Meteor science

Results of CMN 2013 search for new showers across CMN and SonotaCo databases II

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This is the second paper (out of three) of a report series presenting the results on the discovery of new meteoroid streams across a variety of video meteor databases. The search method used compared each meteor to all others in the same database that was constructed by combining Croatian Meteor Network databases for 2007 to 2010 and SonotaCo databases for 2007 to 2011. The second set of 24 possible new showers is described in this article.

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1 Introduction

This article is the second in a series of papers describing new meteoroid streams discovered by searching existing video meteor databases and covers 24 possible new showers. A description of the background and processing procedures for the stream search methodology can be found in the first article of the series (Andreić et al., 2014). A file containing all individual orbits of the new showers described in this article can be downloaded from the CMN web page:
`http://cmn.rgn.hr/downloads/downloads.html`

The orbital elements of the new showers discussed herein are summarized in Table 1 as obtained from applying search and discovery tools to the CMN and Sonotaco databases. Each of the showers listed were also successfully tested for detection through an examination of the IMO single station video database.

To conserve space, the radiant plots have been grouped together (Figures 1–3). Values of the generic D-criterion defined as the mean value of $D_{SH}/2$, $D_H/2$ and D_D (with the additional constraint that all three have to be smaller than a preset limit – see Andreić et al. (2014)) are coded as gray scale circles in the figures. Note that in the electronic edition they are color-coded for easier visualization. Additionally, radiants that belong to the new showers are indicated by larger sized circles.

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2 Descriptions of new showers

What follows is a description of each of the 24 new streams discovered, but requiring confirmation before they can be considered 'established' showers by the IAU.

2.1 32 Leonis Minorids (573 TLM)

The video orbit databases contained 27 meteors spread over 13 days which could be associated with this shower 573 TLM. The number of orbits per day averages 2.4, being slightly higher in flux during the first part of the activity period. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from November 16 to December 5, the mean corresponding to November 27.

There are two other radiants that are active at roughly the same solar longitude and close in equatorial coordinates, 339 PSU and 440 NLM. There are no orbital elements for 339 PSU in the IAU MDC, but the new radiant's position is separated by about 8° (mostly in declination) at the moment of mean solar longitude for 339 PSU. Also the difference in geocentric velocities is about 4 km/s, so it is unlikely that they are the same shower. The radiant of 440 NLM has about the same 8° offset the 573 TLM radiant but mostly in right ascension. Since the D_{SH} for these two showers is 0.52, they are clearly different streams.

2.2 γ Ursae Majorids (574 GMA)

21 meteors spread over 11 days are associated with this shower. The number of orbits per day is about 1.9. Apart from a clearly evident daily motion, the radiant plot does not reveal any structure. Active from November 29 to December 9, the mean corresponding to December 4.

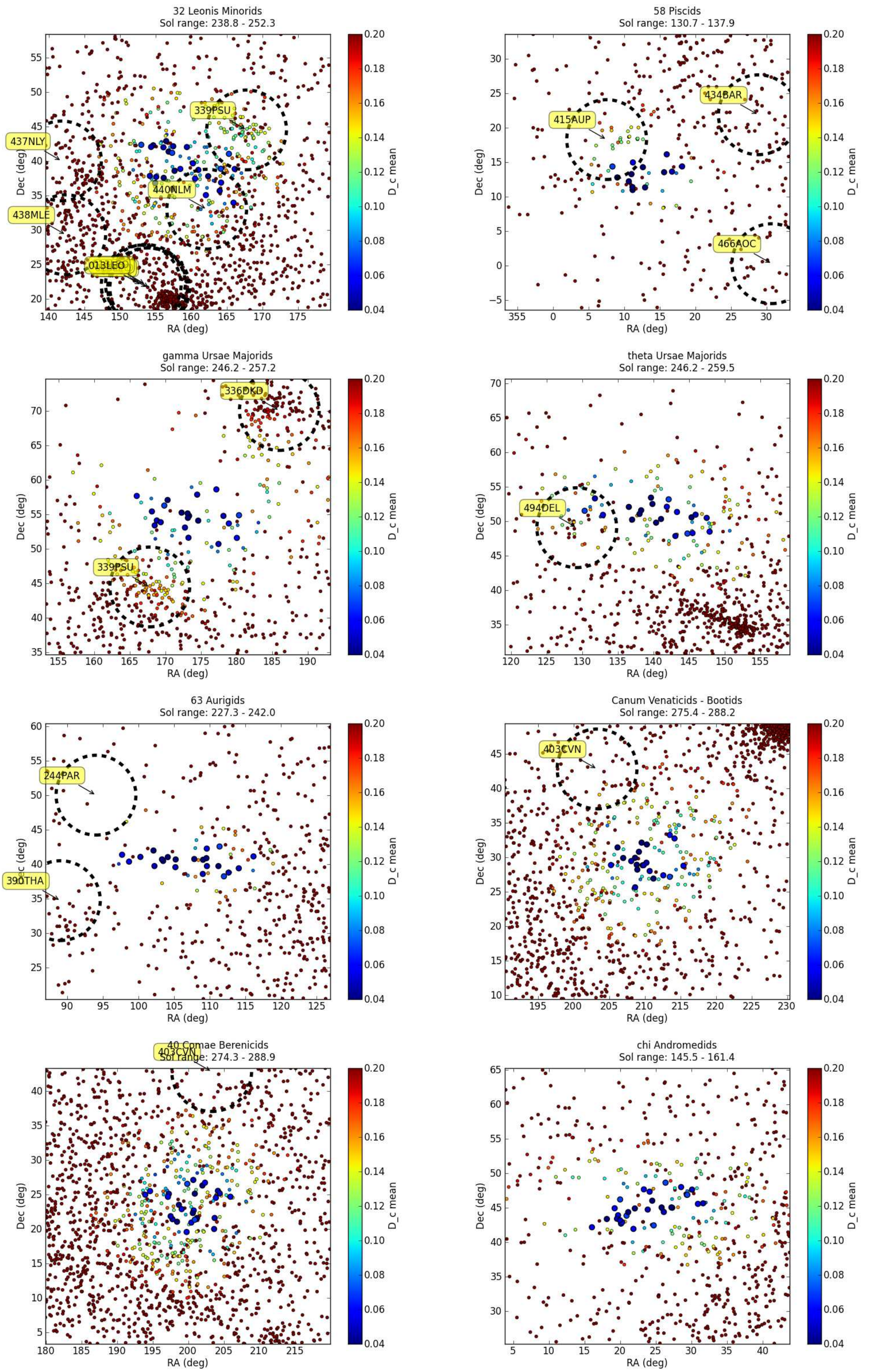

Figure 1 – Radiant plots of showers 573 TLM to 580 CHA.

2.3 63 Aurigids (575 SAU)

22 meteors spread over 14 days are associated with this shower. The number of orbits per day is about 1.6, being slightly stronger in flux around the mean solar longitude. The radiant plot is highly stretched by the daily motion, but does not reveal any structure. Active from November 10 to 22, the mean corresponding to November 18.

2.4 40 Comae Berenicids (576 FOB)

26 meteors spread over 14 days are associated with this shower. The number of orbits per day is about 1.9. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from December 26 to January 9, the mean corresponding to January 3.

2.5 58 Piscids (577 FPI)

13 meteors spread over 7 days are associated with this shower. The number of orbits per day is about 1.9, with flux slightly higher at the beginning of the activity period. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from August 3 to 11, the mean corresponding to August 6. Note that the shower 415 AUP is active at the same time, with the radiants being separated by about 6° and possessing similar geocentric velocities (66 vs. 64.2 km/s). Again, further analysis is not possible due to the lack of orbital elements for the 415 AUP, so we can only conclude that these two showers may be marginally related in some way.

2.6 θ Ursae Majorids (578 TUM)

21 meteors spread over 13 days are associated with this shower. The number of orbits per day is about 1.6. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from November 29 to December 12, the mean corresponding to December 5. Note that 494 DEL is active at the same time, but the radiants are separated by about 11°, so it is highly unlikely that they are identical. A D_{SH} value of 0.41 confirms that this possible new shower cannot be considered the same as 494 DEL.

2.7 Canum Venaticids-Bootids (579 TCV)

21 meteors spread over 13 days are associated with this shower. The number of orbits per day is about 1.6. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from December 28 to January 9, the mean corresponding to January 2.

2.8 χ Andromedids (580 CHA)

29 meteors spread over 16 days are associated with this shower. The number of orbits per day is about 1.8. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from August 19 to September 4, the mean corresponding to August 27.

2.9 90 Herculids (581 NHE)

18 meteors spread over 11 days are associated with this shower. The number of orbits per day is about 1.6. The radiant plot is quite scattered and does not reveal any structure. Active from April 20 to May 7, the mean corresponding to April 28. This shower may be related to 6 LYR, whose radiant is about 11° away, but with a $D_{SH} = 0.30$ they are clearly different showers.

2.10 January β Craterids (582 JBC)

16 meteors spread over 9 days are associated with this shower. The number of orbits per day is about 1.8. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from December 31 to January 9, the mean corresponding to January 4. A possible parent body for this shower is comet C/1092 A1. A D_{SH} of 0.19 indicates the possibility of connection between 582 JBC and this comet. An Earth MOID of 0.05 AU is rather large, but angular orbital elements of the comet and 582 JBC are very similar. Thus, there is clearly a need for dynamical modeling analysis of this comet and its relation to 582 JBC.

2.11 12 Taurids (583 TTA)

37 meteors spread over 21 days are associated with this shower. The number of orbits per day is about 1.8. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from August 27 to September 18, the mean corresponding to September 7.

2.12 Cepheids-Cassiopeiids (584 GCE)

21 meteors spread over 12 days are associated with this shower. The number of orbits per day is about 1.8. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from August 7 to 20, the mean corresponding to August 14.

2.13 33 Hydrids (585 THY)

31 meteors spread over 18 days are associated with this shower. The number of orbits per day is about 1.7. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from December 5 to 23, the mean corresponding to December 14.

2.14 2 Lacertids (586 TLA)

18 meteors spread over 11 days are associated with this shower. The number of orbits per day is about 1.6. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from July 30 to August 11, the mean corresponding to August 5.

2.15 59 Cygnids (587 FNC)

22 meteors spread over 13 days are associated with this shower. The number of orbits per day is about 1.7. The radiant plot does not reveal any structure. Active from August 5 to 19, the mean corresponding to August 10.

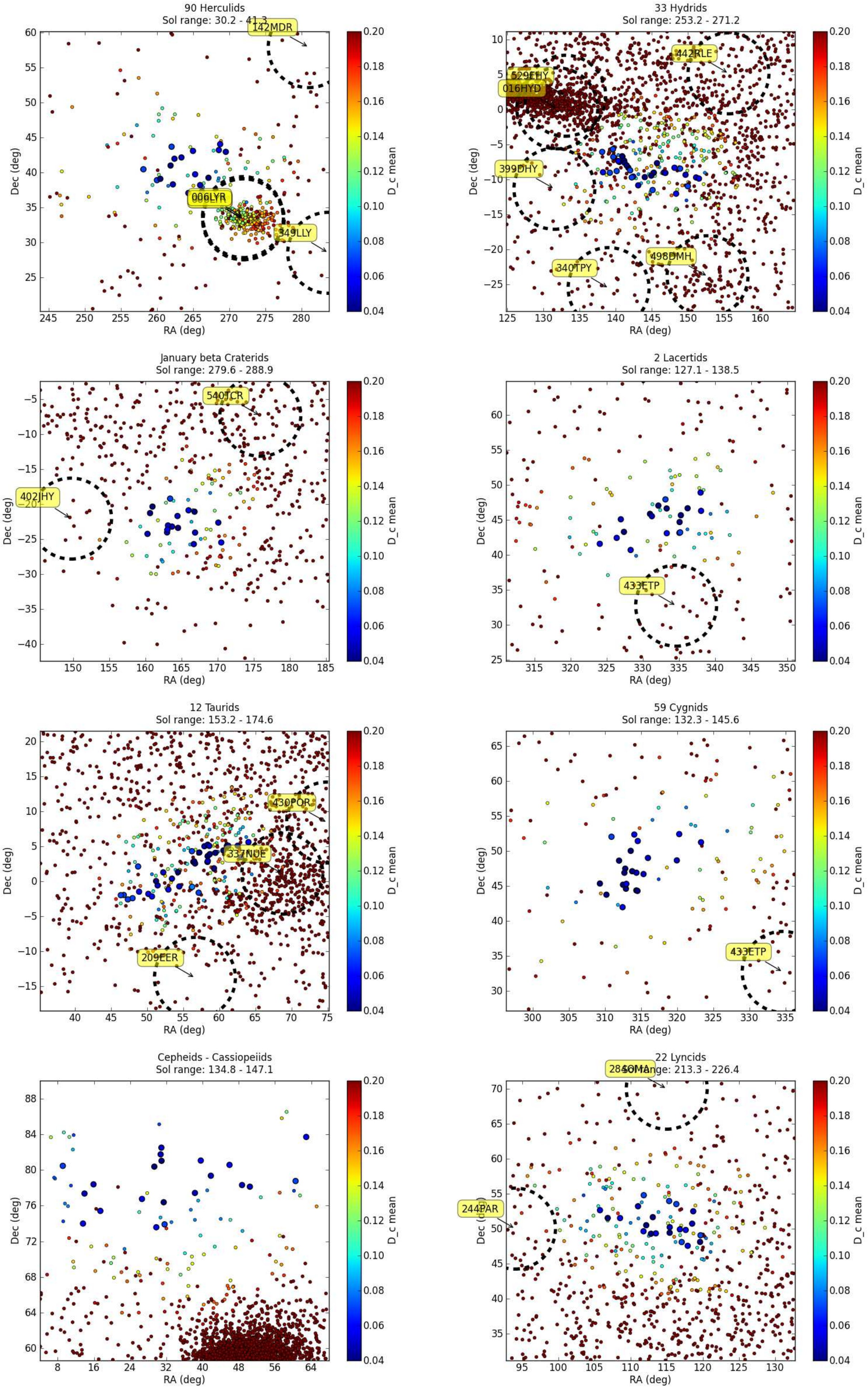

Figure 2 – Radiant plots of showers 581 NHE to 588 TTL.

2.16 22 Lyncids (588 TTL)

22 meteors spread over 13 days are associated with this shower. The number of orbits per day is about 1.7. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from October 27 to November 9, the mean corresponding to November 3.

2.17 50 Cancrids (589 FCA)

32 meteors spread over 19 days are associated with this shower. The number of orbits per day is about 1.7. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from November 18 to December 7, the mean corresponding to November 28.

2.18 10 Canum Venaticids (590 VCT)

20 meteors spread over 12 days are associated with this shower. The number of orbits per day is about 1.7. Apart from daily motion, radiant plot does not reveal any structure. Active from January 6 to 18, the mean corresponding to January 11.

2.19 ζ Bootids (591 ZBO)

23 meteors spread over 14 days are associated with this shower. The number of orbits per day is about 1.6. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from February 8 to 22, the mean corresponding to February 16. Note the radiant of 34 DSE is about 10° away, but with a D_{SH} of 0.78 we are dealing with two clearly different showers.

2.20 91 Piscids (592 PON)

22 meteors spread over 14 days are associated with this shower. The number of orbits per day is about 1.6. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from August 2 to 17, the mean corresponding to August 9.

2.21 28 Lyncids (593 TOL)

28 meteors spread over 18 days are associated with this shower. The number of orbits per day is about 1.6. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from October 28 to November 15, the mean corresponding to November 5.

2.22 Serpentids-Coronae Borealids (594 RSE)

17 meteors spread over 11 days are associated with this shower. The number of orbits per day is about 1.5. The radiant plot is compact and does not reveal any structure, apart from effects of daily motion. Active from January 13 to 24 the mean corresponding to January 19.

2.23 13 Taurids (595 TTT)

29 meteors spread over 20 days are associated with this shower. The number of orbits per day is about 1.5. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from September 6 to September 27, the mean corresponding to September 18.

2.24 78 Ursae Majorids (596 MUS)

17 meteors spread over 13 days are associated with this shower. The number of orbits per day is about 1.3. Apart from the clearly evident daily motion, the radiant plot does not reveal any structure. Active from January 1 to 14, the mean corresponding to January 6.

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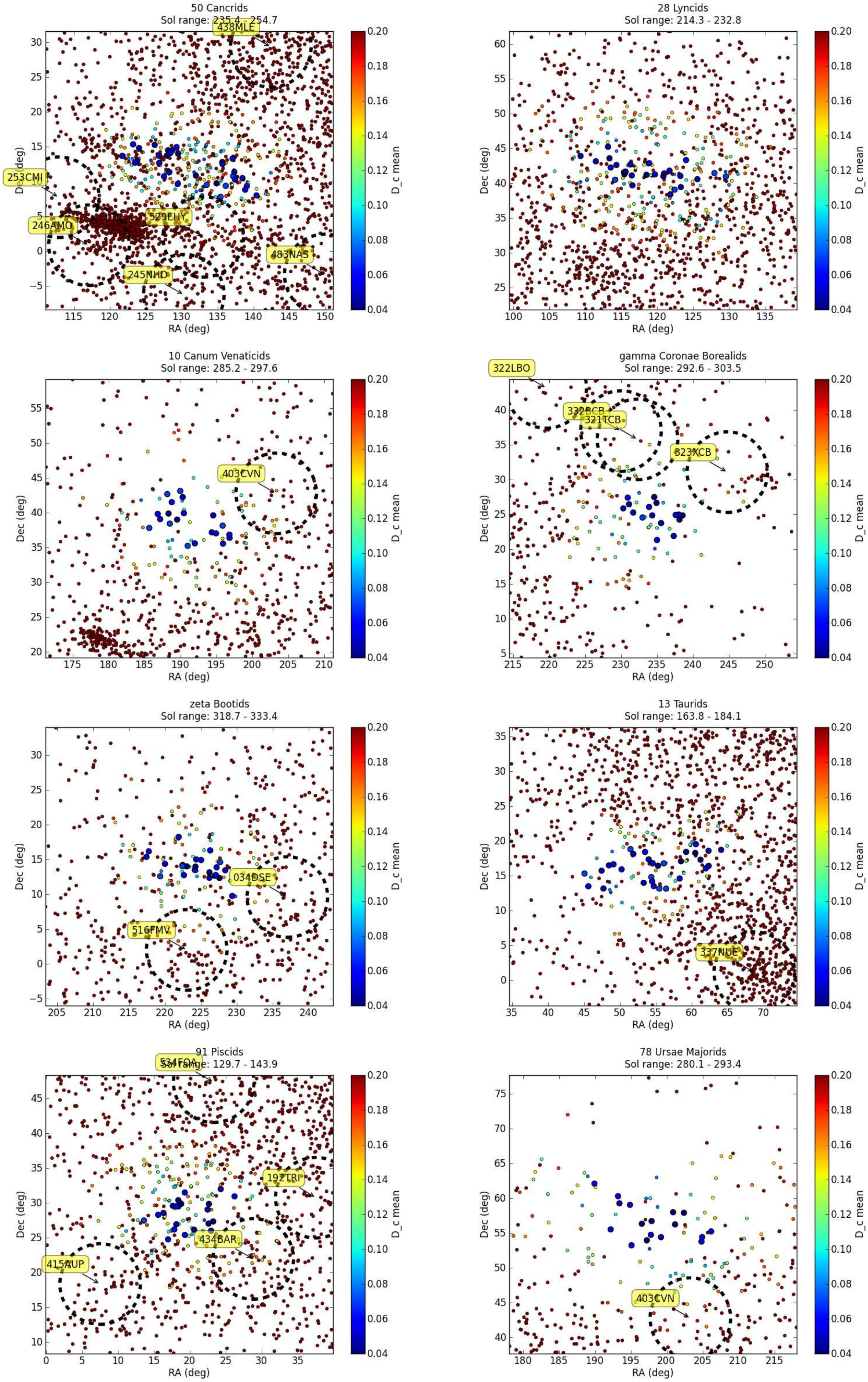

Figure 3 – Radiant plots of showers 589 FCA to 596 MUS.

Table 1 – Mean orbits of the newly discovered showers. The columns labeled ID and name are the IAU's identification and name of the shower; $\lambda_\odot$ solar longitude range of the orbits covering the active period; $\overline{\lambda_\odot}$ average solar longitude; RA and DEC are the equatorial coordinates of the mean radiant; dRA and dDEC are the daily motion of the radiant's drift in RA and DEC; v_g is the geocentric velocity in km/s; q perihelion distance in AU, e eccentricity; ω argument of perihelion; Ω longitude of the ascending node; i inclination; and N is the number of associated orbits. The error values are one standard deviation of the corresponding parameter. In the case of RA and DEC, there is a contribution of the daily motion to the dispersion of the radiants. All angular values are given in degrees.

ID	name	$\lambda_\odot$	$\overline{\lambda_\odot}$	RA	DEC	dRA	dDEC	$v_{\rm g}$	q	e	ω	Ω	i	N
573 TLM	32 Leonis Minorids	239–252	245	159.1 ± 4	39.1 ± 2.5	0.84	−0.35	64.4 ± 0.8	0.925 ± 0.019	0.880 ± 0.052	209.7 ± 4	244.9 ± 4	130.6 ± 3.5	27
574 GMA	γ Ursae Majorids	246–257	252	173.3 ± 4	54.7 ± 2.0	1.17	−0.37	54.4 ± 1.3	0.918 ± 0.014	0.891 ± 0.046	211.2 ± 3	251.7 ± 3	98.7 ± 3.0	21
575 SAU	63 Aurigids	227–242	235	107.0 ± 5	40.4 ± 1.1	1.22	−0.07	56.5 ± 0.8	0.222 ± 0.013	0.980 ± 0.017	304.6 ± 2	235.4 ± 4	119.8 ± 3.3	22
576 FOB	40 Comae Berenicids	274–289	282	200.4 ± 3	23.5 ± 2.2	0.65	−0.24	64.6 ± 1.1	0.975 ± 0.007	0.878 ± 0.051	189.6 ± 5	282.2 ± 4	129.0 ± 3.8	26
577 FPI	58 Piscids	131–138	134	12.6 ± 3	13.4 ± 1.5	1.16	0.38	64.2 ± 0.7	0.486 ± 0.018	0.954 ± 0.034	273.9 ± 2	133.8 ± 2	163.4 ± 3.3	13
578 TUM	θ Ursae Majorids	246–259	253	140.6 ± 5	50.9 ± 1.6	1.30	−0.24	54.8 ± 1.3	0.535 ± 0.022	0.965 ± 0.047	266.1 ± 3	253.2 ± 3	101.3 ± 3.0	21
579 TCV	Canum Venaticids-Bootids	275–288	282	210.1 ± 3	29.4 ± 2.0	0.69	−0.17	59.9 ± 1.1	0.977 ± 0.005	0.861 ± 0.047	171.6 ± 4	281.8 ± 3	113.7 ± 3.3	21
580 CHA	χ Andromedids	145–161	154	23.9 ± 4	45.0 ± 1.8	0.92	0.31	58.9 ± 1.0	0.750 ± 0.028	0.923 ± 0.052	242.4 ± 4	153.6 ± 4	117.0 ± 2.5	29
581 NHE	90 Herculids	30–41	38	264.3 ± 3	40.3 ± 2.4	0.50	0.19	39.0 ± 1.7	0.912 ± 0.023	0.929 ± 0.053	216.3 ± 5	37.6 ± 3	62.9 ± 3.1	18
582 JBC	January β Craterids	280–289	284	164.6 ± 3	-22.8 ± 1.8	0.80	−0.30	63.8 ± 0.8	0.793 ± 0.025	0.922 ± 0.046	53.4 ± 4	103.8 ± 3	129.4 ± 3.0	16
583 TTA	12 Taurids	153–175	164	55.5 ± 5	1.8 ± 2.7	0.80	0.39	65.2 ± 0.8	0.707 ± 0.032	0.954 ± 0.043	67.2 ± 4	344.1 ± 6	146.0 ± 3.3	37
584 GCE	Cepheids-Cassiopeiids	135–147	141	33.3 ± 15	78.5 ± 2.8	2.85	0.42	45.6 ± 1.4	0.972 ± 0.014	0.888 ± 0.045	156.3 ± 4	140.8 ± 4	79.1 ± 3.2	21
585 THY	33 Hydrids	253–271	262	143.8 ± 4	-8.7 ± 1.5	0.71	−0.18	64.9 ± 1.0	0.676 ± 0.041	0.980 ± 0.051	68.4 ± 5	81.9 ± 5	136.5 ± 2.6	31
586 TLA	2 Lacertids	127–138	133	332.2 ± 4	44.8 ± 2.2	0.63	0.53	44.0 ± 1.6	0.768 ± 0.023	0.923 ± 0.038	240.4 ± 3	132.8 ± 3	74.1 ± 3.9	18
587 FNC	59 Cygnids	132–146	137	314.2 ± 3	47.5 ± 3.0	0.23	0.57	35.3 ± 1.5	0.852 ± 0.024	0.931 ± 0.040	227.8 ± 4	137.0 ± 3	54.4 ± 3.0	22
588 TTL	22 Lyncids	213–226	220	114.3 ± 4	50.8 ± 2.0	1.02	−0.24	60.6 ± 1.1	0.710 ± 0.030	0.892 ± 0.056	246.6 ± 4	220.1 ± 3	122.9 ± 3.3	22
589 FCA	50 Cancrids	235–255	245	131.3 ± 5	11.9 ± 2.2	0.87	−0.27	66.6 ± 0.8	0.528 ± 0.034	0.965 ± 0.046	86.9 ± 4	65.4 ± 6	167.4 ± 3.3	32
590 VCT	10 Canum Venaticids	285–298	291	191.3 ± 3	38.8 ± 2.3	0.75	−0.26	54.9 ± 1.3	0.724 ± 0.022	0.908 ± 0.048	243.6 ± 3	291.1 ± 4	101.0 ± 3.7	20
591 ZBO	ζ Bootids	319–333	327	224.2 ± 3	13.9 ± 1.7	0.72	−0.23	62.5 ± 1.1	0.785 ± 0.029	0.933 ± 0.057	234.9 ± 4	327.2 ± 4	124.4 ± 2.7	23
592 PON	91 Piscids	130–144	136	19.6 ± 3	28.4 ± 2.0	0.75	0.37	64.8 ± 1.0	0.788 ± 0.027	0.891 ± 0.051	238.2 ± 4	136.3 ± 3	144.7 ± 3.7	22
593 TOL	28 Lyncids	214–233	223	118.5 ± 5	41.6 ± 1.5	0.99	−0.13	65.1 ± 0.9	0.716 ± 0.035	0.944 ± 0.053	244.6 ± 5	222.6 ± 5	140.1 ± 2.7	28
594 RSE	Serpentids-Coronae Borealids	293–303	298	234.9 ± 3	25.1 ± 1.6	0.71	−0.20	56.6 ± 1.0	0.902 ± 0.017	0.917 ± 0.046	145.9 ± 4	298.4 ± 3	103.7 ± 2.1	17
595 TTT	13 Taurids	164–184	175	55.1 ± 5	16.1 ± 1.9	0.92	0.16	64.5 ± 0.9	0.434 ± 0.029	0.974 ± 0.038	98.8 ± 4	354.8 ± 6	172.2 ± 3.9	29
596 MUS	78 Ursae Majorids	280–293	286	198.1 ± 5	56.6 ± 2.5	0.96	−0.43	45.2 ± 1.5	0.865 ± 0.021	0.911 ± 0.037	221.5 ± 4	285.8 ± 4	75.6 ± 3.0	17