Meteor activity from the Perseus-Auriga region in September and October

Jürgen Rendtel [1] *and Sirko Molau* [2]

A systematic search was carried out for radiants of high-inclination meteor showers in September and October based on data collected over eleven years with cameras of the IMO Video Meteor Network. The Aurigids (206 AUR), with an outburst in 2007, and the September ε-Perseids (208 SPE), with an outburst in 2008, were the most prominent showers. Detailed SPE outburst data of 2008 are presented. Data of the October Lyncids (228 OLY) and the β-Aurigids (210 BAU) stored in the database of the IAU Meteor Data Center have been confirmed. Radiant data of the September Lyncids (81 SLY) have been improved, and the activity period of the δ-Aurigids (224 DAU) has been better defined. Two new radiants have been detected: the September-October Lyncids (424 SOL) and the ψ-Aurigids (425 PSA). All showers are at high-inclination orbits and may be part of a complex which could be similar to the Kreutz group of comets.

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1 Introduction

In the detailed analysis of video meteor data published in August 2009 (Molau & Rendtel, 2009) the radiants in the Perseus-Auriga region in September and October were excluded because of their complex appearance. In that paper we described the most prominent showers from this region, the Aurigids (206 AUR) and the September ε-Perseids (208 SPE). Further, the September Lyncids (81 SLY) were associated with one of the radiants found active for only three data bins.

The case of these high-inclination showers was also selected for a separate paper because of the probable existence of more than two showers in that region and in the specified period. Meteor activity from that region has been the subject of earlier analyses. Those analyses focussed on the question of the relation between the September Perseids as described by Hoffmeister (1948) and the δ-Aurigids found by Drummond (1982). In the IMO meteor shower working list, these two showers were put together for many years as their radiant and velocity data allowed them to be considered as one continuous source (Rendtel, 1993). Later, Dubietis & Arlt (2002) found arguments that these should be considered two independent sources, with the September Perseids being active mainly around September 9 and the δ-Aurigids being detectable in early October with a period of very low activity around 190° Solar longitude. However, the radiant position found from modern data (video as well as visual) strongly suggested that the activity in (early) September occurs from a radiant which is at a different position from the previously listed September Perseid radiant. This was strongly supported when an unexpected outburst was observed on 2008 September 9, from a radiant which fits with the September ε-Perseids (208 SPE), which is about 10° off from the (former) September Perseid radiant (Jenniskens, 2008). The outburst observed on 2008 September 9 was centered at $08^{h}20^{m}$ UT (±20 min) and lasted for about four hours (Jenniskens, 2008; Molau & Kac, 2008). Most meteors were in the magnitude range between +4 and −8. Table 1 gives a summary of observations around the September Perseid outburst; a preliminary analysis of the radiant position and activity profile was published by Molau & Kac (2008).

For the present analysis we added further video data obtained to the sample used for the previous paper (Molau & Rendtel, 2009) and repeated the analysis for the period between 150° and 215° in Solar longitude (corresponding to August 23 – October 29). The total sample for this interval contains 168 830 meteors. The number of meteors per bin of 2° length varies from a low of 1328 meteors (at 191°) to a high of 6000 meteors (at 208° – the Orionid maximum).

When looking for possible radiants in the Perseus-Auriga region in the sky, we have to carefully distinguish them from the activity coming from the diffuse Northern Apex source (Campbell-Brown & Jones, 2006; SonotaCo, 2009). These apex meteors have velocities which are quite similar to the high-inclination showers.

As in the previous analysis, we refer to the data stored in the files of the IAU Commission 22 Meteor Data Center (IAU MDC) data base and also use the respective designation. All data presented here, has been confirmed by the IAU Commission 22 working group for shower designation.

2 Confirmation of radiants from the IAU data base

First, we checked the radiant and activity data for the Aurigids (206 AUR) and the September-ε Perseids (208 SPE), which we easily detected in the data sample. Both showers have produced activity outbursts within the ten years of the video camera network operation (cf. Rendtel, 2007, for the 206 AUR and Table 1 for the 208 SPE). Results for these two showers were listed in the previous paper (Molau & Rendtel, 2009), and the position and drift can be seen in Figure 1. We can also confirm the detection of the October Lyncids (228 OLY). The data fit the entry in the IAU MDC data base. The activity occurs only in the last portion of the interval and can be found in Figure 3.

[1]Eschenweg 16, 14476 Potsdam & Astrophys. Inst. Potsdam, An der Sternwarte 16, 14482 Potsdam, Germany
Email: jrendtel@aip.de
[2]Abenstalstr. 13, 84072 Seysdorf, Germany
Email: sirko@molau.de

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Table 1 – Observational data of the period centered around the September ε-Perseid outburst on 2008 September 9, covering the period from September 8 (evening) to September 10 (morning). An activity profile derived from complete data of the IMO Video Meteor Network was published by Molau & Kac (2008). The video data listed below is just to characterize the size of the sample.

Period UT	SPE meteors	Lim. magn.	Method	Location	Observer	Reference
1853–2300 2300–0200 0200–0342	2 2 3	≈ 4	video (Sep 08–09)	near Venice, Italy 12.1°E, 45.6°N	E. Stomeo	Stomeo, 2008
2300–0130	8	6.3	visual (Sep 08–09)	Viernau, Germany 10.5°E, 50.7°N	P. Bader	Rendtel, 2008
0058–0248	4	6.2	visual	Potsdam, Germany 13.0°E, 52.5°N	J. Rendtel	Rendtel, 2008
0455–0555 0600–0700 0700–0800 0800–0900 0900–0945	4 2 9 16 5	5.7 5.7 5.8 5.8 5.6	visual	Ames, Iowa, USA 93.6°W, 42.1°N	P. Martsching	Martsching, 2008
0620–1030	25 brighter -2		all-sky video	Marshall Space Flight Center, 97°W, 38°N	W.J. Cooke	Jenniskens, 2008
0726–0921	11		wide-field camera low-light-level video	Kelowna, BC, Canada 119.5°W 49.9°N	J. Brower	Jenniskens, 2008
0732–1047	14	≈ 2	video	Tucson, Arizona, USA 111°W, 32°N	C. Hergenrother	Hergenrother, 2008
0700–1200	4	6.0	video	San Diego, USA 117.1°W, 32.1°N	R. Lunsford	Molau & Kac, 2008
0718–1005	"increased rate"		forward met. scatter	Helsinki, Finland 25°E, 60°N	E. Lyytinen	Jenniskens, 2008
2245–0055	0	6.2	visual (Sep 09–10)	Potsdam, Germany 13.0°E, 52.4°N	S. Näther	Rendtel, 2008
2357–0215	6	6.2	visual (Sep 09–10)	Potsdam, Germany 13.0°E, 52.5°N	J. Rendtel	Rendtel, 2008

Two further weak sources listed in the IAU MDC data base can probably be associated with radiants derived from our data: between September 17 and 19 (174°–176°) we find a radiant at $\alpha = 43°, \delta = +65°$ with $V_\infty = 54$ km/s. This is not far from the position given for the September β-Cassiopeids (207 SCS). However, both the radiant and the velocity do not fit well and we would not have recognized the case if it were not in the data base. We did not check the coincidence in further detail as the source is away from the region we focussed on.

Another radiant at $\alpha = 87°, \delta = +49°$ with $V_\infty = 70$ km/s fits nicely with the β-Aurigids (210 BAU) for which the IAU MDC gives $\alpha = 86°, \delta = +43°$ at 67 km/s. Like the previous case, this weak source can be detected only over three bins between 179° and 181° (September 22–25). Its drift is included in Figure 2.

3 Delta Aurigids and radiants in Lynx

The initial question was whether there is a continuous activity from the Perseus-Auriga region starting with the shower listed as 208 SPE, becoming the 224 DAU (δ-Aurigids) later in September and October. The δ-Aurigids were discussed in detail by Drummond (1982) and because of the similarity with the activity in early September these were considered as coming from one source (Rendtel, 1993). Analyses of observations later indicated that there are two distinct sources (Dubietis & Arlt, 2002).

From the updated video meteor data we checked the activity from the Northern Apex source which is not too far from the region. This source forms no defined radiant but rather a scattered area from which meteors occur on retrograde orbits (Campbell-Brown & Jones, 2006). The size of this region may have a radius of about 10°. Thus any distinct source should be about 20° away from the (average) North Apex source center. We determined this source also from our data and calculated a mean center and its average drift over the entire period. At this point we checked for possible other sources.

First, we come back to the case of the September Lyncids (81 SLY). Already in our previous analysis (Molau & Rendtel, 2009) we stated that this is a weak source of short duration which can be detected only over three bins. Since the data for the entry in the IAU MDC data base was of low accuracy, we decided to assign the activity found in our data with the entry in the data base. Now, the present analysis shows two weak sources. In the interval 165–173° we find a radiant at $\alpha = 111°, \delta = +56°$ at 59 km/s which fits well to the current entry in the IAU MDC data base $(107°, +55°, 61$ km/s). We suggest that this should remain the 81 SLY entry (see Figure 1). The short duration shower found in the 2009 analysis—which was then associated with the 81 SLY—is different as we find $\alpha = 110°, \delta = +48$ at $V_\infty = 68$ km/s. Unfortunately, this is also in the constellation Lynx with few and no named stars. Hence it is now September-October-Lyncids (424 SOL, shown in Figure 2) because both the September Lyncids (81 SLY) and the October Lyncids (228 OLY) were already listed. Their radiants and drifts occur in Figures 1 and 3, respectively.

With the δ-Aurigids, we again find two radiants which both are more than 20° away from the Apex and also that distance from each other. Both radiants deviate from the data listed in the IAU MDC. At 191° Solar longitude – given as the maximum of the shower 224 DAU, our data show nothing in the respective region. The two sources we can detect occur later. The more western radiant fits reasonably with the 224 DAU data if extrapolated. We suggest a change in the entry for the 224 DAU and the addition of a radiant which is named ψ-Aurigids (425 PSA). The respective data are listed in Table 2, and the positions can be seen in Figure 3. Possibly, the two radiants we find from the present video data were not separated in the previous analyses – although this would not explain the difference in the activity data.

4 Rejected sources

Three more radiants have been detected from our data. They are all closer to the apex than the 20 degree limit mentioned in section 3. Further, the associated activity expressed in the rate VR strongly varies between neighbouring bins, indicating that the data do not represent a reliable source. Finally, the deviation between radiant positions calculated for successive bins also exceeds the limits set in our 2009 paper.

5 Conclusions

There are several weak sources producing activity from the region between Perseus, Lynx and Auriga. In the case of the first of the stronger showers, the Aurigids (206 AUR), the parent comet C/1911 N1 (Kiess) is confirmed. The radiant and activity of the September ε-Perseids (208 SPE) is also well established, at least after the activity outburst observed in 2008, although a parent object is not yet known. Further weak showers with radiants in the same region are the δ-Aurigids (224 DAU) which are definitely separate from the September ε-Perseids (208 SPE). Three radiants in the constellation Lynx were found. They do not form a continuous source as their positions in the sky differ significantly in declination. This becomes obvious in the summarizing Figure 4. The September-October-Lyncids (424 SOL) are a new detection. The two showers in Auriga, the β-Aurigids (210 BAU) and the newly detected ψ-Aurigids (425 PSA) are of short duration (detected over three and five bins, respectively). Except for the peculiar Aurigids (206 AUR), no parent objects are known. Perhaps all or some of these showers $(130° < i < 150°)$ result from a group of comets on highly inclined orbits, somewhat similar to the Kreutz group.

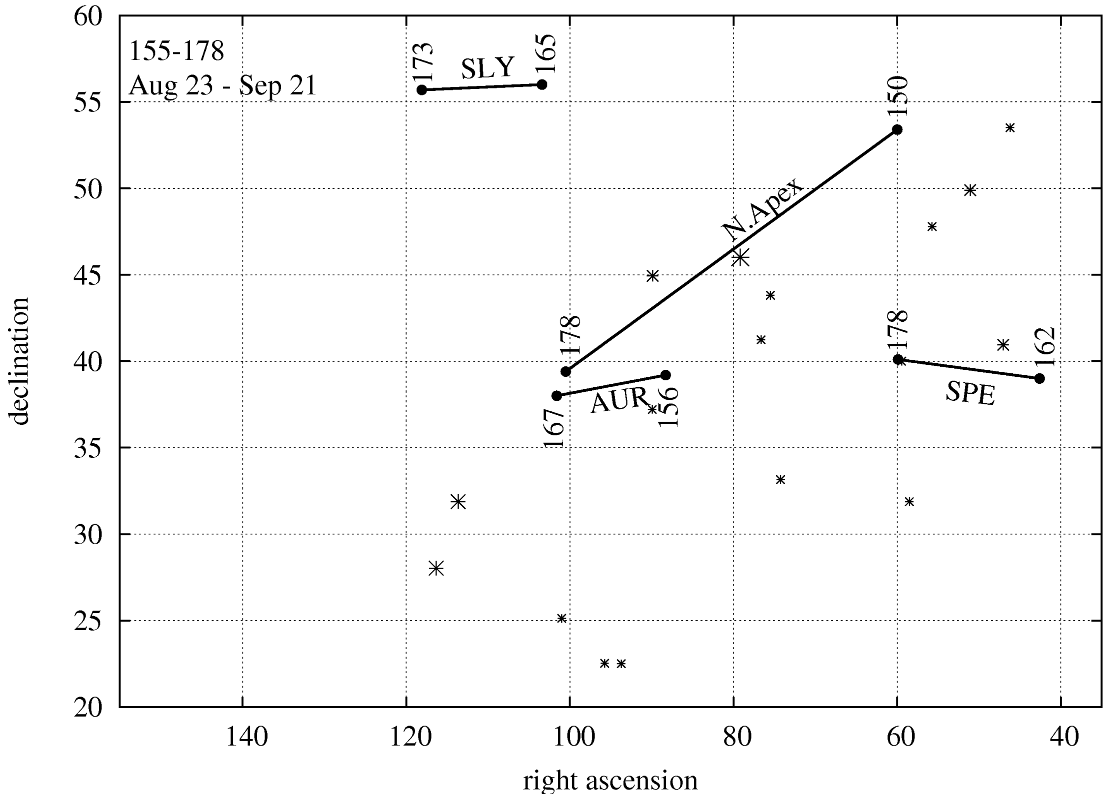

Figure 1 – Radiants in the Perseus-Auriga region in the period 155–178°. Here we find two considerable showers and the Northern Apex source. The numbers along the radiant drifts denote the corresponding Solar longitudes. Bright stars of Perseus, Auriga and Gemini are shown as asterisks.

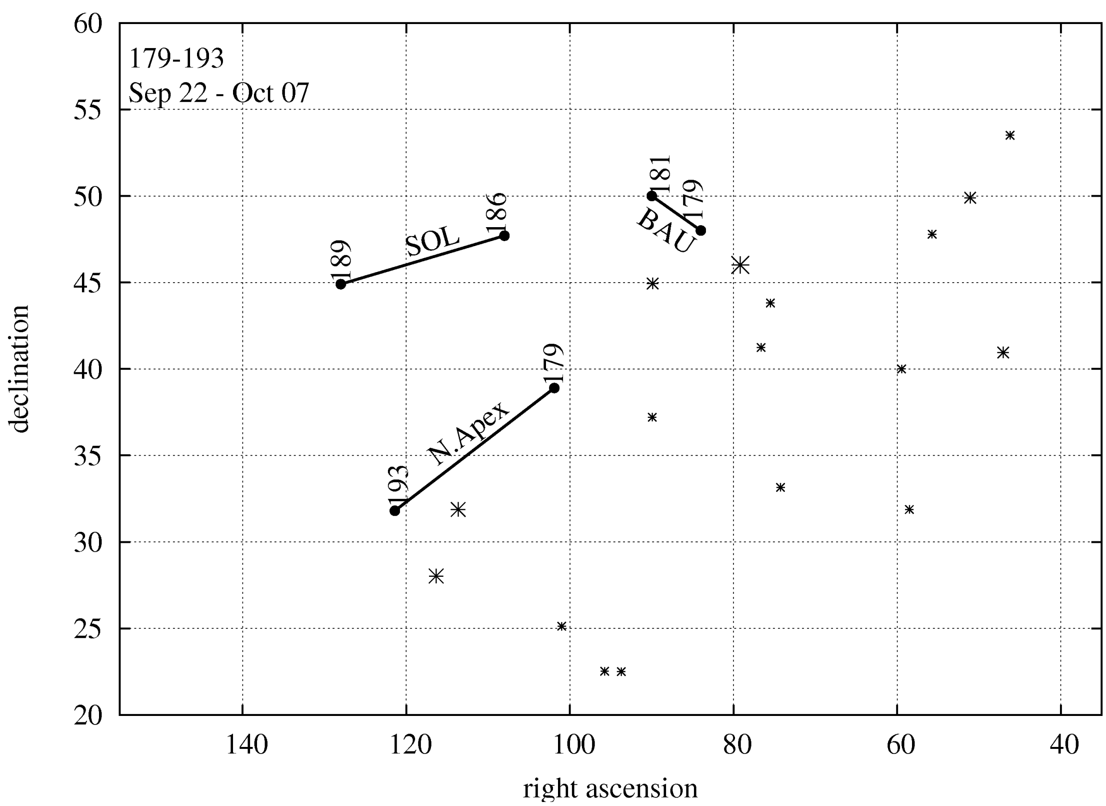

Figure 2 – Radiants in the Perseus-Auriga region in the 179–193° period. The numbers along the radiant drifts denote the corresponding Solar longitudes.

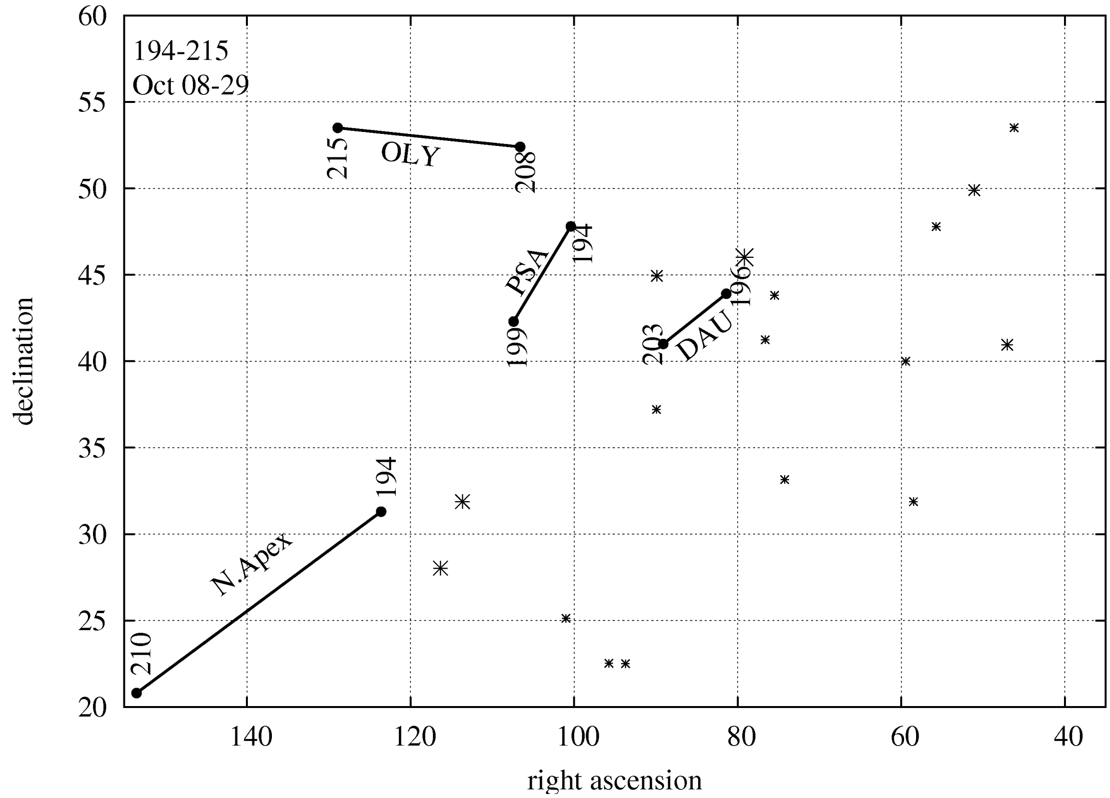

Figure 3 – Radiants in the Perseus-Auriga region in the 194–215° period. The numbers along the radiant drifts denote the corresponding Solar longitudes.

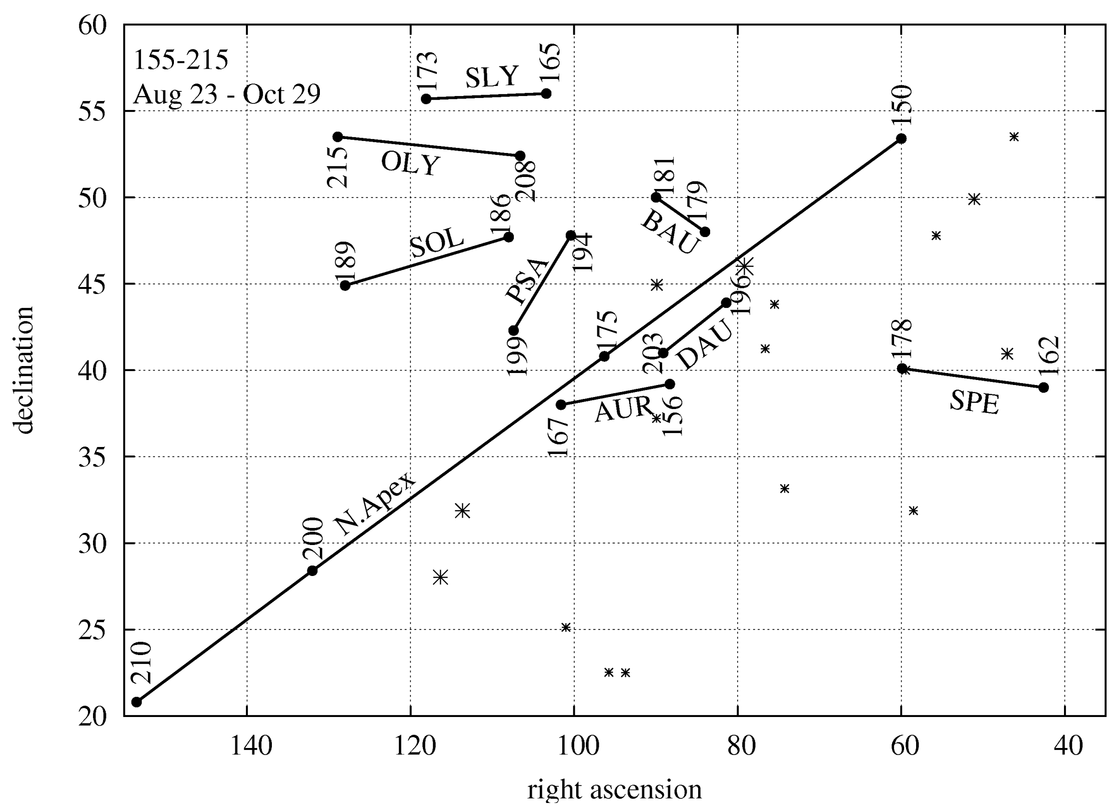

Figure 4 – All radiants in the Perseus-Auriga region which were detected during the entire period under study. The numbers along the radiant drifts denote the corresponding Solar longitudes, the three-letter codes refer to the IAU meteor shower designation.

Table 2 – Data of the meteor showers discussed in this paper sorted by Solar longitude (J2000.0). (V) refers to the obtained video data, (L) gives the values of the MDC list. VR is the video rate (explained by Molau & Rendtel, 2009). The last column gives the number of meteors associated with the shower radiant. Information for the Northern Apex source found from the video meteor data are given for comparison.

Shower	Peak $\lambda_\odot$[°]		Period $\lambda_\odot$[°]	Rad. position and drift [°]				V_∞ [km/s]		Max.	Meteors
	(V)	(L)	(V)	α	$\Delta\alpha$	δ	$\Delta\delta$	(V)	(L)	VR	
206 AUR	159	158	156–167	93	+1.1	+39	−0.1	67	67	3.0	1128
208 SPE	167	170	162–178	48	+1.1	+40	+0.1	66	65	3.3	1930
81 SLY	169	167	165–173	111	+1.8	+56	−0.0	59	62	1.8	530
210 BAU	180	179	179–181	87	+3.1	+49	+1.2	70	67	1.8	559
424 SOL	186	–	186–189	110	−2.9	+48	−0.7	68	–	1.6	237
224 DAU	198	191	196–203	84	+1.1	+44	−0.4	67	66	1.7	744
425 PSA	199	–	194–199	107	+1.4	+42	−1.1	69	–	2.0	602
228 OLY	210	206	208–215	113	+3.2	+53	+0.2	61	66	1.3	516
N.Apex			150–215		+1.4		−0.5	68	68		2408

References

Campbell-Brown M. and Jones J. (2006). "Annual variation of sporadic meteor rates". *MNRAS*, **367**, 709–716.

Drummond J. (1982). "A note on the Delta Aurigid meteor stream". *Icarus*, **51**, 655–659.

Dubietis A. and Arlt R. (2002). "The current Delta-Aurigid meteor shower". *WGN, Journal of the IMO*, **30**, 168–174.

Hergenrother C. (2008). "September Perseids – 2008/09/09 – prelim video results". `http://lists.meteorobs.org/pipermail/meteorobs/2008-September/008844.html` . Meteorobs mailing list, message 008844 (Sep. 9, 2008).

Hoffmeister C. (1948). *Meteorströme*. J.A. Barth, Leipzig.

Jenniskens P. (2008). "September Perseid meteors 2008". *Electronic Telegram No. 1501, Central Bureau for Astronomical Telegrams.* (Sep. 9, 2008).

Martsching P. (2008). "Sept Perseids 08/09 Sept 2008". `http://lists.meteorobs.org/pipermail/meteorobs/2008-September/008847.html` . Meteorobs mailing list, message 008847 (Sep. 9, 2008).

Molau S. and Kac J. (2008). "Results of the IMO Video Meteor Network – September 2008". *WGN, Journal of the IMO*, **36**, 112–113.

Molau S. and Rendtel J. (2009). "A comprehensive list of meteor showers obtained from 10 years of observations with the IMO Video Meteor Network". *WGN, Journal of the IMO*, **37**, 98–121.

Rendtel J. (1993). "Radiant and orbits of δ-Aurigids and September Perseids". In Očenáš D. and Zimnikoval P., editors, *Proceedings of the IMC Smolenice 1992*, pages 67–73. IMO.

Rendtel J. (2007). "Visual observations of the Aurigid peak on 2007 September 1". *WGN, Journal of the IMO*, **35**, 108–112.

Rendtel J. (2008). "Visuelle Meteorbeobachtungen im September 2008". *Meteoros*, **11**, 190–191.

SonotaCo (2009). "A meteor shower catalog based on video observations in 2007–2008". *WGN, Journal of the IMO*, **37**, 55–62.

Stomeo E. (2008). "September Perseids". `http://lists.meteorobs.org/pipermail/meteorobs/2008-September/008855.html` . Meteorobs mailing list, message 008855 (Sep. 10, 2008).

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