Daytime Meteor Showers

Jürgen Rendtel
Outline

• Motivation

• Meteor shower radiants
  General sources, known showers

• Current data
  Activity level? Activity period? Shower parameter?

• Observing possibilities & proposal

• Conclusions
Motivation: why daytime showers?

Shower Calendar 2014

<table>
<thead>
<tr>
<th>Shower</th>
<th>Activity</th>
<th>Max Date</th>
<th>$\lambda_\odot$ 2000</th>
<th>Radiant $\alpha$</th>
<th>$\delta$</th>
<th>Best observed $50^\circ$ N</th>
<th>Best observed $35^\circ$ S</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cap/Sagittariids</td>
<td>Jan 13-Feb 04</td>
<td>Feb 01*</td>
<td>312.7</td>
<td>299°</td>
<td>−15°</td>
<td>11h−14h</td>
<td>09h−14h</td>
<td>Medium*</td>
</tr>
<tr>
<td>x-Capricornids</td>
<td>Jan 29-Feb 28</td>
<td>Feb 13*</td>
<td>324.7</td>
<td>315°</td>
<td>−24°</td>
<td>10h−13h</td>
<td>08h−15h</td>
<td>Low*</td>
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<tr>
<td>Piscids (Apr)</td>
<td>Apr 08-Apr 29</td>
<td>Apr 20</td>
<td>30.3</td>
<td>7°</td>
<td>+07°</td>
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<td>08h−13h</td>
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<td>δ-Piscids</td>
<td>Apr 24-Apr 24</td>
<td>Apr 24</td>
<td>34.2</td>
<td>11°</td>
<td>+12°</td>
<td>07h−14h</td>
<td>08h−13h</td>
<td>Low</td>
</tr>
<tr>
<td>ε-Arietids</td>
<td>Apr 24-May 27</td>
<td>May 09</td>
<td>48.7</td>
<td>44°</td>
<td>+21°</td>
<td>08h−15h</td>
<td>10h−14h</td>
<td>Low</td>
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<tr>
<td>Arietids (May)</td>
<td>May 04-Jun 06</td>
<td>May 16</td>
<td>55.5</td>
<td>37°</td>
<td>+18°</td>
<td>08h−15h</td>
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<td>Jun 07*</td>
<td>76.7</td>
<td>44°</td>
<td>+24°</td>
<td>06h−14h</td>
<td>08h−12h</td>
<td>High</td>
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<td>ζ-Perseids</td>
<td>May 20-Jul 05</td>
<td>Jun 09*</td>
<td>78.6</td>
<td>62°</td>
<td>+23°</td>
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<td>09h−13h</td>
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<td>β-Taurids</td>
<td>Jun 05-Jul 17</td>
<td>Jun 28</td>
<td>96.7</td>
<td>86°</td>
<td>+19°</td>
<td>08h−15h</td>
<td>09h−13h</td>
<td>Medium*</td>
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<tr>
<td>γ-Leonids</td>
<td>Aug 14-Sep 12</td>
<td>Aug 25</td>
<td>152.2</td>
<td>155°</td>
<td>+20°</td>
<td>08h−16h</td>
<td>10h−14h</td>
<td>Low*</td>
</tr>
<tr>
<td>Sextantids</td>
<td>Sep 09-Oct 09</td>
<td>Sep 27*</td>
<td>184.3</td>
<td>152°</td>
<td>00°</td>
<td>06h−12h</td>
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</table>

Discussion while preparing the 2015 Calendar:
- data stored in IAU MDC – which shower do we speak about?
- detection, activity level and periods uncertain
- profiles from radio (FS) and radar (BS) available?
Sources

... of sporadic meteors

daytime showers

Approx. 70° east of Apex

CMOR radar observations, Campbell-Brown, 2004
Sources

... of sporadic meteors

AMOR radar observations 1990-91, Baggaley
Sources

... ecliptical showers

Connection between branches of one stream (Asher, 2000)
Jupiter-family comets on Apollo-like orbits
V 11..45 km/s (peak ~20 km/s)
Known daytime showers

Data stored in IAU MDC

Most cases only original detection papers listed (1950s-1970s)

**Example: 171 ARI**

- Clegg, Hughes, Lovell (1947)
- Almond (1951) – orbits
- Sekanina (1976)

Recent studies – based on radar data

Difference in meteoroid sizes: FS ~ visual/video, BS much smaller

Brown et al., 2008 ff. analyses of CMOR

Janches et al., 2013 – southern hemisphere SAAMER data

Campbell-Brown, 2004: ARI June 08, ZHR ~ 200, r = 2.75
Known daytime showers

Data stored in IAU MDC

Most cases only original detection papers listed (1950s-1970s)

**Example: 171 ARI (Daytime Arietids)**

Similarity Daytime Arietids – comets Marsden group

- Marsden group – sunskirters, perihel 6-15 RO
- complex of: Marsden group comets (~ 5.5 years orbital period)
  - 96P/Machholz
  - Daytime Arietids (1.6-2.3 years period), δ Aquariids
  - (QUA + 2003EH1 ?)

Known daytime showers

Data stored in IAU MDC

Most cases only original detection papers listed (1950s-1970s)

**Example: 221 DSX (Daytime Sextantids)**

Phaethon – Geminid – complex (Ohtsuka et al., 2006; Ryabova et al., 2014)

„medium activity“ – from Weiss (1960)

Recent data: Galligan & Baggaley (2002) – AMOR radar

Various peaks Sep 27-30,

probably over a longer period / extending into early October
Observing possibilities

Data stored in IAU MDC

Most radiants of daytime showers 5-25 deg west of the Sun

Largest elongations:

- 293 DCE (o Cetids) / 152 NOC (N ω Cetids) in May 31 / 38 deg
- 171 ARI (Arietids) 35 deg
- 221 DSX (Sextantids) 33 deg

171 ARI and 221 DSX – activity level medium-high (Cetids: low)

Promising for combined observations to calibrate methods

Next: some details
Observing possibilities

Radio and radar data

Analyses necessary

Sugimoto published profiles for major showers and some events

Example: ARI 2011

Optical data?

Few possibilities:

171 ARI early June

221 DSX end September

Problem: how much can be seen?
Observing possibilities

Optical data?

Analyses of EDMOND data (Rudawska et al., 2014) include 171 ARI
(also Fujiwara 2004 video data)

Figure 5: Identified summer meteor showers. Colour represents number of members of a shower, while the size represents $D$ value based on the similarity measure between the mean orbital parameters of a cluster and linked with it the IAU MDC meteor shower (column 12 and 13 in Table 1 respectively).
Observing possibilities

Optical data?

Analyses of EDMOND data (Rudawska et al., 2014) include 221 DSX

Figure 6: Identified autumn meteor showers. Colour represents number of members of a shower, while the size represents $D$-value based on the similarity measure between the mean orbital parameters of a cluster and linked with it the IAU MDC meteor shower (column 12 and 13 in Table I respectively).
Observing possibilities

Optical data?

171 ARI early June

Radiant 10 deg (twilight)

ZHR 10:  n=2 (LM 6.5)
         n=1 (LM 5.5)

ZHR 100: n=20 (LM 6.5)
         n= 8 (LM 5.5)

Here: 30 deg N, 0430 h LT
Observing possibilities

Optical data?

221 DSX end September
slightly better (twilight)
Radiant ~ 10 deg
ZHR 10: n=2 (LM 6.5)
        n=1 (LM 5.5)
ZHR 50: n=10 (LM 6.5)
        n= 4 (LM 5.5)

Here: 30 deg N, 05 h LT
Proposal

Comprehensive data set

**Target:** 221 DSX

**Optical data,** including
- video (add to radiant list)
- visual (info to observers)

Both restricted to ~1hr/night

**Radio data**

**Aim:**

Calibration of data sets

Activity period, profile

Population/mass index

**Period:** Sep 22-Oct 5
### Conclusion

Establish a revised Table step by step (select shower, high/low rate), apply various techniques (optical, radio), calibrate data, compare with radar data ($r$, ZHR/flux, activity)

**@187.5 deg: RA=154, De=0, V=32km/s, interval 180-195 deg**

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<th>Activity</th>
<th>Max Date</th>
<th>$\lambda_0$ 2000</th>
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<td>Jan 13–Feb 04</td>
<td>Feb 01</td>
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<td>299°–15° 11h–14h</td>
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<td>$\chi$-Capricornids (114 DXC)</td>
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<td>April Piscids (144 APS)</td>
<td>Apr 20–Apr 26</td>
<td>Apr 22</td>
<td>32°5</td>
<td>9°+11° 07h–14h</td>
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<td>Apr 24–May 27</td>
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<td>85°+23° 08h–15h</td>
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<td>$\gamma$-Leonids (203 GLE)</td>
<td>Aug 14–Sep 12</td>
<td>Aug 25</td>
<td>152°2</td>
<td>155°+20° 08h–16h</td>
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<td>$\kappa$-Leonids (212 KLE)</td>
<td>Sep 06–Oct 03</td>
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<td>Sextantids (221 DSX)</td>
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<td>154°0° 06h–12h</td>
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## Conclusion

### Shower Calendar 2015 + Meteor Shower Workbook 2014

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<td>N. $\omega$-Cetids (150 NDC)</td>
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<td>May 14-Jun 24</td>
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**September 2014:**

**221 DSX first project**

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