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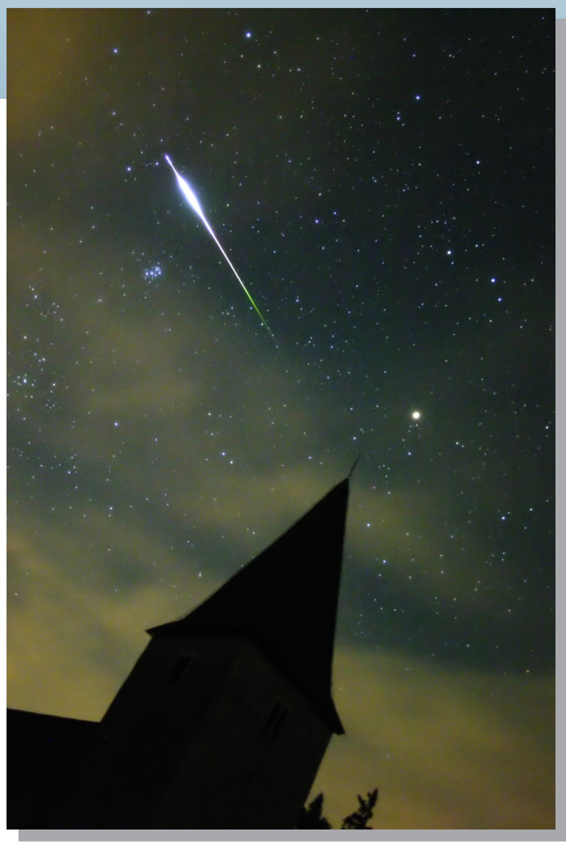

Lyrids
Conference
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Shower names

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Front cover photo

A −7th magnitude meteor in Taurus/Perseus caught with a Canon 300D digital camera on 2005 August 11 at $01^h57^m50^s$ UT. Photo by Simon Krulec and Peter Atanackov.

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` .

Cover design Rainer Arlt

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Editorial — The people behind the pages

Chris Trayner

When we buy a ticket from a machine we put in some money, press some buttons, and a ticket appears — it's a simple as that. Certainly WGN readers will realise that there is more to producing IMO publications than that, but they might be interested to know just who is involved.

WGN has grown a lot since the early days of a small-circulation newsletter. For much of its early history it was produced single-handed by Paul Roggemans. Then it went international, IMCs were organised and the IMO was formed. More recently, the RMS (Radio Meteor School) has appeared, and may become a regular event.

At the same time the available technology has changed, and changed the way people work. With desk-top publishing, individuals and small groups can produce a standard of publication that would have required expensive professional work in the past. The internet has also changed the way we organise ourselves — the global village has been here for some time now. This is especially true for minority interests like meteor observation: there are too few enthusiasts in any one country to run such an organisation, but across there world there are enough.

The IMO team

So who produces WGN? Most obviously, the authors. I edit it, but I am assisted by a sizeable team. Rainer Arlt, Javor Kac, Jürgen Rendtel, Paul Roggemans and Mihaela Triglav-Čekada help with editing, checking for scientific correctness and proofreading. They know far more about meteor science than I do, and are essential to maintaining the standard of WGN. Most recently, Wayne T. Hally from the USA is joining us to help with proofreading the English.

Over the four years I have been editing, a software system called ImoLatE (IMO LaTeX Environment) has been developed, and is now used for IMC and RMS proceedings as well.

When I have finished editing WGN in England, it goes over the internet to Rainer Arlt in Potsdam. He handles the printing.

When it is printed, it is put in envelopes by Ina Rendtel, Rainer Arlt and Roland Winkler. But this could not happen without an up-to-date list of subscribers, and this comes from Marc Gyssens, our Treasurer.

Conferences

The IMC and RMS are organised by a different group of people each year, so it is impractical to name them all. Those who have been to an IMC will have no doubt about the debt of gratitude we owe them, though.

When each IMC or RMS finishes most people can relax, but for the editors of the Proceedings the work has only just begun. Producing a volume of Proceedings is an enormous amount of work, equivalent to several issues of WGN. It is also done by people who are new to the job, and will take time to 'learn the ropes', to use an expression from the days of sailing ships.

The Web and DVDs

The IMO website has also changed radically over the last few years. In the past it was just a collection of pages to read — none the less valuable for that, though. Now it has grown to include online mechanism for renewing subscription and paying for IMC, RMS and back issues. This has largely been the brainchild of Luc Bastiaens, a very enthusiastic and capable webmaster, though I have no doubt that there are others assisting him.

The publication of back issues on DVD is the most recent innovation. This project has been driven by Cis Verbeeck and Luc Bastiaens, though again there were others who helped as well.

Finally, we are making our back issues available to NASA ADS, the Astrophysical Data System run by the US space agency. This makes them available freely to anyone. The lists of authors, titles, abstracts and so on go to ADS within a week or so of publication; again, Mihaela Triglav-Čekada handles this. We are also grateful to NASA ADS, and to Caroline Stern Grant of ADS who handles our input. ADS get the full WGN (as PDFs) annually between one and two years after publication, so the 2006 issues will be available at the end of 2007.

So the IMO produces far more than it did even ten years ago. There are many people behind each page you read, whether it is a paper or a web page. 'Many hands make light work', but there is always more work that we would like to do. If you want to get involved in any way, you only have to email us — you will get a friendly reception.

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Letter — Naming Names

Alastair McBeath [1]

When I read in WGN **34:5** (2006 October, p.127) the proposal that we should revert to using the '-iid' suffix for showers with radiants in constellations like Sagittarius, I, perhaps naïvely, assumed it was just one of those slightly silly academic kite-flying exercises that no one ever takes very seriously. It was thus with considerable surprise I found such nomenclature had been used in the 2008 IMO Meteor Shower Calendar, enclosed with WGN **35:3** (2007 June), without any discussion between IMO officers, such that even after I had prepared and submitted the final Calendar text for publication, nobody mentioned to me that we might be doing so!

We discussed the problem in detail some years ago, when the IMO was founded, because of the considerable confusion that existed among observers then as to how to pronounce, and even spell, some of the shower names, due to the odd occurrence of the '-iids' ending ('Perseiids' for example, which I have come across). Latin is after all a language long dead and scarcely taught these days, unlike English which is very much alive and constantly changing. The conclusion of those discussions was that it was more reasonable to apply Occam's Razor and common sense, and standardize on only using the '-ids' suffix. Thus the various Aquarids (as they had always been called, a delicious anomaly!) were fine already, but 'Sagittariids' became Sagittarids, etc., as we have used in the Shower Calendar throughout its existence prior to 2008, and also in the IMO's Handbooks and website. Doubtless a few Latin 'purists' shed a tear or two and consoled themselves with a quiet drink in a darkened room briefly, but life was suddenly a lot easier for the majority of us, no longer wasting considerable time and effort over such a trivial stumbling block to making meteor astronomy more publicly accessible.

The problem arises because in English, the double-i does not occur ordinarily, thus its pronunciation and usage is a mystery. Hence 'Aquariids' might end up pronounced more as something we might find in a marsh — 'Aqua-reeds' — or 'Aqua-rI-ids', or 'Aquaree-Ids', or 'Aqua-ri-ids', or 'Aqua-rIds' (where 'I' is pronounced as the personal pronoun, and 'i' the short form from 'its'), or worse still called just 'the Aquarius meteors'. Only occasionally might someone chance onto the nearer approximation of 'Aquaree-ids'. Exaggeration, or a joke? Sadly not. The above are simply a few examples I encountered with the old 'Sagittariids' pronunciation before we simplified the name. If we wish to use such a double vowel not as a diphthong or as something incomprehensible, we can use a diacritic (as in 'naïve' above, or 'Boötes', for instance). So in English, we should spell shower names where the double-i is insisted upon as 'Aquariïds' instead. That should confuse everyone nicely again.[2]

It matters little what we call things as long as we all understand what is meant, but there seems little point to me in making common names for things more complicated than we need. Who cares that 'fridge' is an amended contraction of 'refrigerator', from the Latin 're-', 'again, back', and 'frigerare', 'to make cool', as long as it keeps the food and drink cold and fresh? Consequently, I suggest a simple reapplication of Occam's Razor and common sense by those of us not sequestered in the ivory towers of académe, to let us return to the simpler 'Aquarids', 'Sagittarids', etc., in future when we wish to describe those meteor showers. Comments anyone?

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[2] Especially any German readers who might try to work out what an i-Umlaut would sound like! –*Ed.*

Letter — A Virtual Meteor Observatory

Geert Barentsen, [1,4]*, Jonathan McAuliffe* [2,4] *and Detlef Koschny* [3,4]

A recent trend in astronomy is the creation of so-called Virtual Observatories, which are initiatives aimed at providing improved access to astronomical data and computing resources. For example, it has become possible to query a specific part of the sky for observations from different surveys, allowing one to seamlessly combine data from multiple instruments and wavelengths. (For example, one may try the query interfaces at (USNVO, 2007).)

Various projects have been funded to make Virtual Observatories available for different communities. These projects include the European Virtual Observatory (EURO-VO, 2007), the Virtual Solar Observatory (VSO, 2005), the Virtual Solar-Terrestrial Observatory (VSTO, 2007), the Virtual Magnetospheric Observatory (VMO, 2007), the Virtual Space Physics Observatory (VSPO, 2007), the ESA Virtual Observatory (ESA-VO, 2007) and many others. One may visit their websites to see the concept of a Virtual Observatory demonstrated. The projects generally use technical standards that have been put forward by the International Virtual Observatory Alliance (IVOA) (IVOA, 2007).

A recent discussion in the Meteor Orbit Determination Working Group (MODWG) (MODWG, 2007) on the naming of an online database for video observations (Koschny & McAuliffe, 2007) has led to the idea for a Virtual Meteor Observatory. The Virtual Meteor Observatory (VMO) would be a central informatics platform for the meteor science community, providing online access to data resources from different institutions and groups. The VMO would make it easier to combine data from different observing projects, allowing new research and more comprehensive analyses to be performed.

The VMO is similar to the earlier concept of a Unified Meteor Database (Barentsen, 2007), but will use Virtual Observatory standards to increase the visibility and recognition for meteor data in the astronomical community. The development of the VMO may also be an opportunity to obtain funding for a long-term collaborative effort in the meteor science community.

A first version of the VMO was started to be developed by the first author as part of the Meteor Research Group of the European Space Agency. It will focus in particular on storing meteor orbits determined by video observations, including an update of the video meteor database.

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Conferences

Report of the 2007 Radio Meteor School

Jean-Marc Wislez [1]

An account of the 2007 Radio Meteor School is given.

Received 2007 July 5

The 2007 IMC in Bareges saw a new edition of the Radio Meteor School. The concept was different, however: instead of a school, it was more of a workshop or a progress meeting: no core lecturer like Oleg or Svetlana, and the meeting was much shorter. Also the audience was more inclined towards practice than theory. Even though it was different, there were several very interesting lectures and exchanges!

Many familiar faces were missing, all for good reasons, but we welcomed again a group of 11 people, almost exactly the number predicted by Antonio (Martinez Picar, 2007). The 2007 RMS team included Galina Ryabova from Russia, Masa-Yuki Yamamoto and Kazuka Noguchi from Japan, Jean-Louis Rault and Jérémie Vaubaillon from France, Danielle Moser from the USA, Marc Neijts, Frans De Keizer and Frans Lowiessen from the Netherlands, and finally Stijn Calders and Jean-Marc Wislez from Belgium.

We started Wednesday afternoon with an introduction to radio meteor observing by the spectrogram method, presented by Jean-Louis. This was very welcome, as several people in the audience were new to radio meteors or to spectrogram observations. It was also a good refresher, and a starting point for a few discussions.

This talk was followed by a theoretical presentation by Galina. Referring to Oleg's theory as described in the Proceedings of the Radio Meteor School 2005 and building on an old and forgotten Russian paper, she proposed an alternative method for calculating the minimal detectable line density α_0 for backscatter, which is an essential parameter in the characterization of the radar sensitivity. The presented method follows a numerical approach rather than an analytical one, and can thus easily be used with the latest numerical atmospheric and ablation models, rather than with more approximate analytical or empirical models. This presentation will result in a paper: 'one more method to determine radar sensitivity'. In general she proposed to use the meteor data processing method as presented in the RMS 2005 proceedings, but to try to get rid of the empirical formulas it includes, and make advantage of the huge processing power of modern computers to go for a fully numerical approach using recent atmospheric and ablation models.

On Thursday morning, Masa-Yuki and Kazuka presented recent achievements at the Kochi University of Technology. First, Kazuka talked to us about the Meteor Echo Counter v1.0 program he wrote to automatically count echoes on HROFFT images, and generate corresponding activity graphs. The software is highly tunable, and showed good results. Several suggestions were welcomed to further improve its functionality (e.g. providing an output table with one line per meteor echo, or providing correction for the masking effect by long echoes), and an English translation of the main labels was promised. The software was distributed to the participants, and was immediately tested on Marc's data. It should also be compared with HROFFT2RMOB and Spectrogramme.

Figure 1 – L'Hospitalet, where both RMS and IMC were held. Photo: Casper ter Kuile.

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The second lecture was about the HRO interferometer project, and was an extended and updated version of the excellent presentation that Masa-Yuki gave at the 2006 IMC in the Netherlands. Basically the Kochi University of Technology has developed and is operating a fully functional radio meteor interferometer. This is a major step towards getting much more precise meteor shower data. Many discussions were triggered on the technical details and on the possibility of duplicating this achievement in Europe. Another Japanese project was mentioned with a series of synchronized receiver stations at only a few kilometers distance from each other. Also this is a major step, this time to acquire data on individual meteors. Personally, I was very excited about these two projects, as the combination of the both approaches would result in my dream set-up, as I described in an unpublished paper in 1996, and published in the RMS 2005 Proceedings (Wislez, 2006). In the latter paper, I explain that this approach allows the determination of a lot of meteor parameters we really want to know for doing science.

The school ended with a short explanation on a suggested approach for getting both the spectrogram and a decent power profile from a given meteor, in order to have maximal information on an observed meteor reflection. This resulted in a series of tests conducted with Spectrum Laboratory by Stijn Calders throughout the rest of our stay at Bareges. During both the RMS and the IMC, the portable receiver set-up of Jean-Louis was intensively used for tests and to support discussions.

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Figure 2 – Delegates to the RMS. Left: Jérémie Vaubaillon (photo: Casper ter Kuile). Right: Galina Ryabova (photo: Jérémie Vaubaillon).

Lyrids

The Lyrid meteor shower in 2006 and 2007

Jürgen Rendtel [1] *and Rainer Arlt* [2]

Visual meteor observations during the 2007 Lyrids are analysed. A peak ZHR of 20.4 ± 1.1 and occurred at $\lambda_\odot = 32\overset{\circ}{.}31 \pm 0\overset{\circ}{.}05$ (corresponding to 2007 April 22, $22^{\rm h}20^{\rm m}$ UT), quite similar to other recent returns. Since there were some expectations for enhanced rates in 2006 due to the 1-revolution dust trail of comet C 1861/G1 (Thatcher), this data was re-analysed. No significant activity increase was found.

Received 2007 August 23

1 Introduction

The Lyrids are related with comet C 1861/G1 (Thatcher). Details of early observations and outbursts is given by Arter & Williams (1995), Rendtel, Arlt & McBeath (1995) and Arter & Williams (1997). The shower recurs annually with a relatively constant activity. The radiant reaches sufficient elevation for useful observations already before local midnight in northern latitudes, and the activity can be monitored for about five hours per night at best. Average ZHRs are of the order of 15 to 20. The typical duration of a peak is about six hours (FWHM) and can thus be observed mainly by observers from a limited geographical longitude range. The annual peaks do not occur at a fixed solar longitudes but vary considerably in time (Table 1).

There are indications that the annual Lyrid activity be modulated by a 12-year outburst cycle (cf. Jenniskens, 1995, and references therein). At such times ZHRs well above 100 can be observed (see Table 1). The most recent documented Lyrid outburst occurred in 1982 (Adams, 1982; Spalding, 1982; Porubčan & Cevolani, 1985). While enhancements in some years seem to be driven by Jovian perturbations (Arter & Williams, 2002), neither the 1994 return (Dubietis & Arlt, 2000) nor the 2006 return (see Section 5 of this paper) of the Lyrids showed enhanced rates.

Table 1 – The table summarizes visual outburst data listed in (Arter & Williams, 1995), 1988–2000 data from Table 2 in (Dubietis & Arlt, 2000), 2003 data from (Dubietis & Arlt, 2003) and the recent 2006 and 2007 results calculated in this work. All solar longitudes refer to J2000.

Year	$\lambda_\odot$	ZHR
1803	32°05	670
1922	31°994	360–600
1922	32°006	180
1934	32°07	56–80
1945	31°943	100
1946	31°966	110
1946	31°970	80
1982	32°076	253
1988	32°3	21
1993	32°35	23
1994	32°1	17
1995	32°45	14
1996	32°4	18
1998	32°4	18
1999	32°15	21
2000	32°05	16
2003	32°32	19
2006	32°28	20
2007	32°31	20

2 Observational data in 2007

The astronomical conditions were almost perfect in 2007 with the first-quarter Moon on April 24. So the favourable part of the night with high radiant positions remained undisturbed. The input possibility on the IMO webpage with an on-the-fly graph obviously stimulated observers to provide their data soon after the observation.

The sample included in this paper was collected by 64 visual observers from 18 countries worldwide. It contains data of 1757 Lyrids observed in 308.52 hours effective observing time. The following observers contributed to the 2007 Lyrid analysis (five-letter code of the VMDB, effective observing time, and number of Lyrids):

Salvador Aguirre (AGUSJ, 1ʰ00, 8), Rainer Arlt (ARLRA, 3ʰ11, 36), Pierre Bader (BADPI, 11ʰ45, 118), Ricardas Balciunas (BALRJ, 3ʰ00, 32), Ana Bankovic (BANAN, 5ʰ32, 32), Ivana Belic (BELIJ, 5ʰ07, 66), Felix Bettonvil (BETFE, 1ʰ78, 8), Jean-Marie Biets (BIEJE, 2ʰ48, 16), Andreas Buchmann (BUCAN, 6ʰ12, 44), Ionut Costache (COSIJ, 2ʰ68, 80), Tibor Csórgei (CSOTJ, 0ʰ50, 10), Ivana Cvijovic (CVIIJ, 3ʰ60, 84), Nenad Davidovic (DAVNJ, 7ʰ40, 82), Dariusz Dorosz (DORDA, 6ʰ50, 64), Gunther Fleerackers (FLEGJ, 2ʰ33, 22), Stela Frencheva (FREST, 4ʰ09, 54), George W. Gliba (GLIGE, 3ʰ00, 46), Mitja Govedic (GOVMI, 8ʰ95, 178), Robin Gray (GRARO, 1ʰ03, 0), Pavol Habuda (HABPA, 2ʰ33, 36), Wayne T. Hally (HALWA, 8ʰ70, 70), Joost Hartman (HARJS, 2ʰ07, 8), Roberto Haver (HAVRO, 4ʰ18, 84), Visnja Jankov (JANVI, 6ʰ00, 24), Carl Johannink (JOHCA, 2ʰ63, 24), Jay Kansara (KANJJ, 3ʰ43, 18), Roy Keeris (KEERJ, 2ʰ91, 20), André Knöfel (KNOAN, 8ʰ76, 84), Sandra Lakicevic (LAKSJ, 10ʰ40, 142), Alister Ling (LINAJ, 1ʰ72, 12), Paul Martsching (MARPA, 8ʰ00, 24), Pierre

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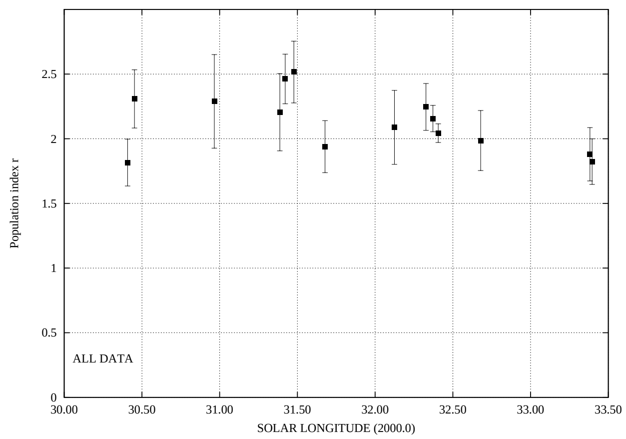

Figure 1 – Profile of the population index r of the 2007 Lyrids, based on all available magnitude data.

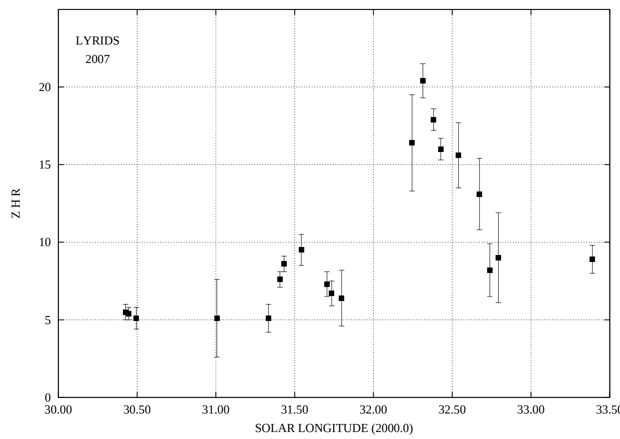

Figure 2 – ZHR-profile of the 2007 Lyrids based on all data with lm ≥ 5.5 and the radiant at least 20 degrees above the horizon and a maximum correction factor of $C = 5.0$

Martin (MARPI, $2^{\rm h}.15$, 40), Stefan Martinka (MARST, $10^{\rm h}.59$, 128), Alastair McBeath (MCBAL, $3^{\rm h}.75$, 60), Bruce McCurdy (MCCBR, $4^{\rm h}.83$, 42), Ana Milovanovic (MILAJ, $4^{\rm h}.00$, 34), Milka Miletic (MILMI, $7^{\rm h}.32$, 86), Koen Miskotte (MISKO, $7^{\rm h}.45$, 110), Sabine Wächter (MORSA, $1^{\rm h}.25$, 6), Sven Näther (NATSV, $7^{\rm h}.25$, 46), Martin Nedved (NEDMA, $4^{\rm h}.28$, 76), Markku Nissinen (NISMA, $1^{\rm h}.32$, 22), Danica Pajovic (PAJDJ, $5^{\rm h}.33$, 102), Dusan Pavlovic (PAVDJ, $8^{\rm h}.50$, 94), Swapnil Pawar (PAWSJ, $2^{\rm h}.95$, 12), Mila Popović (POPMI, $10^{\rm h}.08$, 110), Jatin Rathod (RATJJ, $3^{\rm h}.46$, 10), Jürgen Rendtel (RENJU, $20^{\rm h}.84$, 202), Branislav Savic (SAVBR, $8^{\rm h}.35$, 118), Mila Savic (SAVMJ, $5^{\rm h}.30$, 38), Ulrich Sperberg (SPEUL, $4^{\rm h}.29$, 26), Wesley Stone (STOWE, $2^{\rm h}.00$, 30), Marija Todorovic (TODMJ, $4^{\rm h}.00$, 52), David Vansteenlant (VANDJ, $2^{\rm h}.05$, 32), Michel Vandeputte (VANMC, $12^{\rm h}.25$, 254), Jovan Vasiljevic (VASIJ, $2^{\rm h}.33$, 36), Jovan Vasiljevic (VASJJ, $2^{\rm h}.33$, 10), Jan Verfl (VERJX, $3^{\rm h}.26$, 48), Nemanja Vojvodic (VOJNJ, $5^{\rm h}.92$, 32), Frank Wächter (WACFR, $1^{\rm h}.25$, 8), William Watson (WATWI, $2^{\rm h}.50$, 10), Thomas Weiland (WEITH, $4^{\rm h}.50$, 82), Roland Winkler (WINRO, $2^{\rm h}.14$, 6), Kim S. Youmans (YOUKI, $3^{\rm h}.00$, 34),

3 Population index profile in 2007

On most occasions observers describe the Lyrids as a shower with mainly faint meteors. This is obvious from recent analyses: Dubietis & Arlt (Figure 10 therein) find an average population index of $r = 2.1 \pm 0.08$ for the near-maximum period between 31° and 33° and a value of $r = 1.95 \pm 0.07$ for the immediate peak period close to $\lambda_\odot = 32^\circ\!.2$. This corresponds to the fact that we find a considerable portion of bright meteors during the peak period. However, fireballs are a rare exception (Beech & Nikolova, 1999).

In 2007 we had 162 magnitude distributions available for the analysis. The method used for the calculation of the population index r was described by Arlt (2003). Due to the smaller sample as compared with the Leonids or other major showers, the individual bins were constructed so as to contain 50 Lyrids each. This caused larger errors, but we were interested in possible short minima of the population index r close to the activity maximum. The result is shown in Figure 1.

Alternatively, we checked whether magnitude data obtained under poor conditions yielded systematic deviations in the profile. Therefore the same calculation was done for all intervals with a limiting magnitude of at least +5.8, then involving 118 magnitude distributions. The difference between the two profiles is very small. Obviously, the increase of the number of fainter meteors remains constant in the relevant interval, indicating that the procedure is relatively robust against the conditions. For the ZHR calculation we use the r-profile shown in Figure 1 which includes all magnitude data.

4 ZHR profile in 2007

For the ZHR calculation we use the r-profile derived from all available magnitude data. As mentioned in the Introduction, the coverage of the global data is not complete. Gaps occur due to the distribution of the observers' locations. In particular, data between $10^{\rm h}$ and $19^{\rm h}$ UT are missing — that is mainly the 'pacific gap'. Again, we did several calculations of the ZHR profile using different limits for the limiting magnitude to avoid over-corrections. Here we present a ZHR-profile for the entire period which is covered by observations (Figure 2). It is based on the r-profile described in the previous section (Figure 1). The ZHR profile shown in Figure 2 included 321 intervals with lm $\geq +5.5$. The maximum correction factor was set to $C = 5.0$, the radiant elevation $h_{\rm rad} \geq 20°$. Stronger criteria did not change the shape of the profile, but since some data points were omitted, the gaps became larger. We used a zenith exponent $\gamma = 1.0$ for all profiles. The recent analysis of the Orionids 2006 (Rendtel, 2007) indicates that a value of $\gamma > 1.0$ leads to overcorrections. Detailed information on the calculated values is listed in Table 2.

Applying the routine analysis to all intervals with a lm $\geq +5.8$ using the criteria listed above yields a peak ZHR of 26 ± 6.7 at $\lambda_\odot = 32^\circ\!.26$, that is 2007 April 22, $21^{\rm h}10^{\rm m}$ UT. However, the point defining the peak is based on four intervals containing only 14 Lyrids, obtained when the radiant was between 20 and 30 degrees above the horizon. Additionally, in the same intervals the sporadic rates were about two times of the average of about 8, indicating a systematic deviation.

Therefore we consider the profile shown in Figure 2 as the conclusive ZHR profile of the 2007 Lyrid return. The peak ZHR of ZHR $= 20.4 \pm 1.1$ occurred at $\lambda_\odot = 32\overset{\circ}{.}31 \pm 0\overset{\circ}{.}05$, i.e. on 2007 April 22, $22^{\rm h}20^{\rm m}$ UT. This point is composed of 57 intervals containing 330 Lyrids. As already mentioned, data is missing from the interval between $31\overset{\circ}{.}9$ and $32\overset{\circ}{.}2$, about $12^{\rm h}$ to $19^{\rm h}$ UT on April 22.

Surprisingly, we find a small maximum of the Lyrids already in the night before with a ZHR of 9.5 ± 1.0 (Figure 2). The maximum value itself at $\lambda_\odot = 31\overset{\circ}{.}54$ (2007 April 22, $03^{\rm h}20^{\rm m}$ UT) is based on 15 intervals containing 82 Lyrid meteors, and the neighbouring ZHRs support that this is not just a short statistical fluctuation. Looking into the values of the population index r, we see that this period is characterized by higher values of $r \approx 2.5$ than in the immediate peak period. Hence this portion of the stream was mainly composed of smaller meteoroids. We can exclude observational effects, because of the size of the sample, no intervals with exceptional conditions, the radiant elevation well above the chosen limits and no intersection between regions with different astronomical conditions.

5 Comparison with 2006

While the IMO's VMDB contains a nearly continuous data set of the 2007 return with only the 'Pacific gap', there are some larger gaps in the near-peak period in the 2006 data set. The 2006 return is of particular interest because it was expected that the Earth encounters the 1-revolution dust trail of comet C 1861/G1 (Thatcher) on 2006 April 22, $09^{\rm h}25^{\rm m}$ UT, i.e. $\lambda_\odot = 32\overset{\circ}{.}03$ (Lyytinen 2006). Therefore we re-analysed the 2006 data set. Unfortunately, the amount of magnitude data is not sufficient to calculate a reliable profile of the population index r for 2006. Seen the 2007 data as well as other population index data of previous returns, we assumed a constant value of $r = 2.2$ for the entire period. The respective 2006 profile is shown in Figure 3. For comparison, we show the ZHR graph of the 2007 return at the same scale and the same interval as for the 2006 return in Figure 4. Unfortunately, the expected peak period is not covered by visual data, hence we cannot draw a conclusion about any further peak.

Continuous data, which can be provided by radar and forward scatter radio observations, does not give conclusive hints at high Lyrid rates in 2006. Data of the CMOR radar in Canada (Brown, personal communication) do not show an increase of the Lyrid activity around the maximum in 2006.

6 Discussion

In 2007 the available visual data document a Lyrid return which resembled very much the average over the last decade. A small ZHR maximum $0\overset{\circ}{.}77$ before the main peak is found. The meteoroid size distribution does not vary significantly in the entire period between $30\overset{\circ}{.}4$ and $33\overset{\circ}{.}5$ as seen form the r-profile (Figure 1).

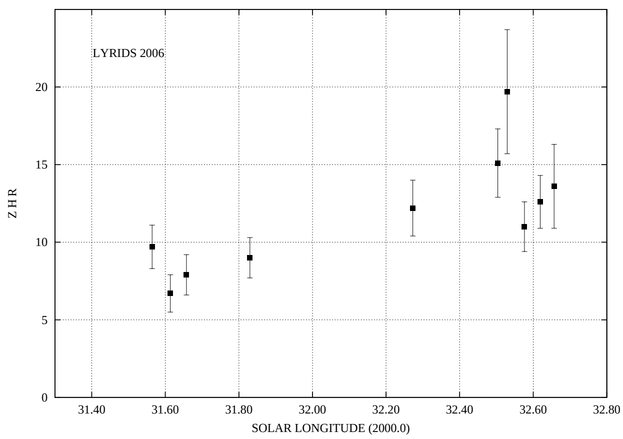

Figure 3 – ZHR-profile of the 2006 Lyrids around the maximum and the expected encounter time with the 1-revolution dust trail of comet C 1861/G1 (Thatcher) at $\lambda_\odot = 32\overset{\circ}{.}03$. Here a constant value of $r = 2.2$ was assumed.

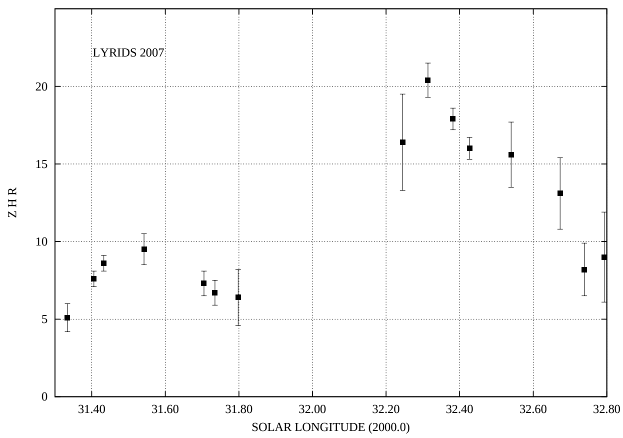

Figure 4 – Detail of the 2007 ZHR profile for the same period as shown in Figure 3 for the 2006 Lyrid return.

From the data provided by the Radio Meteor Observation Bulletin (RMOB), we calculated a tentative activity profile from the forward scatter radio data of 2007, calibrating the rate with the data of four adjacent nights around the maximum. The radio data do not show a systematic Lyrid rate increase in the period of $32\overset{\circ}{.}2$–$32\overset{\circ}{.}6$.

The 2006 visual data series has large gaps due to the uneven distribution of the observers and unfavourable weather conditions at several observing locations. Therefore, the peak ZHR cannot be calculated with the same accuracy as in 2007. Radar data showed that there was no Lyrid activity at outburst level caused by the young filament.

The data listed in Table 1 show that there was no event supporting the suspected 12-year periodicity in Lyrid outbursts. The last outburst occurred in 1982, while 1994 and 2006 yielded 'average' returns with no unusual activity. If we only consider the outbursts with rates above 200 (Table 1), this would rather support a periodicity of about 60 years, or five Jupiter revolutions. Whether the parent comet could have provided meteoroids in one region which remains in a 1:5 commensurability with Jupiter must remain speculative based on the available Lyrid data. It is interesting, however, that the next predicted Lyrid outbursts are in 2040 and 2041 (Lyytinen & Jenniskens 2003) — 58 and 59 years after the last outburst in 1982.

7 Conclusions

The 2007 Lyrid return provided us with considerable magnitude and rate data. The population index profile is rather smooth with no significant structure in the vicinity of the peak. A ZHR maximum of ZHR = 20.4 ± 1.1 was found at $\lambda_\odot = 32\overset{\circ}{.}31 \pm 0\overset{\circ}{.}05$, corresponding to 2007 April 22, $22^{\rm h}20^{\rm m}$ UT. The maximum ZHR is similar to the average over the last decade and the position is almost identical with the 1996 and 2003 Lyrids. The re-analysed 2006 data yield a maximum of ZHR = 19.7 ± 4.0 at $\lambda_\odot = 32\overset{\circ}{.}53 \pm 0\overset{\circ}{.}1$, corresponding to 2006 April 22, $21^{\rm h}40^{\rm m}$ UT. This is of comparable strength with the maximum rates found over the last decade. Visual data in 2006 do not cover the expected encounter time of the 1-revolution dust trail of C 1861/G1 (Thatcher). Other data indicate that no high-level activity occurred in 2006.

Acknowledgements:

We thank all observers sending their data to the IMO's Visual Meteor Data Base (VMDB). Without their contribution, this analysis would not have been possible.

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Table 2 – ZHR and population index for the 2007 Lyrids. Obs. gives the number of observers contributing to the average. LYR and SPO is the number of Lyrids and sporadic meteors recorded in the interval, respectively. LM is the average limiting magnitude of all included intervals and the values of r are interpolated from the detailed profile shown in Figure 1.

Date, April 2007	Observers	$\lambda_\odot$(2000.0)	LYR	ZHR	Error	SPO	LM	r	Error
15.575	2	25°114	7	2.5	0.9	26	6.30	3.08	2.37
16.521	7	26°044	19	2.6	0.6	64	6.26	2.92	1.90
17.229	7	26°741	17	2.9	0.7	48	6.23	2.70	1.59
18.719	6	28°194	17	3.2	0.8	44	6.27	2.89	1.95
19.150	7	28°618	15	2.9	0.7	40	6.19	2.86	1.88
19.571	4	29°036	3	1.7	0.9	17	6.06	2.09	1.03
21.000	38	30°426	106	5.5	0.5	231	6.07	2.02	0.20
21.025	54	30°447	152	5.4	0.4	342	6.13	2.11	0.21
21.075	17	30°495	46	5.1	0.7	114	6.22	2.31	0.24
21.592	2	31°006	2	5.1	2.5	8	6.03	2.26	0.31
21.929	14	31°334	34	5.1	0.9	65	6.38	2.22	0.31
22.001	62	31°406	235	7.6	0.5	354	6.17	2.36	0.25
22.030	58	31°433	251	8.6	0.5	356	6.15	2.41	0.24
22.142	15	31°542	82	9.5	1	92	6.30	2.31	0.22
22.312	18	31°705	92	7.3	0.8	82	6.18	1.97	0.21
22.342	15	31°735	77	6.7	0.8	64	6.19	1.96	0.21
22.406	2	31°798	12	6.4	1.8	6	6.39	1.98	0.22
22.865	10	32°245	28	16.4	3.1	17	5.84	2.18	0.22
22.933	57	32°314	330	20.4	1.1	220	5.91	2.20	0.16
23.012	111	32°382	737	17.9	0.7	497	6.04	2.11	0.11
23.052	71	32°427	470	16.0	0.7	328	6.11	2.05	0.09
23.167	11	32°540	54	15.6	2.1	38	6.05	2.02	0.14
23.304	7	32°673	32	13.1	2.3	13	6.01	1.98	0.22
23.371	4	32°739	22	8.2	1.7	24	6.44	1.98	0.23
23.425	1	32°793	9	9.0	2.9	15	6.80	1.97	0.23
23.042	20	33°390	97	8.9	0.9	172	5.81	1.85	0.20

Observational report: 2007 April Lyrids from the Netherlands

Koen Miskotte [1]

Observers of the Dutch Meteor Society and the KNVWS Meteor Section were successful in monitoring the Lyrid meteor stream in 2007 April. The visual observations agree with the IMO activity profile for this Lyrid return and fit with the predicted maximum for the shower given by McBeath (2006).

Received 2007 July 15

1 Introduction

Meteorologically, April was a record-breaker in the Netherlands for both the maximal temperature as well as the number of hour's sunshine. This weather was reflected in the number of clear nights. Unfortunately the number of nights usable for meteor observing was restricted due to hazy sky and/or a lot of cirrus clouds. Nevertheless, members of the Dutch Meteor Society and the KNVWS Meteor Section made a reasonable number of observations near the Lyrid maximum. The nights with the highest activity (April 21/22 and 22/23) were entirely or partially cloudless. This article presents an analysis of the Lyrids in 2007, translated from (Miskotte, 2007).

2 The observations

This analysis is based on the observing reports of the persons listed in Table 2. In order to complete the period before the maximum, observational data of Jürgen Rendtel were downloaded from `http://www.imo.net/` and the observations by Canadian observer Pierre Martin were received by e-mail. Table 2 lists where, by who and how many observations were recorded in April. 327 Lyrids were observed in 55.6 effective observing hours in total. The observations took place in the Netherlands in Ermelo (Koen Miskotte), Lattrop (Arnold Tukkers, Rita Verhoef, Sietse Dijkstra, Carl Johannink) and in Heesch (Felix Bettonvil), in Germany in Gronau (Carl Johannink) and in Belgium in Ellezelles (Michel Vandeputte) and in Wilderen (Jean Marie Biets). The observations of Jürgen Rendtel were done from Marquardt and Liebenhof (Germany) while Pierre Martin watched near Bootland Farm in Ontario, Canada.

Unfortunately the observations of Rita Verhoef could not be listed in the statistics and analyses because her tape recorder failed for unknown reasons to record data.

3 The analyses

As usual the available observations were entered into a spreadsheet for the total number of meteors listed in Table 2. Next the ZHR values were compared and two observations rejected because of the too differing results. Further limiting magnitude (minimum Lm 5.7) and radiant elevation were considered. Radiant positions below 30° were removed as these often produce unreliable ZHR values (mostly overestimates). After this clean up 309 Lyrids were left for definite processing.

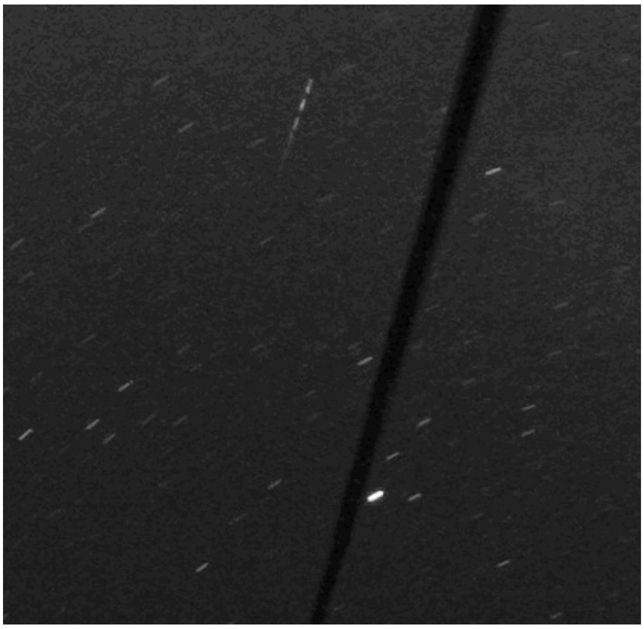

Figure 1 – Part of the exposure by Klaas Jobse from Oostkapelle of the −4 Lyrid.

For the nights near the maximum the ZHR was calculated per hour. Unfortunately the numbers of meteors were too low for decent population index r determination. The IMO value of 2.1 was used for the calculations (McBeath, 2006) and the method of Peter Jenniskens (1994) was applied to obtain the ZHRs.

4 The night of 2007 April 21/22

During the first part of the night some cirrus clouds were noticed. After $23^{\rm h}$ UT the cirrus clouds disappeared rapidly and the second part of the night was crystal clear. The ZHR increased, as expected, from 8 to 13 at the end of the night, see Table 3 and Figure 4.

This night surprised with a spectacular ending with four fairly bright meteors. Koen Miskotte, Sietse Dijkstra and Michel Vandeputte saw a −3 to −4 Lyrid and Koen witnessed moments later an orange coloured −5 antihelion fireball low in the north-northwest. The Lyrid of −4 was photographed by Klaas Jobse from Oostkapelle, unfortunately the −5 antihelion fireball was not photographed. It was probably too low seen from Oostkapelle.

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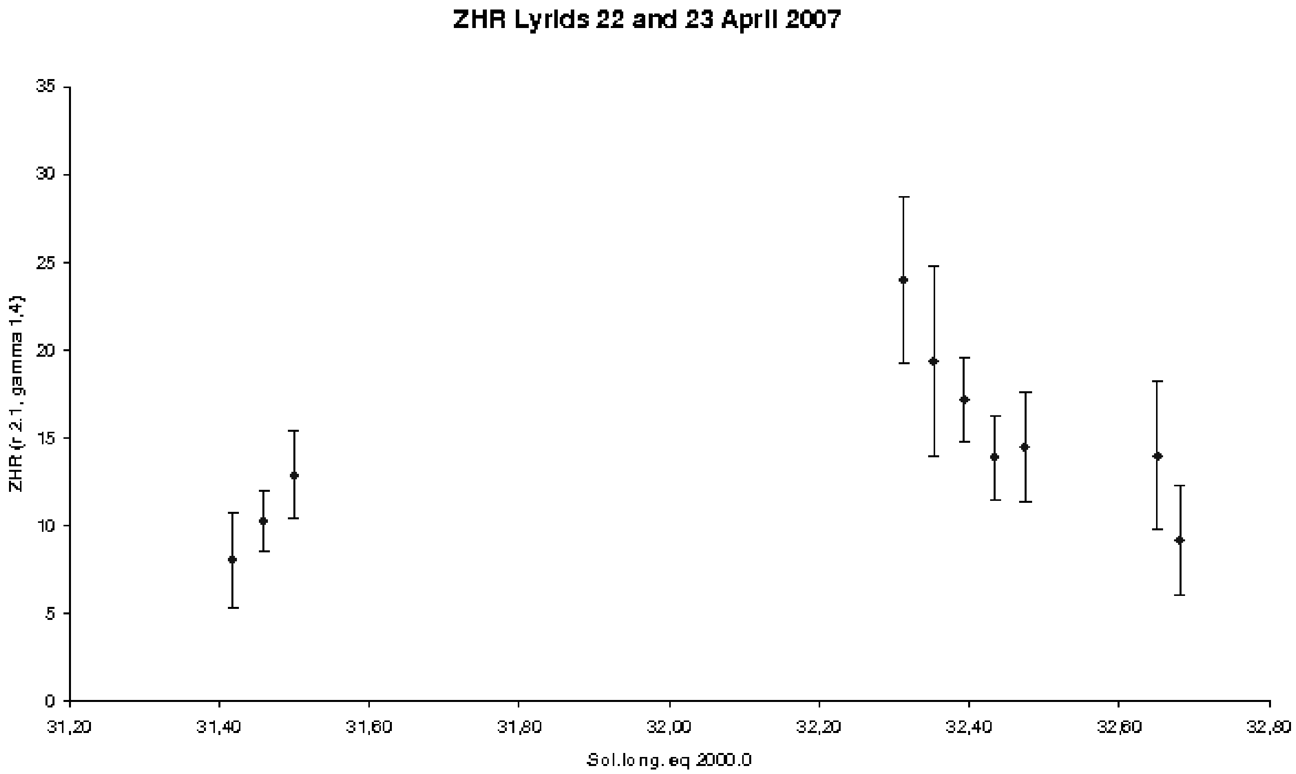

Figure 2 – Combined graph based on the Tables 3 and 4 (nights of 2007 April 21/2 and 22/23).

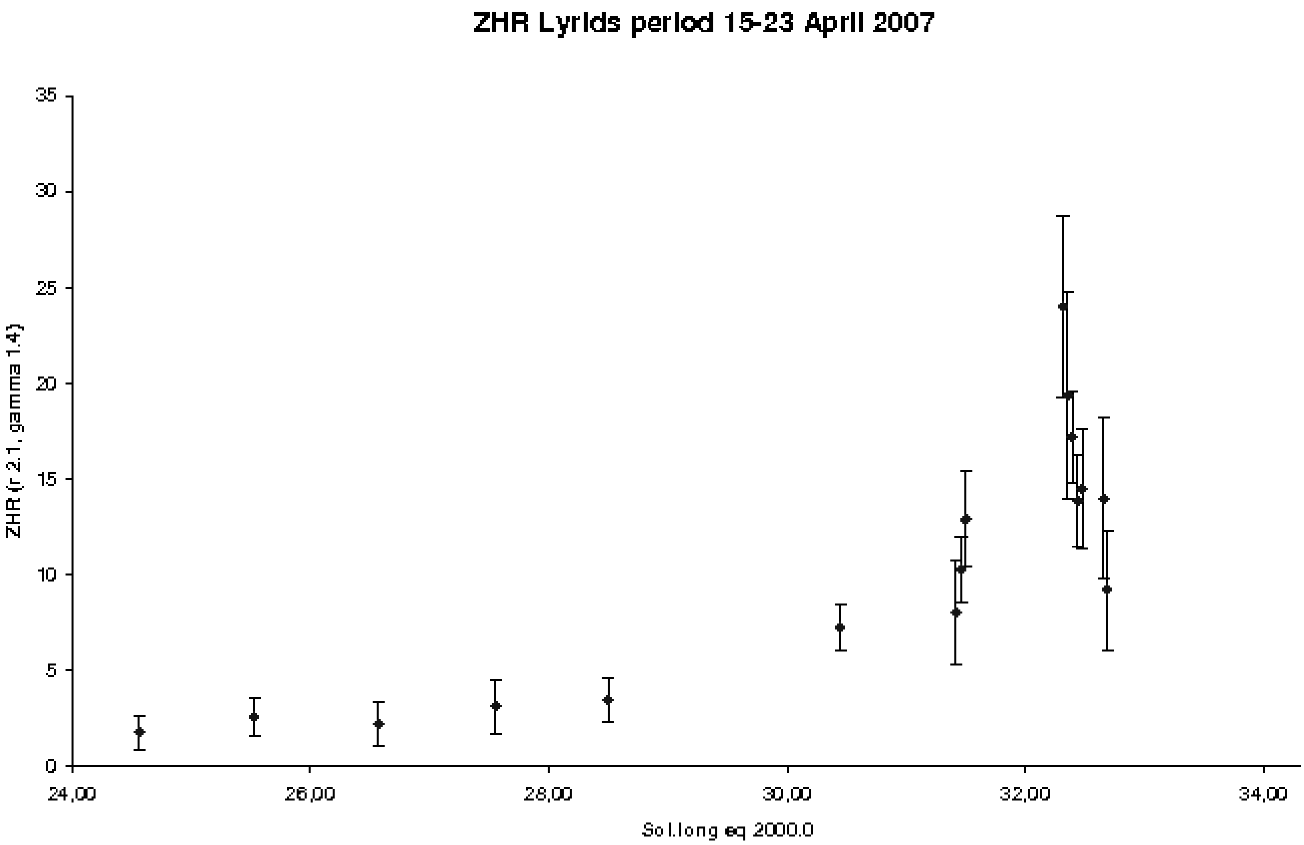

Figure 3 – Lyrids ZHR graph for the period 2007 April 15/16 to 22/23.

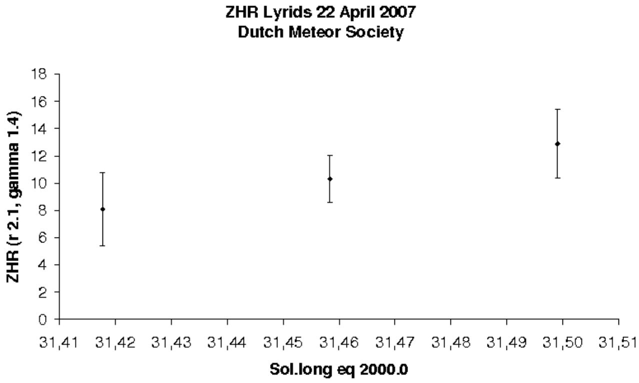

Figure 4 – ZHR Lyrids 2007 April 21/22, based on Table 3.

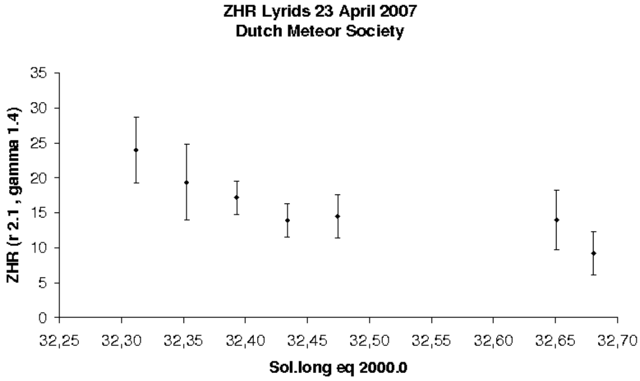

Figure 5 – ZHR graph for the Lyrids on 2007 April 22/23. Observations from Europe between solar longitudes (2000.0) 32°30 and 32°.47, and from Canada for the period 32°.65 and 32°.70.

5 The night of 2007 April 22/23

The tail of a passing cold front temporarily caused occasional medium and high clouds. It was not a top-quality night as far as the quality of the sky was concerned. In spite of this several people were able to conduct observations. Assuming a population index of 2.1 the ZHR values were calculated.

The highest ZHR was obtained at the beginning of the night. This is in line with the expectation of IMO, predicting a maximum on April 22 at $22^{\mathrm{h}}30^{\mathrm{m}}$ UT. Indeed the ZHR values decreased from 24 at $22^{\mathrm{h}}30^{\mathrm{m}}$ UT to 14.5 at $02^{\mathrm{h}}30^{\mathrm{m}}$ UT, see Table 4 and Figure 5. Figure 2 displays the combined results of both 'maximum' nights.

Table 1 – ZHR values of Lyrids for 2007 April 15/16 to 22/23, with a population index 2.1 and zenith attraction exponent 1.4.

$\lambda_\odot$ (2000.0):	ZHR
24.56	1.8 ± 0.9
25.53	2.6 ± 1.0
26.57	2.3 ± 1.1
27.55	3.2 ± 1.4
28.50	3.5 ± 1.2
30.44	7.3 ± 1.2
31.42	8.1 ± 2.7
31.46	10.3 ± 1.7
31.50	12.9 ± 2.5
32.31	24.0 ± 4.7
32.35	19.4 ± 5.4
32.39	17.2 ± 2.4
32.43	13.9 ± 2.4
32.47	14.5 ± 3.1
32.65	14.0 ± 4.2
32.68	9.2 ± 3.1

Although we start with the maximal ZHR of the night, there are some observations of an earlier time, but with the radiant less than 30° above the horizon and this causes too large correction factors in the ZHR. So, we do not know if the maximum actually occurred at $22^{\mathrm{h}}30^{\mathrm{m}}$ UT or that the ZHR before $22^{\mathrm{h}}30^{\mathrm{m}}$ UT was even somehow higher.

6 The nights of 2007 April 15/16 to 22/23

Finally the ZHRs were calculated for the entire period. Because only two observers were active in the period prior to April 21 the data of Jürgen Rendtel were added. This resulted in the data for Figure 3 and Table 1.

7 Conclusions and acknowledgement

All in all this was a very successful observing campaign. The results agree quite well with the activity curve shown on the IMO website. I am grateful to Carl Johannink for his discerning look at the calculations and to Paul Roggemans for the translation of this article for WGN.

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Miskotte K. (2007). "Een geslaagde Lyriden actie". *eRadiant*, **2007-4**, 114.

Table 2 – Observers active during the 2007 Lyrids and who contributed to this report, with C_{p} being the perception coefficient for the observer.

Observer, (IMO code) and country	C_{p}	Nights	T_{eff}	LYR
Biets Jean-Marie (BIEJE), Belgium	0.80	1	2.48	8
Bettonvil Felix (BETFE), Netherlands	1.00	1	1.78	4
Dijkstra Sietse (DIJSI), Netherlands	1.00	2	5.33	30
Johannink Carl (JOHCA), Germany	1.20	2	2.64	12
Martin Pierre (MARPI), Canada	1.00	1	2.15	20
Miskotte Koen (MISKO), Netherlands	1.20	5	13.95	66
Rendtel Jürgen (RUNJE), Germany	1.07	5	10.19	62
Scholten Alex (SCHAL), Netherlands	1.00	1	1.33	8
Tukkers Arnold (TUKAR), Netherlands	1.00	1	1.50	10
Vandeputte Michel (VANMC), Belgium	1.00	4	14.25	107
10 observers		6	55.60	327

Table 3 – Lyrids ZHR during the second half of the night 2007 April 21/22, using data of: DIJSI, JOHCA, MISKO, RENJU en VANMC.

Period	$\lambda_\odot$ (2000.0)	N obs.	LYR	ZHR
$00^{\mathrm{h}}00^{\mathrm{m}}$ – $01^{\mathrm{h}}00^{\mathrm{m}}$	31.42	3	9	8.1 ± 2.7
$01^{\mathrm{h}}00^{\mathrm{m}}$ – $02^{\mathrm{h}}00^{\mathrm{m}}$	31.46	6	37	10.3 ± 1.7
$02^{\mathrm{h}}00^{\mathrm{m}}$ – $03^{\mathrm{h}}00^{\mathrm{m}}$	31.50	4	33	12.9 ± 2.5

Table 4 – ZHR of Lyrids recorded during the night of 2007 April 22/23 based on the observations by BETFE, BIEJE, DIJSI, JOHCA, MARPI, MISKO, RENJU, SCHAL, TUKAR and VANMC.

Period	$\lambda_\odot$ (2000.0)	N obs.	LYR	ZHR
$22^{\mathrm{h}}00^{\mathrm{m}}$ – $23^{\mathrm{h}}00^{\mathrm{m}}$	32.31	6	26	24.0 ± 4.7
$23^{\mathrm{h}}00^{\mathrm{m}}$ – $00^{\mathrm{h}}00^{\mathrm{m}}$	32.35	3	13	19.4 ± 5.4
$00^{\mathrm{h}}00^{\mathrm{m}}$ – $01^{\mathrm{h}}00^{\mathrm{m}}$	32.39	6	51	17.2 ± 2.4
$01^{\mathrm{h}}00^{\mathrm{m}}$ – $02^{\mathrm{h}}00^{\mathrm{m}}$	32.43	5	33	13.9 ± 2.4
$02^{\mathrm{h}}00^{\mathrm{m}}$ – $03^{\mathrm{h}}00^{\mathrm{m}}$	32.47	2	22	14.5 ± 3.1
$06^{\mathrm{h}}20^{\mathrm{m}}$ – $07^{\mathrm{h}}21^{\mathrm{m}}$	32.65	1	11	14.0 ± 4.2
$07^{\mathrm{h}}21^{\mathrm{m}}$ – $08^{\mathrm{h}}35^{\mathrm{m}}$	32.68	1	9	9.2 ± 3.1

Ongoing meteor work

SPA Meteor Section Results: July-September 2004

Alastair McBeath[1]

Information from results collected and analyzed by the SPA Meteor Section is presented and discussed, from the third quarter of 2004. Interesting items included: the probable radio detection of the Southern δ Aquarid maximum around $\lambda_\odot$ (eq. 2000.0) $\sim 126°$–$127°$ (2004 July 28–29); a prolonged Perseid peak on August 11/12, seen in both the radio and visual data, though without being able to confirm the initial IMO visual findings of perhaps three maxima over these two dates; a video Perseid radiant determination at $\alpha = 46{.}^\circ6$, $\delta = +57{.}^\circ3$, correlated for $\lambda_\odot = 139{.}^\circ9$; a 'meteorite' fall over East Anglia, England, on August 11 that was not meteoritic; a UK fireball that received an unexpected amount of attention, seen near dawn on September 24; and a probable main Sextantid radio maximum at $\lambda_\odot \sim 185°$ (September 27).

1 Introduction

Observer activity increased after the fairly slack first half to the year, spurred on by the prospect of a moonless Perseid maximum in August no doubt, though interference was a significant difficulty for the radio observers throughout the quarter. The totals in Table 1 give some details.

Radio observations came from:

Dirk Artoos (Belgium), Alan Heath (England), Bob White (England),

and the following Radio Meteor Observation Bulletin contributors (website: `www.rmob.org`; extracted from RMOBs 132–136 inclusive, 2004 July to November, with thanks to Editor Chris Steyaert for providing them):

Masami Aihara (Japan), Enric Fraile Algeciras (Spain), Mike Boschat (Nova Scotia, Canada), Jeff Brower (Colorado, USA), Maurice de Meyere (Belgium), Gaspard De Wilde (Belgium), Minoru Ehara (Japan), Kenji Fujito (Japan), Ghent University (Belgium), Patrice Guérin (France), Steve Hansen (Massachusetts, USA), Kazuyoshi Kanatsu (Japan), Masaru Kubota (Japan), Kimmo Lehtinen (Finland), Masahiko Matsuda (Kawaguchi Science Museum, Japan), Toshihide Miyake (Japan), Naoki Moriwaki (Japan), Kazuyuki Nagao (Japan), Stan Nelson (New Mexico, USA), Sadao Okamoto (Japan), Mike Otte (Illinois, USA), Shigeo Sambe (Japan), Robert Savard (Québec, Canada), Marcel Schneider (Luxembourg), Hirofumi Sugimoto (Japan), Dave Swan (England), Istvan Tepliczky (Hungary), Ouyang TianJing (Hubei Province, China), Towada Technical High School (Japan), Noguharu Watanabe (Japan), Ilkka Yrjölä (Finland).

The standard analyses outlined for processing the raw radio data were performed as usual in these reports, the modified procedure most recently outlined by (McBeath, 2004).

Steve Evans (England) provided the detailed video results in August, while the visual watchers were:

Arbeitskreis Meteore observers (website: `www.meteoros.de`; data from their journal *Meteoros* 7:9–7:11 inclusive (2004) and 8:1 (2005), sent in by Ina Rendtel; all in Germany where not mentioned): Rainer Arlt, Pierre Bader, Lukas Bolz, Frank Enzlein, Darja Golikowa, Daniel Grün, Jan Hattenbach, Bernd Heinrich, André Knöfel, Ralf Koschack, Ralf Kuschnik, Sirko Molau, Sven Näther (Germany & Poland), Jürgen Rendtel (Germany & Mallorca, Spain), Petra Rendtel, Mario Scheel, Heinrich Wiechell (Greece), Roland Winkler, Oliver Wusk; Mike Alexander (Scotland), Jay Brausch (North Dakota, USA), Chris Cotton (Scotland), Mike Feist (England), Peter Fox (England), Alan Heath (England), Zoltan Hevesi (Hungary), Tony Markham (England), Alastair McBeath (England), Donald Millican (France), George Spalding (England), Julie Yellowley (England).

2 July

After May and June had been relatively free from Sporadic-E interference in 2004 for the radio observers, it seemed almost inevitable in retrospect that things would deteriorate at some point, and such was the case for much of this quarter regrettably, beginning in July. With moonlight also spoiling the late month shower maxima visually, July was quieter than in 2003, as far as reported meteor activity was concerned, though still improved on what had been managed in most months earlier in 2004.

The July 26 to August 1 spell was examined in particular from the radio results, with the better-detected maxima found at $\lambda_\odot \sim 126°$ (in 80% of the surviving datasets; 10 of 12) and 127° (75%; 9 of 12), 2004 July 28 and 29. These formed part of at least a moderately enhanced spell in most results between $\lambda_\odot \sim 125°$–$128°$, much as was reported in the Forward Scatter Meteor Year analyses (McBeath, 2001). No clearer timings for the probable Southern δ Aquarid and α Capricornid maxima, due around July 27 and 29 (McBeath, 2003, p. 7) , could be established, as virtually all the European and North American results were too severely affected by interference, and even the Far Eastern data were not immune to this. The radio maxima near July 28 and 29 would certainly tally with the Southern δ Aquarid peak period derived from 2003 data (McBeath, 2005b).

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IMO bibcode WGN-354-mcbeath-spams2004c
NASA-ADS bibcode 2007JIMO...35...83M

Table 1 – Visual, video and radio hours' totals, visual and video meteor numbers recorded (with a partial breakdown of visual types), per month. Of the August video trails, 193 were Perseids.

	Visual							Video		Radio
Month	Hours	SDA	NDA	CAP	PER	KCG	Meteors	Hours	Meteors	Hours
July	$41\overset{\text{h}}{.}9$	41	16	39	71	—	567	—	—	9018
August	$185\overset{\text{h}}{.}9$	6	21	17	4426	47	5858	47	362	10756
		AUR	DAU	SPI						
September	$43\overset{\text{h}}{.}3$	5	78	42	—	—	475	—	—	7771

3 August

As usual for northern hemisphere observers, the Perseids were anticipated as one of the year's highlights, especially with the potential for two peaks complemented by an almost new Moon, on August 11 around $20^{\rm h}54^{\rm m}$ UT (predicted by Esko Lyytinen) and August 12, between $11^{\rm h}$–$13^{\rm h}20^{\rm m}$ UT, as noted in (McBeath, 2003, pp. 8–9). There was the possibility too of a generally heightened Perseid background level, which could further raise the ZHRs of either or both maxima.

In the end, fairly normal Perseid ZHRs were recorded, at about 80–130 in the preliminary IMO reports (Arlt, 2004 was the most recent), but these were prolonged at that level from roughly August 11, $19^{\rm h}30^{\rm m}$ UT to August 12, $21^{\rm h}30^{\rm m}$ UT, with several fluctuations during that time, producing an unusually sustained peak. In addition, a short, strong spike in ZHRs to $\sim 190 \pm 8$ was superimposed on the profile at $\sim 21^{\rm h}00^{\rm m}$ UT on August 11, with a full width half maximum time for that of slightly under an hour, centred on this point. Two other submaxima were suggested by the initial IMO data, at $\sim 01^{\rm h}30^{\rm m} \pm 1^{\rm h}$ UT, and $\sim 09^{\rm h}30^{\rm m}$ UT, both on August 12. ZHRs for these two at best were $\sim$ 130–150 and $\sim 120 \pm 5$ respectively.

Given that the SPA visual results formed a subset of the IMO ones, it is not surprising this general pattern was seen again in these, as the extended near-maximum spell in Figure 1 indicates. The first strong, short peak was too early for most of our observers to catch with a suitable radiant elevation, so passed effectively unseen, although comments from a couple of watchers in eastern Europe indicated Perseid numbers were unusually enhanced for such a low radiant then. The tail of this first maximum was probably represented in the first two datapoints on August 11/12, centred at $21^{\rm h}$ and $23^{\rm h}$ UT respectively, with mean ZHRs of $\sim 119 \pm 4$ each. Rates dropped after this, but were consistently averaging at or above 100 throughout the night, peaking again at 114 ± 5 towards $09^{\rm h}$ UT on August 12 over the USA.

One point worth making here is that there was a large fluctuation in the initial mean ZHR values on August 11/12, notably in the European results. This was partly why the values were further combined into fewer datapoints in Figure 1. While this removed some of the rather chaotic complexity, it may ultimately have given too simplified a picture. For example, the August 11, $21^{\rm h}$ UT datapoint condensed interval results centred from $\sim 20^{\rm h}15^{\rm m}$ to $\sim 21^{\rm h}45^{\rm m}$ UT, during which time the outlying mean (note *not* individual) ZHRs ranged from $\sim$ 100 to $\sim$ 150, but without a clearer pattern within

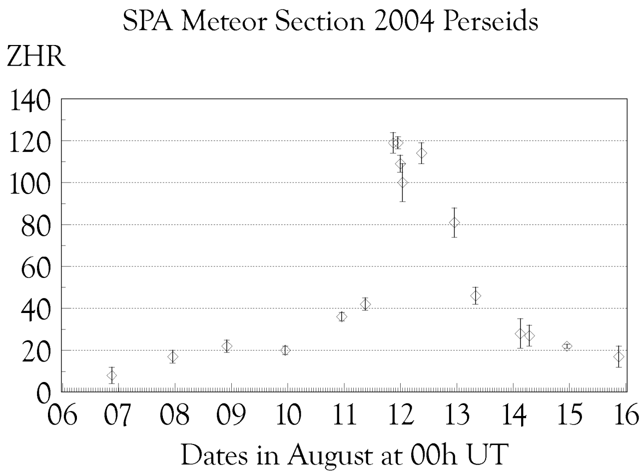

Figure 1 – Mean Perseid ZHRs, typically condensed into single datapoints for most nights when either only European or North American visual results were available, away from the maximum. ZHRs were computed assuming $r = 2.6$, where the LM was +5.5 or better, cloud cover < 20%, and where the radiant elevation was 25° or more, with standard error bars appended.

that time band. Observer perception effects may have been at the root, although if so, it is curious they should have been rather more apparent on this one night than on others adjacent, or compared to recent years. By using only the stronger ZHRs from this datapoint, it would have been possible to more closely replicate the IMO findings, but this could not be justified from the relatively small SPA data sample during this interval.

Table 2 gives a global magnitude distribution for the Perseids and August sporadics. The sporadic numbers were small, but provided some comparison nonetheless. Too few train reports were received to examine those in detail, but $\sim$ 36% of Perseids and $\sim$ 14% of sporadics left persistent trains in August.

From video recordings of the 193 Perseid meteors he collected on various dates between August 1–20 inclusive, Steve Evans was able to compute a compact radiant, corrected to $\lambda_\odot = 139\overset{\circ}{.}9$, centred at $\alpha = 46\overset{\circ}{.}6$, $\delta = +57\overset{\circ}{.}3$, very close to the expected position for that solar longitude. Unfortunately, Steve, as with many UK observers, was unable to cover August 11/12, as the remnants of Hurricane Alex, having re-crossed the Atlantic, sat over the British Isles at this critical time. The generally bright nature of the Perseids this year, and the healthy fireball rate implied by Table 2, allowed a few lucky watchers to see at least a casual bright to fireball-class Perseid or two through the clouds, in some places.

Table 2 – Global magnitude distributions for the 2004 Perseids and August sporadics seen under better sky conditions (cloud cover < 20%, $LM = +5.5$ or better), including mean LMs and corrected mean magnitudes.

Shower	≤ -3	-2	-1	0	$+1$	$+2$	$+3$	$+4$	$\geq +5$	Tot	LM	$\overline{m}_{6.5}$
PER	20	11	24	47	72	113	108	65	30	490	+6.31	+2.04
SPO	2	0	0	4	7	25	24	23	20	105	+6.35	+3.15

The radio results showed an odd lack of a clear pattern over the Perseid maximum. This might suggest that the problems with the visual analysis may have had some physical cause, and not been simply some mathematical or observer-related one. Most of the viable radio datasets that covered the expected maxima and dates to either side did show a distinct peak in echo counts on either August 11 and/or August 12, but there was little consensus as to when these peaks happened, other than coincidentally with the Perseid radiant's best observability for the different locations. From this, it has proven impossible to usefully confirm any of the visually-detected IMO maxima, beyond saying that Perseid activity was present at a generally good to very good radio level from about August 11, $19^{\rm h}$ UT to August 12, $22^{\rm h}$ UT, an interval effectively coincident with the stronger IMO visual ZHRs.

Much of the European and North American data was lost to interference again, which did not help, along with some of the Far Eastern results (aside from a few people who suffered an attack of Murphy's Law, with typically badly-timed equipment failures). However, even between the more complete Japanese observations, there was only a general consensus in slightly more than half the results favouring a stronger peak on August 11/12 (UT) over August 12/13, the difference on the two dates often being marginal, even using the longer duration echo (> 20s) reports.

Overall, it seems a good, prolonged, Perseid maximum spell happened in 2004, with visual ZHRs and higher radio echo counts present for roughly 26 to 27 hours, centred on August 12 at $08^{\rm h}30^{\rm m}$ UT ($\lambda_{\odot} = 139\overset{\circ}{.}9$), though this timing did not represent any of the recorded peaks.

Another event occurred in the UK on the afternoon of August 11/12, although it was one to two weeks later before news filtered out via media sources. At Lowestoft in Suffolk, England, the easternmost point in the British Isles, an elderly woman was cut on the arm by a small rock, said to have fallen from the sky. The object was immediately called a 'meteorite', and newspapers cited quotes from national and local astronomical groups in support of this belief. It was also claimed that no one had ever been hit by a meteorite before, which readers of this journal over the last decade will appreciate to be inaccurate (Gritzner, 1997). Ambiguity in the press reports could suggest this might have meant only that no one in Britain had been so hit, however. [1]

As even the earlier media stories demonstrated in words and photos, e.g. (Belton, 2004), the object recovered was definitely not a meteorite, as anyone having a passing familiarity with the subject should have been able to tell at once. The coloration, size and physical appearance were indicative of something more like old furnace slag, coupled with its density, described as being like that of a walnut - i.e. significantly less dense than most ordinary terrestrial stones, let alone the generally much denser true meteorites. It is not known whether this meant the lady was hit by this object, most likely thrown by some unseen assailant, if so, though perhaps dropped by a bird, or whether she was really hit by a genuine meteorite which was overlooked in favour of the small stone that was collected, which was apparently different to any others nearby. If it was a real meteorite that was ignored, that object is now lost.

I am most grateful to those who forwarded press cuttings and other information regarding this event, particularly Colin Watling of the Lowestoft and Yarmouth Regional Astronomers, and also Kevin Wright, another local astronomer, who was able to interview the lady in early September, and examine the stone, which he was able to confirm as definitely terrestrial.

4 September

Late August's full Moon saw off the α Aurigid maximum on the cusp of August-September, while there was only the usual low δ Aurigid activity seen near their first peak in early September, as the Moon waned. Nothing beyond the expected mid-month minor radio peaks from (McBeath, 2001) were found around September 14–19, implying no marked return from the possible Orion-Gemini radio shower, suggested as the origin for a radio meteor peak discovered in 1989 (Artoos, 1990) and perhaps again in 1999 (McBeath, 2000).

Later in the month, a fireball estimated at roughly magnitude $-4/-7$ in SPA reports appeared over Britain in the morning twilight sky, at about $05^{\rm h}27^{\rm m}$ UT on September 24. A few sightings arrived directly after it, enough to infer only a probable north-west to south-east trajectory over the southern half of England. This in itself would not warrant mention here, but for the interest the event subsequently generated, following the publication of a problematic report in the Royal Astronomical Society's magazine for 2004 December (Bridges et al., 2004). In this, a possible origin from the κ Aquarid stream was proposed, a shower currently considered inactive visually, plus one whose theoretical radiant was $\sim 10°$ or more below the horizon for most of the sites the fireball was observed from at the time, the latter particularly making such a source an impossibility. Unfortunately, the Bridges' group were unwilling to discuss this, or to allow the fireball sightings they had collected to be re-examined independently, so a letter was prepared and later published by the current author, concerning these difficulties (McBeath, 2005a).

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Moving on to the end of the month, the radio peaks probably due to the daytime Sextantids were recovered at $\lambda_\odot \sim 183°$ (September 25; in 65% of the results, 7 of 11), though not as strongly as at some past returns, and $\lambda_\odot \sim 185°$–$187°$ (September 27–29). The latter produced a particularly obvious maximum at $\lambda_\odot \sim 185°$ in 85% of the datasets (11 of 13), building from 184° for once, probably representing the main Sextantid maximum in 2004, with an additional moderately strong peak at about $\lambda_\odot = 188°$, the very end of September, in 60% of the observations (8 of 13), not seen at this time in the earlier Forward Scatter Meteor Year results (McBeath, 2001). This was found only in the European and Japanese data.

Regrettably, interference once again played a significant role through to late September, for both Europe and North America especially, and the loss of the normal diurnal echo patterns was an additional — perhaps related — failing for some unfortunate observers. All the same, the overall radio meteor behaviour seemed quite similar to the past.

5 Conclusion

The slow start to the northern hemisphere's Sporadic-E season in June was rather deceptive, as when it began, it was both troublesome and unusually persistent throughout this quarter. Despite that, some useful radio data were secured over the apparently prolonged Perseid peak period especially (as found too by the visual watchers), and seeming to pick up a reasonable, if not outstandingly strong, Sextantid return. My final pleasant duty is to thank once more all the contributing observers and correspondents for their excellent efforts during this time, and to wish them every success for their continued work in future.

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SPA Meteor Section Results: October-December 2004

Alastair McBeath[1]

Notes and details extracted from SPA Meteor Section analyses are given with some discussion. No radio Draconid signature was apparent on either October 5 or 8, but the Orionids received useful visual and radio coverage, the shower producing fine activity from October 20 to 24 or so, with a probable peak on October 21/22, when ZHRs were $\sim 24 \pm 2$. The early Leonid peak predicted for November 8/9 was not found in the radio data, though healthy Leonid activity was caught visually and by radio from November 17 to 21 or 22. A ZHR peak was calculated for November 19, at $\sim 26 \pm 2$. The brief, moderately strong Leonid maximum computed from IMO results on November 17 at 21^{h} UT, was also detected by one radio system from Japan. One UK fireball of magnitude $-4/-6$ was seen well enough for an approximate atmospheric trajectory to be established, at $07^{\mathrm{h}}05^{\mathrm{m}}$ UT on November 29. In December, aside from the Ursid results already described, the Geminids were well-seen visually, and by the radio observers. A Geminid peak around $\sim 22^{\mathrm{h}} \pm 1^{\mathrm{h}}$ UT on December 13 ($\lambda_\odot$ (eq. 2000.0) $= 262\overset{\circ}{.}19 \pm 0\overset{\circ}{.}04$), was suggested from the radio findings.

1 Introduction

A very promising final quarter beckoned to observers in 2004, with hardly a moonlit shower maximum at all for once. The weather and radio interference did try to hinder things when they could, but even they failed to spoil matters as much as they sometimes can. There was a sudden drop in radio hours from November onwards, which largely resulted from the majority of Japanese observers no longer reporting their results in the Radio Meteor Observation Bulletins (RMOBs). Table 1 has the overall tallies.

The Section's Ursid results were discussed earlier (McBeath, 2005a), and the observers reporting solely during that epoch are not repeated in the lists below.

Radio observations came from:

> Dirk Artoos (Belgium); Gilberto Klar Renner (Brazil); Bob White (England);

and the following RMOB reporters (website: `www.rmob.org`; data in RMOBs 135 to 137, 2004 October to December inclusive, provided by Editor Chris Steyaert):

> Masami Aihara (Japan), Enric Fraile Algeciras (Spain), Mike Boschat (Nova Scotia, Canada), Jeff Brower (Colorado, USA), Alessandro & Giuseppe Candolini (Italy), Maurice de Meyere (Belgium), Gaspard De Wilde (Belgium), Minoru Ehara (Japan), David Entwistle (England), Kenji Fujito (Japan), Valter Gennaro (Italy), Ghent University (Belgium), Patrice Guérin (France), Steve Hansen (Massachusetts, USA), Masaru Kubota (Japan), Kimmo Lehtinen (Finland), Masahiko Matsuda (Kawaguchi Science Museum, Japan), Toshihide Miyake (Japan), Naoki Moriwaki (Japan), Kazuyuki Nagao (Japan), Stan Nelson (New Mexico, USA), Sadao Okamoto (Japan), Mike Otte (Illinois, USA), Robert Savard (Québec, Canada), Marcel Schneider (Luxembourg), Ton Schoenmaker (Netherlands), Hirofumi Sugimoto (Japan), Dave Swan (England), Istvan Tepliczky (Hungary), Ouyang TianJing (Hubei Province, China), Ilkka Yrjölä (Finland).

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NASA-ADS bibcode 2007JIMO...35...87M

Analyses of the raw radio data were performed as normal, as described most recently in (McBeath, 2004). Video results were provided by Steve Evans (England) in October, while the visual observers comprised:

> *Arbeitskreis Meteore* watchers (website: `www.meteoros.de`; data from their journal *Meteoros* 7:12 (2004), 8:1 and 8:2 (2005), sent in by Ina Rendtel), all in Germany unless stated: Pierre Bader, Christoph Gerber, Ralf Koschack, Sven Näther, Jürgen Rendtel (Canary Islands & Germany), Roland Winkler; Jay Brausch (North Dakota, USA), Tim Cooper (South Africa), Mike Dale (Scotland), Sarthak Dasadia (India), Meredic Hallett (Wales), Bob Lunsford (California, USA), Alastair McBeath (England), Jonathan Shanklin (England), George Spalding (England), Richard Taibi (Maryland, USA).

2 October

After the moderately strong radio peak at $\lambda_\odot \sim 188°$ reported previously (McBeath, 2007), the early October radio results showed signs of the usual minor maxima from the Forward Scatter Meteor Year (McBeath, 2001), several of which were recently suggested as perhaps due to a continuation of lesser peaks from the daylight Sextantids, following their late September maximum (McBeath, 2005b). That from the extended $\lambda_\odot = 195°–196°$ period gave a good response in virtually all the usable datasets (90%; 11 of 12) at $\lambda_\odot \sim 96°$ (2004 October 9), and through to 197° (October 10) in a further majority (58%; 7 of 12), not seen before. No activity attributable to the Draconids, either around October 5 (Arlt, 2004a) – when no significant visual Draconid rates were reported anyway – or on October 8 (McBeath, 2003, p. 12) could be found.

Later in the month, the largely moonless Orionids received some good coverage over their maximum especially in the Section's visual results, as Figure 1 illustrates. Mean ZHRs were around or above 20 from October 20/21 to 24/25 in these, the marginally highest, 24 ± 2, achieved roughly as expected, on October 21/22.

The radio results gave a similar pattern, with healthy rates found in most viable results ($\sim 80\%$), from $\lambda_\odot = 207°–210°$ (October 20–23), while some (at least 65%) extended this from $\lambda_\odot \sim 206°$ to 211°

Table 1 – Visual, video and radio hours' totals, visual and video meteor numbers recorded (with a partial breakdown of visual types), per month. Twelve of October's video meteors were Orionids.

	Visual						Video		Radio
Month	Hours	NTA	STA	ORI	—	Meteors	Hours	Meteors	Hours
October	$63^{h}.0$	50	65	537	—	1293	$7^{h}.8$	45	10278
		NTA	STA	ORI	LEO				
November	$42^{h}.4$	16	18	2	188	583	—	—	4831
		GEM	URS	COM					
December	$100^{h}.2$	2959	111	47	—	4143	—	—	5833

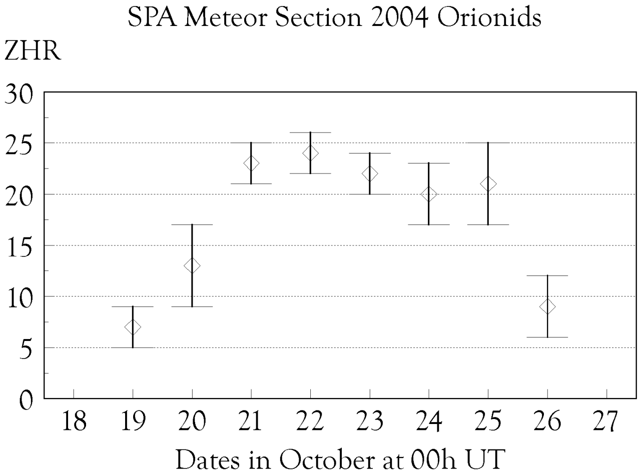

Figure 1 – Orionid mean nightly ZHRs, the available information condensed into single datapoints per date, computed using $r = 2.9$, where the LM was +5.5 or better, cloud cover < 20%, and the radiant elevation was at least 30°.

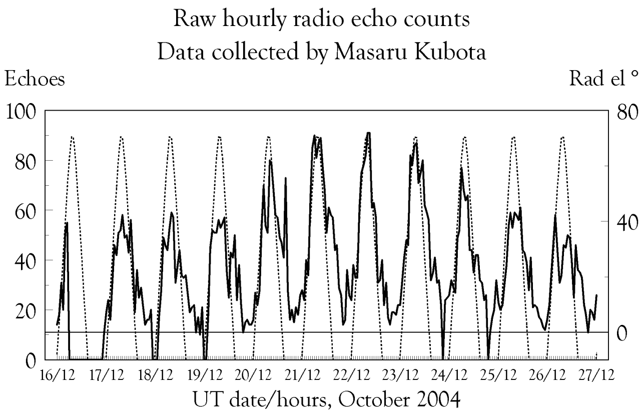

Figure 2 – Raw hourly radio echo counts over the main Orionid maximum in 2004, from data collected by Masaru Kubota. In Figures 2 and 3, the thicker, irregular line, keyed to the left-hand y-axis, shows the raw hourly echo count values, while the thinner, daily-symmetrical curve (keyed to the right-hand y-axis) gives the Orionid radiant elevation for each observer's site. All the graphs were from data collected continuously, and drops to zero showed either times when the system was suffering equipment problems or was otherwise not operating, or where interference intervened.

less strongly. A further, more modest, response was noted at about $\lambda_\odot \sim 212°$ and 213° as well (October 25 and 26, in 40% or 50% of the results respectively). A marginally stronger peak appeared at $\lambda_\odot \sim 209°$, exactly to time with the visual results. Figures 2 and 3 give two sample radio graphs, with some of the clearer Orionid signatures.

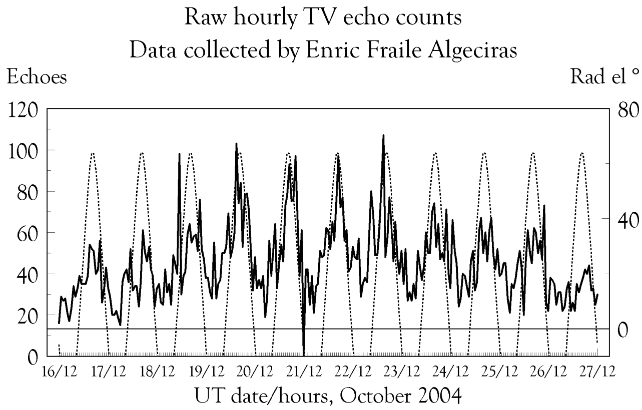

Figure 3 – As Figure 2, but from raw TV echo count data collected by Enric Fraile Algeciras.

Details from the visual and radio Orionid behaviour in 2004 seem to be in-line with the findings of Dubietis (2003), where Orionid rates were expected to be about halfway between their latest 12-year trough and the next peak, towards 2008–2010.

Only the normal minor radio maxima were seen later in October, with no suggestion in these or the visual reports to indicate any unexpected Taurid activity was present, as last in 1998 (McBeath, 1999).

3 November

Due to the prediction of an unusually very early possible Leonid peak, on November 8/9 (Vaubaillon, 2004), it was decided to analyze the radio results collected continuously from October 16 to November 25, in order to investigate any signs of out of the ordinary activity. Having done this, nothing untoward was found prior to mid November. All the previously-detected minor maxima were recovered much as the Forward Scatter Meteor Year analyses (McBeath, 2001) suggested. The moderately stronger peaks were noted at $\lambda_\odot \sim 223°$ (November 4/5; in 75% of the usable results, 6 of 8) and 230° (November 11/12; 90%, 7 of 8), quite normally. The rather vague minor peak typically present at $\lambda_\odot \sim 227°$ (November 8/9) was found then certainly (in 75% of reports, 6 of 8), and it is possible this may have masked any very weak Leonid activity, such as was inferred by a few observations in the IMO results (Arlt, 2004c). There was no radio evidence at all for a peak of order ZHR ~ 50, as earlier predicted, nor for any significant increase in faint meteors from such an event, so it seems reasonable to conclude that either no Leonid peak happened on November 8/9, or it was of so low a

Table 2 – Global magnitude distributions for the 2004 Orionids, Leonids, Geminids and October, November and December sporadics, seen under better sky conditions (cloud cover < 20%, $LM = +5.5$ or better), including mean LMs and corrected mean magnitudes.

Shower	≤ -3	-2	-1	0	$+1$	$+2$	$+3$	$+4$	$\geq +5$	Tot	LM	$\overline{m}_{6.5}$
ORI	1	4	7	14	37	64	75	52	18	272	+6.43	+2.54
OCT SPO	1	0	2	2	11	35	47	54	17	169	+6.37	+3.19
LEO	5	6	8	19	28	38	27	20	9	160	+6.15	+2.04
NOV SPO	0	1	2	6	22	23	37	38	24	153	+6.01	+3.40
GEM	21	30	54	113	216	298	325	248	90	1395	+6.23	+2.44
DEC SPO	2	4	4	18	40	61	103	98	55	385	+6.39	+3.03

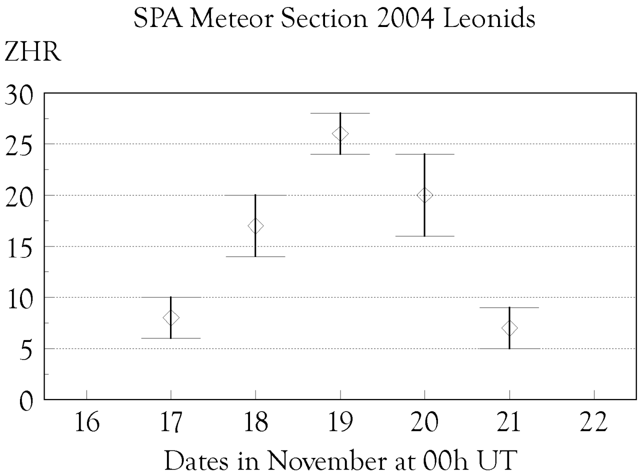

Figure 4 – Mean nightly Leonid ZHRs, condensed into single datapoints per date from the results available, computed as for Figure 1, except using $r = 2.5$.

level as to be effectively unobservable using the current forward scatter systems.

Most visual results from the month concentrated around the later Leonid maxima, with a raft of potential peak times predicted, from the nodal crossing at $\sim 8^{h}30^{m}$ UT on November 17 (McBeath, 2003, pp. 14–15), to the encounter with Comet 55P/Tempel-Tuttle's 25-revolution stream trail, around 10^{h} UT on November 21 (Arlt, 2004b). The probably stronger trail encounters were expected to cluster on November 19, as also noted by Arlt (2004c). Although the SPA Leonid sample was rather limited, it was possible to construct a crude nightly-mean ZHR graph, Figure 4, which gave an indication that rates were indeed best on November 19, at $\sim 26 \pm 2$. Too few observations were available to allow anything even approximating the temporal finesse of Arlt (2004c), however. Table 2 gives global magnitude distributions for the Leonids and concurrent sporadics.

Figures 5 and 6 show a sample of the radio details which gave a clearer response over the main Leonid epoch in 2004.

In general the majority of the radio data gave enhanced activity probably due to the Leonids from roughly 04^{h} UT on November 17 to 15^{h} UT on November 21, although a lesser proportion of the datasets could support such activity continuing to $\sim 9^{h}$ UT on November 22. There was little consensus beyond this as to when any of the better maxima may have taken place, so it was not possible to say whether any of the predicted peaks produced increased radio rates or not, nor to check for independent confirmation of the second visual maximum found by Arlt (2004c) on November 19/20 at $\sim 0^{h}$ UT.

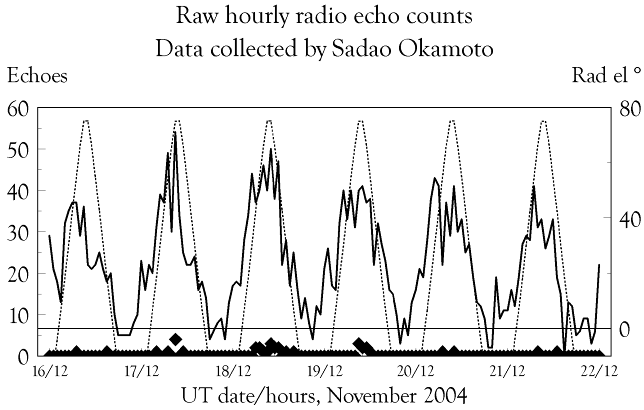

Figure 5 – Raw hourly radio echo counts over the main Leonid maxima in 2004, from data collected by Sadao Okamoto. In Figures 5 and 6, the thicker, irregular line, keyed to the left-hand y-axis, shows the raw hourly echo count values, while the thinner, daily-symmetrical curve (keyed to the right-hand y-axis) gives the Leonid radiant elevation for each observer's site. All the graphs were from data collected continuously, and drops to zero showed either times when the system was suffering equipment problems or was otherwise not operating, or where interference intervened. The heavier symbol-line which runs chiefly along the x-axis in Figure 5 only, gives hourly echo counts keyed to the left-hand y-axis for echoes of > 20s duration. Very few of these were registered, hence the line rarely moves above zero, but the Leonid activity on three dates did seem to be additionally highlighted using these rare events.

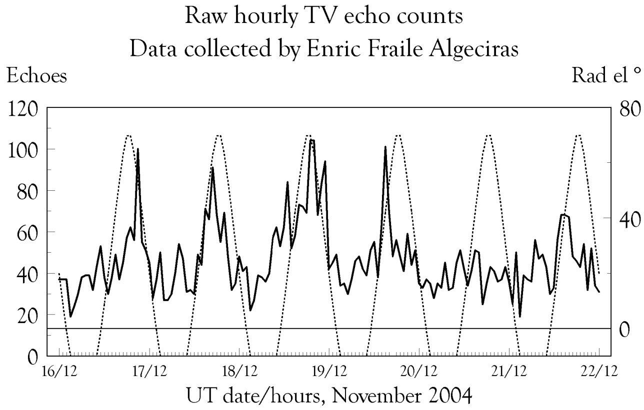

Figure 6 – As Figure 5, but from raw TV echo count data collected by Enric Fraile Algeciras. The apparent loss of a clear diurnal signature on November 21 and 22 was seen in other European datasets as well.

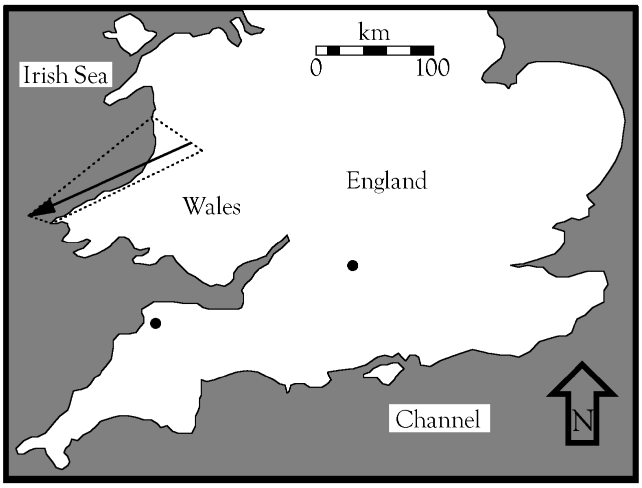

Figure 7 – A sketch map of Wales and southern England, showing the location of the two observers of the November 29 fireball (filled circles), and the most probable projected surface track – the arrowed line – for the fireball. The dashed box surrounding this track gives the outlying possible area within which the witness reports indicated the fireball most likely occurred.

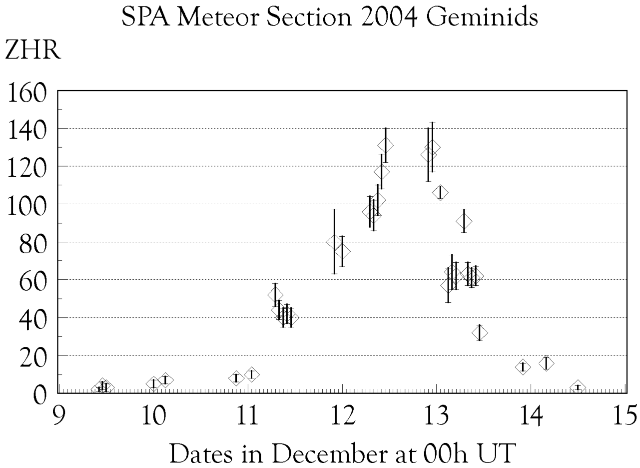

Figure 8 – Mean Geminid ZHRs, computed as for Figure 1, but using $r = 2.5$.

However, the sole Far Eastern dataset, Sadao Okamoto's (Figure 5), did show a very sharp, strong maximum in the 21^h–22^h UT bin of November 17, both from the all-echo counts and the very long duration ones (shown as the highest such value in Figure 5). This seemed most significant, considering the very short visual peak exactly coincident in the IMO data (Arlt, 2004c) , which contained the highest Leonid ZHRs found from the whole IMO 2004 shower profile, $\sim 37{\pm}4$. It was unfortunate no other Far Eastern radio reports were available for correlation, as the 21^h UT timing meant radio observers elsewhere in the world did not have access to the Leonid radiant then. Despite this, it seems this did provide good support for the first visual maximum. The peak at this time was especially interesting, as nothing was predicted within $\sim 12^h$ of then, implying there are still unsuspected facets to the Leonid meteoroid stream as a whole. The fact that the several other predictions did not coincide to better than $\sim 2.5^h$ with any observed peaks (and that once only, for the 1733 dust trail to the IMO November 19/20, $\sim 0^h$ UT maximum), was also fascinating, along with the Leonid ZHRs being better than the inter-storm average of $\sim$ 10–15 for around three consecutive days. The Leonid storms may be over for now, but the shower has clearly not returned to 'normal' yet!

The visual Leonid coverage meant the expected α Monocerotid near-maximum interval received some observations too, but the predicted peak at 08^h45^m UT on November 21 (McBeath, 2003, p. 15) passed unobserved, and only very low rates were seen at other times. No radio signature then suggestive of a strong outburst like that in 1995 was noted, at least. Several of the observers (70–80% of the results recording it) did find the echo count spike at $\lambda_\odot \sim 238°$–$239°$ (November 20–21) somewhat more strongly than normal, but there was only limited correlation between datasets that this may have happened for a short while at some time in the 01^h–07^h UT period of November 20, with the places it was found indicative that neither an α Monocerotid nor Leonid source could be used as an explanation for all.

Just before the end of the month, around 07^h05^m UT on November 29, a magnitude $-4/-6$ fireball was reported from two sites in southern England. Unusually, both observers were able to estimate reasonable sky positional details for the trail they each saw, and it was possible to use these to triangulate to the object's approximate trajectory. The likely projected surface track is shown in Figure 7.

The indicated trajectory was thus on a general east-north-east to west-south-west path, beginning around 100 km above the central Cambrian Mountains of mid-western Wales, maybe $\sim$ 40 km south-east of Cader Idris (near 52° N, 3.°6 W). It passed over the southern part of Cardigan Bay, ending at roughly 45 km altitude, perhaps $\sim$ 30 km west of St David's Head ($\sim$ 51.°9 N, 5.°7 W). Note though that only one observer was able to give a start position for the visible trail, so this point was not closely constrained. The atmospheric trajectory implied would have been $\sim$ 165 km long, at an angle of descent of $\sim 20°$ from the horizontal. Visible flight duration estimates – not helped by the presence of a $\sim$ 30-second persistent train – suggested an atmospheric velocity, not allowing for deceleration, of $\sim$ 47 km/s. Any meteorites following the line of the more probable flight would have splashed down into St George's Channel or the Celtic Sea far from land, between southern Ireland and south-west England.

4 December

Most visual observers gave their best endeavours near the Moon-free Geminid maximum, due on December 13/14, around $22^h20^m \pm 2.3^h$ UT (McBeath, 2003, pp. 18–19), allowing some fine coverage of most of the shower, as Figure 8 illustrates. Global magnitude distributions for the Geminids and December sporadics are in Table 2.

From the overall trends to either side of the gap in results between $\sim 12^h$–21^h UT on December 13, we might imply a peak between these times, but this cannot be proven thus. Best ZHRs to either side of the break were similar, at $\sim 130{\pm}11$, comparable to the ini-

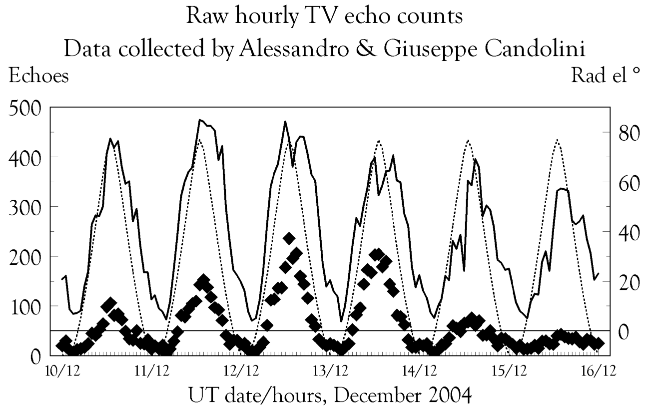

Figure 9 – Raw hourly radio echo counts over the Geminid maximum in 2004, from data collected by Alessandro and Giuseppe Candolini. In Figures 9 and 10, the thicker, irregular line, keyed to the left-hand y-axis, shows the raw hourly echo count values, while the thinner, daily-symmetrical curve (keyed to the right-hand y-axis) gives the Geminid radiant elevation for each site. All the graphs were from data collected continuously. The heavier symbol-line which runs below the thinner all-echoes line in this graph alone, has hourly echo counts again keyed to the left-hand y-axis, but for echoes of > 1s duration. These gave a much clearer impression of the activity due to the Geminids than the all-echo counts here.

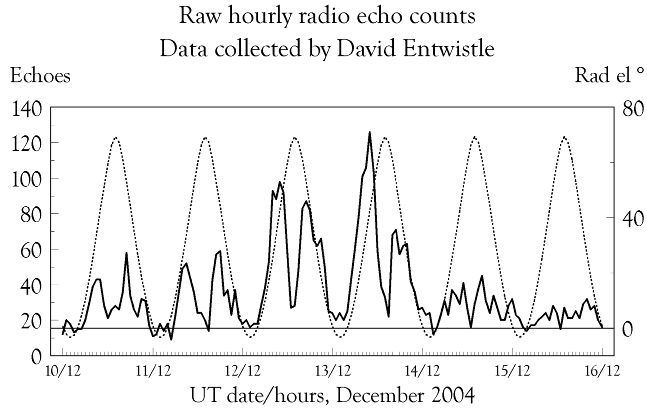

Figure 10 – As Figure 9, but from echo count data collected by David Entwistle.

tial IMO findings (Arlt, 2004d), but short of the IMO's best, when ZHRs of $\sim 160 \pm 13$ were reported near December 13, 20^{h} UT.

Relatively few viable radio datasets were available covering the critical interval with the Geminid radiant detectable. Most of those systems gave a modest to good response due to the shower as a whole, particularly from Europe. A closer examination of the counts suggested a significant peak occurred while the radiant was not especially optimally-elevated, between $\sim 21^{\mathrm{h}}$–01^{h} UT on December 13/14. The weighted mean time for those systems displaying something during this interval, was $\sim 22^{\mathrm{h}}02^{\mathrm{m}} \pm 1^{\mathrm{h}}$ UT ($\lambda_{\odot} = 262\overset{\circ}{.}19 \pm 0\overset{\circ}{.}04$), more or less as expected. There was no good evidence for a peak as early as $\sim 20^{\mathrm{h}}$ UT on December 13, as echo counts then were typically marginally lower than at the same time on December 12. Figures 9 and 10 show two sets of radio results to help give an idea of how the radio Geminids behaved.

The Ursid results were of course detailed earlier, as noted in the Introduction.

5 Conclusion

A busy quarter to end the year, much as has become the norm during recent times, thanks to the Leonid storms. Even without one, the Leonids still generated a focal point for observers, along with the more usually-strong late year showers like the Orionids and Geminids.

As always, my grateful thanks are sent to all the contributing observers for their results, allowing these analyses to continue. Clear skies for all your watching!

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History

Meteor Beliefs Project: Meteors as prognosticators of strong winds in Classical thought

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The connection made by Classical authors between the appearance of obvious meteor activity and strong winds is explored. This link apparently did not persist into later times, except poetically, but it was surprisingly long-lived in its earlier period.

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1 Introduction

Some of the meteor beliefs we have examined during this Project seem to have lasted for a very long time. Others have come and gone like the whims of fashion. Here, we concentrate on one aspect which seems to have been peculiar to the Classical world in its more generally-held form, though its origins may predate the texts, and perhaps even the civilizations, discussed below. This is the connection between meteors and strong winds, such that sighting unusual numbers of 'shooting stars' was said to forecast gales. We present this material in the August journal, as this is during the height of the northern hemisphere's hurricane and cyclone season. Perhaps we should blame the Perseids for such events, following ancient custom?

2 Aristotle ignites

As we learnt earlier in relation to the probable meteorite fall at Aegospotami in 467 BC, Aristotle (384–322 BC) believed this object had been lifted simply by the force of a wind exacerbated by the presence of a bright comet. This was because, as he stated, he thought frequent bright comets induced strong winds in the atmosphere (McBeath & Gheorghe, 2005). Aristotle also noted that meteors and comets were of one substance, a hot, dry exhalation from the Earth, capable of being ignited in the upper atmosphere. The chief differences were that the quantity of combustible material was far greater in comets, and that meteors moved much more quickly. This was all detailed in his Meteorologica, Book I.VII (Lee, 1952, pp. 48–57), and appeared from its phrasing to have been his own theory on the matter.

Consequently, when Aristotle talked of comets, by implication, he was also talking of meteors, or at least his text can be read that way, which seems to be where the idea of meteors as prognosticators of winds came from. One sentence is sufficiently ambiguous on the point to demonstrate. Aristotle had explained the differences between comets and meteors as outlined above, and although he had just been discussing comets further, his next section began:

'We may regard it as a proof that their constitution is fiery the fact that their appearance in any number is a sign of coming wind and drought.'

Meteorologica I.VII.19–20 (op. cit., pp. 54–55).

Given that comets are not and - by the ancient accounts - were not liable to appear together in quantities with any real frequency, it is not surprising the alternative meteoric option might be preferred for estimating when strong winds could happen. From this authority, the idea just ran and ran.

3 Aratus elaborates

Part of the description of the sky and the constellations by Aratus of Soli (circa 315 to circa 245 BC), the Phaenomena, was a section later copyists sometimes subtitled 'Weather Signs'. One piece of this dealt with meteors and the wind. Phaenomena, lines 926–932:

'When through the dark night shooting stars fly thick and their track behind is white, expect a wind coming in the same path. If other shooting stars confront them and others from other quarters dart, then be on thy guard for winds from every quarter - winds, which beyond all else are hard to judge, and blow beyond men's power to predict.'

(Mair & Mair, 1955, pp. 278–279.)

Perhaps wisely, these were far from the only forecasters of winds Aratus described. His 'Weather Signs' material seems to have come from a similar, earlier text, attributed to Theophrastus (the relevant Greek text is given by Mair & Mair (loc. cit.), as footnote d). It is clear that the link between winds and meteors had been somewhat modified already, within a century or so of Aristotle's time.

4 Virgil repeats

We have met the great Roman poet Virgil (70–19 BC) in this Project before, though here, he has simply translated the earlier Greek texts into Latin. Georgics I.365–368:

'Often, too, when wind is threatening, you will see stars shoot headlong from the sky, and behind them long trails of flame, gleaming white amid night's blackness'

(Fairclough, 1935, pp. 106–107).

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5 Pliny reinforces

Pliny the Elder (23–79 AD) has become a familiar name as a source of Project information too. He made several points in his Natural History (*NH*), Books II and XVIII, on this topic.

NH II.XXXVI.100:

'Also stars appear to shoot to and fro; this invariably portends the rise of a fierce hurricane from the same quarter.'

(Rackham, 1949, pp. 244–245.)

NH II.XXXVIII.104:

'...most men attribute the hurling of thunderbolts and lightning to the winds' violence, and indeed hold that the cause of the rain of stones that sometimes occurs is that the stones are caught up by the wind...'

(op. cit., pp. 248–249).

We have included this quote because of links elsewhere with meteors and lightning or thunder, but partly because it provides one of the few near-contemporary attempts to explain the rains of stones we have discussed before from ancient Roman sources (Gheorghe & McBeath, 2006b, McBeath, 2007). It also paraphrases Aristotle's explanation for larger stones like that at Aegospotami falling from the heavens.

From Pliny's details on weather forecasting, *NH* XVIII.LXXX.351:

'In the third place must come the observations of the stars. These are sometimes seen to move to and fro, and this is immediately followed by wind in the quarter in which they have given this presage.'

(Rackham, 1950, pp. 408–409.)

This expands and modifies the first quote from Book II here, while reinforcing the general point. The final reference harks back to Aratus, but seems to add in the fixed stars too. *NH* XVIII.LXXX.352 (ibid.):

'If several shooting stars are seen, they will announce winds from the quarters in the direction of which they travel, making a white track, steady winds if the stars twinkle, but if this occurs in several parts of the sky, shifting winds and blowing from all quarters.'

6 Seneca concludes

Seneca's Natural Questions (*NQ*), written around 62–65 AD, was the last of the Classical commentaries with anything much to say on the subject that included some fresh elements. For centuries after, much scientific knowledge and investigation atrophied into a vaguely Aristotelian amalgam of what the ancients believed, with a few amendments and omissions. One thing that seems to have vanished was a belief in meteors as predictors of strong winds, such that by the 16th century, William Fulke could write a detailed treatise on all manner of atmospheric 'meteors', including 'shooting stars' and the wind itself, without once referring to this earlier link (McBeath & Gheorghe, 2007). However, John Milton still felt able to poetically re-use the idea that sailors might employ meteor sightings as a guide to the prediction and direction of strong winds in the mid 17th century (Paradise Lost IV, 555–560; see (Gheorghe & McBeath, 2006a)).

Seneca was quite definite about why meteors and winds were connected. *NQ* I.1.1 (Corcoran, 1971, pp. 14–15):

'Hear what I think about those fires which the atmosphere drives across the sky. They move obliquely at very high speeds, which is proof that they have been driven by a great force. It is obvious that they do not move on their own accord but are hurled.'

He was of course quite right to draw attention to the high meteoric speeds, but remained fixated by the idea that this speed must have come from the atmosphere alone. He continued, *NQ* I.1.12–13 (op. cit., pp. 20–21):

'Sailors think it is a sign of storm when many stars fly across the sky. But if they are a sign of winds they belong in the region where winds come from, that is, in the atmosphere, which is right between the moon and earth.'

This either assumed a much thicker atmosphere than the real one, or else a far smaller distance between the Earth and Moon, clearly. Seneca still subscribed to the notion of meteors being produced by gaseous, flammable matter, somehow injected into, or carried up to, the high atmosphere, where it might be set alight. *NQ* I.14.5 (op. cit., pp. 76–77):

'How, then, do they get started? The fire is ignited by the friction of the air and propelled violently by a wind.'

He continued by admitting there could be other types of ignition mechanism, due to variable circumstances in the atmosphere, though he was a little vague regarding the processes involved, unsurprisingly. His final comment was more definite. *NQ* I.14.6 (ibid.):

'Falling lights of this sort indicate wind; and, in fact, wind from the region where they started burning.'

7 Conclusion

While it is straightforward enough to see how the argument bringing together meteors and strong winds logically progressed from Aristotle's notes, it is more surprising it took so long for it to fall from favour. Even in Aratus' time, numerous other portents of strong winds were listed, entirely unconnected with meteors, so it seems likely that meteors were never regarded as an altogether reliable source of information on this point. Given the frequency of strong winds modernly - likely to be little different in Classical times - concurrently readily-detectable meteor activity could never have kept pace. There may be a suggestion in all this that most of those writing about such matters, were not especially keen observers of the natural phenomena they wrote about, and like too many modern authors, simply continued to repeat the copied mistakes of others in their own works.

In one respect, meteors and wind still remain connected however. As was pointed out earlier (McBeath, 2004, p. 36), 'meteorism' as a term for bowel-flatulence remains in modern medical use, deriving from the tract Epidemics attributed to Hippocrates, written around 410 BC. If this dating is correct, it might really mean

Aristotle did not invent the concept, but was repeating earlier ideas in connecting meteors with wind, or it might simply mean he had adapted the medical idea for explaining the external world too.

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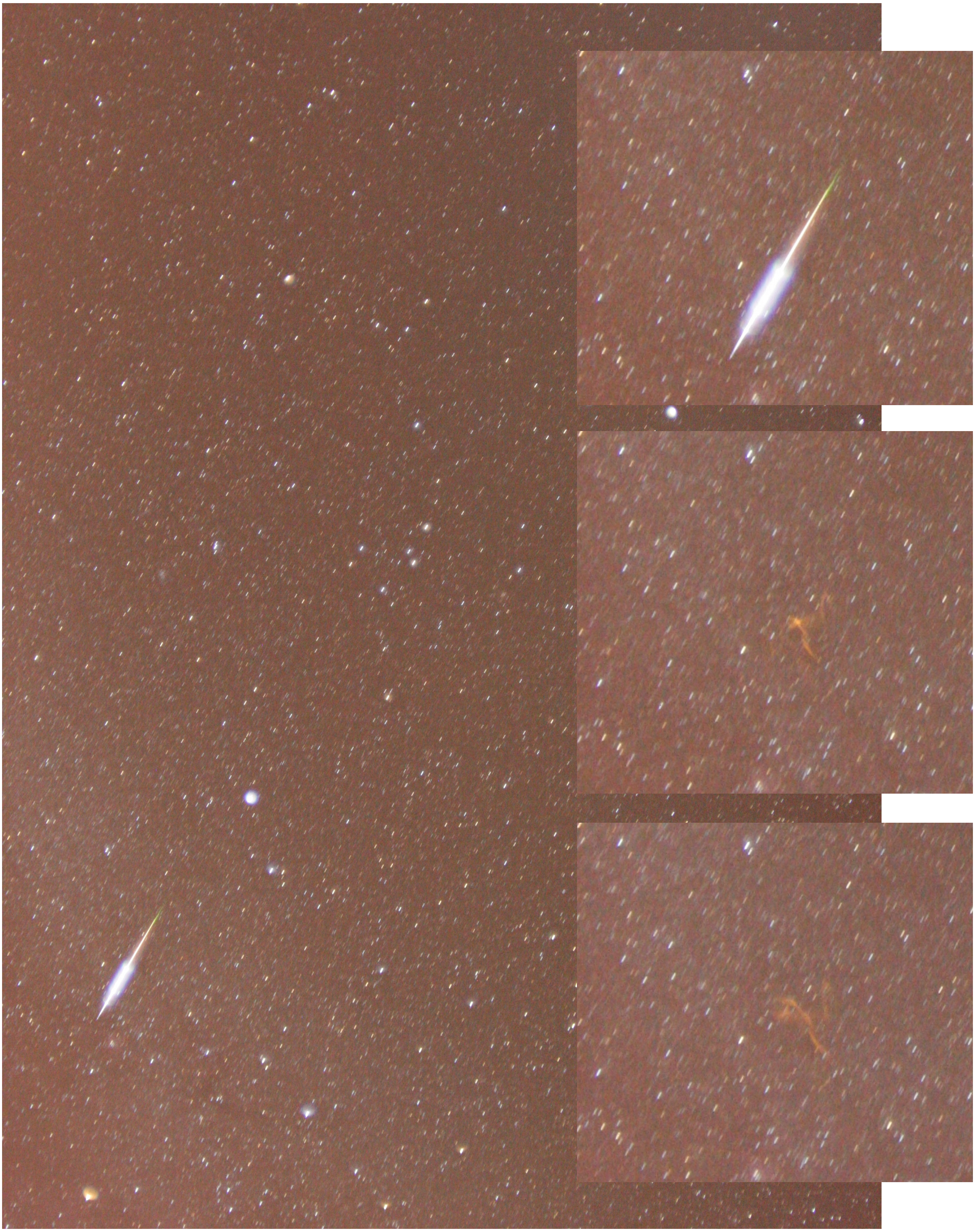
σ Hydrid in 2006



This σ Hydrid was photographed by Jürgen Rendtel in Tenerife on 2006 December 3.
The bright star in the main image is α CMi (Procyon) and Hydra's head is above.
The persistent train lasted more than 3 minutes. Insets (top to bottom): $06^{\mathrm{h}}28^{\mathrm{m}}00^{\mathrm{s}}$–$06^{\mathrm{h}}28^{\mathrm{m}}59^{\mathrm{s}}$ UT: fireball; $06^{\mathrm{h}}29^{\mathrm{m}}00^{\mathrm{s}}$–$06^{\mathrm{h}}29^{\mathrm{m}}59^{\mathrm{s}}$ UT: first train image; $06^{\mathrm{h}}30^{\mathrm{m}}00^{\mathrm{s}}$–$06^{\mathrm{h}}30^{\mathrm{m}}59^{\mathrm{s}}$ UT: second train image.
Camera: digital Canon 20D, equivalent film speed ISO 3200, lens $f = 16$ mm $f/2.8$.