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Orionids
Conference
Questionnaire
Telescopic meteors

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Preliminary results

Front cover photo

A meteor with Comet Hale-Bopp in the background. Photograph by Ricardas Balciunas. Date: 1996 August 11. (Since the intention was to photograph the comet, no meteor details were recorded.) Instrument: $f = 360$ mm, $f/4.5$ astrograph. Film: Kodak 400.

Writing for WGN This Journal welcomes papers submitted for publication. All papers are reviewed for scientific content, and edited for English and style. Instructions for authors can be found in WGN **31:4**, 124–128, and at `http://www.imo.net/articles/writingforwgn.pdf` .

Legal address International Meteor Organization, Mattheessensstraat 60, 2540 Hove, Belgium.

Editorial — Surveys and conferences

Chris Trayner

Readership survey

WGN started out from small beginnings, a news-sheet for interested meteor observers. It simply contained whatever readers submitted, whatever news could be found and whatever seemed relevant. This was evidently a good diet, for it prospered and grew into the publication we have today. But is it what readers want now? The world changes, and so do people's needs. Maybe what readers want now is love stories and horoscopes . . . well, probably not those!

For probably the first time in its existence, WGN is running a survey of what readers want. In this issue you will find a two-page questionnaire. It is printed immediately after this page, with an introductory explanation. To save you cutting the pages out of your WGN, you should find another copy inserted as a loose sheet. You can, alternatively, answer it on the web. This survey grew out of discussions on the Council newsgroup, but Cis Verbeeck takes the credit for having written the questionnaire, agreed it with the Council and prepared it for publication.

One could usefully ask further questions — where is IMO going? where should it be going? Indeed, we will ask these questions later, but they are better kept for a separate survey. For now, please let us know how you would like WGN to evolve. But please don't vote for love stories or horoscopes!

International Meteor Conference 2008

By the time that you read this there will be less than three months to go before IMC. Personally, having been prevented from getting to the last one, I can't wait; I expect the organisers feel otherwise, and are wondering how they will get everything ready in time!

Those who have been to an IMC will not need telling how enjoyable it is. Those who have not been have a treat in store for them. It is often said that personal contact is as useful in science as reading journal papers, and IMC is a classic example of this. It is not just a place where old friendships are renewed and new ones made, important though that is. It is also a place where brainstorming sessions take place and new ideas for observations are planned. The really innovative ideas don't get dreamed up in formal sessions — they appear over coffee, in the bar or at a barbecue on the beach. (I remember us sketching out an entire new radio meteor observational programme by a night-time bonfire on the shores of the Black Sea near Varna.) So if you haven't booked in for IMC yet, do so quick — reading the Proceedings later will give you the equations, but not the magic.

IMO bibcode WGN-363-editorial NASA-ADS bibcode 2008JIMO...36...45T

Take part in the WGN Questionnaire and win a free WGN and IMC DVD!

The IMO Council

As many faithful WGN readers will remember, the International Meteor Organization was founded just 20 years ago, on 1988 May 1. Twenty Geminid returns, twenty Perseid showers, and my oh my, twenty Leonid returns. While many exciting meteor events were observed, we can also look back on many impressive achievements by the IMO and the meteor community in general. After such a long time, it is worthwhile to stop for a while and think things over, to see what journey we have made and in which direction we want to be heading.

Any avid reader of Editorials or Janus sections in this journal will be quite aware that the IMO is an organization that exists for and by grace of its members. In order to know what IMO members think about and expect from the organization and its journal, the IMO Council will issue two questionnaires this year. The first one is solely about WGN and can be found below. The second questionnaire will focus on the IMO as organization, and will be presented to you later this year.

The Council kindly invites all WGN readers to take some time to fill out the WGN questionnaire below, either by sending a paper version to Cis Verbeeck or by surfing to the IMO website: `http://www.imo.net/survey`. A copy of the paper form is included so you do not have to cut out or copy pages of your WGN.

Your filled in questionnaire should reach Cis or the website *before 2008 September 30.*

The questionnaire

In order to complete the questionnaire, answer the eleven questions. For multiple choice questions, just choose one option from those provided unless instructed otherwise. In some questions, we invite you to add your comments.

The questionnaire results will be published in WGN, enabling us all to see what WGN readers think and feel about their journal and what lessons can be learned from this.

Prize draw

To encourage our readers even more, a randomly chosen participant will win a free WGN and IMC DVD (including shipment), containing WGN Vols. 6–30 and IMC Proceedings 1991, 1993–1996, 2001–2004.

- **Paper version:** With this WGN you should find a slip of paper with a numerical code — write this Prize Draw Code at the end of the form and keep the slip.
- **Online version:** After the questionnaire page, online participants will get a second page where they can enter their name if they wish.

The list of names will be kept separately from the list of answers. A random winner will be picked from the list of names plus the list of codes from those who filled in the paper version (and who can be identified later if they step forward), excluding Council members and IMO officers. So tell us your opinion and preferences regarding WGN, and who knows . . . maybe you will be the lucky winner!

IMO bibcode WGN-363-verbeeck-questionnaire NASA-ADS bibcode 2008JIMO...36...46I

WGN Questionnaire Form

Filled out paper versions of this questionnaire should be sent to Cis Verbeeck; see details at the bottom of the next page. You can also participate online on the IMO website: `http://www.imo.net/survey`. The questionnaire should reach Cis or the website *before 2008 September 30.* Fill in your Prize Draw Code at the bottom of the next page and answer the 12 questions. For multiple choice questions, just choose one option from those provided (by circling your option) unless instructed otherwise. In some questions, we invite you to add your comments.

1. **How many years have you been a WGN reader?** 0-2 / 2-5 / 5-10 / > 10
2. **In terms of meteor astronomy, do you consider yourself:**
   (a) an amateur / a professional; and
   (b) **your level of expertise to be:** beginner / intermediate / advanced?
3. **How do you judge the contents of WGN overall?**
   Very good / Good / Quite good / OK / Quite poor / Poor / Very poor / No opinion
4. **Would you like to see more, less or the same of any of the following?**
   (a) **Theoretical articles** (e.g. stream modeling, shower and outburst predictions, ZHR computation methods) — Much more / More / The same / Less / Much less / No opinion
   (b) **Practical articles** (e.g. how to observe, how to analyze data, advice on equipment) — Much more / More / The same / Less / Much less / No opinion
   (c) **Detailed shower analyses from recent observations** — Much more / More / The same / Less / Much less / No opinion
   (d) **Historical articles** (e.g. biographies of notable past meteor astronomers, earlier meteor showers, Meteor Beliefs Project) — Much more / More / The same / Less / Much less / No opinion
   (e) **Reports from local observing campaigns, expeditions and projects** — Much more / More / The same / Less / Much less / No opinion
   (f) **Conference announcements and reports** — Much more / More / The same / Less / Much less / No opinion
   (g) **Letters and opinion articles** (e.g. Janus, editorials) — Much more / More / The same / Less / Much less / No opinion
   (h) **Articles aimed at beginners or youngsters** — Much more / More / The same / Less / Much less / No opinion
   (i) **Information notices from the IMO** (e.g. new publications, subscription information, news of Council discussions and decisions) — Much more / More / The same / Less / Much less / No opinion
   (j) **Photographs and illustrations** — Much more / More / The same / Less / Much less / No opinion
   (k) **Fireball reports** — Much more / More / The same / Less / Much less / No opinion
   (l) **Imaging meteor work** (e.g. photography, spectroscopy, video) — Much more / More / The same / Less / Much less / No opinion
   (m) **Radio meteor work** — Much more / More / The same / Less / Much less / No opinion
   (n) **Telescopic meteor work** — Much more / More / The same / Less / Much less / No opinion
   (o) **Visual meteor work** — Much more / More / The same / Less / Much less / No opinion
5. **Are there topics which currently feature rarely or not at all in WGN that you would like to see included in future?** Yes / No

   If "Yes", please indicate your preferences from this list *(mark all those you prefer):*
   (a) Biographies of prominent living amateur and professional meteor workers.
   (b) Book reviews.
   (c) Impact events and craters.
   (d) Meteorites.
   (e) Meteor-related comet and asteroid news.
   (f) Meteor-related professional institute reports and news.

(g) Other (please specify): ______________________________
____
____

6. Do you find **the level of discussion and articles in WGN** is currently: Much too complicated / Too complicated / A little too complicated / About right / A little too simple / Too simple / Much too simple / No opinion?

7. Do you think **the physical appearance of WGN** (e.g. page layout and size, typeface, font size, photographs and illustrations) is currently: Very good / Good / Quite good / OK / Quite poor / Poor / Very poor / No opinion?

8. As WGN is edited by committed volunteers having busy jobs, **the journal often arrives late in your mailbox.** Does this: Bother you a lot / Bother you / Bother you a bit / Not bother you at all / No opinion?

9. **Does WGN represent good value for money for you presently?** Yes / No

   If "No", is there a **particular reason** (please state)? ______________________________
   ____
   ____
   ____

10. If an **electronic version of WGN** were to be available as part of your usual IMO membership, as well as the paper version, but without costing you any more than the current fee, **would you prefer to read:** Only the printed version / Only the electronic version / Both (though I'd find the printed version more useful) / Both (though I'd find the electronic version more useful) / Both (and I'd find both equally useful) / No opinion?

11. **Do you regularly read any other meteor-related publications apart from WGN?** Yes / No

    If "Yes", please indicate which from the following list *(mark all those you read):*

    (a) e-Radiant
    (b) IMO-News e-mail list.
    (c) Meteorobs e-mail list.
    (d) Meteoor.
    (e) Meteoros.
    (f) Meteor Trails.
    (g) Radiometeoren e-mail list.
    (h) Radio Meteor Observation Bulletin.

    (h) Other (please state): ______________________________
    ____
    ____

12. **If you have any other comments about WGN, please give them here:** ______________________________
    ____
    ____
    ____
    ____
    ____
    ____

Thank you for taking the time to complete this questionnaire. Good luck in the prize draw!

Cis Verbeeck,
Grote Steenweg 469,
2600 Berchem,
Belgium

Please return this form to the address shown on the left. If you fold the form in three, you can make the address show through the window of a window envelope.
Copy your Prize Draw Code from the slip of paper included in this WGN into the space on the right. Keep the slip of paper.

Prize Draw Code:

Conferences

International Meteor Conference 2008
September 18–21, Šachtička, Banská Bystrica, Slovakia

Stanislav Kaniansky and Daniel Očenáš

Location and period

The 2008 International Meteor Conference (IMC) will take place from September 18 to 21 in a very picturesque setting, in the town of Šachtička. Šachtička is a touristic site popular mainly for winter sports. It is 1000 m above sea level, and only 8 km away from the city of Banská Bystrica. Banská Bystrica (see `http://eng.banskabystrica.sk` for more information on the city in English) is located in central Slovakia. It is the most important historical, cultural and economic center of this part of the country. It is the capital of the Banská Bystrica Region. Banská Bystrica lies on the river Hron and is surrounding by beautiful mountains. The first written reference to the city dates back to year 1255.

Banská Bystrica used to be known as a mining town. Gold, silver, lead, and copper were mined here. Nowadays, it is a modern city with more than 80 000 inhabitants. The Vartovka Hill, very close to the city, is the location of the *Astronomical Observatory of Banská Bystrica*. In the past, Vartovka served as a watch tower.

Venue

The conference will take place in *Hotel Šachtička*. For more information in English, please visit `http://www.sachticka.sk/index_en.html`. There are double rooms and double rooms with an extra bed. Each room has toilet, shower, and TV.

The main conference room can seat 136 people, and is also suitable for posters. There are also smaller conference rooms. They are equipped with a sound system, TV, video, flipcharts, overhead projectors, silver screens, data projectors, DVD players, microphones, internet access, and similar amenities.

How to get there

Banská Bystrica can be reached from the Slovak capital of Bratislava by plane, train or bus. There is an airline connection between Bratislava and Sliac Airport, located 15 km from the city. Train and bus connections between Bratislava and Banská Bystrica are direct, i.e., they do not require a transfer. From Banská Bystrica, a short car ride will take you to your hotel.

To give you an idea, we calculated the distances from some major, capital cities in Central Europe to Šachtička:

Budapest–Šachtička	187 km
Bratislava–Šachtička	200 km
Vienna–Šachtička	282 km
Prague–Šachtička	541 km
Warsaw–Šachtička	554 km

Local Organization

This year, the Local Organization is in the hands of the Maximilián Hell District Observatory and Planetarium at Žiar nad Hronom, and the Observatory of Banská Bystrica. It is co-organized by the Department of Astronomy, Physics of the Earth and Meteorology of the Faculty of Mathematics, Physics and Informatics of the Comenius University at Bratislava, and by the Slovak Central Observatory at Hurbanovo. The Local Organizing Committee (LOC) is composed as follows:

Daniel Očenáš, Observatory of Banská Bystrica;
Stanislav Kaniansky, Maximilián Hell District Observatory and Planetarium;
Juraj Tóth, Comenius University, Bratislava;
Teodor Pintér, Slovak Central Observatory.

IMO bibcode WGN-363-kaniansky-imcann NASA-ADS bibcode 2008JIMO...36...49K

Registration fee

The registration fee amounts to 150 EUR. If you book no later than June 30, 2008, however, you get a 10 EUR deduction, and you pay only 140 EUR. In this amount is included:

- a parking place for those coming by car;
- general conference materials and a 2008 IMC T-shirt;
- accommodation for 3 nights;
- all meals (from dinner of Thursday, September 18, up to lunch on Sunday, September 21);
- refreshments during coffee breaks;
- the conference excursion and barbecue;
- the proceedings.

We also encourage you to give a presentation of your results or the results of your group. Make sure your registration as well as the abstract of the talk(s) you intend to give before August 31, 2008. However, we strongly advise you not to wait that long and register at your earliest convenience.

Practical information

To register, please visit `http://www.imo.net/imc2008` and fill out the registration form that you will find there by following the appropriate link. Alternatively, you can fill out the paper registration form you find here and send it to *Marc Gyssens, IMO Treasurer, Heerbaan 74, B-2530 Boechout, Belgium.* **However, please use the webform if you can!** The paper form is intended only for those having no easy access to the internet.

For your registration to remain valid, the IMO excepts to receive either the full sum of 140 EUR (early)/150 EUR (late) or a prepayment of at least 70 EUR **within two weeks after registration**. If you have registered electronically, you will be automatically directed to the page with payment information. For those who cannot register electronically, the paper form contains this info as well. Electronic registrants get automatic confirmation emails for both receipt of their registration and receipt of (each) payment. If you only make a prepayment, you can pay the balance at a later data or at the conference itself.

Contact information

For more information, check the IMC 2008 website at `http://www.imo.net/imc2008`.

For further questions regarding registration and payment, please contact the IMO Treasurer, Marc Gyssens, via email at `treasurer@imo.net` or write to him—Marc Gyssens, Heerbaan 74, B-2530 Boechout, Belgium.

For all other questions, contact the LOC via e-mail at `imc2008@imo.net` or write to them—Stanislav Kaniansky, Krajská hvezdáreň a planetárium M. Hella, Duklianskych hrdinov 21, SK-965 01 Žiar nad Hronom, Slovakia. This is in particular the case for those needing a formal invitation to obtain a visa. Notice that such invitations will be supplied only to serious applicants known to the international meteor community.[1]

[1] It is the participant's responsibility to obtain all documents required to enter Slovakia. Failure to do so does not constitute a valid reason for full or partial reimbursement of the registration fee or prepayments thereof.

International Meteor Conference
Šachtička, Banská Bystrica, Slovakia, 2008 September 18–21
Registration form

Do not use if you have internet access! Please register electronically on `http://www.imo.net/imc2008` if you can. If you have **no** internet access, fill out one form for each individual participant should fill return it to Marc Gyssens, IMO Treasurer, Heerbaan 74, B-2530 Boechout, Belgium, as soon as possible. Registration will be guaranteed only after Marc Gyssens has received either the full registration fee of 140 EUR (up to June 30)/150 EUR (from July 1 onward) or a pre-payment of at least 70 EUR. We expect this payment to arrive within two weeks after the form.

Name: ______________________ Address: ______________________

____

____

Phone: ____________ Fax: ____________ E-mail: ____________

- I wish to register for the IMC 2008 from September 18 to 21.
- I intend to travel by ________, together with ______________________
- I want to share a room with ______________________
- T-shirt: Size (S-M-L-XL): ________ Gender: ________ (included in fee)
- I am vegetarian.

For participants wishing to contribute to the program:

Lecture: ______________________

Requirements: ______________________

Duration: ________ minutes

Workshop: ______________________

Poster(s): ______________________ Space: ________ m^2

Comments:

- I am paying the entire registration fee of 140 EUR (early)/150 EUR (late)
- I am paying the advance (70 EUR) now, the remainder later
- I want a single room (add 30 EUR to the registration fee).

The indicated amount should be sent to IMO Treasurer, Marc Gyssens. The following payment options are available:

- **International bank transfer** to the International Meteor Organization, Mattheessensstraat 60, B-2540, Hove, Belgium, IBAN account number: BE30 0014 7327 5911, BIC bank code: GEBABEBB (Fortis Bank, Belgium). This is recommended for people living in the European Union, as it is no more costly than a domestic bank transfer when done correctly.
- **PayPal payment** to `payment@imo.net`. In that case, we must ask you to add the costs involved in the transaction (3.4% of the total sum, plus 0.35 EUR).
- **Other arrangements**. Please contact the IMO Treasurer for information.

Telescopic meteors

1996 – 2001 Polish Telescopic Meteor DataBase

Radosław Poleski [1,2,3], *Konrad Szaruga* [1,2] *and Michał Jurek* [2]

A summary of 1996 – 2001 telescopic observations collected by the Comets and Meteors Workshop is presented. 6380 meteors were seen during 714.28 effective observing hours by 31 observers. The distribution of meteor magnitudes and observed velocities is analyzed. For each observed event date, time of appearance, magnitude, angular velocity and equatorial coordinates are given. Additional information about each observing run is given as well as a three letter code which connects observations and data on meteors. The full 1996 – 2001 Polish Telescopic Meteor DataBase (PTMDB) is accessible electronically (from `http://pkim.org/`).

Received 2008 March 31

1 Introduction

Since its foundation in 1988, the International Meteor Organization (IMO) has collected results of meteor observations obtained by all kinds of techniques, such as visual, photographic, video, radio and telescopic. IMO has published the Visual Meteor DataBase (VMDB, downloadable from `http://www.imo.net/data/visual`) which contains visual observing results. Up to now the VMDB contains 129 139.61 hours of effective observing time with 3 046 226 meteors observed between 1984 and 2007. Unfortunately, the VMDB contains only hourly rates and magnitude distributions of meteors from the IMO Working List of Visual Meteor Showers. The information about equatorial coordinates and angular velocities of particular events is not presented. This makes correction of classification errors and detection of new (mostly weak) showers impossible.

Frequent telescopic meteor observations have been made in Czechoslovakia for around 30 years since 1946. Huge amounts of data were collected during that period, but they are not accessible electronically. The first results of these observations were published by Kresáková and Kresák (1955) . They made attempts at luminosity function, ratio of beginning and ending heights of meteors and hourly rates calculations. More than 1000^{h} of effective time of telescopic observations and almost 4000 meteors were analyzed.

(Kresáková, 1978) summarized the results based on many thousands of telescopic meteors and introduced the formula for meteor rate predictions. The influence of the instrument's properties such as aperture, magnification and field of view was examined. The most important factor discussed was the effect of the high observed angular velocities on the apparent brightness of meteors.

During the 1991 Perseid campaign 40 meteors were observed both telescopically and using a TV-camera system (Pravec & Boček, 1992). There were 152 individual telescopic recordings for these 40 meteors. This permitted a much better investigation of different factors influencing the results obtained by observers. Differences between more and less experienced observers were found. Even improvement in the quality of recordings during a few days long campaign was found.

Since 1995 there were few announcements (Currie, 1995; Olech et al., 1999) of telescopic meteor showers. The analysis were in most cases done using the Radiant software (Arlt, 1992).

2 Observational data

Telescopic observations require a wide-field refractor or binoculars mounted on a tripod and should be done by experienced observers. Each year the Polish Comets and Meteors Workshop organizes a summer astronomical camp in the Warsaw University Astronomical Observatory Ostrowik Station. Thus most of our data were obtained during July and August. Here data collected since 1996 are presented. Part of them were previously published (Olech & Jurek, 2000). Some transcript errors in that publication have been corrected.

For each meteor its path was plotted on the skychart and its properties were noted. The database consists of 6380 meteors plotted during $714\overset{h}{.}28$ of effective observing time by 31 observers. Most often 10×50 mm binoculars were used by observers. One should note that some observers do not give reliable observations. We think they were many of the observers who observed only for few hours and this encourages one to remove specific observations before any analysis is done. Observers were told to keep their fields $20 - 45°$ away from the radiant of the main observed shower so the PTMDB is rather useless for analysis done using the method described by (Porubčan, 1973).

Table 1 summarizes our observations year by year and Table 2 gives the total effective time and number of observed meteors for all our observers.

Figure 1 shows the distribution of magnitudes of all observed meteors. It can be seen that the logarithm of number of meteors depends linearly on magnitude for the range $m = 0 - 7$ and drops at $m = 8$. Thus the probability of detection of a telescopic meteor drops around 8 mag. It is obvious that estimations of both very bright (i.e. brighter than brightest star in the field) and very

[1]Warsaw University Astronomical Observatory, Al. Ujazdowskie 4, 00-478 Warsaw, Poland.
[2]Comets and Meteors Workshop, Warsaw, Poland.
[3]Email: `rpoleski@astrouw.edu.pl`

IMO bibcode WGN-363-poleski-telescopic
NASA-ADS bibcode 2008JIMO...36...52P

Table 1 – Number of observers, total effective observing time ($T_{\rm eff}$) and number of meteors (N) observed each year.

Year	No. of observers	$T_{\rm eff}$	N
1996	8	18.62	95
1997	10	36.60	230
1998	8	110.62	749
1999	12	163.43	2071
2000	13	182.87	1580
2001	14	202.14	1655
Total	31	714.28	6380

Table 2 – Total effective observing time ($T_{\rm eff}$) and number of meteors (N) seen by each observer.

Observer	IMO Code	$T_{\rm eff}$	N
Konrad Szaruga	SZAKO	148.27	1297
Wiśniewski Mariusz	WISMA	90.95	1289
Michał Jurek	JURMC	74.22	663
Marcin Gajos	GAJMR	62.71	479
Michał Kozak	KOZMI	46.68	281
Izabela Fitoł	FITIZ	42.37	537
Kamil Złoczewski	ZLOKA	41.32	227
Wojciech Jonderko	JONWO	30.14	279
Krzysztof Socha	SOCKR	23.04	171
Aleksander Trofimowicz	TROAL	21.18	177
Marcin Konopka	KONMA	19.62	98
Mariola Czubaszek	CZUMA	16.25	246
Albert Witczak	WITAL	16.05	72
Tomasz Dziubiński	DZITO	14.24	93
Tomasz Fajfer	FAJTO	13.50	95
Beata Czmut	CZMBE	12.60	117
Jarosław Dygos	DYGJA	11.01	73
Piotr Szakacz	SZAPI	5.60	22
Andrzej Skoczewski	SKOAN	4.10	24
Konrad Lotczyk	LOTKO	3.78	20
Paweł Brewczak	BREPA	3.67	6
Łukasz Kowalski	KOWLF	3.50	72
Krzysztof Mularczyk	MULKR	1.50	9
Ewa Dygos	DYGEW	1.19	4
Łukasz Pospieszny	POSLU	1.18	4
Jan Bielecki	BIEJF	1.00	5
Rafał Kopacki	KOPRA	1.00	3
Krzysztof Wtorek	WTOKR	1.00	3
Maciej Reszelski	RESMA	0.98	10
Michał Kopczak	KOPMC	0.88	2
Luiza Wojciechowska	WOJLU	0.75	2

faint meteors (i.e. near limiting magnitude) is not precise. Different telescopes were used for observations and this influences the histogram much.

Table 3 gives the distribution of observed velocities. More then 60% of all meteors have C and D velocities which may suggest some kind of bias in this data.

3 Description of tables

The PTMDB is composed of two ASCII files: `head9601.txt` (hereafter *head file*) and `coor9601.txt` (hereafter *coor file*). The former contains information about each observing run and the latter information about each meteor. Both have three letter cross-reference codes.

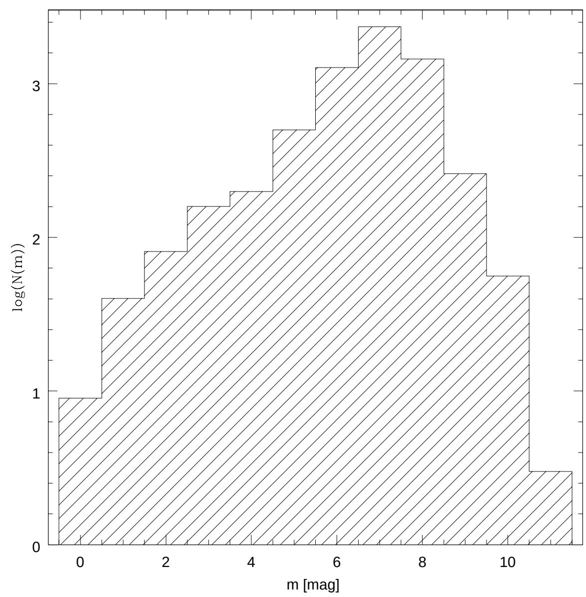

Figure 1 – Histogram of meteor magnitudes. A logarithmic scale is used.

Table 3 – Distribution of observed meteor velocities.

Velocity	No. of meteors
0	57
A	141
B	665
C	2005
D	1982
E	1164
F	366

There are the following data in the columns of the head file: three letter code, IMO observer's code, geographical coordinates of the observing site (4 columns), date of beginning of observing night (format DD MM YY, 3 columns), UT time of beginning and ending of observation (format HHMM HHMM, 2 columns), solar longitude (J2000) of the middle time of the observing run, equatorial coordinates of the center of the observed field (2 columns), effective time (in hours), naked-eye stellar limiting magnitude, telescopic stellar limiting magnitude, diameter of the telescope (in mm), magnification and diameter of the field of view (in degrees, estimated during observation). If any of the values was not noted by observer then 0 is given. A sample of the file is presented in Figure 2.

The coor file contains following data in columns: beginning and ending dates of the observation night (3 columns), number of meteors in the observation, magnitude, velocity (a subjective scale A – F is used where A corresponds to around 2°/s and F corresponds to over 25°/s, 0 is given for stationary meteors), UT time of appearance, equatorial coordinates of beginning and ending point (4 columns), IMO observer's code and three letter cross-reference code. A sample of the file is presented in Figure 3.

AUQ	SZAKO	21.4	E	52.1	N	12	07	01	2007	2139	110.537	297	18	1.23	0.00	7.68	35	8	6.5
AUR	SZAKO	21.4	E	52.1	N	12	07	01	2206	2310	110.607	315	10	1.00	0.00	8.05	35	8	6.5
AUS	SZAKO	21.4	E	52.1	N	12	07	01	2328	0001	110.650	315	10	0.50	0.00	7.00	35	8	6.5
AUT	JURMC	21.4	E	52.1	N	12	07	01	2047	2119	110.544	233	87	0.47	5.87	8.10	50	10	5.0
AUU	JURMC	21.4	E	52.1	N	12	07	01	2206	2320	110.610	267	54	1.00	6.08	8.49	50	10	5.0

Figure 2 – Sample of a Head File

2001	07	12/13	001	5.0	D	20:11	296.63	18.71	295.70	18.27	SZAKO	AUQ
2001	07	12/13	002	5.5	E	20:16	298.25	17.92	297.17	17.95	SZAKO	AUQ
2001	07	12/13	003	6.0	C	20:20	297.50	19.03	297.08	18.81	SZAKO	AUQ
2001	07	12/13	004	6.0	E	20:22	296.42	18.17	297.47	18.59	SZAKO	AUQ
2001	07	12/13	005	6.5	C	20:42	297.47	18.27	297.42	19.24	SZAKO	AUQ

Figure 3 – Sample of a Coor File

4 Conclusions

Telescopic meteor observations can still be used for the analysis of weak meteor showers. The data presented here were collected by different observers with different experience. They can be used for the analysis of showers active during summer, when most of the data were collected, as well as for the calibration of telescopic meteor observations. The number of meteors drops down around magnitude 8. Some kind of bias can be seen in the distribution of observed angular velocities. The database is the biggest of this type accessible electronically for the astronomical community.

Acknowledgements

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Orionids

The 2007 Orionids from visual observations

Rainer Arlt [1], *Jürgen Rendtel* [2] *and Pierre Bader* [3]

Following up on the enhanced activity of the 2006 Orionids, we present an analysis of the 2007 Orionids based on visual observations. A maximum activity of ZHR = 80 ± 5 meteors per hour is found at a solar longitude of $208^{\circ}.45$ (eq. J2000.0) corresponding to about 2007 October 22, $08^{\rm h}$ UT. The peak was preceded by another maximum of 70 ± 4 meteors per hour near a solar longitude of $280^{\circ}.1$, corresponding to about 2007 October 22, $0^{\rm h}$ UT. The visual activity was a bit higher than in 2006 when ZHRs reached values near 60 meteors per hour. The population index was slightly below 2.0, while it went down to 1.6 in 2006. During the times of highest activity, the population index was 2.1 and 2.2, respectively. The maximum spatial number density was about 100 particles in a cube with edges of 1000 km length, which corresponds to a flux density of 0.024 particles per square kilometer per hour. The mass index was around 1.7 with 1.6 being the minimum value. Enhanced rates above the average pre-2006 profile were observed for a duration of at least 5 days. The enhanced rates in 2006 and 2007 are likely due to dust in 1:6 mean motion resonance with Jupiter, according to Sato & Watanabe (2007). The corresponding dust trails were laid down during perihelion passages of 1P/Halley 30–45 revolutions ago.

1 Introduction

After the great surprise of the 2006 return of the Orionid meteor shower with Zenithal Hourly Rates (ZHR) of about 60, the 2007 maximum of the Orionids was awaited with fairly high expectations. The vast majority of data is submitted by electronic mail, with a substantial part making use of the electronic visual report form on the IMO web site. The form has the advantage that reports are checked for consistency before being submitted. Note that the data are not directly going into the VMDB, since quality evaluation, additional requests for details from observers, and possible amendments of the reports are still best done manually. But the standardized output style and the consistency checks are already of great help for the maintenance of the VMDB. Observers are highly encouraged to make use of the form, even though it may initially look complicated to casual observers, and error messages are more 'inexorable' than a human data recipient.

The Orionid meteor shower is caused by dust from the most famous comet, 1P/Halley. The particles encounter Earth near the ascending nodes of their orbits. The radiant at maximum activity is located near a position of $\alpha = 95°$ and $\delta = +16°$, and the entry velocity in the Earth's atmosphere is about 66 km/s. The data are taken from the shower list by Arlt & Rendtel (2006). The orbit of 1P/Halley does not come very close to that of the Earth. It takes the particles quite a few revolutions (roughly more than 20) to get into Earth-crossing orbits and to produce Orionid meteors. For that reason, observations of the Orionids provide suites of particle flux profiles which are interesting for long-term evolution models of streams at considerable distance from their parent object's orbits. The present analysis computes profiles of the population index and the ZHR of the Orionid meteor shower, and mass index and spatial number density profiles of the corresponding meteoroid stream.

In 2007, 83 observers reported their data from the Orionid activity period, covering $546^{\rm h}.6$ of observing time. The total number of Orionids seen was 6179. We are grateful to the following observers who sent in their data to the Visual Meteor Database of the IMO (showing name, (IMO observer code, hours of observation, number of meteors seen)):

Salvador Aguirre (`AGUSA`, $19^{\rm h}.10$, 244), Plamena Aleksandrova (`ALEPL`, $3^{\rm h}.75$, 19), Pierre Bader (`BADPI`, $10^{\rm h}.15$, 18), Felix Bettonvil (`BETFE`, $3^{\rm h}.03$, 134), Jean-Marie Biets (`BIEJE`, $9^{\rm h}.08$, 66), Michael Boschat (`BOSMI`, $1^{\rm h}.00$, 5), Gennadij Bugarevych (`BUGGE`, $9^{\rm h}.06$, 10), Dushyant Chauhan (`CHADU`, $1^{\rm h}.18$, 32), Neha Das (`DASNE`, $0^{\rm h}.96$, 5), Namrata Date (`DATNA`, $1^{\rm h}.48$, 7), Daniel Delaney (`DELDA`, $1^{\rm h}.00$, 9), Peter Detterline (`DETPE`, $8^{\rm h}.33$, 230), Sietse Dijkstra (`DIJSI`, $19^{\rm h}.12$, 274), Todor Dimitrov (`DIMTO`, $4^{\rm h}.17$, 19), Irena Divisova (`DIVIR`, $36^{\rm h}.75$, 38), Dariusz Dorosz (`DORDA`, $1^{\rm h}.33$, 62), Audrius Dubietis (`DUBAU`, $1^{\rm h}.00$, 3), Frank Enzlein (`ENZFR`, $7^{\rm h}.84$, 235), Eric Flescher (`FLEER`, $2^{\rm h}.00$, 9), George W. Gliba (`GLIGE`, $2^{\rm h}.00$, 89), William Godley (`GODWI`, $8^{\rm h}.00$, 44), Sylvie Gorkova (`GORSY`, $3^{\rm h}.00$, 2), Mitja Govedic (`GOVMI`, $0^{\rm h}.85$, 26), Robin Gray (`GRARO`, $3^{\rm h}.08$, 4), Wayne T. Hally (`HALWA`, $19^{\rm h}.05$, 167), Vilem Heblik (`HEBVI`, $7^{\rm h}.75$, 42), Carl Hergenrother (`HERCR`, $5^{\rm h}.46$, 67), Carl Johannink (`JOHCA`, $11^{\rm h}.63$, 221), Kearn Jones (`JONKR`, $1^{\rm h}.42$, 5), Kundan Kadam (`KADKU`, $4^{\rm h}.08$, 18), Jay Kansara (`KANJA`, $3^{\rm h}.67$, 37), Roy Keeris (`KEERO`, $0^{\rm h}.90$, 13), André Knöfel (`KNOAN`, $8^{\rm h}.97$, 5), Jakub Koukal (`KOUJA`, $69^{\rm h}.91$, 191), Pete Kozich (`KOZPE`, $1^{\rm h}.25$, 64), Dovilė Krauleidienė (`KRADO`, $1^{\rm h}.00$, 2), Peter van Leuteren (`LEUPE`, $6^{\rm h}.00$, 153), Xiaoyun Ma (`MA XI`, $2^{\rm h}.08$, 26), Adam Marsh (`MARAD`, $3^{\rm h}.50$, 54), Paul

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Martsching (MARPA, $16\overset{h}{.}00$, 151), Pierre Martin (MARPI, $8\overset{h}{.}69$, 313), Antonio Martinez (MARTI, $1\overset{h}{.}00$, 13), Alastair McBeath (MCBAL, $5\overset{h}{.}50$, 58), Bruce McCurdy (MCCBR, $3\overset{h}{.}50$, 6), Frédéric Merlin (MERFR, $1\overset{h}{.}75$, 29), Koen Miskotte (MISKO, $20\overset{h}{.}45$, 378), Sabine Wächter (MORSA, $4\overset{h}{.}29$, 4), David Moyer (MOYDA, $1\overset{h}{.}00$, 33), Sven Näther (NATSV, $21\overset{h}{.}22$, 81), Tereza Novotna (NOVTE, $1\overset{h}{.}50$, 22), David Oesper (OESDA, $4\overset{h}{.}00$, 46), Daniel van Os (OSVDA, $0\overset{h}{.}72$, 4), Swapnil Pawar (PAWSW, $3\overset{h}{.}30$, 24), Richard Pollard (POLRI, $3\overset{h}{.}50$, 30), Jürgen Rendtel (RENJU, $25\overset{h}{.}84$, 259), Mileny Roche Lamas (ROCMI, $1\overset{h}{.}99$, 1), Amanda Rowan (ROWAM, $1\overset{h}{.}00$, 11), Tomoko Sato (SATTM, $1\overset{h}{.}32$, 34), René Scurbecq (SCURE, $3\overset{h}{.}23$, 89), Ulrich Sperberg (SPEUL, $2\overset{h}{.}30$, 58), Octaaf Steen (STEOC, $2\overset{h}{.}13$, 18), Boris Stoilov (STOBO, $1\overset{h}{.}92$, 1), Con Stoitsis (STOCO, $2\overset{h}{.}25$, 6), Wesley Stone (STOWE, $1\overset{h}{.}79$, 100), Richard Taibi (TAIRI, $1\overset{h}{.}16$, 16), Rafaél R. Torregrosa Soler (TORRQ, $1\overset{h}{.}08$, 3), Blanca Troughton Luque (TROBL, $2\overset{h}{.}33$, 20), Shigeo Uchiyama (UCHSH, $3\overset{h}{.}40$, 20), Devdatta Urankar (URADE, $1\overset{h}{.}50$, 13), Simona Vaduvescu (VADSI, $6\overset{h}{.}45$, 159), David Vansteelant (VANDV, $1\overset{h}{.}58$, 28), Hendrik Vandenbruaene (VANHE, $1\overset{h}{.}66$, 15), Michel Vandeputte (VANMC, $40\overset{h}{.}53$, 727), Valentin Velkov (VELVA, $3\overset{h}{.}34$, 20), Rita Verhoef (VERRI, $5\overset{h}{.}25$, 151), William Walbek (WALWI, $1\overset{h}{.}33$, 36), William Watson (WATWI, $12\overset{h}{.}06$, 341), Thomas Weiland (WEITH, $4\overset{h}{.}90$, 65), Roland Winkler (WINRO, $3\overset{h}{.}93$, 3), San Zhan (ZHASA, $1\overset{h}{.}18$, 33), Jin Zhu (ZHUJI, $1\overset{h}{.}38$, 40), Jurga Zieniūtė (ZIEJU, $1\overset{h}{.}00$, 4), Koos Van Zyl (ZYLKO, $8\overset{h}{.}40$, 67)

2 Analysis steps

The correction of meteor observations to a standard limiting magnitude of +6.5 requires the knowledge of the population index r. If the fraction of bright meteors in a meteor shower is relatively large, the correction for limiting magnitudes lower than +6.5 will be smaller than if there is a large fraction of faint meteors. In order to reduce the influence of very high corrections upon observations with low limiting magnitudes, we selected only observations with $\mathrm{lm} \geq +5.8$ for the entire analysis. Out of 881 observing periods for rate data, we retained 663 records obtained under good conditions. From the total of 384 magnitude distributions, a set of 258 distributions with $\mathrm{lm} \geq +5.8$ was used. The data set is about half the size of the 2006 one when 12 000 Orionids were available.

The population index is determined from the magnitude distributions of Orionids. The method described in Arlt (2003) was used to derive a profile of the population index versus time. Again, an adaptive bin-size algorithm is used for constructing averaging windows which are the result of the compromise between a minimum number of meteor magnitudes and an acceptable window length. More details are given below for the ZHR averaging which uses the same principle. Error margins depend non-linearly on r and the meteor number involved; the values have been derived by Monte Carlo simulations and are also given in Arlt (2003).

The activity of a meteor shower is measured with the Zenithal Hourly Rate (ZHR) which is the hourly meteor number corrected for a limiting magnitude of +6.5 and a radiant elevation of 90°. The ZHR profile is based on the population index profile. Values in between the individual population indices obtained above are interpolated linearly. We employ a weighted averaging for the ZHR with the total correction coming from the stellar limiting magnitude lm (thereby using the population index), possible obstructions of the field of view expressed by F, the radiant elevation h_{R}, and the effective observing time T_{eff}. The average ZHR is given by

$$\overline{\mathrm{ZHR}} = \left(\sum_{i=1}^{N} n_i + 1\right) \Big/ \sum_{i=1}^{N} C_i\,, \qquad (1)$$

where the n_i and the C_i are the number of Orionids and the total correction factors of the N individual observing periods, respectively. The total correction is computed by

$$C = \frac{r^{6.5-\mathrm{lm}}\,F}{T_{\mathrm{eff}}\,\sin h_{\mathrm{R}}} \qquad (2)$$

Upon averaging the rate data, a maximum correction factor $r^{6.5-\mathrm{lm}}\,F/\sin h_{\mathrm{R}} < 5$ was applied. Additionally, the radiant elevation was limited to a minimum of 20° in order to avoid large corrections which may bring along systematic errors. Other corrections like perception differences among observers or non-geometrical corrections for the radiant elevation (zenith exponent) were not applied.

The averaging is adaptive in that the bin size varies according to the number of meteors available from the data records. A minimum and maximum window length are given together with an optimum meteor number, which the algorithm tries to collect in an averaging bin. Until a solar longitude of 205°, we tried setting the window width to vary between $0\overset{\circ}{.}5$ and 1° requesting an optimum meteor number of 100. This was never achieved, so the averaging bins have always been 1° as it turned out during the analysis. These steps are fine, though, during the periods away from the activity maximum. In a second part between $\lambda_{\odot} = 205°$ and 209°, we set the window length to be between $0\overset{\circ}{.}08$ and $0\overset{\circ}{.}16$ and again requested a meteor number of 100. Because of rather unevenly distributed observing periods, all three possible cases were encountered by the algorithm: a meteor number of (just below) 100 was matched with a bin width between the two extrema, not enough meteors were found when the bin width had been extended to the maximum of $0\overset{\circ}{.}16$, and the meteor number already exceeded 100 when starting with the minimum bin width of $0\overset{\circ}{.}08$. In principle, with minimum and maximum set to zero and infinity, respectively, a profile with a constant meteor number in each average can be achieved (constant only to a degree which the reported Orionid numbers in observing intervals allow, since individual meteors are not accessible in the VMDB). The distribution of averages will be very uneven, however, and details, although less significantly documented, may be lost.

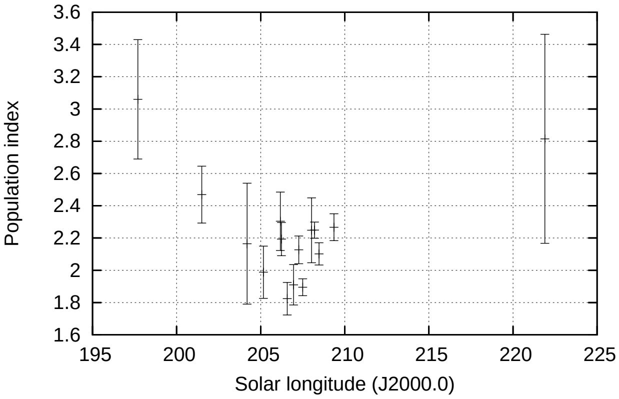

Figure 1 – Population index profile of the 2007 Orionids over the entire activity period.

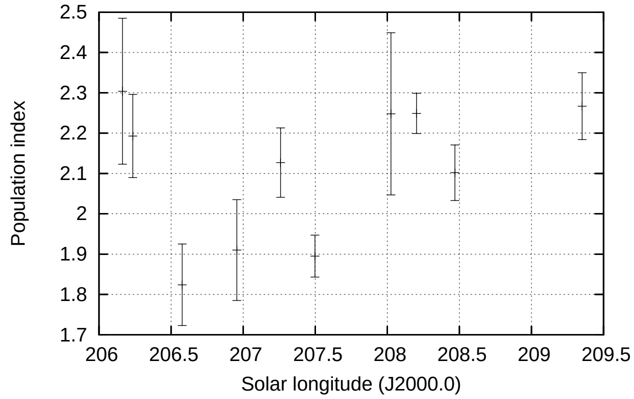

Figure 2 – Population index profile of the 2007 Orionids near their maximum.

3 Results

The full profile of the population index r of the 2007 Orionids is shown in Figure 1. The activity period of the shower begins with a high population index of 3; the r-value drops gradually to 2.0 at about a solar longitude of 205°. A larger amount of data allowed for a more highly resolved profile between solar longitudes 205° and 209°. The results show a rather variable population index. The values lie between 1.9 and 2.5 for a long period of about 18 days, before r goes back to high values of $r \approx 3$ at $\lambda_\odot = 219°$ (roughly November 2).

A magnification of the profile shown in Figure 1 is shown in Figure 2. We find two main minima of r near $\lambda_\odot = 206.^\circ6$ (corresponding to about October 20, 12^h UT) and $\lambda_\odot = 207.^\circ5$ (October 21, 09^h UT). While the error margins indicate these are significant features, their distance of exactly one day lead us to be cautious. The periods around these points are characterized by observations with high limiting magnitudes. If the observers did not report an adequate number of faint meteors, their magnitude distributions will lead to underestimated population indices. We conclude here, that the r-value may not have been below 2.0 at these two instances, but still relatively low and definitely at $r < 2.5$.

For comparison, we repeat the results from the analysis of the 2006 Orionids (Rendtel, 2007) in Figure 3. A much higher sampling was used for the 2006 profile; one has to look at the result in a smoothing manner to see whether there are features repeating in 2007. On average, the r-values were significantly lower in 2006 than in 2007. While r varied between 1.6 and ~ 2.2 in the former, it was just below 2.0 and reached up to 2.3 in 2007 during the same window of solar longitudes. In other words, the unusually large fraction of bright meteors in 2006 was not seen in October 2007. The peculiarly low value of 1.6 in 2006 coincides with the minimum population index in 2007 of $r = 1.9$ around or shortly after $207.^\circ5$. One should be careful though to conclude that the particular part of Orionid activity was caused by the same part (dust trail or filament) of the Orionid meteoroid stream, just from that single fact. Interestingly, also the highest r-value in that period occurs at the same time in both 2006 and 2007 with $r \approx 2.3$ near or shortly after $\lambda_\odot = 208°$.

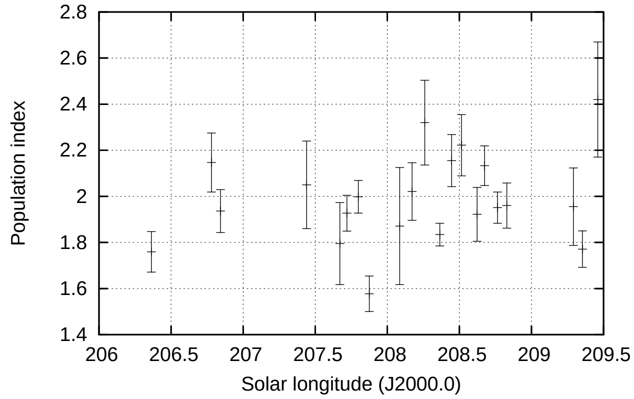

Figure 3 – Population index profile of the 2006 Orionids near their maximum.

The ZHR profile determined from the above mentioned 663 observing periods with Orionid rate data is shown in Figure 4. The averaging is done by employing Equation 1 and the error margins refer to $\mathrm{ZHR}/\sqrt{\sum n_i + 1}$. The profile is based on the population index derived earlier and shown in Figure 1. The r-profile is interpolated linearly; a method considered sufficiently accurate given the fact that the averaged population indices have non-negligible error bars on their own. The dashed line in Figure 4 is an average activity profile derived from all VMDB observations of 1984–2005 applying a population index of 2.3. Orionid ZHRs were above the average over the last decades for at least 5 days in 2007.

The full numerical data of the ZHR profile are given in Table 1 along with the interpolated population indices from the curve in Figure 1. Note that nearly all average limiting magnitudes are above +6 as a result of the selection made above.

A magnification of the identical ZHR profile is shown in Figure 5 where the short-term variations of the Orionid activity become visible. Variations in the ZHR profile are not particularly linked to the low-r features discussed above. The two population index minima seem to have a minor influence on the curve.

Finally, we also repeat the ZHR profile of the 2006 Orionid analysis by Rendtel (2007). Again, we overplot the 'annual' ZHR curve based on 1984–2005 data for comparison. The 2007 ZHRs actually exceed the 2006 rates by about 20%. The results are certainly not in-

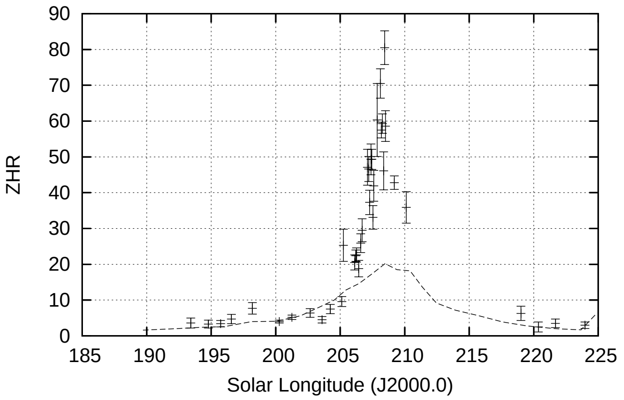

Figure 4 – ZHR profile of the 2007 Orionids. The dashed line shows an average profile of the Orionids of 1984–2005.

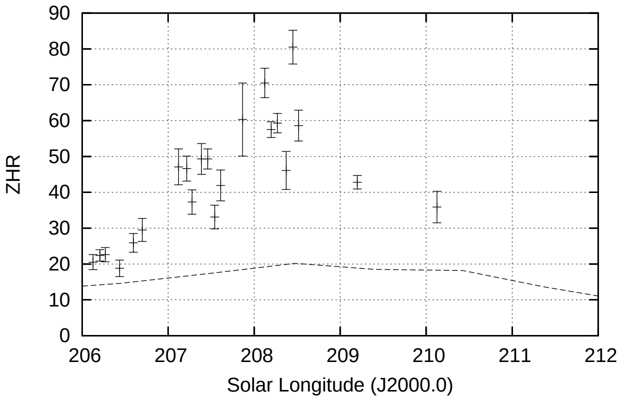

Figure 5 – Magnification of Figure 4 with the ZHR profile of the 2007 Orionids around their maximum.

flated by unfavourable conditions, since we selected only observations with limiting magnitude of lm $\geq +5.8$ and radiant elevations of $h_R \geq 20°$. We believe that systematic radiant-height effects can only have a minor effect on the absolute level of maximum Orionid activity. The result will thus be very interesting for stream modeling which may give new insights in the dynamics of far-Earth streams such as the Orionids when explaining the peaks of both 2006 and 2007. We are discussing a recent attempt in the Conclusions.

The coverage of the 2007 activity of the Orionids by visual observations gradually decreases after a solar longitude of $\lambda_\odot = 208\overset{\circ}{.}5$ because of the increased interference with the Moon. While we do not detect any recurrence of the short Orionid maximum just before $\lambda_\odot = 210°$ found in the 2006 data, a short-lived peak may be hidden in the longer averages over the sparser data. The duration of enhanced rates (again meaning ZHR > 25) was about the same in 2006 with about 5 days as in 2007.

The ZHR is an observational measure of the shower's activity from the viewpoint of a visual observer, since it refers to a typical field of view of a visual observer and is not corrected for the reduced perception of meteors towards the limiting magnitude. It is appropriate to convert the ZHR into a number density of particles within the Orionid meteoroid stream (Koschack & Rendtel 1990). The conversion again involves the population index making the results critically depend-

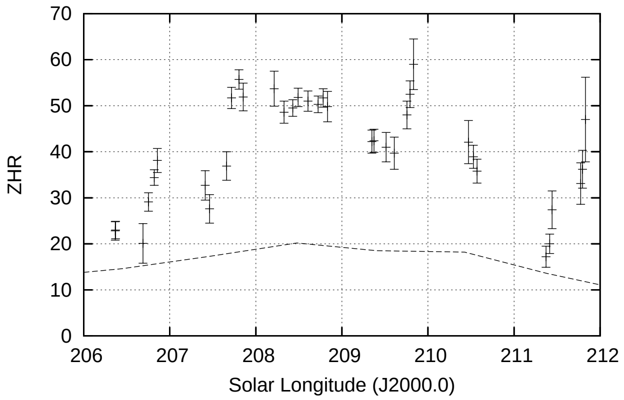

Figure 6 – ZHR profile of the 2006 Orionids around their maximum.

Table 1 – Numerical data of the visual activity of the 2007 Orionids after averaging. The ZHR data are the same as shown in Figure 4. Dates are in UT and refer to October and November 2007, solar longitudes $\lambda_\odot$ refer to equinox J2000.0. The population indices r are interpolated values from Figure 1.

Date	$\lambda_\odot$	n	ZHR	$\overline{\text{lm}}$	r
7.17	$193\overset{\circ}{.}418$	6	3.6 ± 1.4	6.07	3.06 ± 0.37
8.56	$194\overset{\circ}{.}787$	8	3.3 ± 1.1	6.19	3.06 ± 0.37
9.52	$195\overset{\circ}{.}729$	14	3.4 ± 0.9	6.13	3.06 ± 0.37
10.37	$196\overset{\circ}{.}574$	11	4.7 ± 1.3	6.11	3.06 ± 0.37
12.00	$198\overset{\circ}{.}190$	22	7.7 ± 1.6	6.27	2.98 ± 0.35
14.12	$200\overset{\circ}{.}280$	87	4.0 ± 0.4	6.38	2.66 ± 0.24
15.11	$201\overset{\circ}{.}262$	81	5.2 ± 0.6	6.29	2.50 ± 0.19
16.53	$202\overset{\circ}{.}670$	25	6.4 ± 1.2	6.32	2.34 ± 0.26
17.46	$203\overset{\circ}{.}597$	25	4.5 ± 0.9	6.48	2.24 ± 0.33
18.10	$204\overset{\circ}{.}233$	30	7.5 ± 1.3	6.44	2.16 ± 0.36
19.00	$205\overset{\circ}{.}127$	43	9.6 ± 1.4	6.08	2.00 ± 0.17
19.13	$205\overset{\circ}{.}248$	30	25.3 ± 4.5	6.47	2.02 ± 0.16
20.01	$206\overset{\circ}{.}125$	97	20.5 ± 2.1	6.33	2.29 ± 0.18
20.09	$206\overset{\circ}{.}206$	188	22.4 ± 1.6	6.31	2.24 ± 0.13
20.15	$206\overset{\circ}{.}269$	123	22.6 ± 2.0	6.31	2.16 ± 0.10
20.32	$206\overset{\circ}{.}436$	67	18.8 ± 2.3	6.12	1.97 ± 0.10
20.48	$206\overset{\circ}{.}596$	97	25.9 ± 2.6	6.29	1.85 ± 0.10
20.59	$206\overset{\circ}{.}699$	82	29.5 ± 3.2	6.84	1.85 ± 0.11
21.01	$207\overset{\circ}{.}121$	89	47.1 ± 5.0	6.36	2.03 ± 0.10
21.11	$207\overset{\circ}{.}216$	174	46.6 ± 3.5	6.31	2.09 ± 0.09
21.17	$207\overset{\circ}{.}278$	120	37.3 ± 3.4	6.37	2.11 ± 0.08
21.28	$207\overset{\circ}{.}387$	130	49.3 ± 4.3	6.25	2.00 ± 0.07
21.35	$207\overset{\circ}{.}459$	300	49.3 ± 2.8	6.31	1.93 ± 0.06
21.43	$207\overset{\circ}{.}541$	100	33.1 ± 3.3	6.58	1.92 ± 0.06
21.50	$207\overset{\circ}{.}609$	94	41.9 ± 4.3	6.90	1.97 ± 0.08
21.76	$207\overset{\circ}{.}864$	34	60.3 ± 10.2	5.95	2.14 ± 0.16
22.02	$208\overset{\circ}{.}123$	292	70.5 ± 4.1	6.16	2.25 ± 0.12
22.09	$208\overset{\circ}{.}197$	680	57.5 ± 2.2	6.32	2.25 ± 0.06
22.17	$208\overset{\circ}{.}270$	484	59.3 ± 2.7	6.35	2.22 ± 0.05
22.27	$208\overset{\circ}{.}372$	74	46.1 ± 5.3	6.10	2.15 ± 0.06
22.35	$208\overset{\circ}{.}450$	297	80.5 ± 4.7	6.25	2.11 ± 0.07
22.41	$208\overset{\circ}{.}516$	184	58.6 ± 4.3	6.26	2.11 ± 0.07
23.10	$209\overset{\circ}{.}200$	492	42.8 ± 1.9	6.23	2.24 ± 0.08
24.03	$210\overset{\circ}{.}125$	66	35.9 ± 4.4	6.26	2.30 ± 0.11
1.94	$219\overset{\circ}{.}013$	9	6.3 ± 2.0	5.95	2.69 ± 0.52
3.28	$220\overset{\circ}{.}360$	2	2.5 ± 1.4	6.39	2.74 ± 0.58
4.60	$221\overset{\circ}{.}681$	7	3.5 ± 1.2	6.27	2.81 ± 0.64
6.89	$223\overset{\circ}{.}979$	9	3.0 ± 0.9	6.13	2.82 ± 0.65

ing on the accuracy of r. Since this analysis is based on a relatively limited sample of magnitude distributions, we cannot hope to interpret details of the number density profile, but the order of magnitude of the density may be of good enough quality for comparisons of the densities in different years, i.e. in different sections of the stream. Computing the spatial number density of a meteoroid stream requires the geocentric velocity. The values here are computed assuming a geocentric velocity of 66.9 km/s accounting for the 1:6 resonance particles modeled by Sato & Watanabe (2007). Figure 7 shows the result for particles causing meteors of magnitude +6.5 or brighter near the Orionid maximum. These are particles with $3 \cdot 10^{-5}$ g and larger, according to the mass-magnitude relations based on Verniani (1973) and re-written by Koschack & Rendtel (1990). The number densities can be converted into a meteoroid flux density by dividing it by the geocentric velocity (caring for the units though). The flux density at maximum is 0.024 meteoroids per hour per km^2. The spatial number density of the pre-2006 Orionid profile is about 30 particles per 10^9 km^3, corresponding to a flux density of 0.007 km^{-2} h^{-1}. The number is based on the average ZHR profile shown as a dashed line in Figures 4–6 and a population index of 2.3.

Note how the influence of the population index revealed that the first peak with a ZHR near 70 was formed by a stream density which is actually larger than that for the second maximum with a ZHR of 80. Since the population index during the latter was lower, there were actually not very many particles missed by the observers. Of course, the error margins on the spatial number densities are large and the differences are not significant, but the comparison is still good for an illustration of the effects at work.

We also converted the population index profile into a mass index profile and show the result in Figure 8. We follow the same conversion of mass into intensity as was used above for the mass limit and was based on Verniani (1973) and employ – only using the definition of stellar magnitudes – the relation

$$s = 1 + 2.3 \log r \tag{3}$$

and approximate the error margins by

$$\Delta s = 2.3 \Delta r / r. \tag{4}$$

The lowest mass index found for the 2007 Orionids is 1.6, while values varied around 1.7 ± 0.1 during the time of maximum activity.

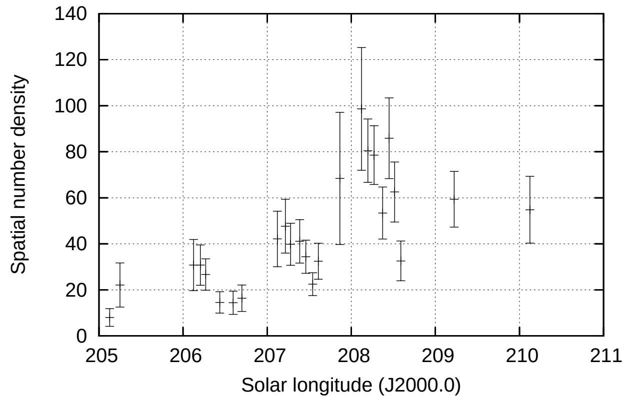

Figure 7 – Spatial number density of Orionid particles causing meteors of at least magnitude +6.5 in a cube of 10^9 km^3 during the 2007 maximum. Note that the plotted solar longitude range is different from the ZHR plots.

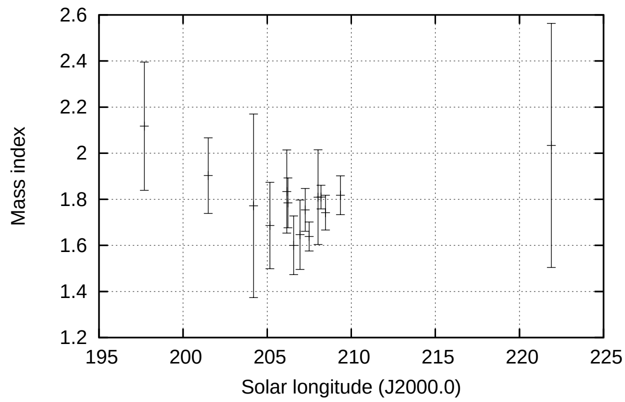

Figure 8 – Mass index in the 2007 cross-section of the Orionid meteoroid stream. It represents the differential decrease of particle numbers with increasing mass.

4 Conclusions

The Orionid meteors showed significantly heightened activity in 2007 compared to their long-term behavior of pre-2006 data covered by the Visual Meteor Database (Dubietis, 2003), and compared to the long-term analysis by Rendtel (2008) going back from 2006 to 1944. Even more than 60 years ago, the Orionid ZHR was very likely between 20 and 30.

The evolution of particle orbits of the parent Comet 1P/Halley was studied by Sato & Watanabe (2007). According to their computations, the 2006 outburst of the Orionids was caused by particles in orbits resonant with Jupiter. These orbits were fed by Comet Halley at three perihelion passages about 40 orbital periods ago. The authors also suggest encounters with similar particles in 2007 to 2009. Their figure 1 actually seems to suggest near-Earth nodes of similarly old particle orbits until 2011.

A follow-up of these computations is shown on the web page of Mikiya Sato (2007). Dust trails are found close to the orbit of the Earth in 2007 on October 19, around 23$^{\text{h}}$ UT, and on October 21, near 17$^{\text{h}}$ and 20$^{\text{h}}$UT, corresponding to solar longitudes of 206°.07, 207°.81, and 207°.94, respectively. We do not find significant enhancements in Orionid activity at these times. The chances to detect activity from these specific dust trails were indeed stated to be weak by Sato. There is a first, weak maximum in activity after the encounter with the 1265 BC trail at $\lambda_\odot = 206°.25$ with a ZHR of 22.5 which exceeds an apparent 'background profile' of 18–20 only marginally. As for the second encounter possibility, if the low population index r at 207°.8 is not caused by a systematic problem, it may be an indication of the encounter with the dust trail of 1197 BC, found by Sato (2007). When looking back at 2006, we also see some discrepancy between the dust trail timings from the model and the observed peaks as reported by Rendtel (2007). Of the trails or trail parts with three highest $f_{\rm M}$-values, the one at $\lambda_\odot = 209\overset{\circ}{.}824$ has a nice match, while the ones at $\lambda_\odot = 207\overset{\circ}{.}464$ and $\lambda_\odot = 209\overset{\circ}{.}824$ do not have any dramatic association with an observed peak. Given the age of the trails, one certainly has to assume larger time-spans for the peaks to fall into, than for young trails which were encountered e.g. during the 1999 and 2001 Leonids.

Old trails can be rather wide in solar longitude as we have seen with the 1998 Leonid fireball storm and the related dust trail of 1333; see Arlt (1998) for observational results and Asher et al. (1999) for the modeling. Looking at the results by Sato and Watanabe, the origin of both the 2006 and 2007 enhanced rates appears to be dust from the perihelion passages of Comet 1P/Halley 30–45 revolutions ago. All the relevant particles are in 1:6 mean motion resonance with Jupiter. The modeling is also in line with the absence of enhanced Orionid rates in the past, at least back to 1966.

We conclude that the Orionid meteor shower delivered enhanced activity in 2007 with maximum ZHRs of about 80 near a solar longitude of $208\overset{\circ}{.}45$ (2007 October 22, $8^{\rm h}$ UT), whereas the annual Orionid activity is typically 20–25 meteors per hour during a wide maximum centered on $\lambda_\odot = 209°$. The 2007 Orionid maximum is actually split, and exhibits an earlier peak of ZHR $= 70 \pm 4$ at $\lambda_\odot = 208\overset{\circ}{.}12$ (2007 October 22, $0^{\rm h}30^{\rm m}$ UT). The activity in 2007 was even higher than in 2006. The amount of data is smaller though, and the absolute ZHR figures are more uncertain. More generally, we conclude that the heightened Orionid activity of $\lambda_\odot = 208°$–$209°$ occurred again in 2007, while later peaks near 210° and 212° were not detected, possibly because of lack of data.

Maximum spatial number densities of Orionid particles were near 100 in cube of 1000 km edge length. This corresponds to a flux density of about 0.024 $\rm km^{-2}\ h^{-1}$. The differential mass index dropped to values of $s = 1.7 \pm 0.1$.

If the Orionid meteor shower persists in showing ZHRs of 60–70 until about 2011, observers' efforts will be rewarded with the longest major-shower maxima for which catching the right geographical longitude is not overly important. We would like to encourage all observers to plan meteor watches and report their data in 2008, despite the last-quarter moon. Observing fields west of the radiant, in Aries and Cetus, are recommended to avoid too much disturbance from the Moon which is at high declination and hence at high elevations above the horizon in the northern hemisphere. Observations from the southern hemisphere are also encouraged, where the Moon is a bit lower in the sky than the Orionid radiant, and observing directions to the south-west and south are moon-free.

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Preliminary results

Results of the IMO Video Meteor Network — February 2008

Sirko Molau [1]

A few days ago we received the sad news that long-term video observer Stephen Evans died from a massive heart attack. Even though he rarely enjoyed perfect weather at his observing site in England, Steve was a reliable constant in the IMO network. He regularly provided observations to our network that were obtained with great care and characterised by their precision. Steve always shared a few encouraging words with others and there was hardly anything I had to correct in his data. What a pity that he left us on such short notice.

On the other hand, four new cameras stared operation in February. I myself installed REMO2 in Ketzuer, which is operated fully autonomous as her twin camera. Now REMO1 is covering the eastern sky up to zenith, whereas REMO2 observes westward of the zenith. With BMH2, Flavio Castelani installed a second camera at his site as well. For the first time we could welcome a Portuguese observer. Rui Goncalves is operating a camera system similar to REMO2, i.e. a Mintron camera with a 3.8 mm $f/0.8$ Computar lens. Also beyond the big ocean the camera network has grown, as Carl Hergenrother is operating a Supercircuits PC164C camera with a 4 mm $f/1.2$ Computar lens from Tucson in Arizona.

Lets come to the observation result in February. These were once more extraordinary, especially if we keep in mind that data of SRAKA are still missing, and of REMO1 and REMO2 are only available for the first part of the month so far. Thanks to the exceptional weather in central and southern Europe, those 27 cameras operated last month were able to collect more than 2200 hours of effective observing time — more than in any other month before. You really have to melt in your mouth that the 'dirty' month February with only 29 nights outperformed all others! With respect to the meteor number, it could not compete with August or October, but those almost 6000 meteors enlarged the data set for February by well over 50% in just one year. Hence, we should now be able to detect also weak showers at the begin of year reliably in our database.

The observers are listed on the following page.

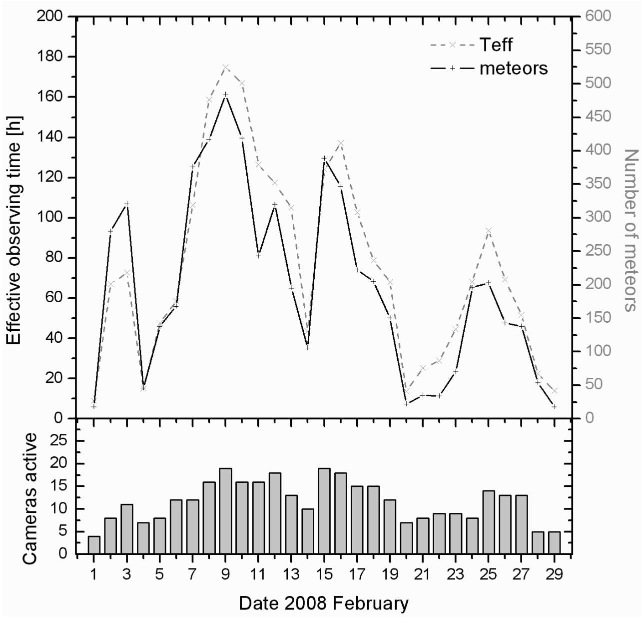

Figure 1 – Monthly summary for the effective observing time (solid black line), number of meteors (dashed gray line) and number of cameras active (bars).

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NASA-ADS bibcode 2008JIMO...36...61M

Table 1 – Observers contributing to February 2008 data of the IMO Video Meteor Network.

Code	Name	Place	Camera	FOV	LM	Nights	Time (h)	Meteors
BENOR	Benitez-S.	Las Palmas	TIMES4 (1.4/50)	⊘ 20°	3 mag	6	17.1	31
			TIMES5 (0.95/50)	⊘ 10°	3 mag	6	10.6	15
BRIBE	Brinkmann	Herne	HERMINE (0.8/6)	⊘ 55°	3 mag	23	124.5	241
CASFL	Castellani	Monte Baldo	BMH1 (0.8/6)	⊘ 55°	3 mag	20	97.7	157
			BMH2 (0.8/6)	⊘ 55°	3 mag	19	105.3	144
CRIST	Crivello	Valbrevenna	STG38 (0.8/3.8)	⊘ 80°	3 mag	2	14.2	28
GONRU	Goncalves	Tomar	TEMPLAR1 (0.8/3.8)	⊘ 80°	3 mag	7	35.9	46
HERCA	Hergenrother	Tucson	SALSA (1.2/4)	⊘ 80°	3 mag	1	2.9	5
HINWO	Hinz	Brannenburg	AKM2 (0.85/25)	⊘ 32°	6 mag	19	169.9	496
KACJA	Kac	Kostanjevec	METKA (0.8/8)	⊘ 42°	4 mag	20	161.4	299
		Kamnik	REZIKA (0.8/6)	⊘ 55°	3 mag	23	147.7	238
		Ljubljana	ORION1 (0.8/8)	⊘ 42°	4 mag	15	104.0	256
KOSDE	Koschny	Noordwijkerhout	ICC4 (0.85/25)	⊘ 25°	5 mag	9	80.2	146
LUNRO	Lunsford	Chula Vista	BOCAM (1.4/50)	⊘ 60°	6 mag	18	146.9	570
MOLSI	Molau	Seysdorf	AVIS2 (1.4/50)	⊘ 60°	6 mag	18	166.5	1222
			MINCAM1 (0.8/6)	⊘ 55°	3 mag	21	174.8	483
		Ketzuer	REMO1 (0.8/3.8)	⊘ 80°	3 mag	8	39.7	105
			REMO2 (0.8/3.8)	⊘ 80°	3 mag	1	9.1	28
PRZDA	Przewozny	Berlin	ARMEFA (0.8/6)	⊘ 55°	3 mag	9	90.1	273
ROBBI	Roberto	Verona	FIAMENE (0.8/3.8)	⊘ 80°	3 mag	14	71.1	144
SLAST	Slavec	Ljubljana	KAYAK1 (1.8/28)	⊘ 50°	4 mag	16	93.1	109
STOEN	Stomeo	Scorze	MIN38 (0.8/3.8)	⊘ 80°	3 mag	11	115.2	241
STRJO	Strunk	Herford	MINCAM2 (0.8/6)	⊘ 55°	3 mag	21	71.8	129
			MINCAM3 (0.8/8)	⊘ 42°	4 mag	11	45.6	87
			MINCAM5 (0.8/6)	⊘ 55°	3 mag	12	77.0	152
WEBMI	Weber	Chouzava	TOMIL (1.4/50)	⊘ 50°	6 mag	2	2.9	15
YRJIL	Yrjola	Kuusankoski	FINEXCAM (0.8/6)	⊘ 55°	3 mag	8	46.0	98
					Overall	29	2211.2	5758

Results of the IMO Video Meteor Network — March 2008

Sirko Molau [1]

A strong February was followed by a weak March. The weather was OK at the begin and end of March, but all the remaining time it was at least in central Europe unsteady and rarely co-operative. Only our two American observers enjoyed better weather and collected most observing time of all. Thanks to the constantly large number of observers (the data from three cameras are still missing), we managed to record once more almost 3000 meteors in well above thousand hours of observing time.

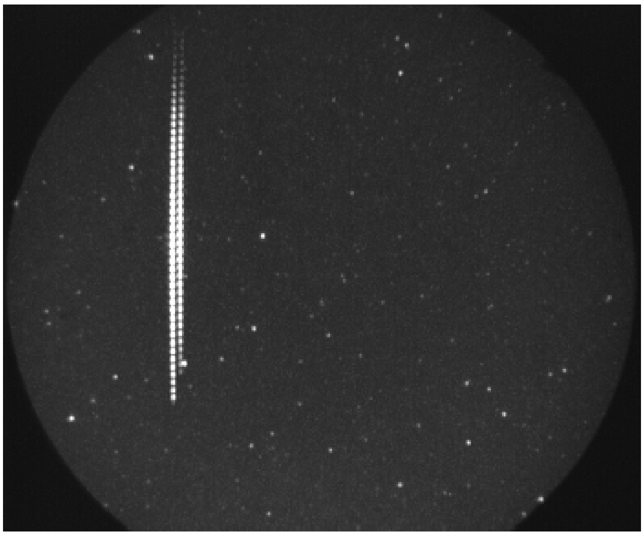

Figure 1 – Double meteor from March 6, 2008, recorded by Wolfgang Hinz with AKM2 (top).

The highlight of last month was reported from Brannenburg: on March 6, $00^h09^m50^s$ UT, Wolfgang Hinz recorded an unusual double meteor (Figure 1). It's not unusual because two meteors appeared by chance at the same instant, but because they appeared in parallel and exactly at the same time. In the course of the years I have seen hundreds of thousand video meteor from the camera network, but this one is unique. I was still thinking about a 'terrestrial' explanation for this event (one camera, for example, recorded reflections for some time, that looked remarkably similar - but they appeared for all bright meteors) when I received a message that Wolfgang had recorded another double meteor of the same type on March 9, $23^h35^m44^s$ UT (Figure 3).

What a strange coincidence, but after a longer inspection of the recording birds, insects and other artefacts could be ruled out. Then I remembered that the fields of view of AKM2 and MINCAM1 overlap partly. Indeed I found that at least the first meteor was recorded by both cameras (Figure 2). However, the recording of Mincam1 showed only one meteor. Only at higher magnification it became clear that this meteor was 'split'. In fact, both meteors were recorded by MINCAM1, but they were not as clearly separated because of the lower scale and maybe also because of the different geometry.

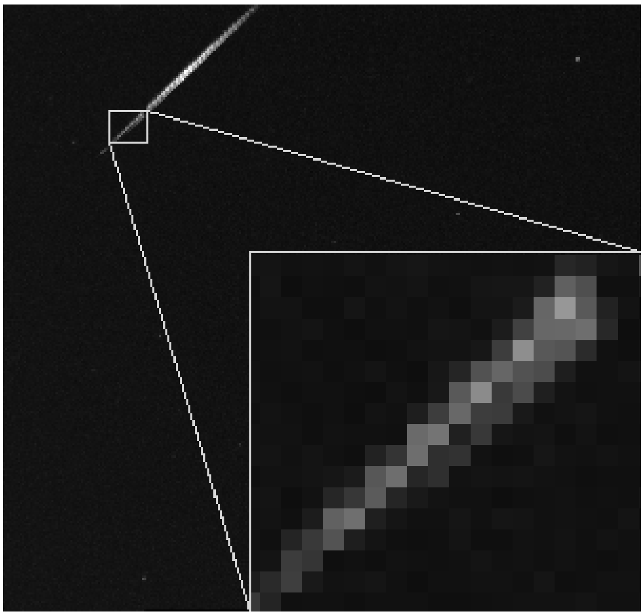

Figure 2 – The same meteor as Figure 1 was captured by Sirko Molau from Seysdorf with MINCAM1 (bottom). Here only one meteor is visible on the first glimpse, but the second one becomes visible at high magnification.

That proves the reality of these events: Wolfgang Hinz recorded indeed two double meteors within just three days and I have no explanation for this 'double first prize'.

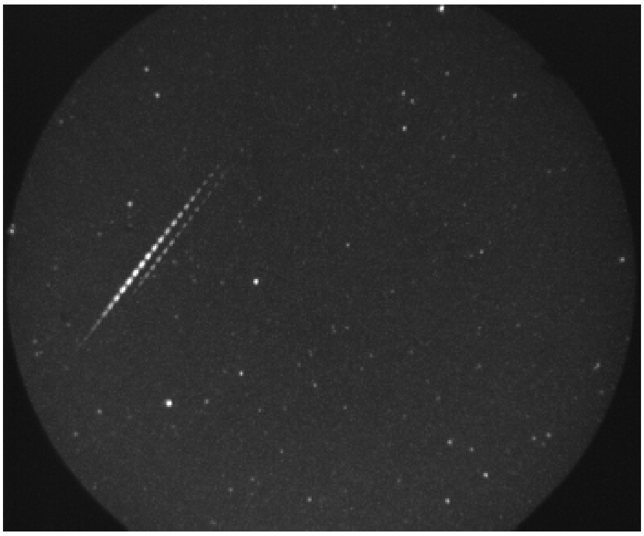

Figure 3 – Already on March 9, 2008, Wolfgang Hinz recorded another double meteor.

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NASA-ADS bibcode 2008JIMO...36...63M

Table 1 – Observers contributing to March 2008 data of the IMO Video Meteor Network.

Code	Name	Place	Camera	FOV	LM	Nights	Time (h)	Meteors
BRIBE	Brinkmann	Herne	HERMINE (0.8/6)	⊘ 55°	3 mag	19	31.4	79
CASFL	Castellani	Monte Baldo	BMH1 (0.8/6)	⊘ 55°	3 mag	18	76.6	112
			BMH2 (0.8/6)	⊘ 55°	3 mag	20	116.8	130
CRIST	Crivello	Valbrevenna	STG38 (0.8/3.8)	⊘ 80°	3 mag	1	7.7	16
GONRU	Goncalves	Tomar	TEMPLAR1 (0.8/3.8)	⊘ 80°	3 mag	9	63.8	97
HERCA	Hergenrother	Tucson	SALSA (1.2/4)	⊘ 80°	3 mag	25	211.8	232
HINWO	Hinz	Brannenburg	AKM2 (0.85/25)	⊘ 32°	6 mag	8	58.3	111
KACJA	Kac	Kostanjevec	METKA (0.8/8)	⊘ 42°	4 mag	13	88.6	150
		Kamnik	REZIKA (0.8/6)	⊘ 55°	3 mag	13	57.2	95
		Ljubljana	ORION1 (0.8/8)	⊘ 42°	4 mag	5	31.1	44
KOSDE	Koschny	Noordwijker-hout	ICC4 (0.85/25)	⊘ 25°	5 mag	3	14.6	19
LUNRO	Lunsford	Chula Vista	BOCAM (1.4/50)	⊘ 60°	6 mag	16	122.7	331
MOLSI	Molau	Seysdorf	AVIS2 (1.4/50)	⊘ 60°	6 mag	11	57.5	385
			MINCAM1 (0.8/6)	⊘ 55°	3 mag	22	70.3	181
PRZDA	Przewozny	Berlin	ARMEFA (0.8/6)	⊘ 55°	3 mag	13	66.8	180
ROBBI	Roberto	Verona	FIAMENE (0.8/3.8)	⊘ 80°	3 mag	13	63.4	102
SLAST	Slavec	Ljubljana	KAYAK1 (1.8/28)	⊘ 50°	4 mag	12	48.2	72
STOEN	Stomeo	Scorze	MIN38 (0.8/3.8)	⊘ 80°	3 mag	12	77.2	146
STORO	Stork	Ondrejov	OND1 (1.4/50)	⊘ 55°	6 mag	1	3.5	45
STRJO	Strunk	Herford	MINCAM2 (0.8/6)	⊘ 55°	3 mag	14	20.4	36
			MINCAM3 (0.8/8)	⊘ 42°	4 mag	5	12.5	23
			MINCAM5 (0.8/6)	⊘ 55°	3 mag	7	23.8	48
WEBMI	Weber	Chouzava	TOMIL (1.4/50)	⊘ 50°	6 mag	1	2.5	23
YRJIL	Yrjola	Kuusankoski	FINEXCAM (0.8/6)	⊘ 55°	3 mag	9	61.3	106
					Overall	31	1388.0	2763

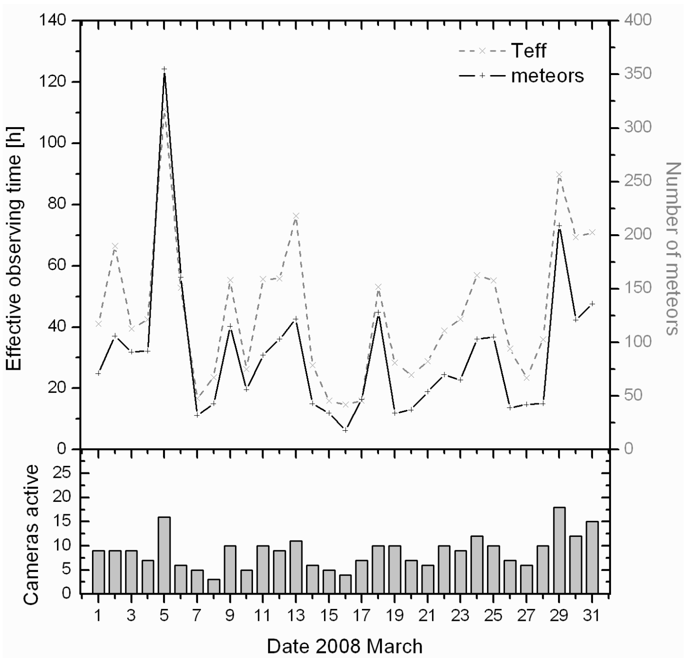


Figure 4 – Monthly summary for the effective observing time (solid black line), number of meteors (dashed gray line) and number of cameras active (bars) in March 2008.

Results of the IMO Video Meteor Network — April 2008

Sirko Molau [1]

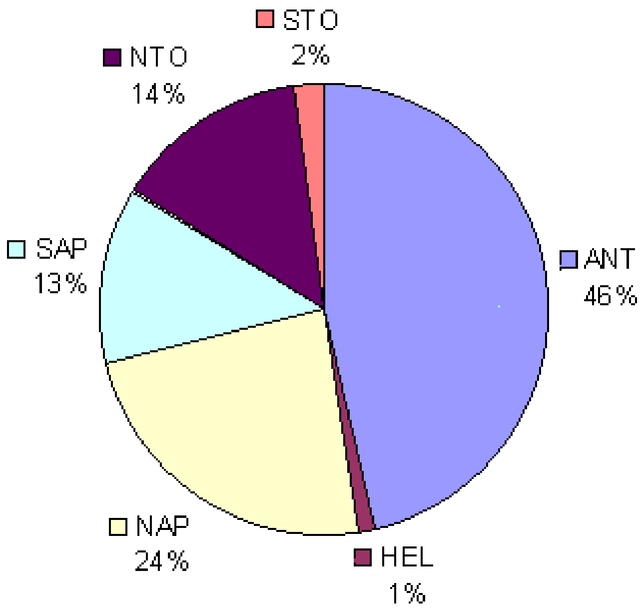
With nearly 1500 hours of effective observing time and more than 3000 meteors, April 2008 could not keep up with the record-breaking April before. However, there were major differences between the individual observing sites. Once more, Carl Hergenrother was on top of the list — he missed only a single night at his Arizona observing site. Observers in northern and western Germany managed to collect twenty and more observing nights as well, but farther south the weather was only mediocre.

'Highlight' of the month with respect to meteors were once more the Lyrids. Their maximum, however, coincided with full moon, so that no spectacular display was to be expected. This is also reflected by the meteor number, which was only slightly higher on April 22 than on other nights. Overall, the activity remained low with an average of two meteor records per hours.

If nothing happens in the sky, then it is time to put some effort into the data analysis. Together with Pete Gural, I analyzed the sporadic meteors in the IMO Video Meteor Database with its nearly 330 000 records. The results were presented a few days ago at the 'Meteoroid and Meteor Observations as a Basis for Models' conference in Huntsville, Alabama. Here I would like to present a few facts and figures from our presentation.

During the analysis, meteors were first assigned to the known meteor showers (based on the IMO Working List). For the remaining meteors it was checked, whether they belong to one of the six known sporadic sources (Helion, Antihelion, N/S Apex , N/S Toroidal — the base data of which were taken from the work of Margaret Campbell-Brown), or whether they were 'true' sporadics. In the end it turned out that about one quarter of all meteors are shower meteors (most of all Perseids, Orionids and Geminds). Another 15% could be assigned to the sporadic sources, and more than half of all meteors (60%) are true sporadics. Among the sporadic sources, about half of the meteors belong to the Antihelion source, and about one quarter to the N Apex source. The remaining meteors are S Apex and N Toroidal meteors in equal frequency (Figure 1). The strength of the northern sporadic branches can be explained easily when considering that 95% of all meteors in the database were recorded in the northern hemisphere. When the meteor frequencies are corrected for the observing geometry it turnes out that the northern and southern branches of the Apex and Toroidal source are about equally strong.

Looking at the annual distribution of meteors (normalized to the overall number of sporadic meteors in that particular solar longitude interval) we see some variation in the activity profile of the N Apex source.



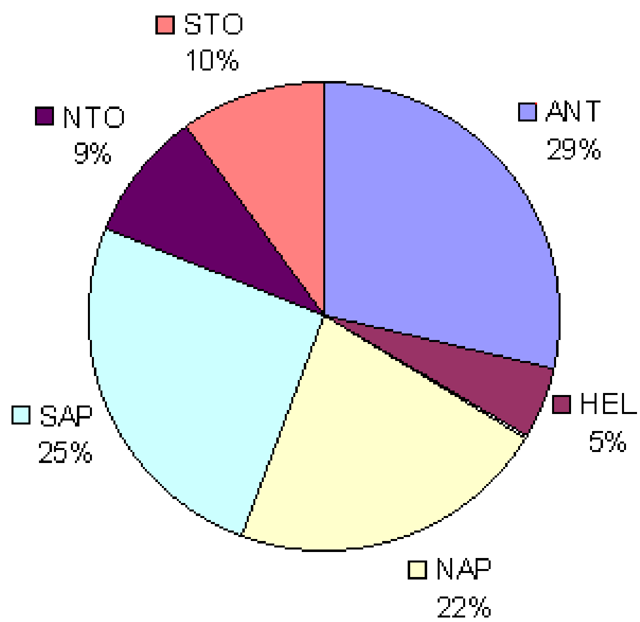


Figure 1 – Relative frequency of the individual sporadic sources in the IMO Video Meteor Database (top — uncorrected; bottom — corrected for observing geometry)

Once more, if the observing geometry (i.e. the observability of a particular source in the course of the year) is accounted for, all sources show at the first approximation a roughly constant activity, and also the percentage of the sporadic sources among all sporadics varies only a little.

It is more tricky to get an estimate of the absolute sporadic activity in the course of the year, as the particular observing conditions of each observation (limiting magnitude, size of field of view) are unknown. The effective observing time per night is also not part of the positional database PosDat. So we normalized the number of sporadics with the overall effective observing time per month (in the hope that the observing conditions

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NASA-ADS bibcode 2008JIMO...36...65M

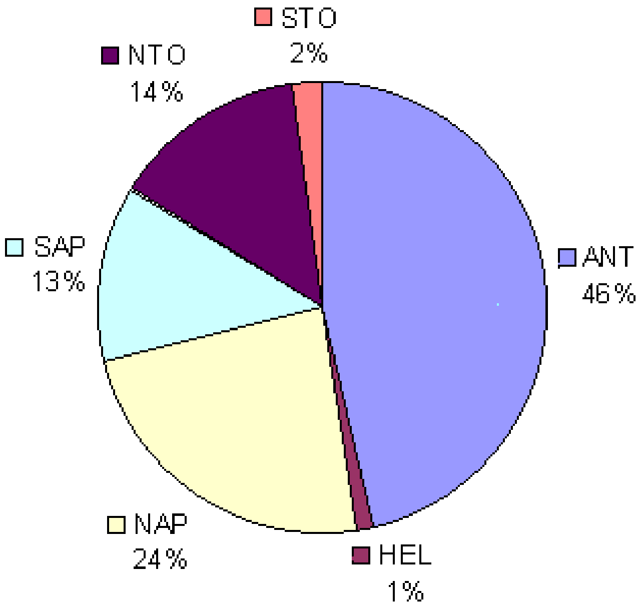

Figure 2 – Annual variation of the average number of sporadic meteors per hour (red — original values; yellow — Sine fit)

are about the same when averaged over many years) and obtained a roughly sinusoidal activity graph with a minimum of more than two sporadics per hour in mid-March and a maximum of more than four sporadics per hour in mid-September (Figure 2).

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Early meteorite spectra

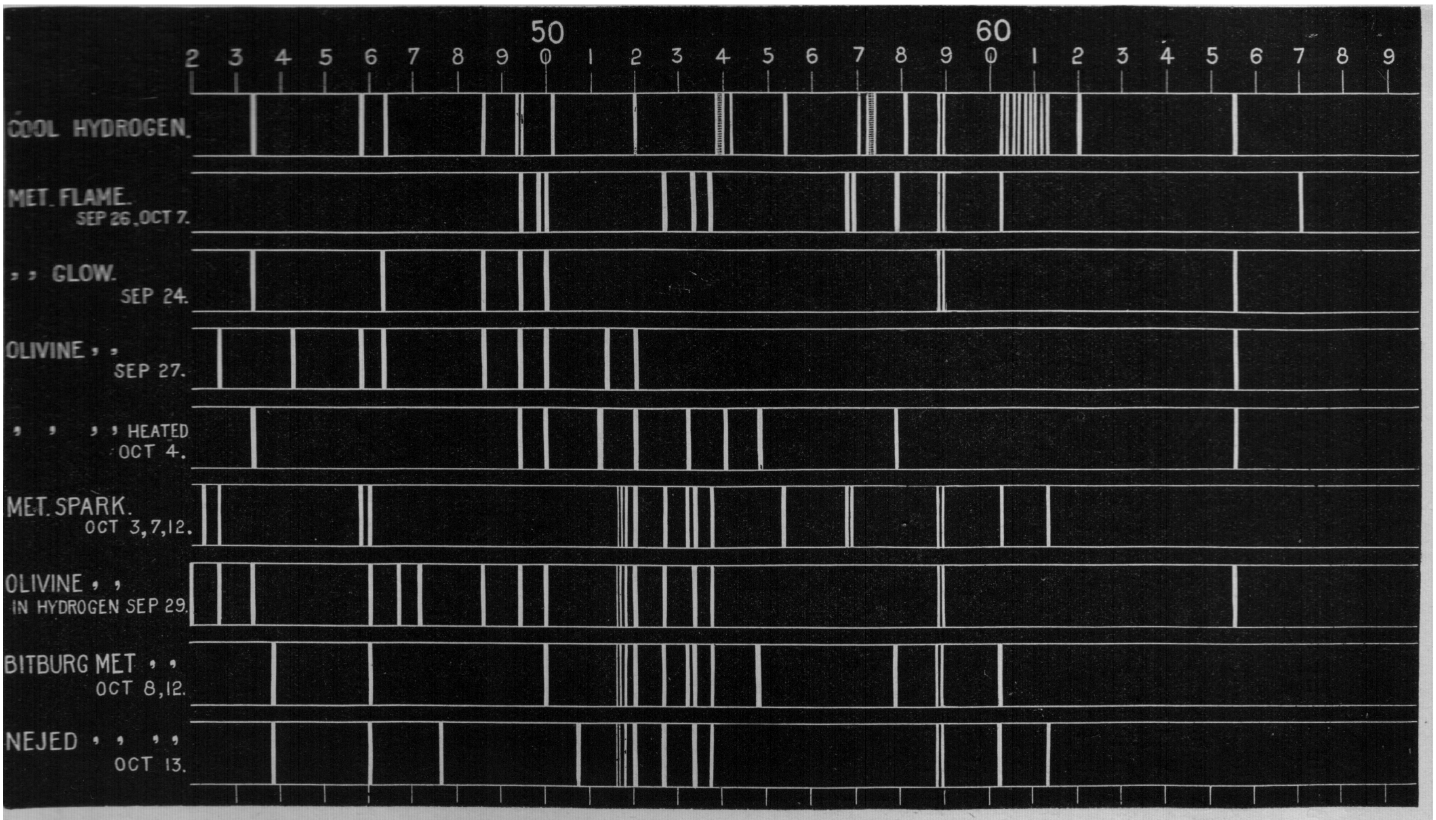

Fig. 11.—Spectra of Olivine and Meteorites under various Conditions.

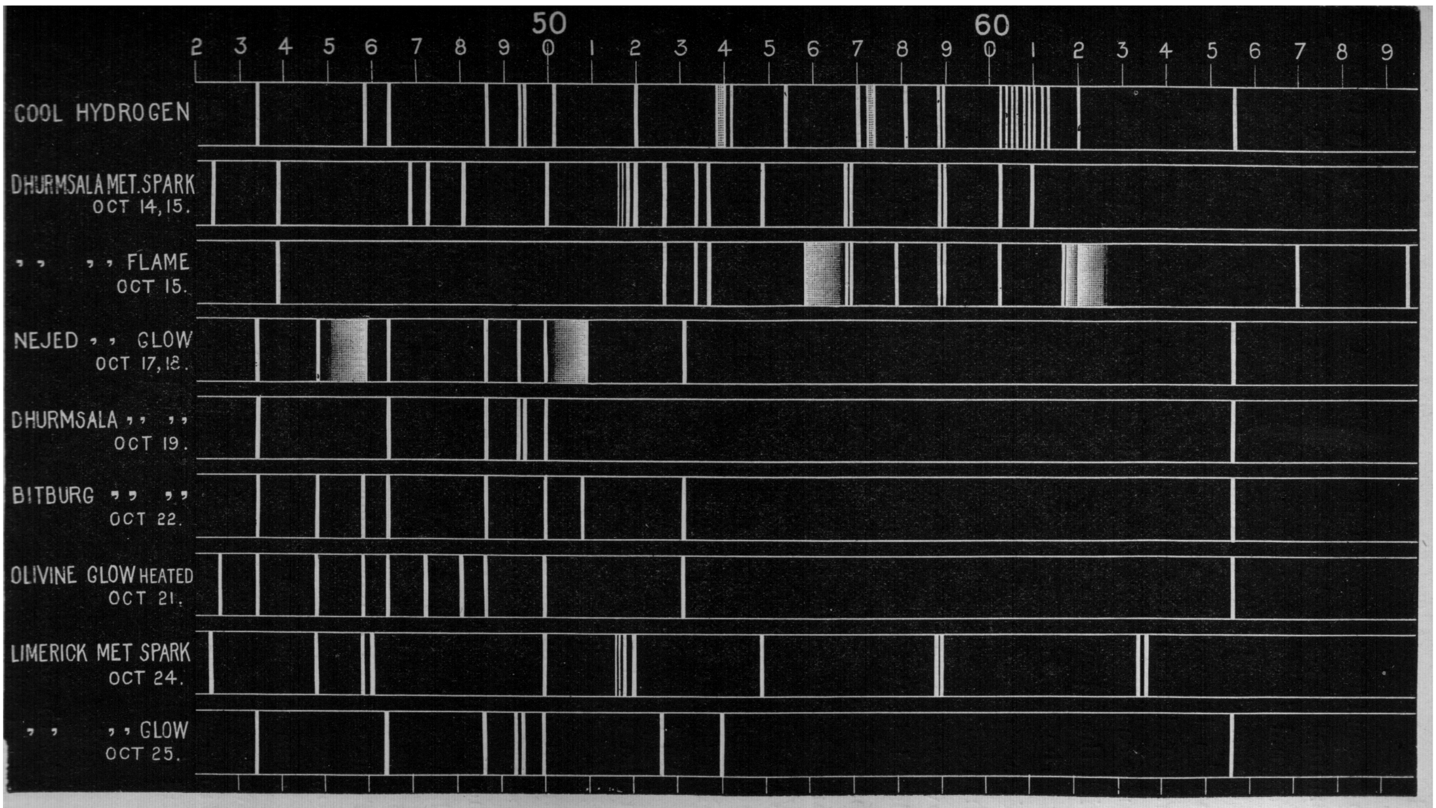

Fig. 12.—Spectra of Olivine and Meteorites under various Conditions.

Before meteor spectra were obtained, some workers heated fragments of meteorites to obtain spectra and compared them with those of known substances.
J. Norman Lockyer (1836–1920, better known for founding the journal *Nature*) published these spectra in *The Meteoritic Hypothesis*, MacMillan, London, 1890, pp. 56–57.