detected by the CILBO double-station. In a second step the number of meteoroids in each mass range was corrected to account for the slower meteoroids. From these results, the 'de-biased' flux was derived and compared to the flux model by Grün et al. (1985). It was found that the slope of the 'de-biased' CILBO flux is similar to the one of the Grün model but the calculated flux values are higher. One simple reason for this difference could be that the Verniani formula for determining the meteoroid mass is based on radio meteor observations and also used a number of simplifications. Alternative methods to derive meteoroid masses from the optical CILBO data are being investigated.

De-biasing of the velocity determination for double station meteor observations from CILBO

Thomas Abin

Since the end of 2011 the Canary Islands Long-Baseline Observatory (CILBO) is under operation (Koschny et al. 2013, Koschny et al. 2014). First scientific results regarding velocity distribution (Drolshagen et al. 2014) and meteoroid flux (Ott et al. 2014) have been obtained. CILBO consists of two cameras, one on Tenerife (camera ICC7) and one on La Palma (ICC9). Until now, approximately 10000 meteors have been simultaneously measured, allowing precise orbit reconstruction. Meteors are detected via MetRec (Molau 1998) and trajectories are currently reconstructed with MOTS version 3 (Koschny & Diaz 2002). For the velocity computation MetRec determines the meteor's photometric center on each individual video frame and derives the distance between two frames (each frame 40 ms long). However, some meteor streams like the Perseids show persistent trains or wakes causing a position determination bias in the software. Slow and bright meteors decelerate significantly during their appearance and cause an additional observational bias. This paper analyses these biases in the CILBO data and determines whether orbit reconstructions need to be corrected as a function of velocity, brightness or meteor shower.

Mass accumulation of Earth from interplanetary dust, meteoroids, asteroids and comets

Sandra Drolshagen

The goal of this paper is to determine the mass that reaches the Earth as interplanetary material. For the large objects the flux model by Brown et al. (2002) was used which is valid for bodies greater than 1 m and is based on sensor data of fireballs that entered the Earth atmosphere. For the small sizes the flux model by Grün et al. (1985) was used, which describes the mass flux at 1 AU for meteoroids in the mass range 10-18 g to about 100 g. The Grün flux was converted to 100 km height by taking the Earth attraction into account and all units were adjusted to compare the model with the one by Brown et al. In a second step both models were combined by an interpolation, what lead to a flux model that covers 38 orders of magnitude in mass. Using recent measurements and alternative flux models the uncertainties of the obtained model was estimated. Recent measurements include in-situ impact data on retrieved space hardware and optical meteor data. Alternative flux models are e.g. a NASA model for large sizes that is an extrapolation of known Near Earth Objects (NEOs) and a model by Halliday et al. (1996) which is based on optical measurements of fireballs. Depending on the models and interpolation used the interplanetary material that enters the Earth atmosphere per day is in the range of 50 -200 tons. The combined model with interpolations suggests deviations from a simple power law. The flux in the diameter range of 1-10 cm appears not as large as suggested by the interpolation. This might be an evidence for the so called "meter-sized barrier" in the evolutionary history of the universe. The size range 1 mm to some tens of cm has one of the largest uncertainties. Meteor data cover exactly this size range and the analysis of optical meteor data is ongoing to improve the flux model.

Influence of the pointing direction and detector sensitivity variations on the detection rate of a double station meteor camera

Thomas Albin

The Canary Islands Long-Baseline Observatory (CILBO) is a double station meteor observation site on Tenerife and La Palma (Koschny et al. 2013, Koschny et al. 2014). For the meteor detection the 40 ms long video frames of the identically built cameras are analyzed by MetRec (Molau 1998). MOTS (version 3, Koschny & Diaz 2002) is used to determine the meteor trajectories of double-station observations. First scientific results regarding the velocity distribution and meteoroid flux have been published by Drolshagen et al. 2014 and Ott et al. 2014. Both authors have found effects related to the Apex direction like e.g. an increasing number of detections in the morning hours. The sporadic meteors from the Apex cause additional observational bias, e.g. in the velocity – magnitude domain or the meteor trail length determination. We show how the detection threshold conditions vary depending on the pointing direction of the cameras for both CILBO cameras. The angular velocity distribution of the meteors depends on the camera orientation. Meteors with a smaller angular velocity illuminate less CCD pixels in the same time interval than faster meteors causing a higher Signal-to-Noise ratio and consequently better detection threshold conditions. Additionally, we analyzed the detection distribution within the field of view of the CILBO cameras. We quantified this effect, which can be attributed mainly to vignetting in the wide-angle system.