

**Linking meteoroid streams
to their parent bodies
by means of
orbital association software tools**

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www.meteoroides.net

Opens the possibility to:

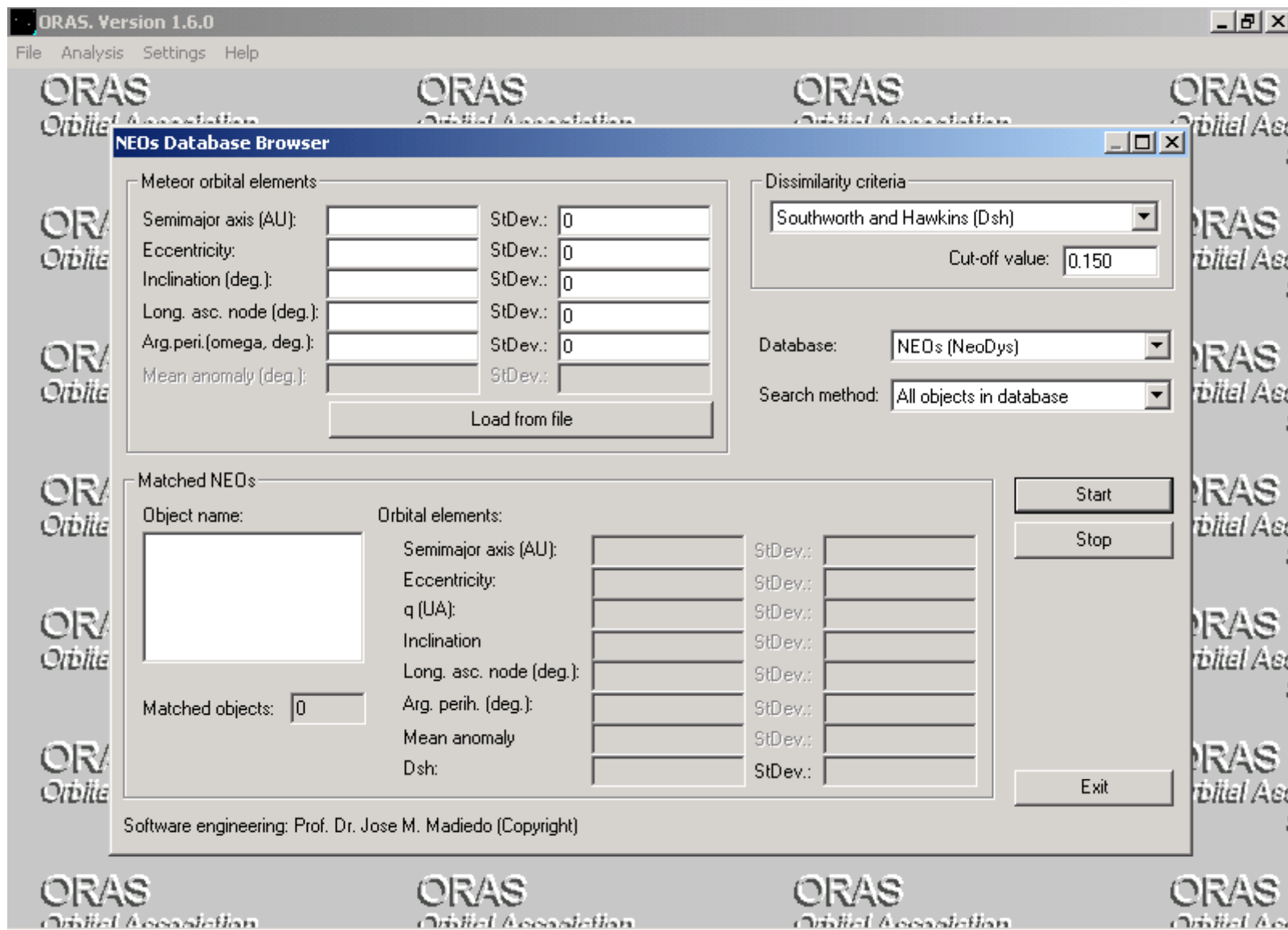
- Increase knowledge about origin of meteoroid streams.
- Extract chemical information.
- Infer information on physical processes (cometary activity, disruptions,).



Dissimilarity criteria:

- ❑ Define adimensional parameter to measure the similarity between two orbits.
- ❑ Southworth and Hawkins D criterion (a, e, i only).
- ❑ D_{SH} criterion (ascending node and longitude of perihelion also).
- ❑ Other criteria: Drummond, Jopek, Valsecci and Jenniskens.

ORAS: ORbital Association Software



Orbital Association Software. Copyright J.M. Madiedo (2008-2012)

Main Features:

- C++, MS-Windows platforms (XP, Vista, 7).
- NeoDys and MPC databases.
- Different dissimilarity criteria are available.
- Post-processing of output data obtained with the orbital integrator Mercury6 (Chambers J. E., MNRAS, 304, 793-799 (1999)).
Allows to establish real (not casual) links.

NEOs Database Browser

Meteor orbital elements

Semimajor axis (AU):	2.42	StDev.:	0
Eccentricity:	0.75	StDev.:	0
Inclination (deg.):	4.6	StDev.:	0
Long. asc. node (deg.):	128.2	StDev.:	0
Arg.peri.(omega, deg.):	237.39	StDev.:	0
Mean anomaly (deg.):		StDev.:	

Load from file

Dissimilarity criteria

Southworth and Hawkins (Dsh)

Database: NEOs (NeoDys)

Search method: All objects in database

Matched NEOs

Object name:	Orbital elements:
1999XK136	Semimajor axis (AU): 2.6458 StDev.:
2001YK4	Eccentricity: 0.7801 StDev.:
2002LG3	q (UA): 0.5819 StDev.:
2007YP56	Inclination: 4.6262 StDev.:
2007YV56	Long. asc. node (deg.): 158.0625 StDev.:
2010JL33	Arg. perih. (deg.): 207.9189 StDev.:
	Mean anomaly: 193.6205 StDev.:
	Dsh: 0.0563 StDev.: 0.0000

Matched objects: 6

Start

Stop

Exit

Software engineering: Prof. Dr. Jose M. Madiedo (Copyright)

Parent body of the γ -Ursae Minorids

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- Included in IAU working list of meteor showers.
- Outburst in Jan. 2010.
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Mag. -5 γ -Ursae Minorid fireball imaged on Jan. 20, 2011 at 20h40m03.2 \pm 0.1s UT

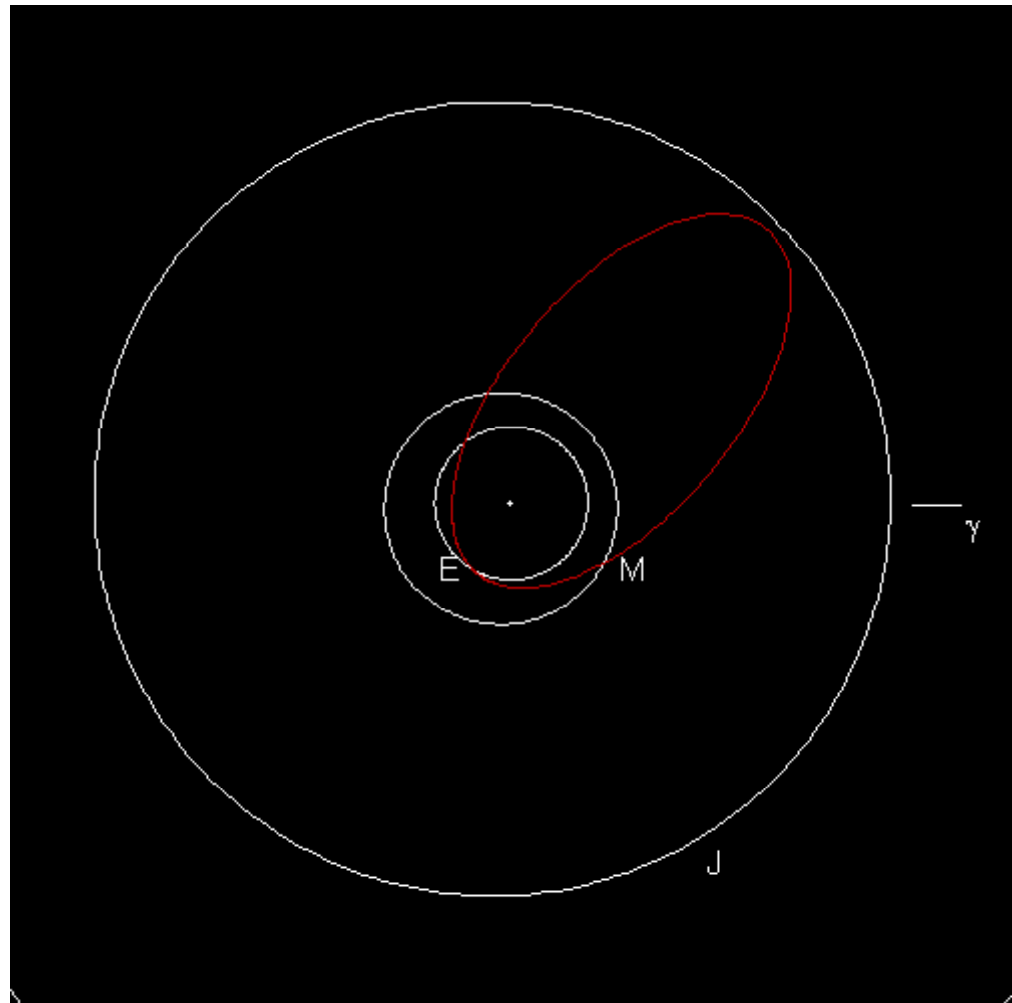
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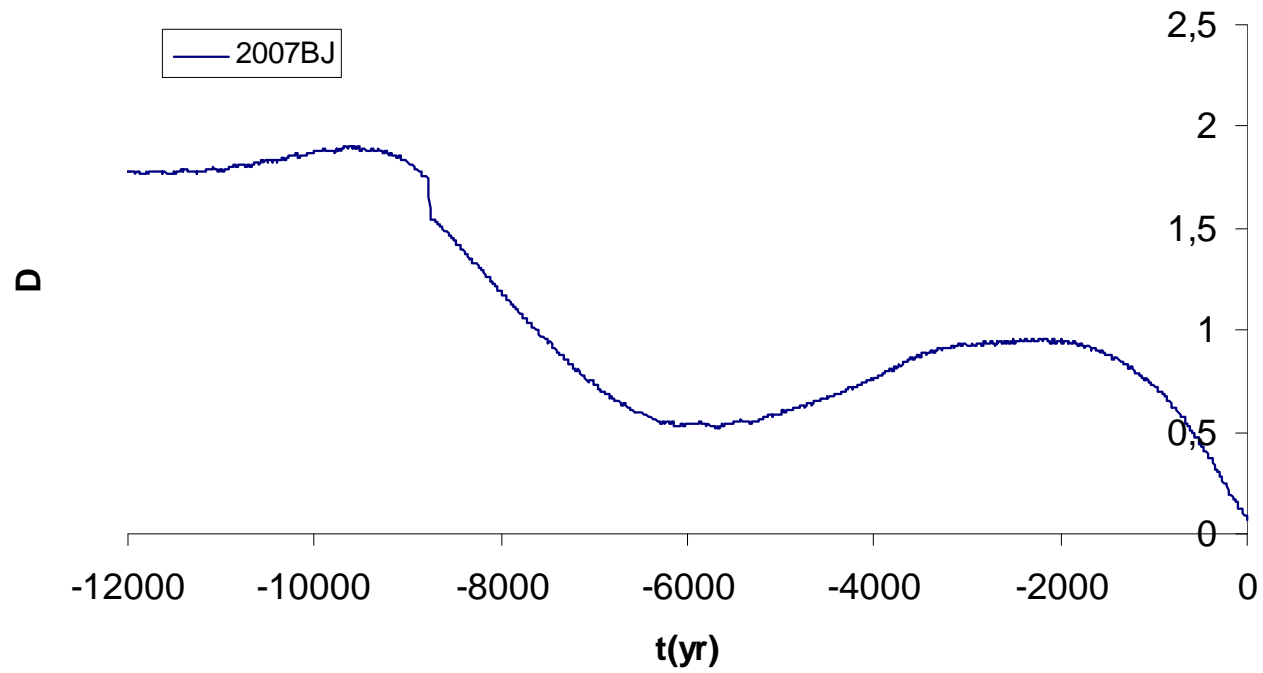
Orbital analysis:

- Potential parent: 2007 BJ.
- Southworth and Hawkins:
Dsh=0.14.
- Jopek D=0.08



Parent body of the γ -Ursae Minorids

Integration backwards in time (Mercury6):

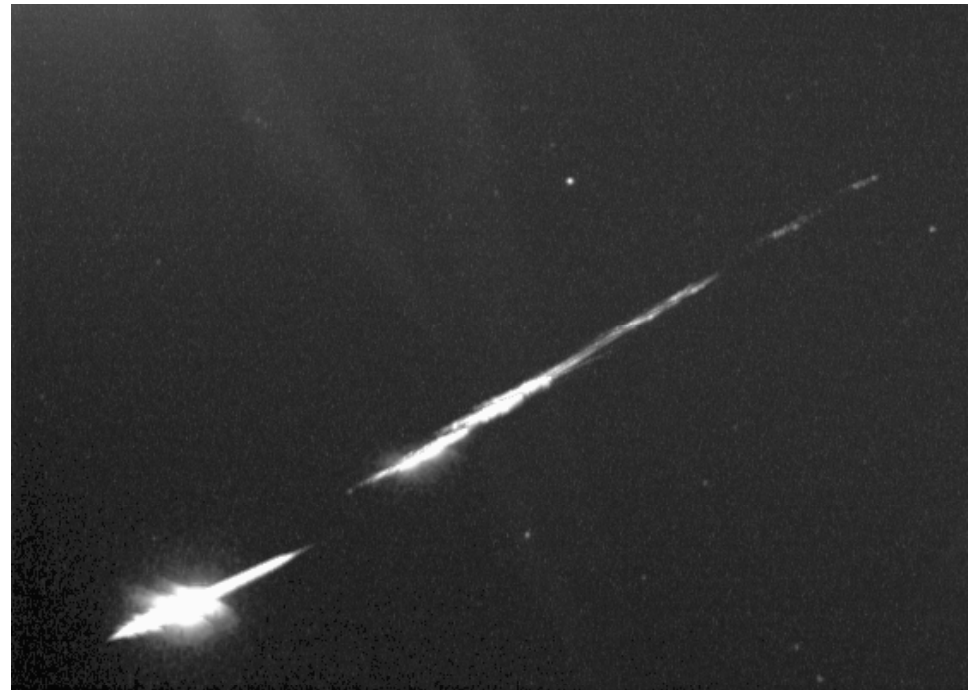


χ -Orionid meteoroid stream:

- Part of the Taurid complex (Jenniskens, 2006).
- Has northern (ORN) and southern (ORS) branches.
- ORN activity period: Nov.16 to Dec.16 (max. on Dec.10).
- ORN accepted parent
body: 2002XM35.
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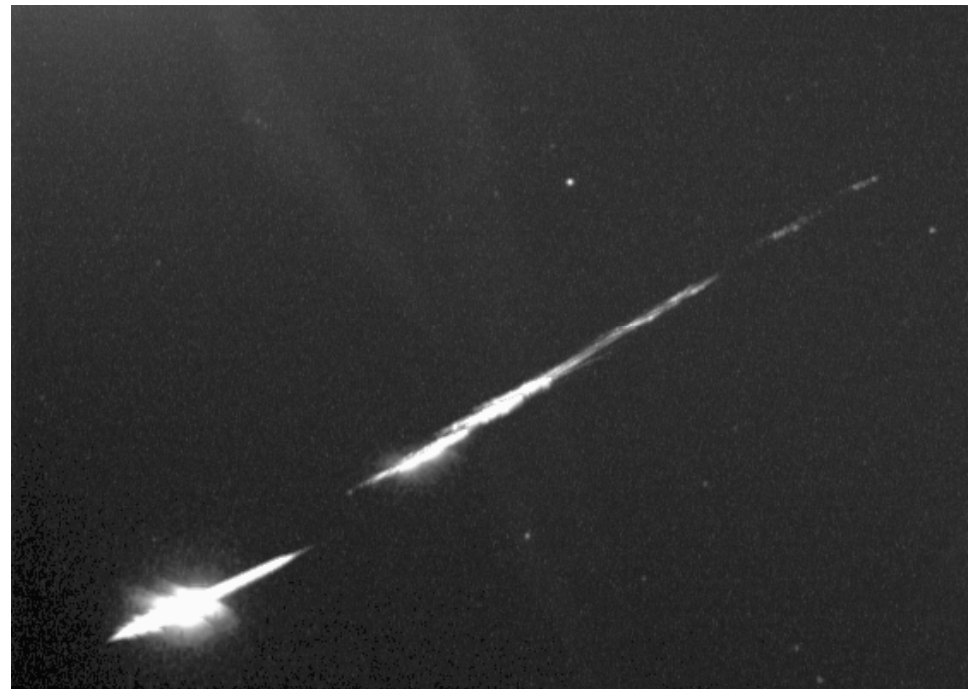
Mag. -7 ± 1 SPMN061211 ORN fireball
(Dec.6, 2011, 20h32m59.4 \pm 0.1s UT).

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Orbital analysis result:

- ❑ 2002 XM35 (Dsh=0.14).
- ❑ 2008 XM1 (Dsh=0.05).

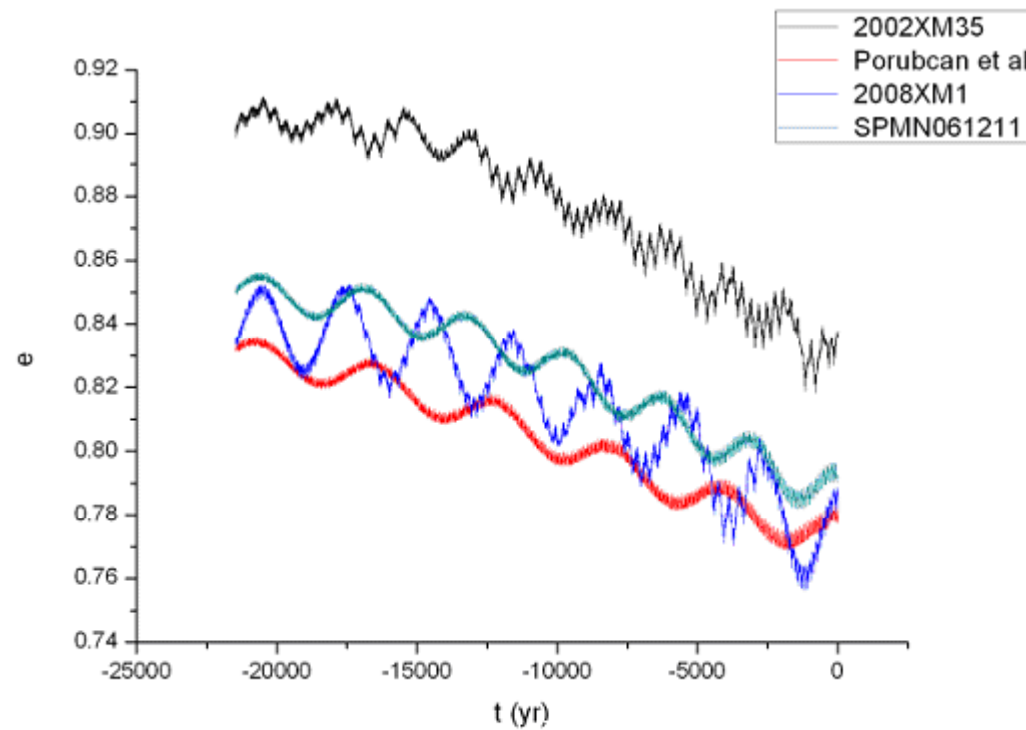


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Parent body of the Northern χ -Orionids

Integration backwards in time (Mercury6):

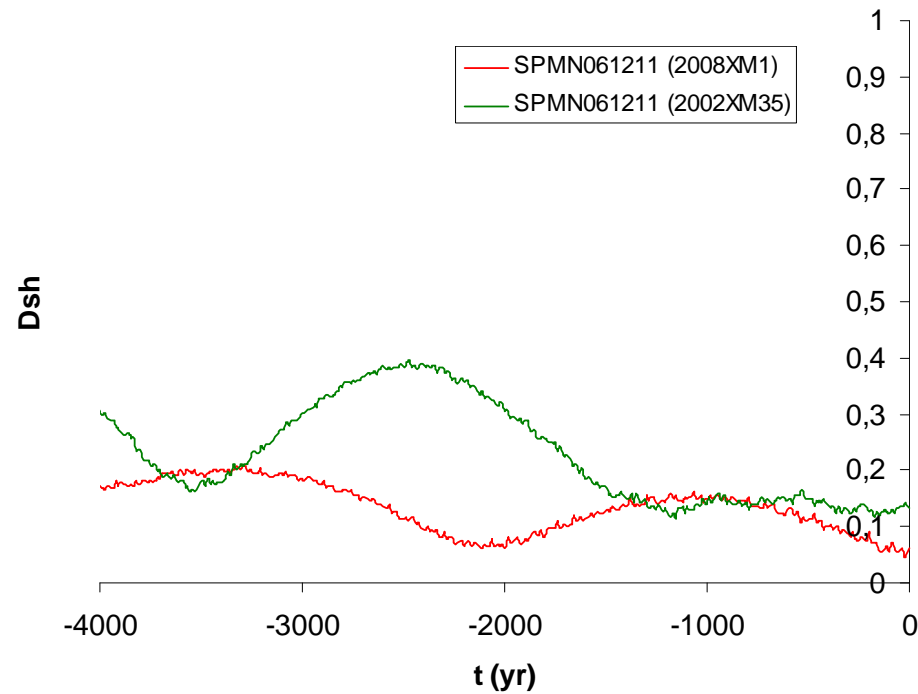
	a (AU)	e	i (°)	ω (°)	Ω (°)
SPMN061211	2.2	0.79	3.2	281.5	254.2322
ORN (N=7)	2.143	0.779	3.3	280.4	256.8
2002XM35	2.3304	0.8361	3.0845	313.4382	229.2701
2008XM1	2.3679	0.7822	4.9954	276.1411	259.8564



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Conclusions

- ❑ We have developed a software tool to establish the potential parent bodies of meteoroid streams.
- ❑ ORAS (ORbital Association Software) package can browse both, the NeoDys and the Minor Planet Center (MPC) databases.
- ❑ The results obtained by this software can be checked and confirmed by performing an integration backwards in time (Mercury 6).
- ❑ One of the latest results obtained in this way is the likely association between the Northern χ -Orionid meteoroid stream (ORN) and the Potentially Hazardous Asteroid 2008XM1.
- ❑ This analysis also suggests a plausible dynamic link between both NEOs, 2008XM1 and 2002XM35.

Acknowledgements

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Thanks for your attention!