Prediction of meteor shower associated with comet 122P/de Vico

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International Meteor Coference 2012, September 20-23, La Palma Island, Canary, Spain

Introduction

- We model a theoretical stream associated with comet 122P/de Vico and follow its dynamical evolution until the present.
- Haley-type comet – orbital period = 74.35 years.
- Osculating elements : q = 0.659337, e = 0.962709, ω = 12.996092°, Ω = 79.624501°, i = 85.382753° (JPL Small-Body database)

Modelling of the stream

- The motion of all theoretical particles is followed with a numerical integration.
- The perturbation from 8 planets – considered.
- Non-gravitational forces - not included.
- The procedure of the modelling consists:

(1) The integration of the parent body into past (equal to 750 orbital revolutions of parent body - P_o).

The initial position and velocity vectors – JPL ephemeris

The integration - integrator RA15 (Everhart 1985)

Modelling of the stream

(2) Modelling 10 000 theoretical particles. All particles – the same magnitude of the ejection velocity equal to 0.001 v_p.

(3) Numerical integration of the stream from ejection until the present.

Integrator RA15 is again used.

The final characteristics of 8 planets and the parent body are taken as initial in this step.

(4) The analysis of main dynamical evolutionary of the theoretical stream.

(5) The selection of the particles – crossing / passing Earth's orbit in the distance shorter than 0.05 AU.

Modelling of the stream

(6) The analysis of the dynamical evolution of the Earth-orbit approaching part of the theoretical stream.

(7) The identification of the Earth-orbit approaching particles with the actually observed meteors.

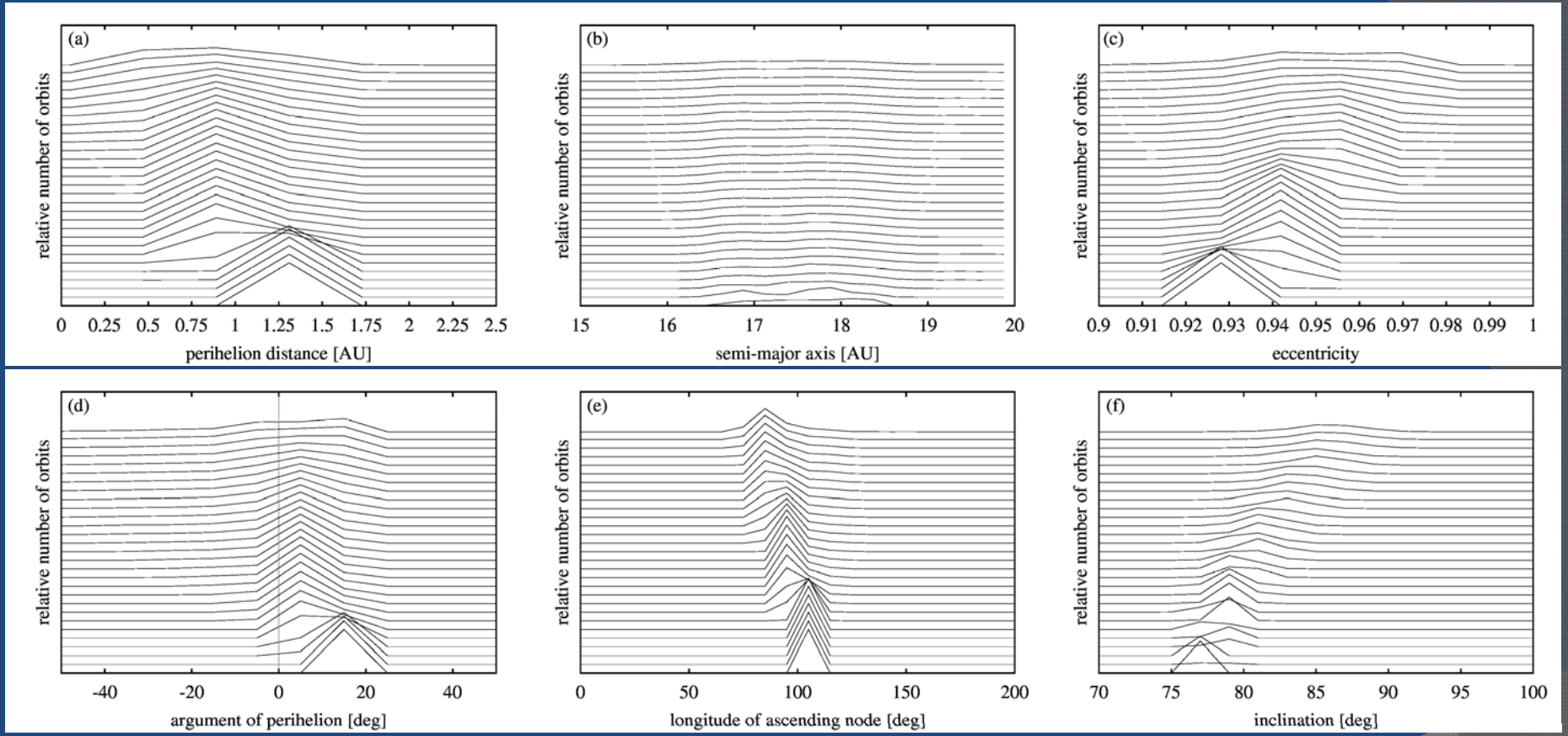
Used - 3 databases: *photographical* (Lindblad et al., 2003)

radio-meteor (Hawkins, 1963; Sekanina & Southworth, 1975; Lindblad , 2003)

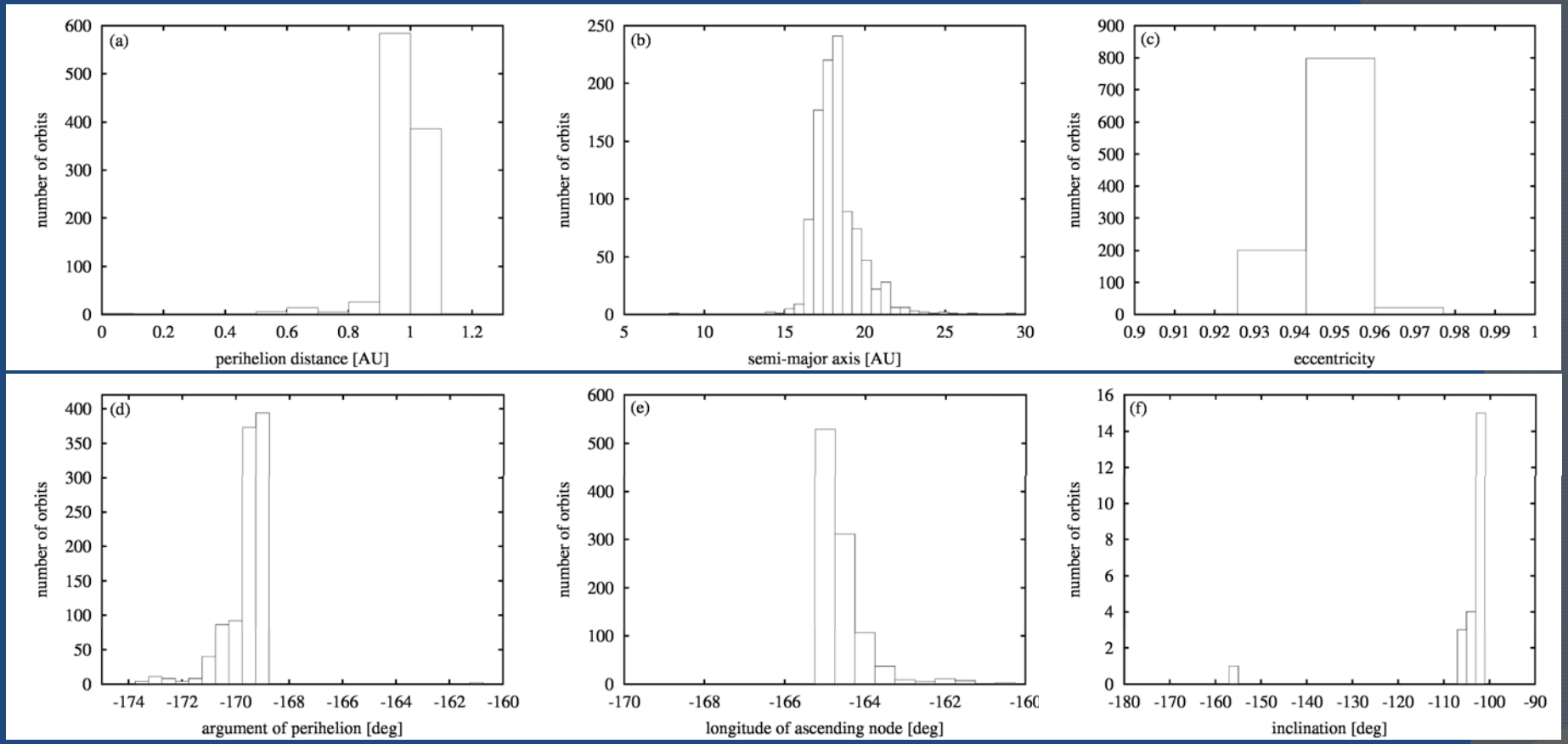
video-meteor (SonotaCo, 2009)

Identification - „break point“ method (Neslušan et al., 1995)

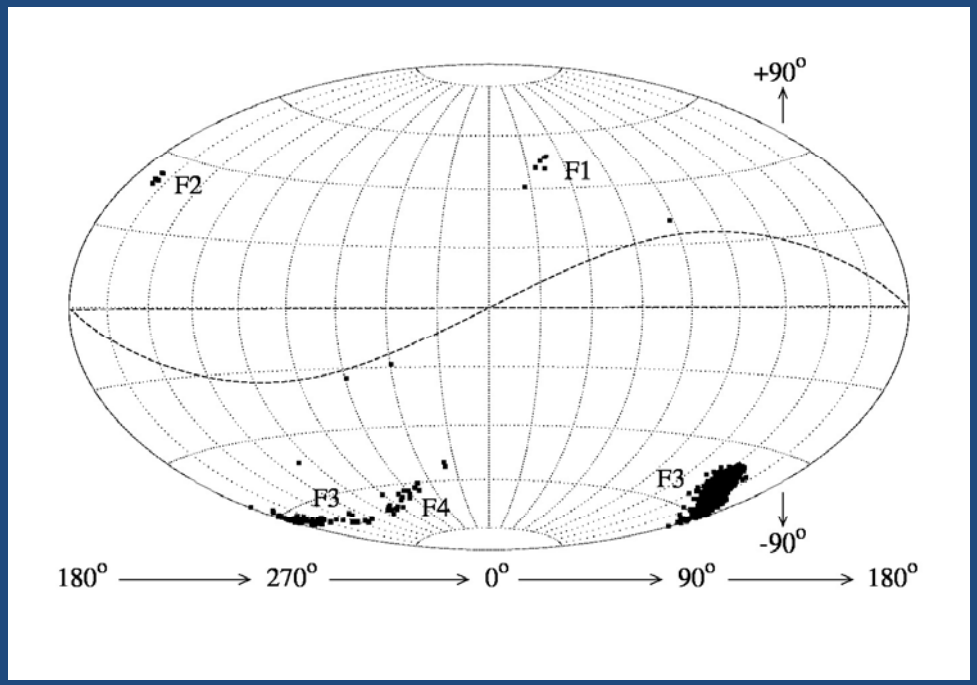
The predicted stream



The evolution of orbital elements of theoretical stream associated with comet 122P/de Vico. The bottom curve illustrates the distribution in the time of modeling. The higher curves show the behaviour for another successive 2000-years intervals. The top curve shows the distribution at the present.



The distribution of orbital elements of the southern Earth-orbit approaching part of theoretical stream associated with comet 122P/de Vico.



Position of radiants of the 122P-stream particles. The stream is split into 4 filaments having 4 distinct areas.

fil.	br.	n	t_{max}	q	a	e	ω	Ω	i	α_g	δ_g	V_g	V_h
1	N	6	Sep. 27.57	0.437	16.8	0.975	279.2	184.4	80.4	26.8	48.1	47.9	41.3
2	N	5	Dec. 20.11	1.010	18.7	0.946	72.3	87.0	84.0	127.1	−30.5	48.5	41.3
3	S	997	June 23.77	0.981	18.3	0.961	212.2	92.2	85.6	317.0	41.6	48.8	41.2
4	S	23	Feb. 19.43	0.642	17.2	0.963	285.8	150.8	84.3	293.2	−65.2	49.3	41.7

Mean orbital characteristics of individual filaments of 122P stream which are predicted to appear as meteor showers in the Earth's atmosphere.

We modelled the theoretical streams for other ejection times – *500, 250, 100* and *50* P_o before the present.

Less and less number of the Earth-orbit approaching particles occurred.

In model for the time *100* and *50*P_o – no Earth-orbit approaching particles.

Conclusion

- The planetary perturbations changed a quite large number of the particles to the orbits approaching the Earth's orbit.
- These particles can hit our planet in 4 filaments (north, south).
- It appears that comet 122P/de Vico would associate a meteor shower (observable on the Earth) if its meteoroids were able to survive an extremely long period orbiting the Sun.

Thank you for your attention!