

**PROBABLE ASTEROIDAL METEOROID STREAMS WITH ASSOCIATED SUBSTREAMS.** J. L. García-Martínez<sup>1</sup> and F. Ortega-Gutiérrez<sup>2</sup>, <sup>1</sup>Posgrado en Ciencias de la Tierra, UNAM, Ciudad Universitaria, México, D. F. pepeluis@correo.unam.mx, <sup>2</sup>Instituto de Geología, UNAM, Ciudad Universitaria, México, D. F. fortega@servidor.unam.mx

**Abstract:** Five meteoroid streams of apparent asteroidal nature have been identified in the IAU\_MDC photographic meteor database. Two streams contain substreams, composed of two or more meteoroids sharing the same orbit; only one asteroid apparently associated with one stream has been identified.

**Observations:** Paying attention to the mean values favored by the peaks in the aphelion distribution of the meteoroids listed in the IAU\_MDC photographic meteor database, a search for possible meteoroid streams has been performed in the same database. As a result five streams (**Table 1**) have been identified with two of them, **S1** and **S3**, containing coherent substreams as part of their structure. Coherent substreams means few meteoroids, usually within a stream, sharing the same orbital parameter values, as can be seen in **Table 2**. Stream **S3** contains only one substream composed of three meteoroids (**SS3**) but stream **S1**, apparently coming from the inner Asteroid Belt, contains eleven such substreams; only the most populated substream (**SS1a**) has been tabulated (**Table 2**). Finally, one Apollo asteroid has been found to have the same mean orbital parameter values as stream **S3** (**Table 3**). This speaks of a possible close relationship between them.

Str	<i>a</i>	<i>q</i>	<i>e</i>	<i>Q</i>	<i>i</i>	$\omega$	$\Omega$
<b>S1</b>	1.350	0.141	0.895	2.562	23.173	324.306	261.89
<b>S2</b>	1.929	0.379	0.802	3.47	4.76	112.84	37.60
<b>S3</b>	2.230	0.363	0.835	4.096	2.982	292.830	231.46
<b>S4</b>	2.462	0.581	0.760	4.343	6.426	257.18	130.70
<b>S5</b>	2.793	0.980	0.648	4.607	71.925	173.01	283.3

**Note:** It is interesting to note that stream **S1**, apparently coming from the inner Asteroid Belt, contains in its structure eleven substreams, including the most populous one (**SS1a**) which includes 11 meteoroids on its orbit (**Table 2**).

**Interpretation:** The five meteoroid streams probably are asteroidal since all of them follow Apollo-like orbits. Even when some Jupiter family Comets (**JFC**) overlap extreme Apollo orbits, in this region, the population of Apollo asteroids far outnumber the comets; nearly 30 to 1. Concerning the origin of meteoroid substreams, what follows is rather speculative: possibly they are asteroidal fragments taken out from a parent asteroid due to impacts received from time to time in such a way that each impact generates one substream. Likely candidates are large Apollos or aver-

age-sized Apollos that spend long periods of time within the Main Belt. Other possibility is substreams are chains of pieces broken apart gradually from one single, loosely bound body. Regarding probable candidates, the Apollo asteroid **2002 XM35** (**Table 3**) is a good candidate to parent body for stream **S3** and substream **SS3**.

**Table 2. Coordinates of substreams SS3 and SS1a, associated with streams S3 and S1, respectively.**

Substrm	<i>a</i>	<i>q</i>	<i>e</i>	<i>Q</i>	<i>i</i>	$\omega$	$\Omega$
<b>SS3</b>	2.086	0.338	0.838	3.84	3.1	296.2	231.4
	2.253	0.338	0.85	4.17	2.5	295.7	224.6
	2.284	0.338	0.852	4.24	6.4	295.5	239.1
<b>SS1a</b>	1.337	0.139	0.896	2.55	23.6	324.7	261.4
	1.343	0.141	0.895	2.55	23.1	324.4	262.4
	1.346	0.14	0.896	2.55	23.4	324.6	261.9
	1.346	0.14	0.896	2.55	22.3	324.6	261.7
	1.337	0.139	0.896	2.55	24.2	324.7	258.2
	1.346	0.144	0.893	2.55	23	324.1	261.8
	1.34	0.138	0.897	2.55	23.1	324.8	261.8
	1.347	0.136	0.899	2.55	24	325.1	262
	1.337	0.139	0.896	2.55	23.6	324.7	262.1
	1.343	0.145	0.892	2.55	20.6	323.9	262.7
	1.343	0.141	0.895	2.55	23.4	324.4	261.8

**Table 3. Stream S3 and probable associated asteroid 2002 XM35.**

Strm/Ast	<i>a</i>	<i>q</i>	<i>e</i>	<i>Q</i>	<i>i</i>	$\omega$	$\Omega$
<b>S3</b>	2.230	0.363	0.835	4.096	2.982	292.830	231.469
<b>2002XM35</b>	2.349	0.375	0.84	4.323	3.1	312	230

**Summary:** Five meteoroid streams of apparent asteroidal nature have been identified. Two of the streams contain substreams, composed of two or more meteoroids on one single orbit. Finally, one asteroid apparently associated with one of the streams and corresponding substreams has been identified.

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**References:** [1] Lindblad B. A. et al. (2003) *Earth, Moon & Planets*, 93, 249–260. [2] Steel D. (1996) *Space Science Review*, 78, 507–553.