Weak Meteor Showers in Photographic and TV Databases

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Abstract

We present the results of an analysis of photographic and TV observations of the meteors from four databases combined into one uniform database. The total number of meteors used in the analysis is 7538 observed in the period 1952-2002. We wanted to demonstrate the possible existence of some minor meteor showers listed in the *IMO Working List of Visual Meteor Showers* and other lists of photographic radiants of minor meteor showers mentioned in some recent papers. Our analysis was done using special software which checks for the existence of almost 30 showers, but in this report we present the results of only those for which we obtained interesting output.

1 Databases

In our analysis we used four databases:

1. *"Orbital Elements of Photographic Meteors"* by McCrosky & Posen (1961),
2. *"Double-Station Observations of 454 TV Meteors"* by Sarma & Jones (1985),
3. databases of the *Dutch Meteor Society (DMS)*,
4. databases of the Japanese *Meteor Science Seminar Working Group (MSSWG)*.

The databases contain only orbital and trajectory data of video and photographic multi-stations meteors.

The first and the second databases we transformed to computer-ready form. In the first database the number of meteors was 2529 from the period 1951 February – 1954 July. The Sarma & Jones data contains 454 meteors from the years 1981-1982.

The *DMS* databases contain TV and photographic observations. The total number of meteors from this data which we used in the analysis is 2194 (1081 meteors detected photographically and 1113 by the TV technique). These meteors were detected in the years 1972-2000.

The Japanese data includes 2154 meteors from 1983-2001. Since 1993 they have pursued double-station TV meteor observations. Before 1992, the data include only double-station photographic observations.

All these databases contain the orbital and physical parameters of the meteor orbits, such as true radiant position (α, δ), velocities, orbital coordinates, photographic magnitude, etc.

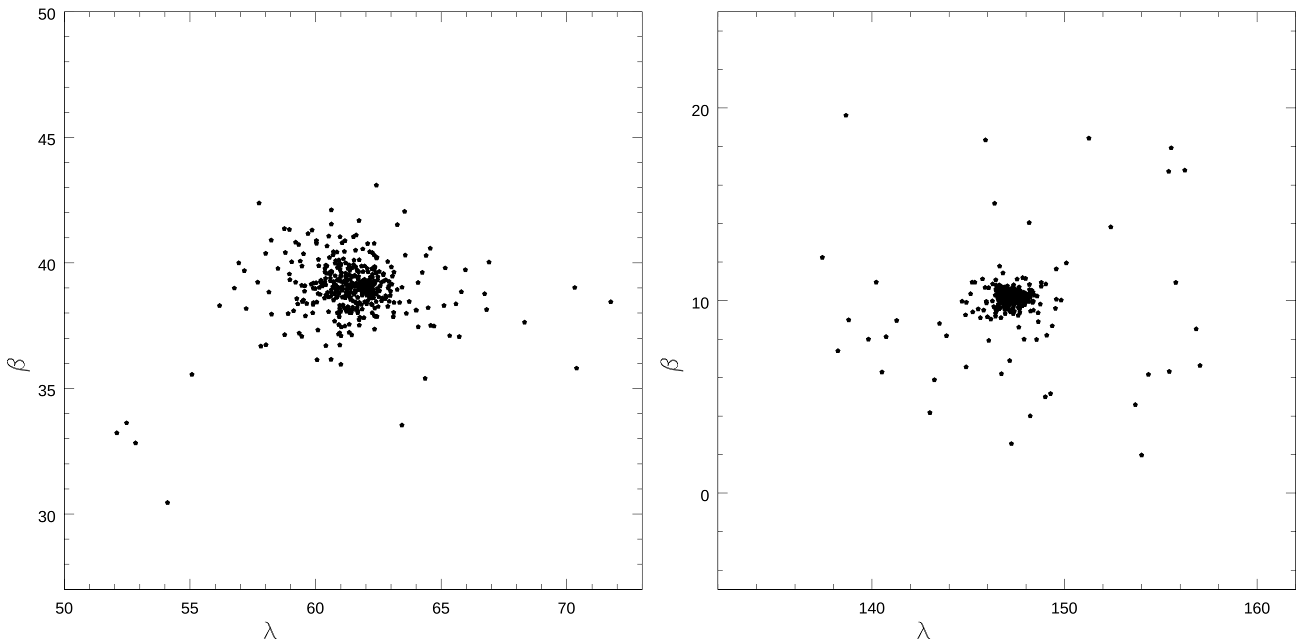

Figure 1: *Left panel: Perseids for* $\Delta\lambda = 1.0°$. *Theoretical radiant:* $\lambda = 61.8°$, $\beta = 38.8°$. *Right panel: Leonids for* $\Delta\lambda = 0.9°$, $\lambda = 147.1°$, $\beta = 10.1°$.

In our analysis we used the date of appearance, coordinates of the radiant and geocentric velocity.

The total number of meteors we included in our analysis is 7538.

2 Software

As an input our program requires the coordinates of center of the radiant (α, δ) during the day of the maximum. We also input the geocentric velocity of the shower. The program transformed the equatorial coordinates to the ecliptical (λ, β). For the different drifts $\Delta\lambda$, the program takes the meteors from the selected period of activity. The coordinates of the radiants of these meteors are then transformed to the day of maximum.

We assumed the area where meteors were taken into account to be $\pm 10°$ around the center of the radiant. The difference from the theoretical velocity could not be larger than 5°. We used this width for all showers.

The tests of the software were made using the data obtained for major meteor showers. The results obtained for Perseids and Leonids are shown in Figure 1.

3 Results

3.1 α-Capricornids

This well known shower is active from July 3 to August 15 with a maximum around July 30. The coordinates of the radiant are $\alpha = 307°$, $\delta = -10°$ $(\lambda = 306.8°, \beta = 8.8°)$ for this day,

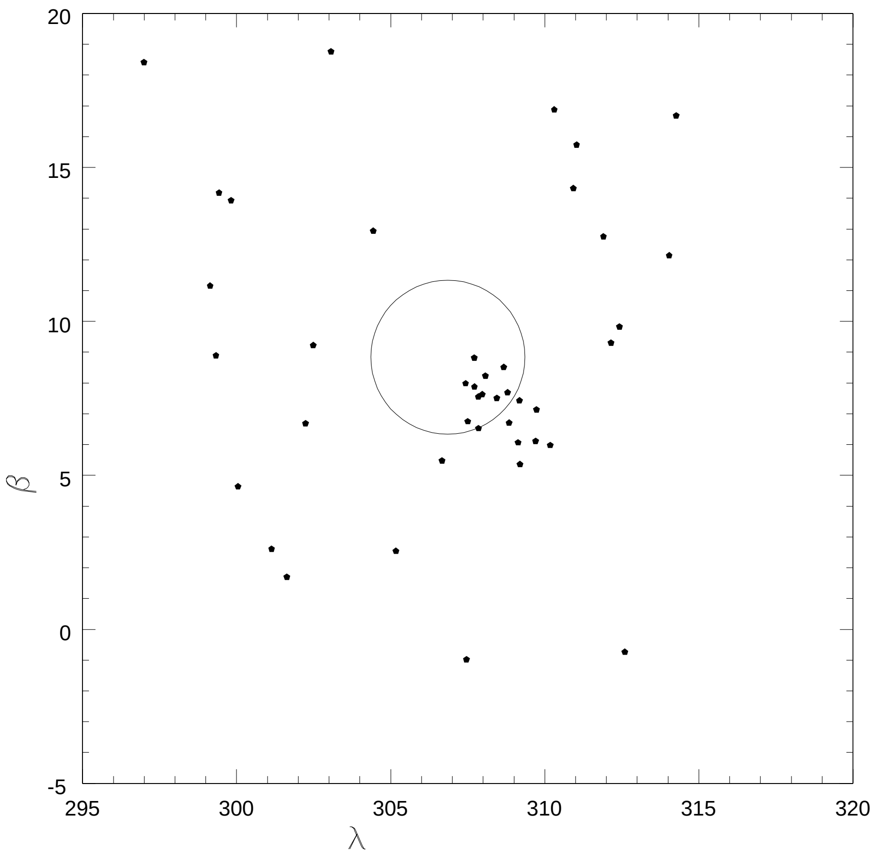

Figure 2: *α-Capricornids for* $\Delta\lambda = 0.7°$. *Theoretical radiant:* $\lambda = 306.8°$, $\beta = 8.8°$.

and the geocentric velocity V_∞ is 25 km/s. Figure 2 shows the area around this radiant and meteors with parameters which match the α-Capricornids well. This picture of the radiant we obtained for a daily drift of 0.7°.

3.2 α-Monocerotids

The shower has a typical ZHR of about 5. The period of activity is November 15–25 with the maximum on November 22. The radiant is at $\alpha = 117°$, $\delta = 1°$ and the entry velocity is 65 km/s. In Figure 3 we can see a distinct radiant in the center of the circle. The theoretical center of the radiant is $\lambda = 118.8°$, $\beta = -19.8°$.

3.3 χ-Orionids

The next shower we selected from the *IMO Working List* was the χ-Orionids. The visual ZHR is around 3. The radiant is located around $\alpha = 82°$, $\delta = 23°$. The activity starts on November 26 with a maximum on December 2 and lasts till December 15. The entry velocity is 28 km/s. The meteors with similar parameters for drift $\Delta\lambda = 0.9°$ are shown in Figure 4. The number near each meteor's radiant denotes its entry velocity.

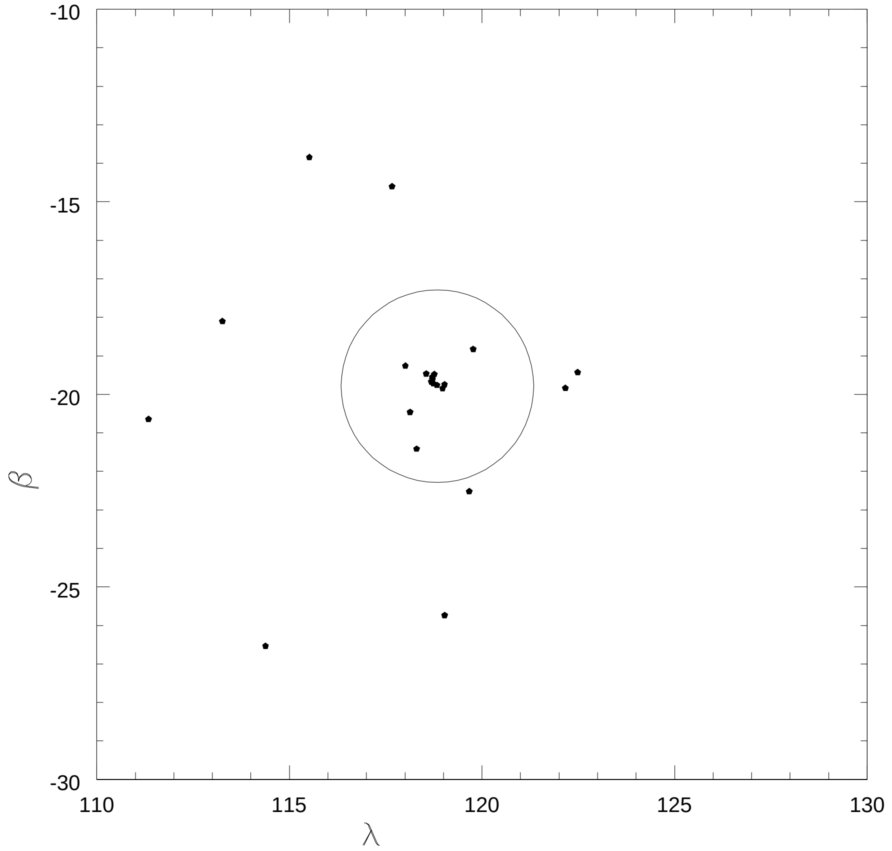

Figure 3: *α-Monocerotids for* $\Delta\lambda = 1.0°$. *Theoretical radiant:* $\lambda = 118.8°$, $\beta = -19.8°$.

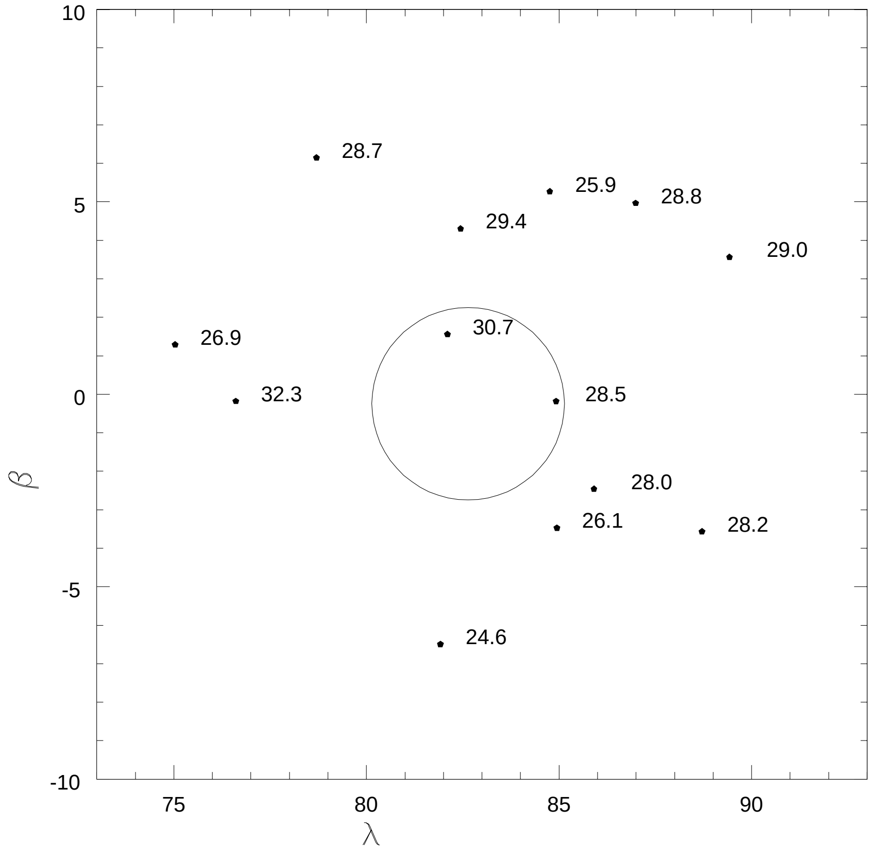

Figure 4: *χ-Orionids for* $\Delta\lambda = 1.0°$. *Theoretical radiant:* $\lambda = 82.6°$, $\beta = -0.2°$.

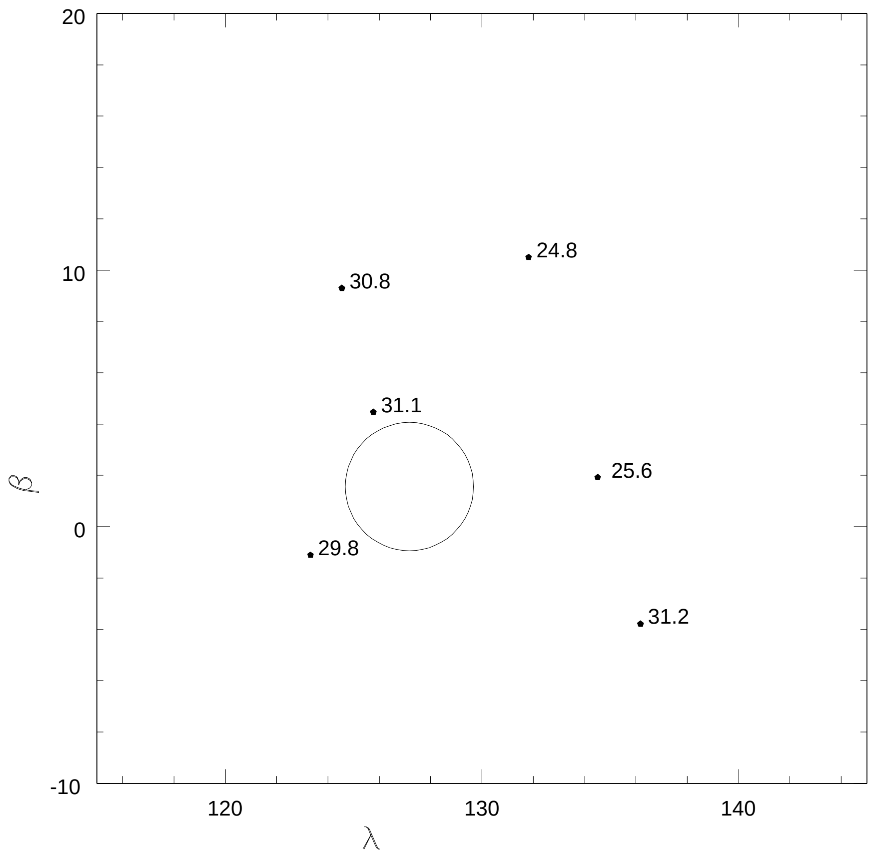

Figure 5: δ-*Cancrids for* $\Delta\lambda = 1.0°$. *Theoretical radiant:* $\lambda = 127.2°$, $\beta = 1.6°$.

3.4 δ-Cancrids

This is one of the minor winter showers. Its activity lasts from January 1st till 24th. The coordinates of the radiant during the maximum (January 17) are $\alpha = 130°$, $\delta = 20°$ and $V_\infty = 28$ km/s. In Figure 5 we can see meteors with their velocities from the area around this radiant. This diagram is computed for $\Delta\lambda = 1.0°$.

3.5 α-Bootids

This shower was checked for $\alpha = 218°$, $\delta = 19°$ and $V_\infty = 20$ km/s. We took meteors from the period April 14 – May 12. The sample from this period has 442 meteors. The results for $\Delta\lambda = 1.0°$ are shown in Figure 6. The maximum was assumed to be on April 27.

3.6 δ-Leonids

The coordinates of the δ-Leonids' radiant are $\alpha = 168°$, $\delta = 16°$ for February 25. The activity starts on February 15 and finishes on March 10. The number of meteors in this period was 241. Only four meteors have similar parameters to the theoretical ones. Figure 7 shows those meteors for $\Delta\lambda = 1.0°$. In our analysis we assumed the velocity to be 23 km/s.

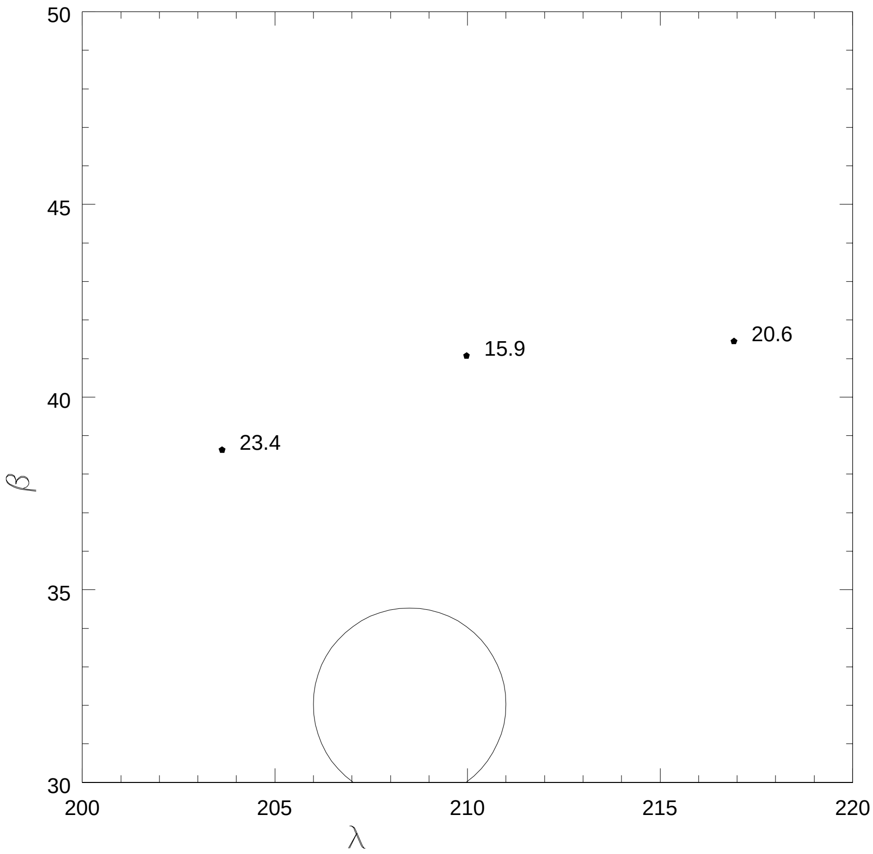

Figure 6: *α-Bootids for* $\Delta\lambda = 1.0°$*. Theoretical radiant:* $\lambda = 208.5°$, $\beta = 32°$.

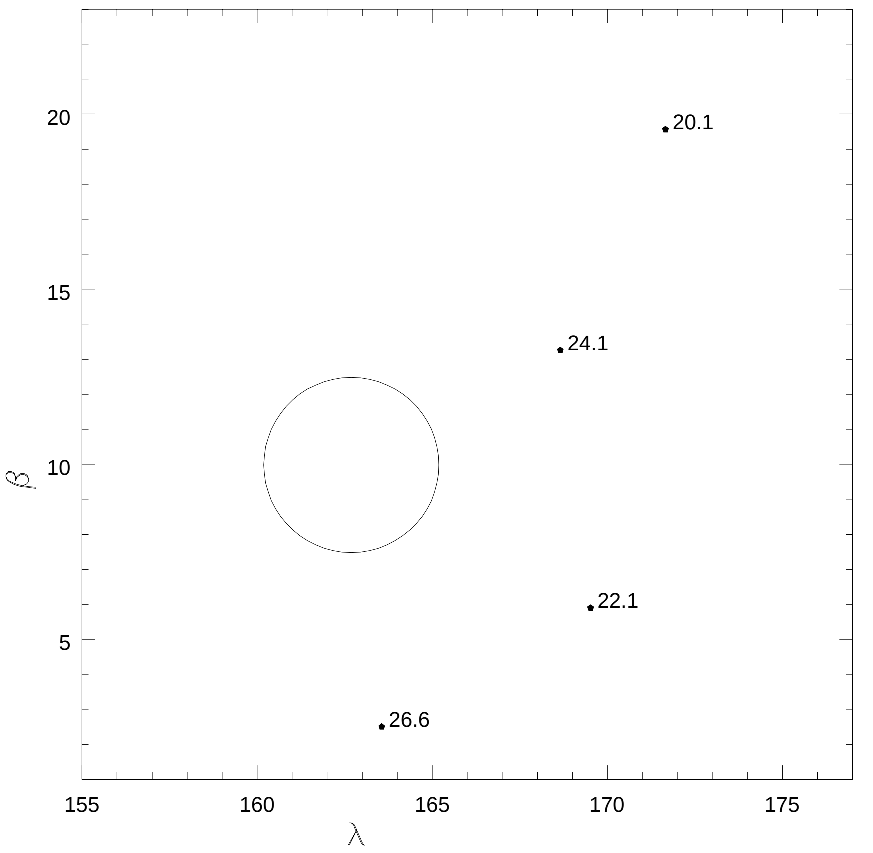

Figure 7: *δ-Leonids for* $\Delta\lambda = 1.0°$*. Theoretical radiant:* $\lambda = 162.7°$, $\beta = 10°$.

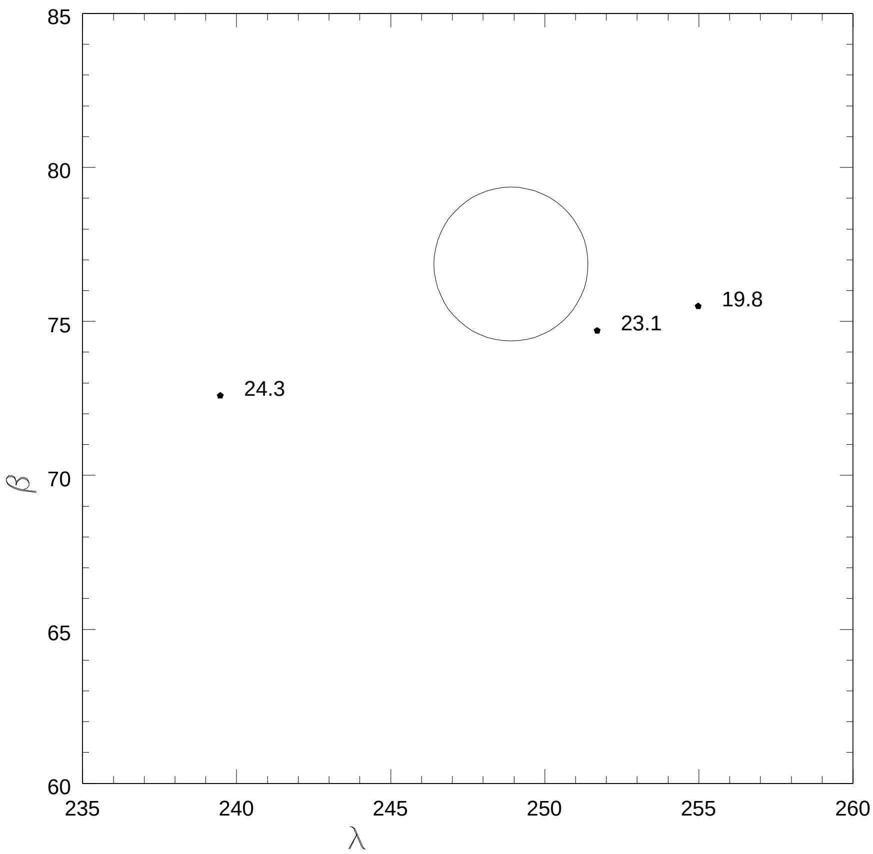

Figure 8: *Draconids for* $\Delta\lambda = 1.0°$*. Theoretical radiant:* $\lambda = 248.9°$, $\beta = 76.9°$.

3.7 Draconids

This shower is characterized by its irregular activity. In the period October 6–10 we found 43 meteors, but only three of them in the area near the theoretical radiant. The entry velocity is equal to 20 km/s and the coordinates of the radiant are $\alpha = 262°$, $\delta = 54°$ (Figure 8).

3.8 ϵ-Geminids

Figure 9 shows the results obtained for the ϵ-Geminids. The coordinates of the radiant during the maximum (October 18) are $\alpha = 102°$, $\delta = 27°$ and $V_\infty = 70$ km/s. The period of activity is October 14–27.

3.9 κ-Cygnids

This weak shower is active during August (3–25, maximum 18th). The velocity is about 25 km/s. The radiant coordinates are $\alpha = 286°$, $\delta = 59°$. The analysis showed that four meteors may belong to this shower (Figure 10). The whole analyzed sample had 1055 meteors.

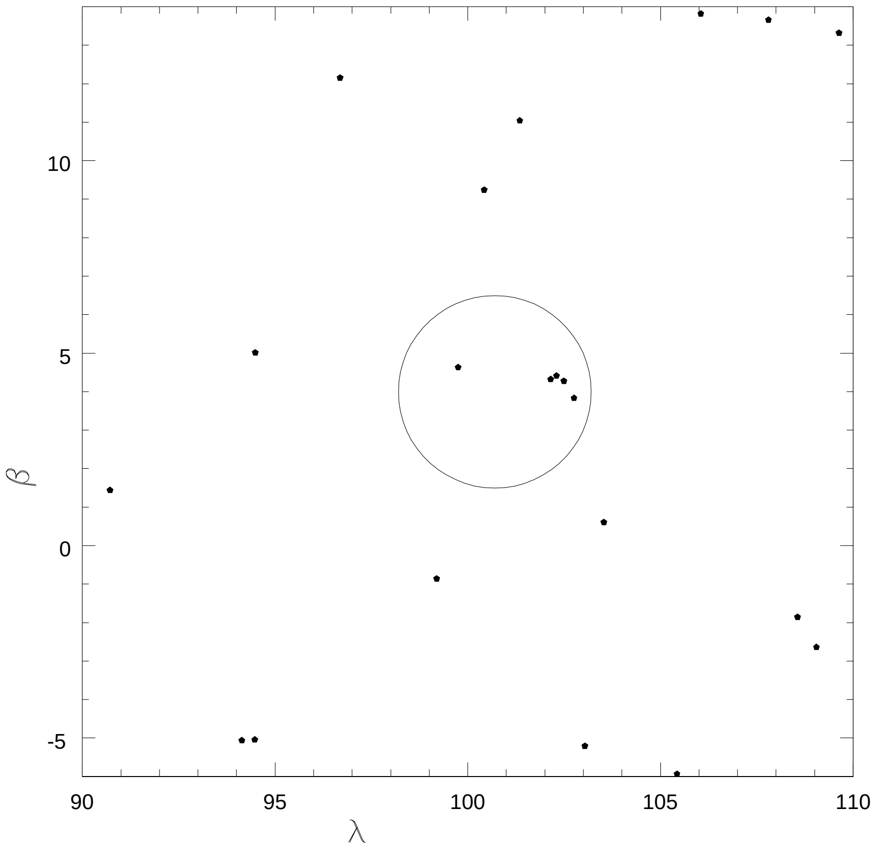

Figure 9: *ϵ-Geminids for $\Delta\lambda = 0.9°$. Theoretical radiant:* $\lambda = 100.7°$, $\beta = 4°$.

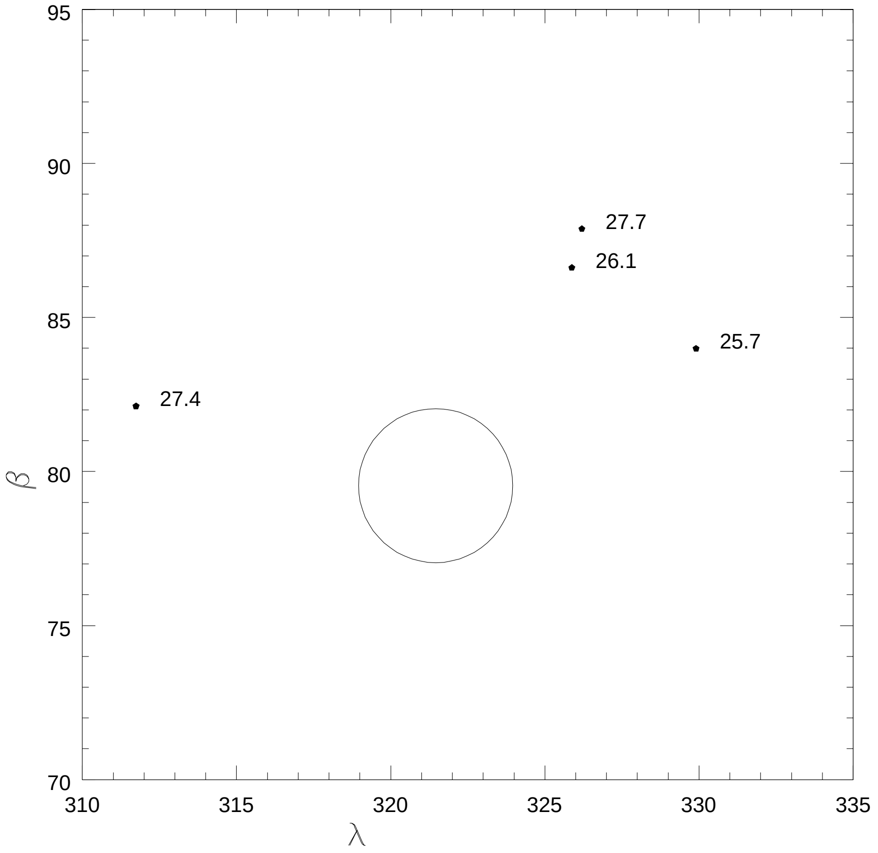

Figure 10: *κ-Cygnids for $\Delta\lambda = 1.0°$. Theoretical radiant:* $\lambda = 321.5°$, $\beta = 79.5°$.

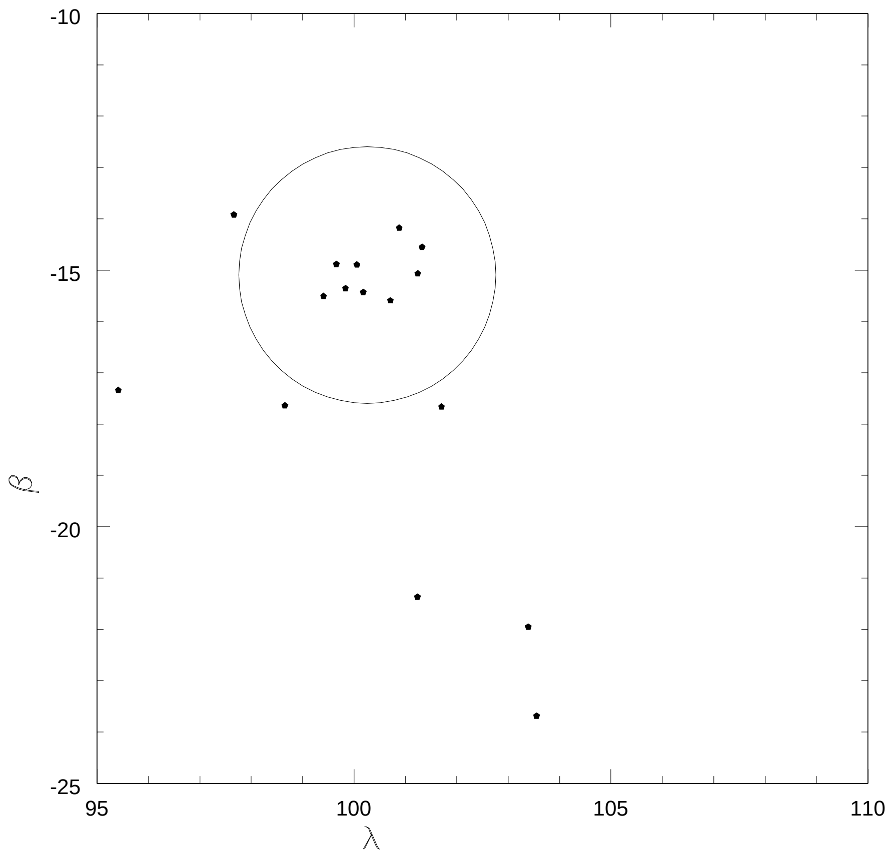

Figure 11: *Monocerotids XII for* $\Delta\lambda = 0.7°$. *Theoretical radiant:* $\lambda = 100.3°$, $\beta = -15.1°$.

3.10 Monocerotids XII

In Figure 11 we see meteors from the period November 27 to December 17 with velocities around 42 km/s. The coordinates of the radiant on the day of the maximum (December 17) are $\alpha = 100°$, $\delta = 8°$. We obtain the best shape of the radiant for $\Delta\lambda = 0.7°$. The diameter of the circle in the diagram is 5°.

3.11 σ-Hydrids

This weak shower (ZHR = 2) is introduced in Figure 13. The meteors were taken from the period December 3–15. The maximum is on December 12 when the radiant coordinates are $\alpha = 127°$, $\delta = 2°$ with $V_\infty = 58$ km/s.

3.12 Delphinids

This possible minor shower is mentioned by Olech, Jurek & Gajos (1999) and Wiśniewski & Olech (2000). Figure 14 shows results for $\alpha = 304°$, $\delta = 5°$, $V_\infty = 35$ km/s and $\Delta\lambda = 1.2°$. We also checked other parameters: $\alpha = 301°$, $\delta = 7°$, $V = 45$ km/s but we found no meteors matching these parameters. The sample of meteors used in analysis had 311 events.

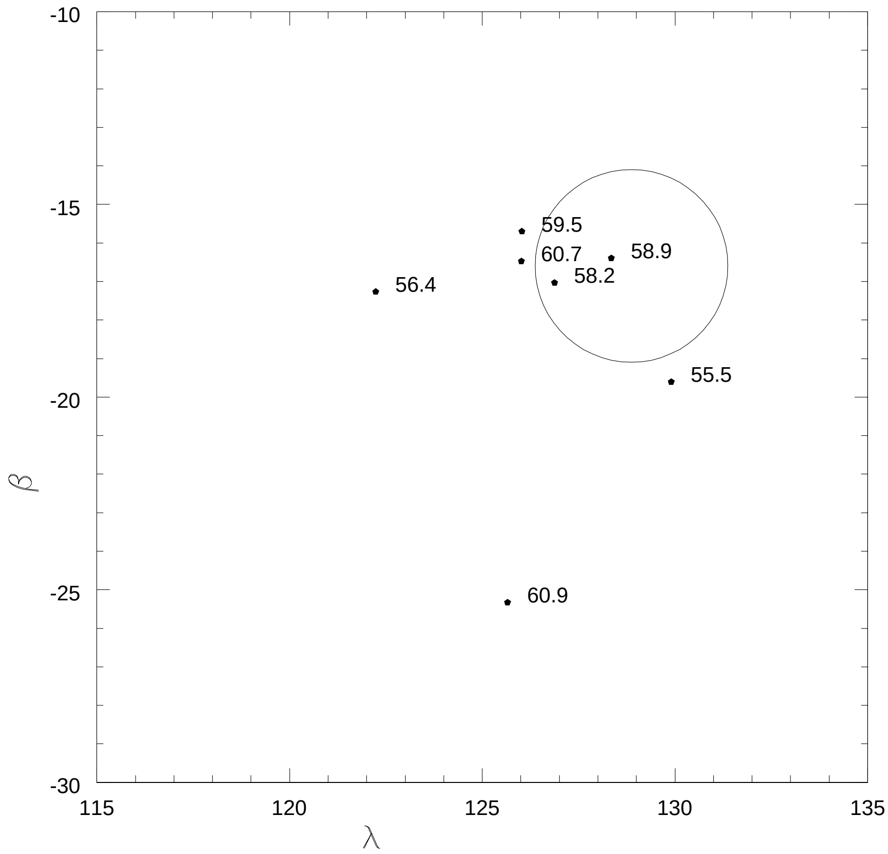

Figure 12: *σ-Hydrids for* $\Delta\lambda = 1.0°$. *Theoretical radiant:* $\lambda = 128.9°$, $\beta = -16.6°$.

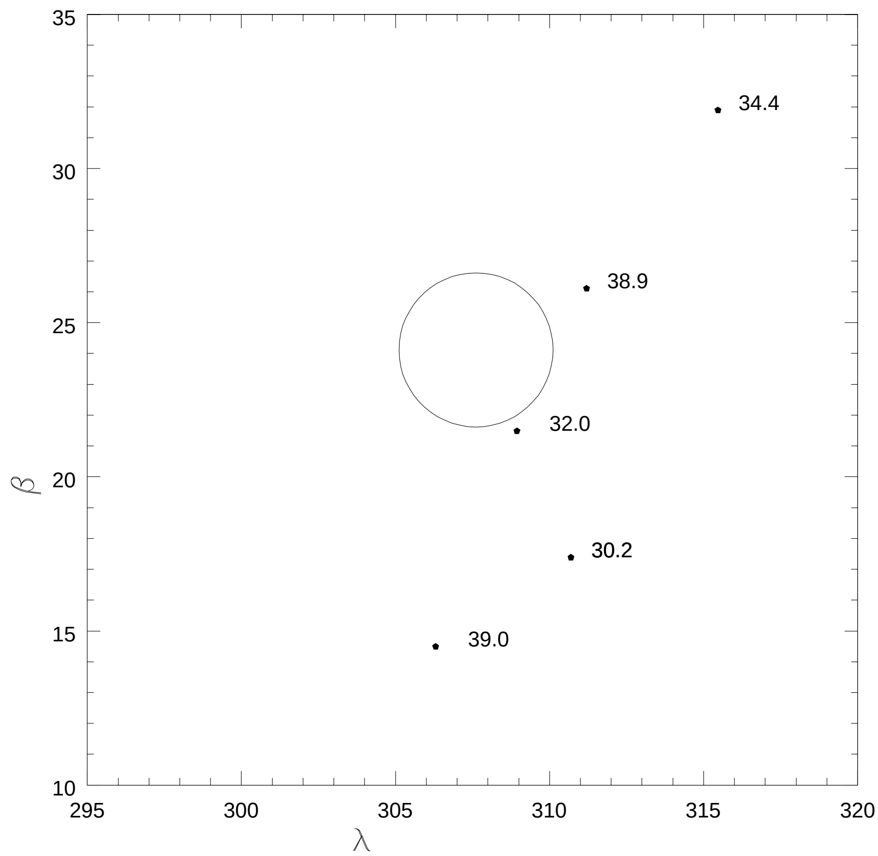

Figure 13: *Delphinids for* $\Delta\lambda = 1.2°$. *Theoretical radiant:* $\lambda = 307.6°$, $\beta = 24.1°$.

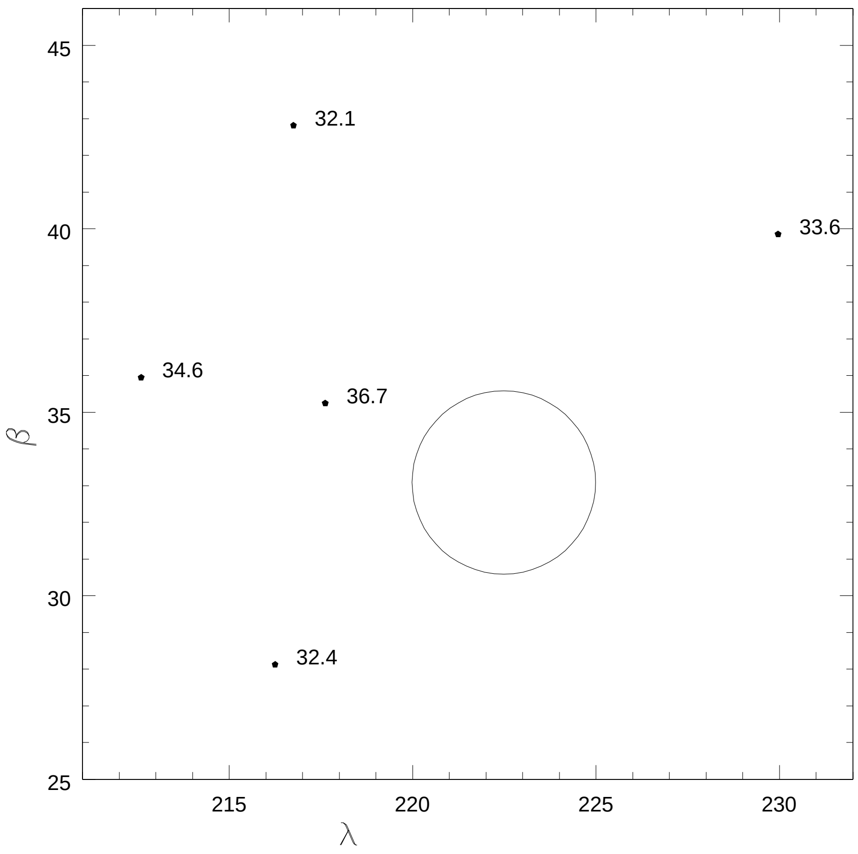

Figure 14: *Serpensids for* $\Delta\lambda = 0.7°$. *Theoretical radiant:* $\lambda = 222.4°$, $\beta = 33.1°$.

3.13 Camelopardalids

This is one of the meteor showers included in the list of photographic radiants of minor meteor showers of Abalakin (1981). It was also mentioned by Velkov (1997). We assumed the radiant is at $\lambda = 68.6°$, $\beta = 45.42°$ and with $V_\infty = 18$ km/s. For these parameters and a drift of $\Delta\lambda = 0.7°$ we found one meteor. Its radiant was at $\lambda = 66.4°$, $\beta = 45.4°$ and its velocity was 18.9 km/s.

3.14 Serpensids

This is also a meteor shower from Abalakin's list: "No.68: $\alpha = 230°$, $\delta = 16°$, $V_\infty = 32.2$ km/s; it is active from April 28 to May 15 with the maximum on May 14". Figure 15 shows results for these parameters.

3.15 ϵ-Aurigids

This shower was observed with a TV system in Japan (Ueda et al., 1994) and during visual observations in Slovakia in 1999 (Habuda, 2000). We assumed September 13 as its maximum day and the radiant position to be at $\alpha = 78°$, $\delta = 42°$. We took meteors from whole of September and assumed the entry velocity equal to 65 km/s. The results for $\Delta\lambda = 1.2°$ are shown in Figure 15.

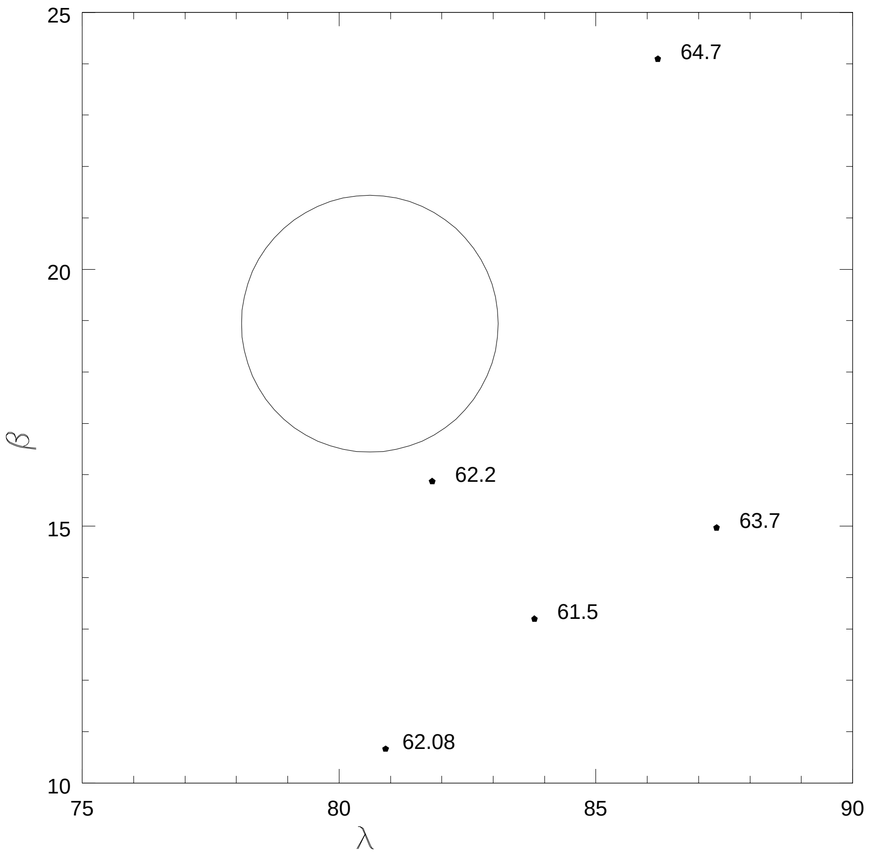

Figure 15: *ϵ-Aurigids for $\Delta\lambda = 1.2°$. Theoretical radiant:* $\lambda = 80.6°$, $\beta = 18.9°$.

4 Conclusions

In our work we have presented the results of a search for known and suspected meteor showers among photographic and video databases available via the Internet and in the literature. We have noted that minor showers such as Serpensids, Delphinids, ϵ-Aurigids, ϵ-Geminids and σ-Hydrids are detectable and are worthy of further investigation.

We also checked many others showers like the ξ-Bootids (Rendtel & Gliba, 2000), ξ-Draconids (Langbroek, 1996; Arlt, 1996) or π-Draconids (Olech, Jurek & Gajos, 1999). Unfortunately we have not found any meteors from these showers. The reason for this situation may be the lack of a large amount of photographic observations in the periods of activity of these showers, or their marginal activity.

Acknowledgments

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