TV Meteor Streams Searching

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Abstract

Using a modified D-criterion (threshold $D_0 = 0.2$), among 531 TV meteor orbits 23 streams have been identified. About 30% of the orbits belong to the stream component. Only 3 streams have orbits inclined more than 30°. Four streams have reciprocal orbits. The major stream Herculids shown to be a complex structure, sensitive on the choice of the D- threshold value. The Taurids complex differs slightly from the photographic one. The ϑ Piscids stream has very small orbit, the mean semi-major axis equals to 0.79 AU. This stream seems to be TV component of the Eccentrides system, but with $D_0 = 0.21$, the ϑ Piscids have joined S.Taurids. The TV Orionids appeared in two branches. One of them includes a single orbit which belongs to the η Aquarids.

Stream searching algorithm

In papers Hawkes et al. 1984 and Sarma,Jones 1985, jointly, results of the television observations of 538 meteors have been published. Using geocentric parameters from these sources, the heliocentric orbits of 531 meteors have been recalculated. These orbits were used to find degree to which the TV meteors are grouped into streams.

We adopted the stream definition proposed for the first time by Southworth and Hawkins 1963, together with the slight modification of their D- orbital similarity criterion, Jopek 1992.

Having the stream definition, the computer searching program was written, and has been run several times with different threshold values D_0 .

Mean parameters of the identified streams

For the detailed study, results corresponding to the $D_0 = 0.200$ were used. The arithmetic mean values of heliocentric and geocentric parameters of each stream are given in Table I. We have met difficulties byidentifyingour streams with those given in papers Southworth,Hawkins 1963, Lindblad 1971a,b,c, Cook 1971, Jopek 1986, we met difficulties very often. Therefore, in the case of the well known major streams their traditional names were used. For the others, the name of the closest star to the mean radiant was adopted.

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Astronomical Inst., Slovak Acad. Sci., Bratislava, 1993, pp. 269-272.

To this end, after transformation to the epoch 1950.0, coordinates of about 1000 brightest stars (up to 4.52^m) taken from the PPM astrometric catalogue were used. In Table I, the names obtained in this way are indicated by asterisk.

Table I. Mean parameters of the meteor streams.
N - membership, e,q,i - orbital elements,
α ,δ - radiant coordinates (1950),
V_G - geocentric velocity (km/sec).

Straem name	N_s	Activity	e	q	i	α_G	δ_G	V_G
ω Piscids*	5	Sep 24-Oct 29	0.789	0.616	2.8	3.3	3.9	21.7
S.Taurids	14	Jul 25-Sep 30	0.719	0.332	7.8	20.7	2.3	23.7
β Triangulids*	5	Nov 4-Nov 4	0.605	0.691	12.0	27.2	34.9	17.6
Perseids	17	Jul 21-Aug 12	0.850	0.928	112.9	40.2	55.2	57.8
N.Taurids	15	Sep 30-Nov 4	0.780	0.409	7.5	47.7	11.9	25.8
ι Aurigids*	3	Sep 24-Sep 30	1.084	0.604	153.4	66.4	34.6	67.2
Orionids 2	4	Oct 29-Nov 4	0.858	0.461	160.9	103.4	14.6	63.0
Orionids 1	5	Oct 29-Nov 4	1.225	0.551	167.8	103.6	17.1	70.5
Cyclids	3	Jul 31-Sep 24	0.016	0.984	0.0	151.8	12.1	0.0
γ Serpentids*	6	Jul 21-Jul 31	0.471	0.994	4.1	240.0	11.0	7.7
η Draconids*	3	Jun 27-Jul 31	0.133	1.002	14.4	247.4	60.6	8.0
Herculids	24	Jul 21-Aug 12	0.620	0.957	23.2	260.7	40.3	16.9
ζ Aquilids*	4	Jul 24-Jul 31	0.497	0.836	15.8	290.3	15.0	14.8
Capricornids	23	Jun 27-Aug 12	0.762	0.602	14.6	304.3	12.5	23.3
9 Pegasids*	4	Jul 21-Jul 31	0.654	0.295	25.5	328.9	13.4	22.1
ι Pegasids*	3	Jul 21-Aug 12	0.767	0.340	13.9	331.7	24.4	26.3
ϑ Aquarids*	5	Jul 24-Jul 30	0.994	0.029	37.2	334.8	-4.7	45.5
ξ Pegasids*	3	Jul 25-Jul 31	0.759	0.231	7.5	336.6	15.6	24.3
6 Lacertids*	3	Jul 24-Jul 30	0.503	0.534	71.7	338.7	39.5	35.9
α Pegasids*	12	Jul 21-Aug 12	0.958	0.098	27.2	340.7	17.5	39.1
π Cepheids*	5	May 6-May 6	0.531	0.934	27.8	346.5	75.5	18.3
ϑ Piscids*	4	Jul 25-Aug 12	0.480	0.411	4.0	351.3	4.9	11.7

Conclusions

The TV meteor catalogue contains 23 streams, what makes about 30% of the sample. The majority of them belongs to the ecliptical complex, only three streams have inclinations of the orbits greater then 30°, and four streams have reciprocal orbits. A considerable number of streams have the orbits of small size : the 9 Pegasids, Cyclids, η Draconids and the extreme case of ϑ Piscids - TV example of the Eccentrids system (Simonenko et al. 1986). Apart from difficulties in unambiguous resolution of streams with low inclined orbits, performed studies revealed to us other troubles connected with the

stream nomenclature. Existing presently, commonly accepted rules are not sufficient to prevent from giving two or more names to the same stream.

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Discussion

Grün : What is the accuracy of your orbit analysis? How can hyperbolic meteors be part of a meteor stream?

Jopek : I can not say anything about the accuracy of my searching. The orbits were determined not by me, among them are also hyperbolas. In a few cases they were included into the stream, simply due to sufficient orbital similarity. The reality of the hyperbolic orbits is an old problem, and they are obtained by any observational techniques.

Roggemans : To which extend is the D-criterion useful to avoid random coincidences and pure chance associations?

Jopek : I have run my stream searching program with an artificial orbit sample (2000 orbits, D_0 = 0.125). The only detected streams were : about 30 streams with membership equal two, and 3 streams with membership equal three. As for real photographic orbits, 86 and 23 streams were detected, respectively.

Farinella : From my experience with searches for orbit clusters, I feel that

the results are very sensitive to the threshold level and to the assumed "random" distribution when the detected groupings have ≤ 5 members. Do you agree?
Jopek : I have experience only with the photographic and TV meteor samples. In my opinion, using reasonable threshold values, probability of detecting a stream with membership greater then three is not a big one.

Lindblad : I want to congratulate Dr Jopek on his interesting results. It is to my knowledge, the first time that a detailed study of the meteor streams in the TV data sample has been made.
Jopek : Thank you Dr Lindblad.

Ceplecha : There are standard deviations published to each orbital element in the original parers. Did you take them into account in your D-criterion analysis?
Jopek : No, I didn't. But I think it is a good idea to see what will happen after introducing standard deviations.

Sekanina : Have you compared the results of your stream search with those using radar meteor samples ?
Jopek : No, I didn't. However, I have recognized that there is similar low percentage of the stream orbits in the TV and radar meteor data.

Keay : The number of meteors in some streams (eg. Herculids) relative to the other better known streams suggests an observational selection effect- maybe geometrical. Is this so?
Jopek : In my search I didn't take into account any observational selection. In the TV sample, Herculids are the most numerous stream. This stream has a complicated structure, and is very sensitive to the threshold value.