PARENT BODIES OF SOME MINOR METEOR SHOWERS

Luboš Neslušan and Mária Hajduková, Jr.

Astronomical Institute of the Slovak Academy of Sciences

IMC 2019, October 3-6, Bollmannsruh, Germany

MODELING METEOROID STREAMS

METHOD: Neslušan, L., A&A 351, 752, (1999)
Tomko, D. & Neslušan, L., A&A , 623, id.A13, 24 pp., (2019)

- initial orbital corridor of the stream around the orbit of the parent body
- alternative corridors - gravitational perturbations
  - non-gravitational forces

} METEOROID STREAM FILAMENTS

- crossing the Earth's orbit = METEOR SHOWERS

RESULTS: - new parent bodies
- predicting new meteor showers
- finding and/or excluding relationships

C/1975 T2 (SUZUKI-SAIGUSA-MORI)

Hajduková, M. Jr. & Neslušan, L., A&A 627, A73 (2019)

	q (au)	e	a (au)	ω (deg)	Ω (deg)	i (deg)	P (yr)
C/1975 T2*	0.838	0.986	58.4	152.0	216.8	118.2	446

C/1964 N1 (IKEYA)

Neslušan, L. & Hajduková, M. Jr., A&A 616, A162 (2018)

	q (au)	e	a (au)	ω (deg)	Ω (deg)	i (deg)	P (yr)
C/1964 N1*	0.822	0.985	53.5	290.8	269.9	171.9	391

C/1979 Y1 (BRADFIELD)

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	q (au)	e	a (au)	ω (deg)	Ω (deg)	i (deg)	P (yr)
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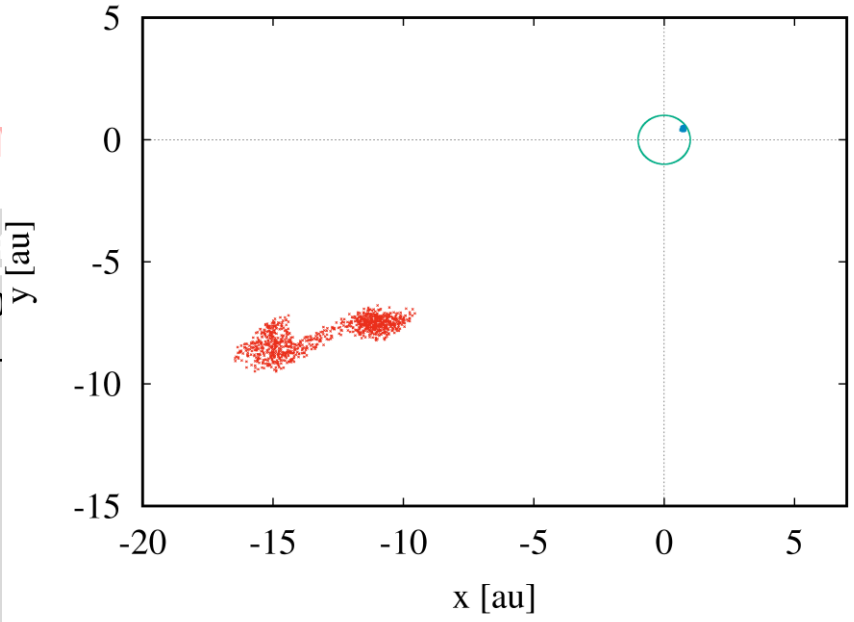
C/1963 A1*	0.632	0.993	95.5	336.3	53.2	160.7	932

*JPL small-body browser (Giorgini et al., 1996)

C/1975 T2

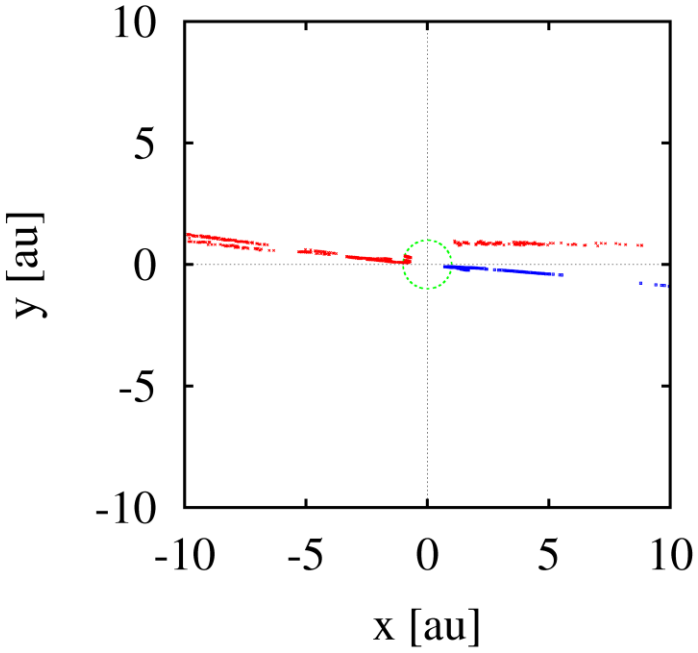
Hajduková, M



	q	P (yr)
C/1975 T2*	0	446

C/1964 N1

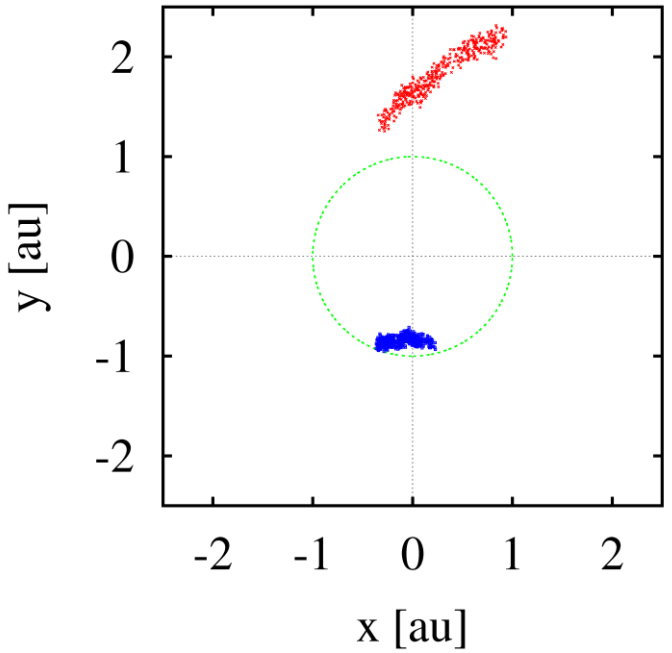
Neslušan, L.



	q	(deg)	P (yr)
C/1964 N1*	0	171.9	391

C/1979 Y1

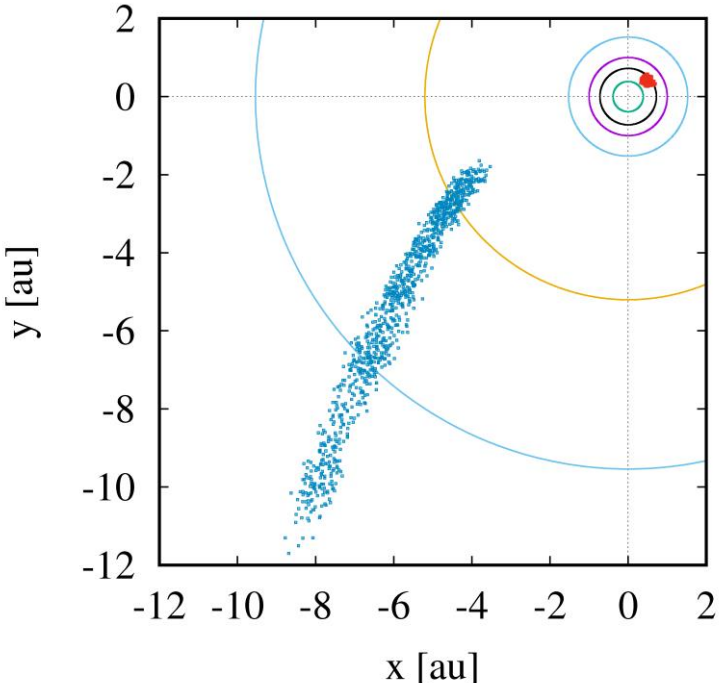
Hajduková, M



	q	deg)	P (yr)
C/1979 Y1*	0	48.6	304.5

C/1963 A1

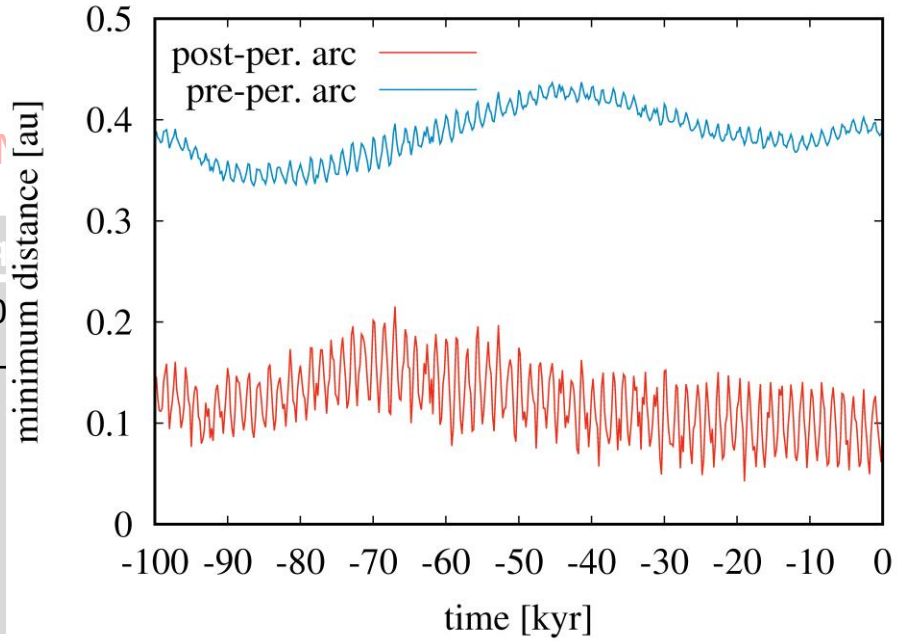
Neslušan, L.



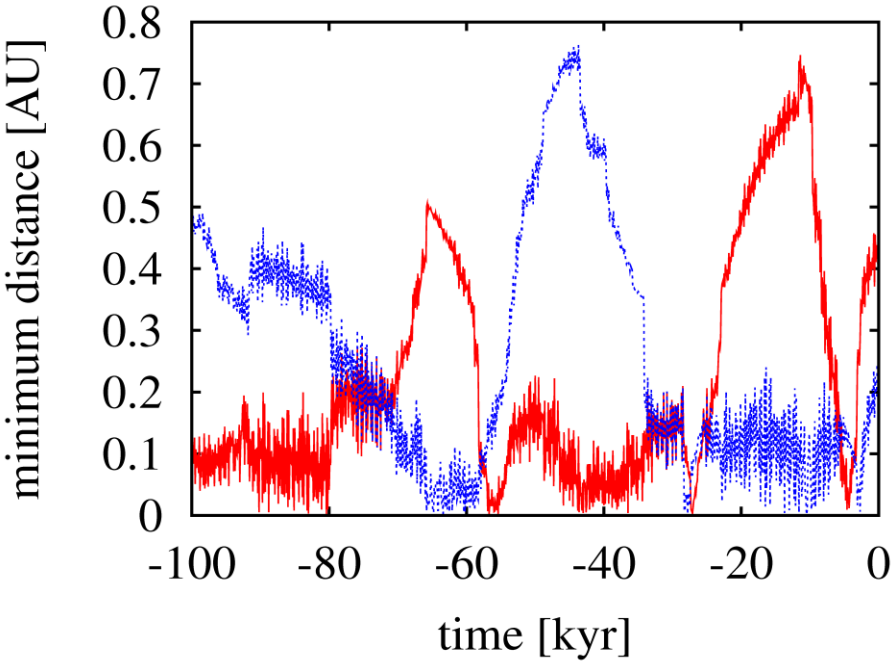
	q	(deg)	P (yr)
C/1963 A1*		60.7	932

Evolution of the orbital nodes positions of the comets during the last suitably long period

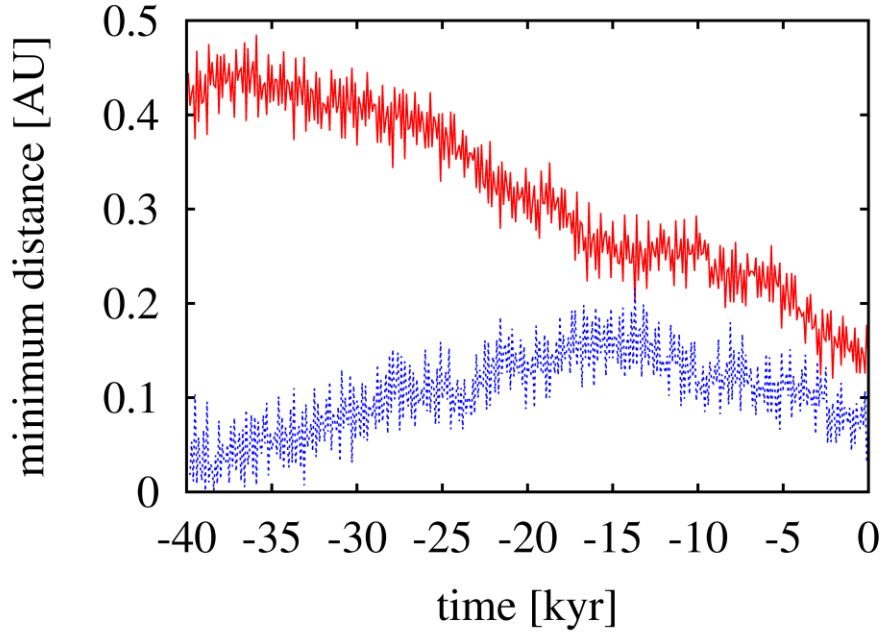
C/1975 T2



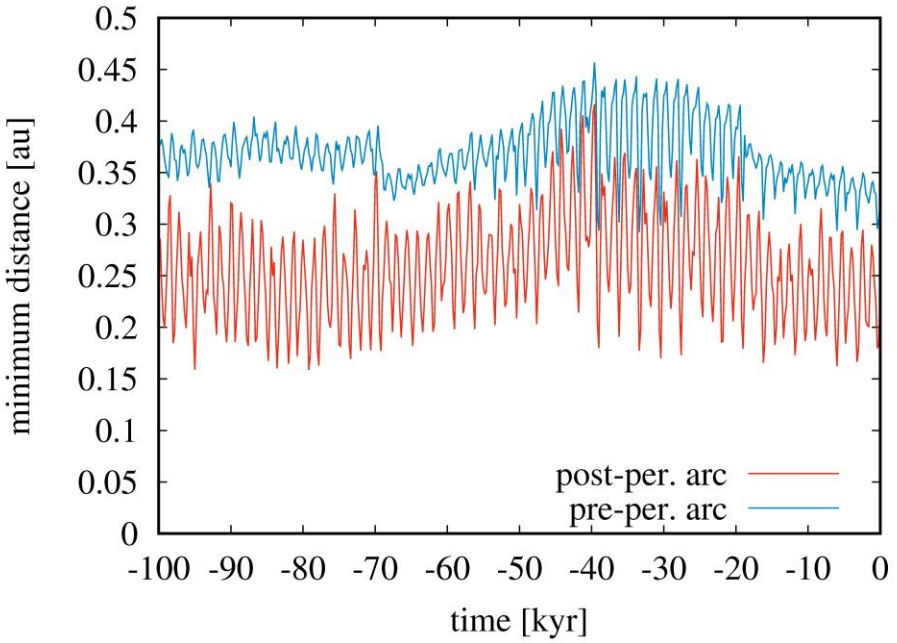
C/1964 N1



C/1979 Y1



C/1963 A1



Evolution of the minimum distance between the orbital arcs of the comets and Earth's orbit

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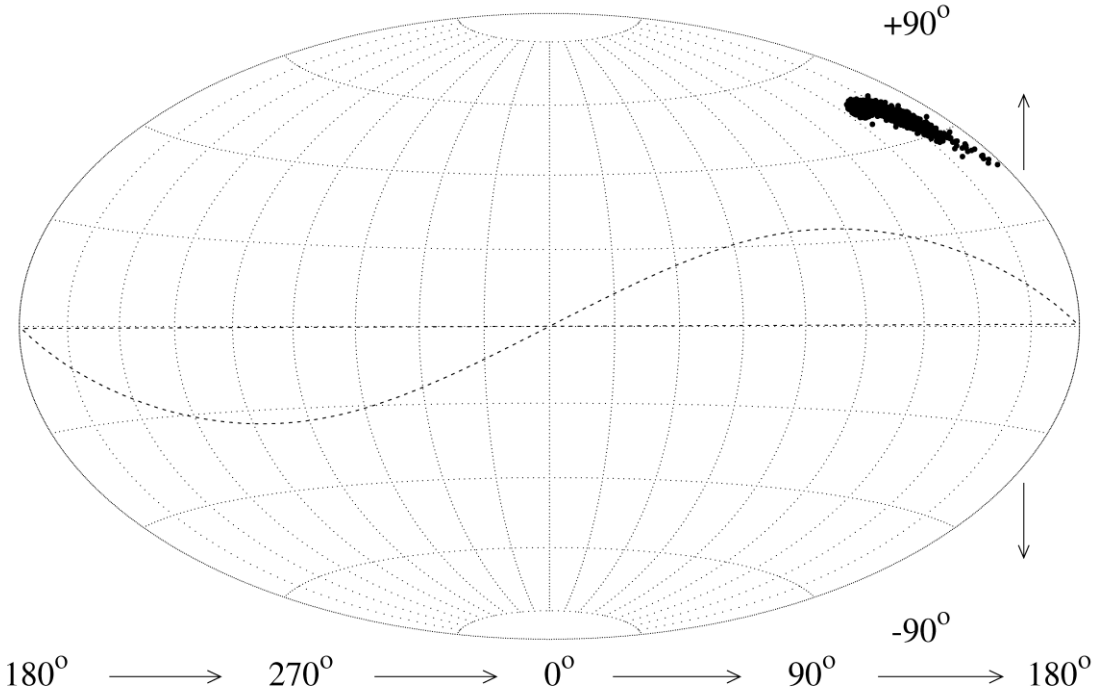
C/1975 T2 Model

The meteoroid stream of the C/1975 T2 does not split; theoretical particles which cross the Earth's orbit create a single meteor shower



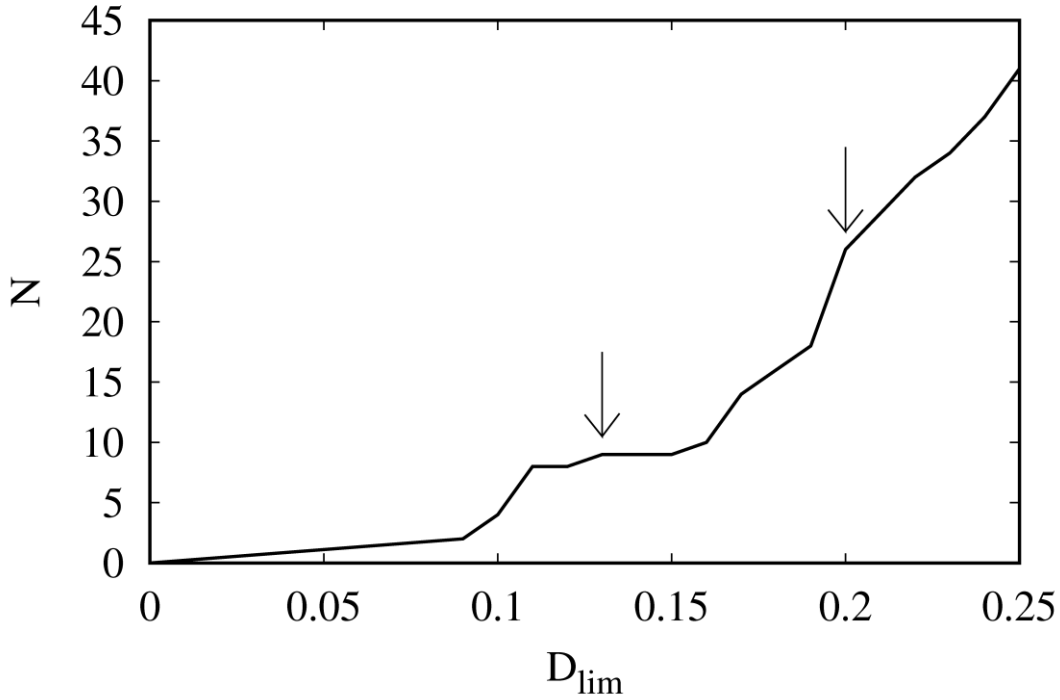
t_{ev} = 80 kyr, $\beta = 10^{-11}$

Equatorial coordinate frame

Separation of the real shower from databases

Break-point method:

Neslušan, L., Svoreň, J. & Porubčan, V., Earth Moon Planets, 110, 41 (2013)

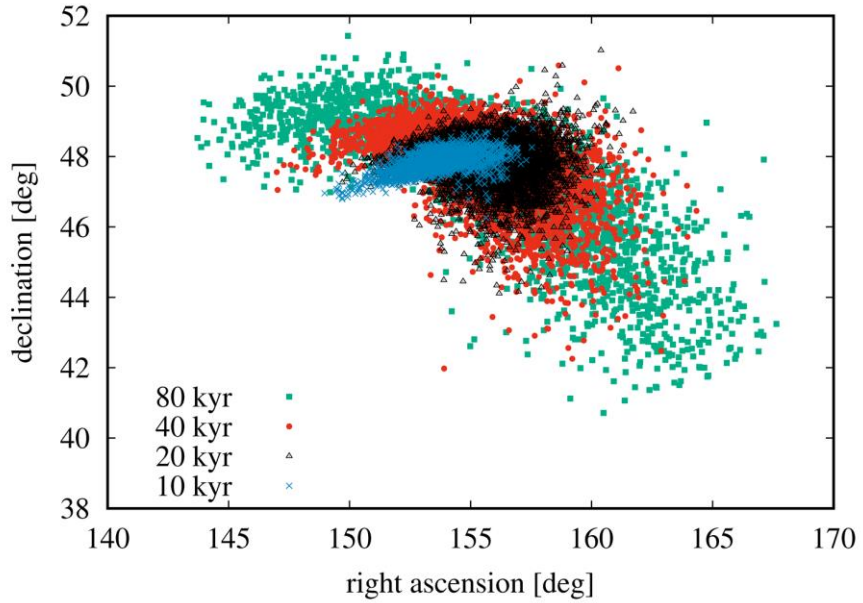


Dependence of the number of real meteors on the limiting value of the Southworth-Hawkins D-discriminant.

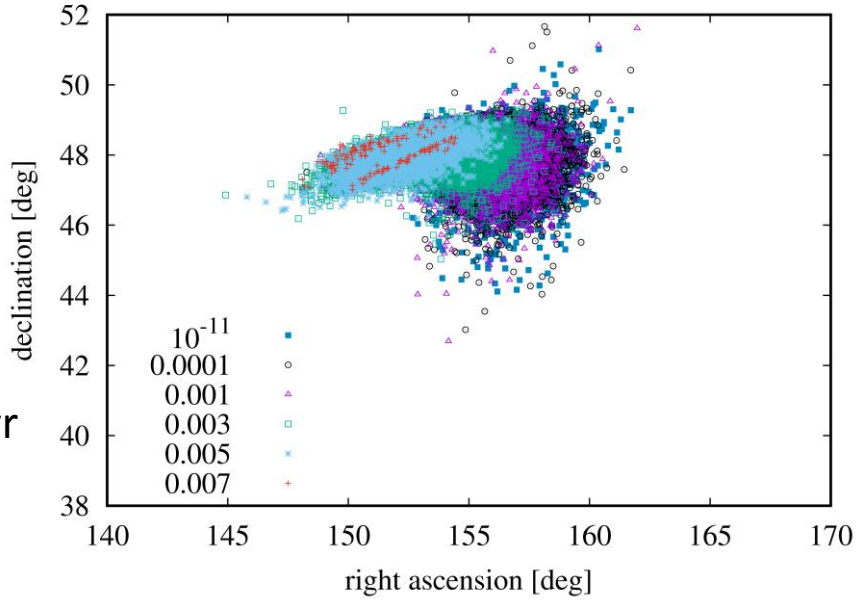
C/1975 T2

Predicted shower

Model
$\beta = 10^{-11}$
t_{ev} ⟶



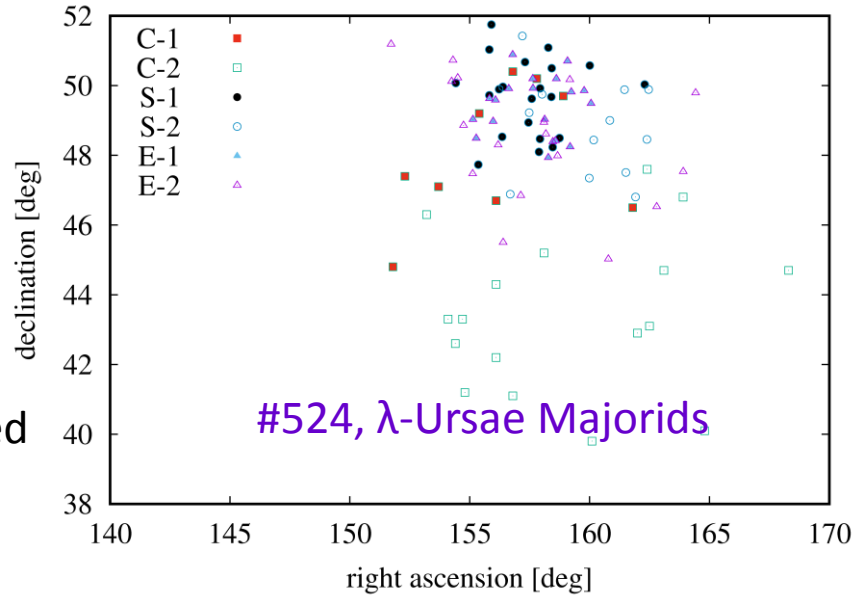
Model
t_{ev} = 20 kyr
β ⟶



Identification

- **with real meteors from the databases**
  - photographic orbits of the IAU MDC (Neslušan et al., 2014)
  - video databases
    - IAU MDC CAMS (Jenniskens et al., 2011; 2016)
    - SonotaCo (SonotaCo, 2009; 2016)
    - EDMOND (Kornoš et al., 2015)
  - radar data (Lindblad, 2003)
- **with the mean orbits from the IAU MDC list of showers** (Jopek & Kaňuchová, 2014)

Observed shower



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#524, λ-Ursae Majorids

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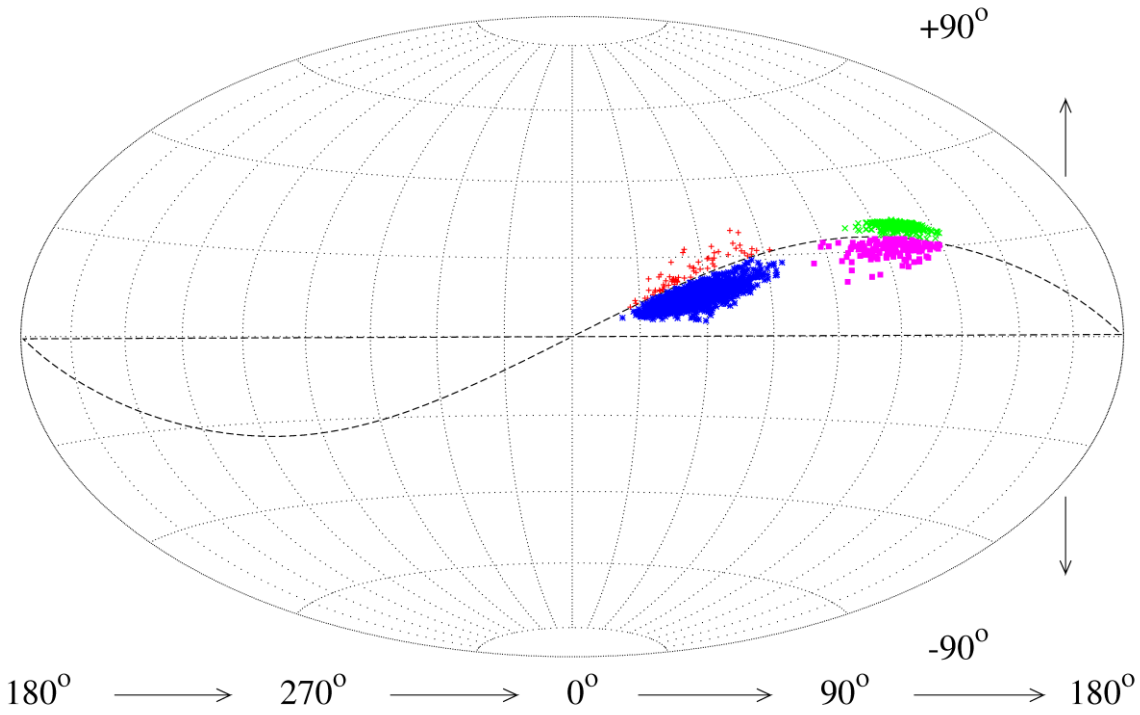
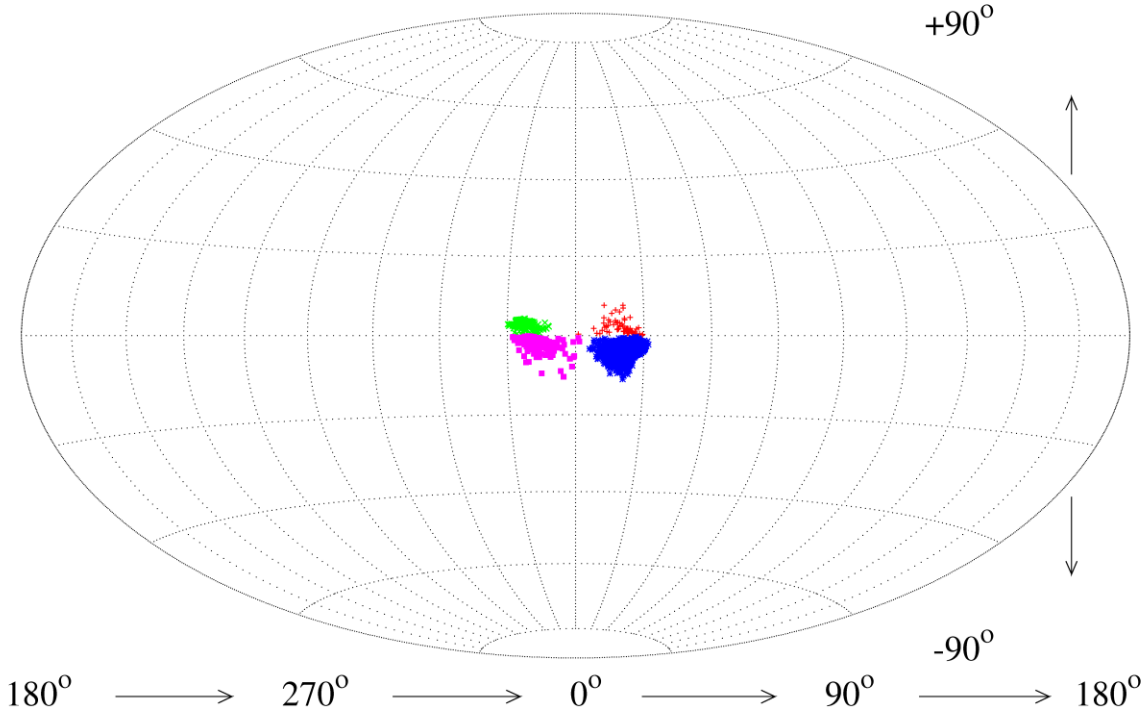
C/1964 N1 Model

Theoretical particles of the meteoroid stream of C/1964 N1, which approach the Earth's orbit, grouped into four filaments corresponding to four meteor showers



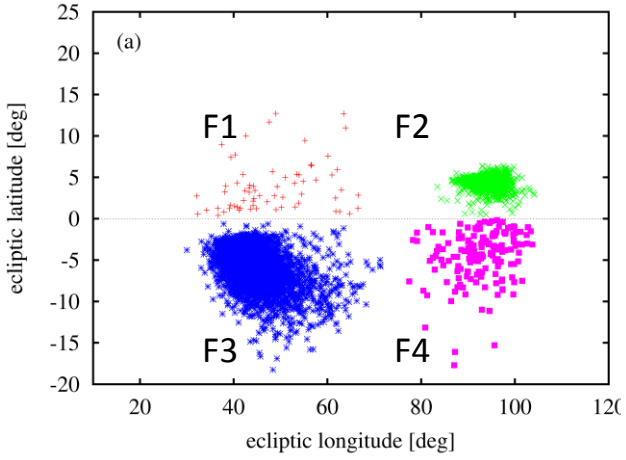
Equatorial coordinate frame



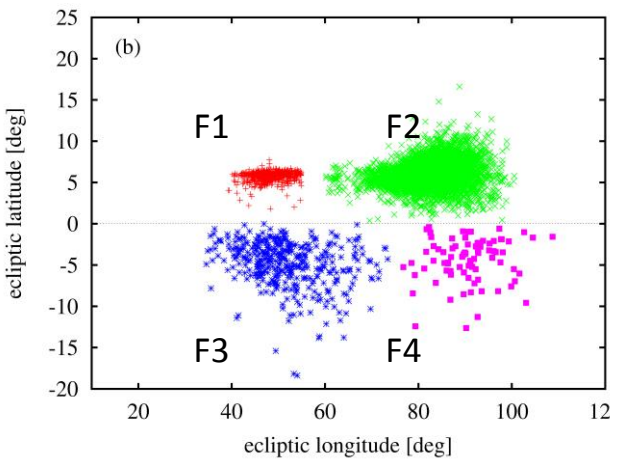
Ecliptical coordinate frame
with the center in the apex of the Earth's motion

C/1964 N1 Predicted showers in various models (t_{ev}, β)

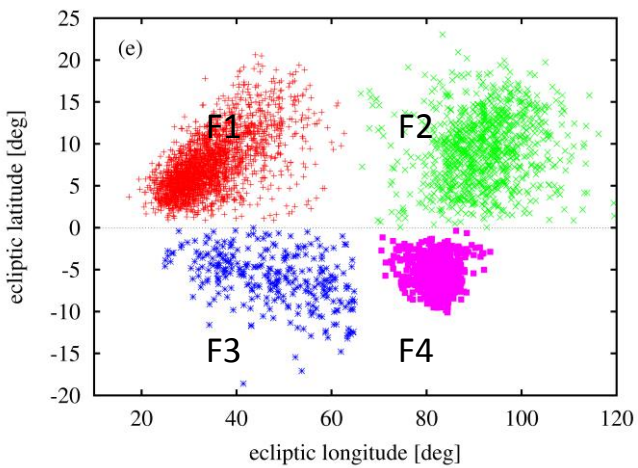
t_{ev} = 20 kyr
β = 0.0001



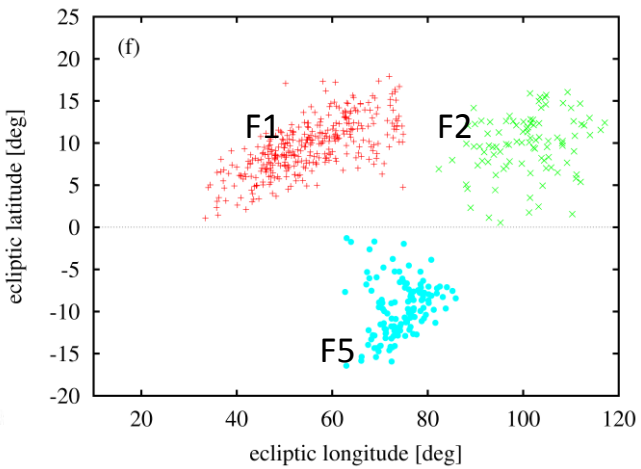
t_{ev} = 40 kyr
β = 0.003



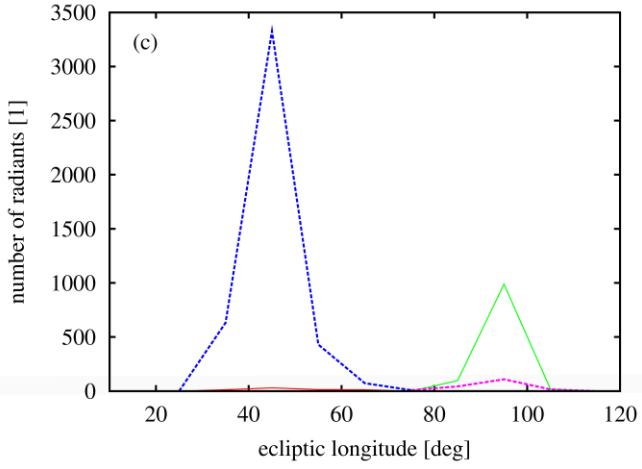
t_{ev} = 80 kyr
β = 0.00001

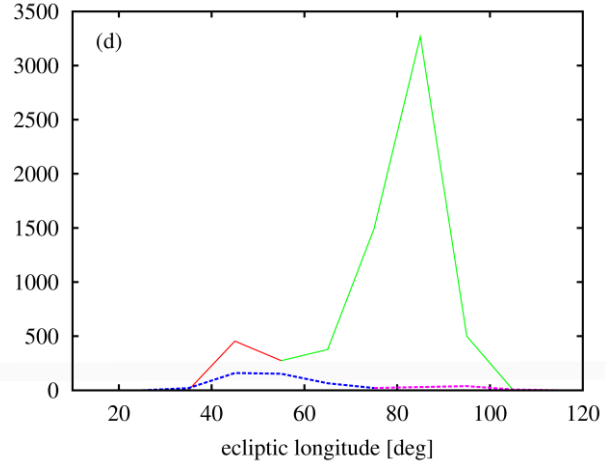


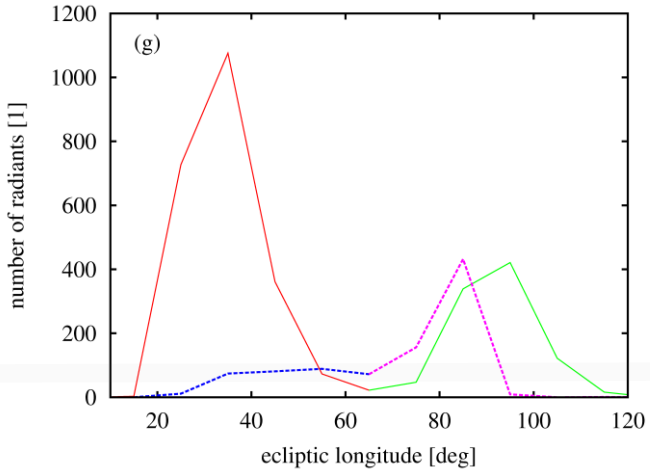
t_{ev} = 80 kyr
β = 0.007

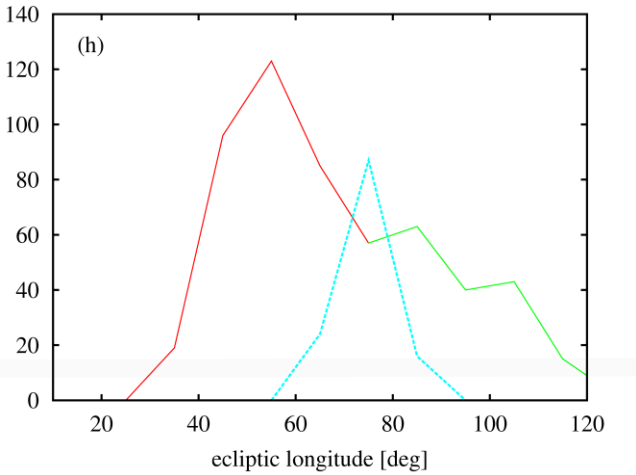


Radiants of the predicted meteor showers (in ecliptical coordinate frame)





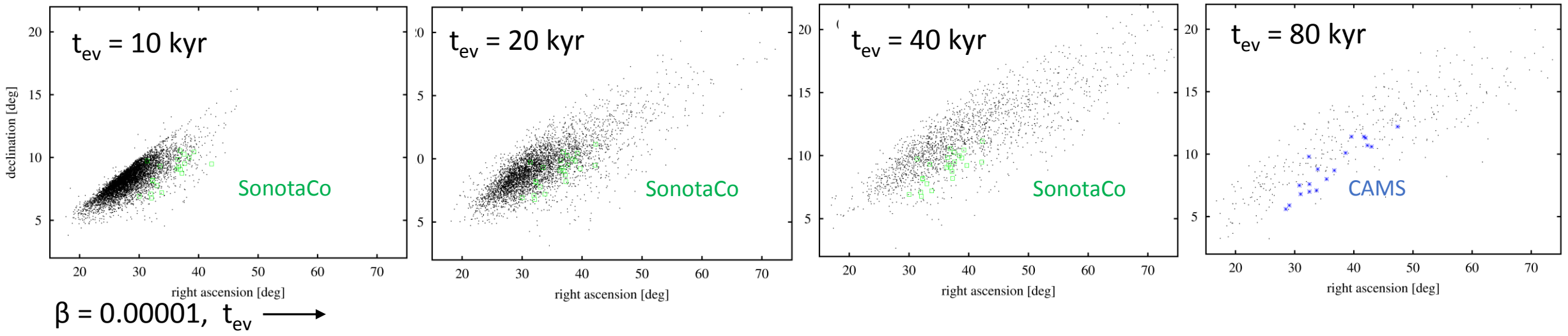




Distribution of these radiants in the ecliptic longitude

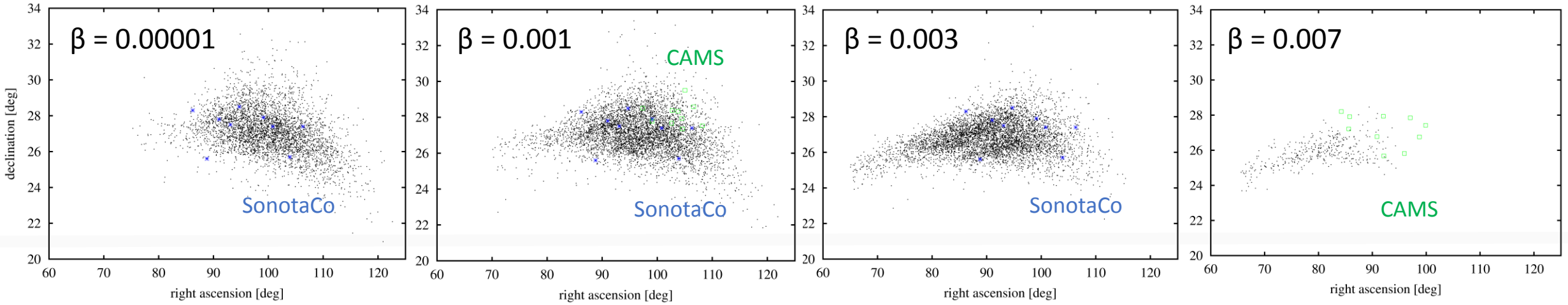
C/1964 N1 Predicted showers and their real counterparts

F3 #533, July ξ-Arietids



β = 0.00001, t_{ev} ⟶

F2 #023, ε-Geminids



t_{ev} = 40 kyr, β ⟶

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#718, ξ-Geminids (?)

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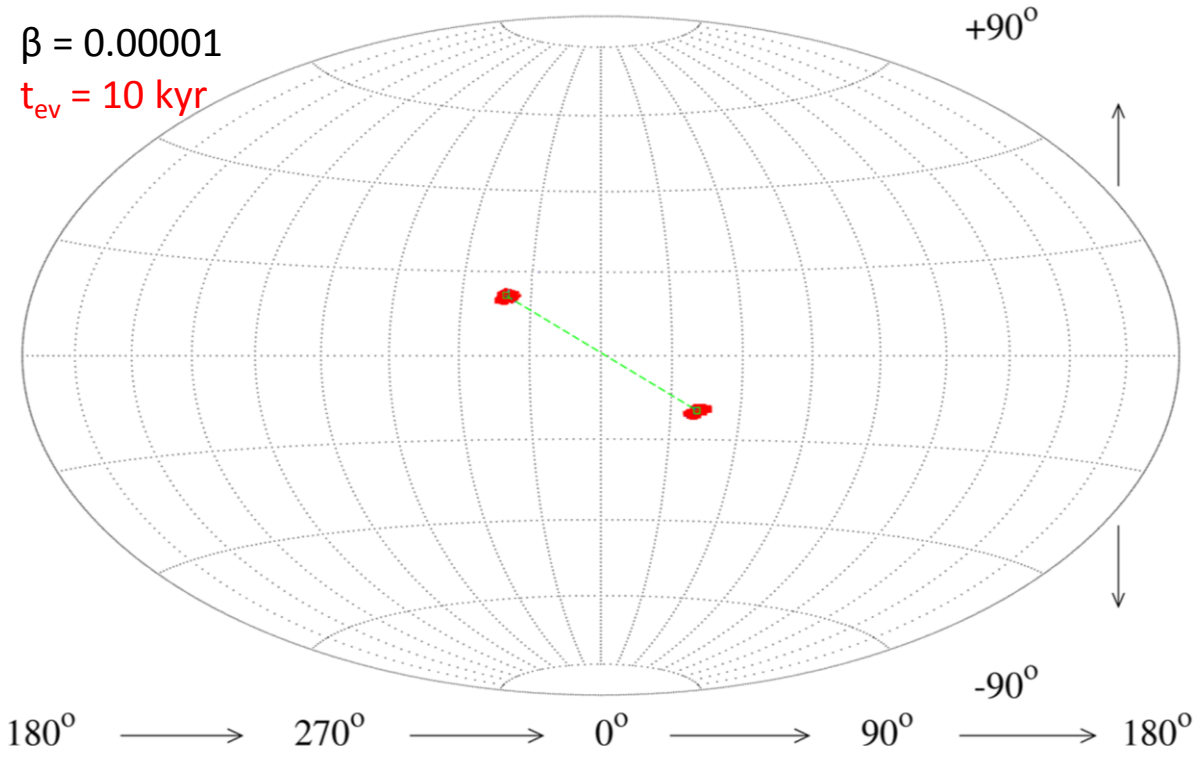
C/1979 Y1 Predicted showers regular



Regular filaments of the theoretical particles which cross the Earth's orbit occurred in each model.

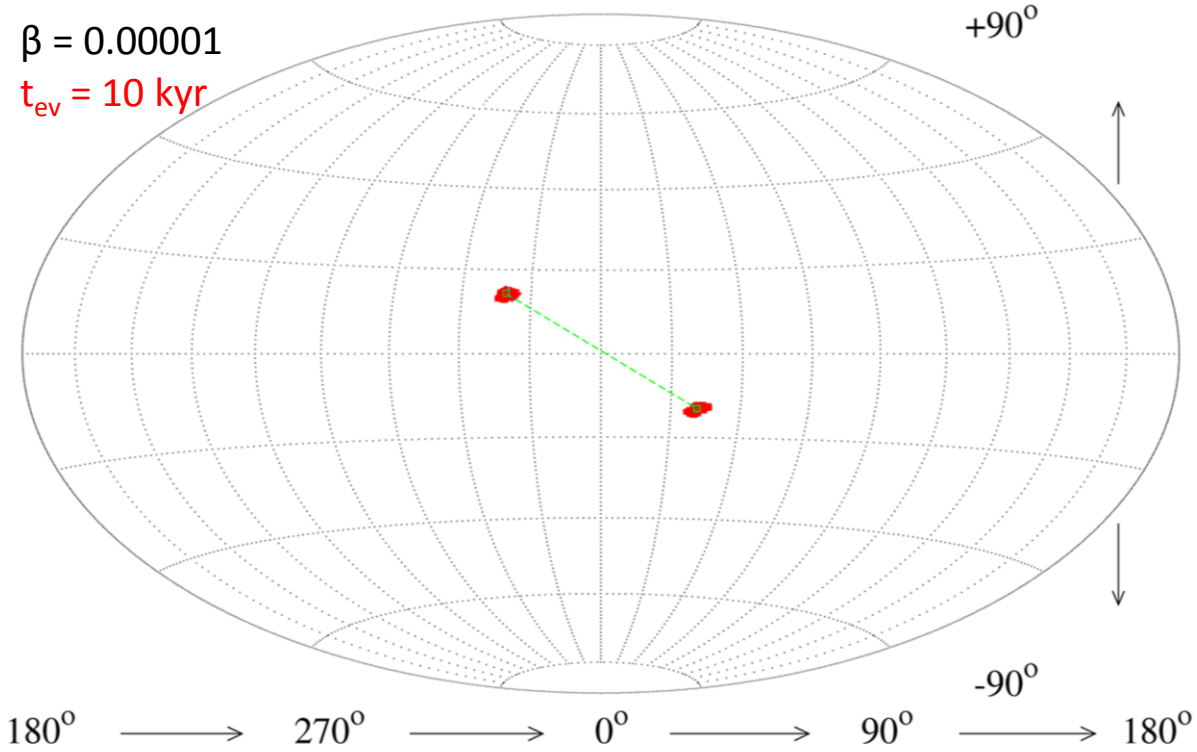
The radiants are shown in the modified ecliptical coordinate frame with the center in the apex of the Earth's motion.

C/1979 Y1 Predicted showers

regular

β = 0.00001

t_{ev} = 10 kyr



transitory

β = 0.0045 and 0.006

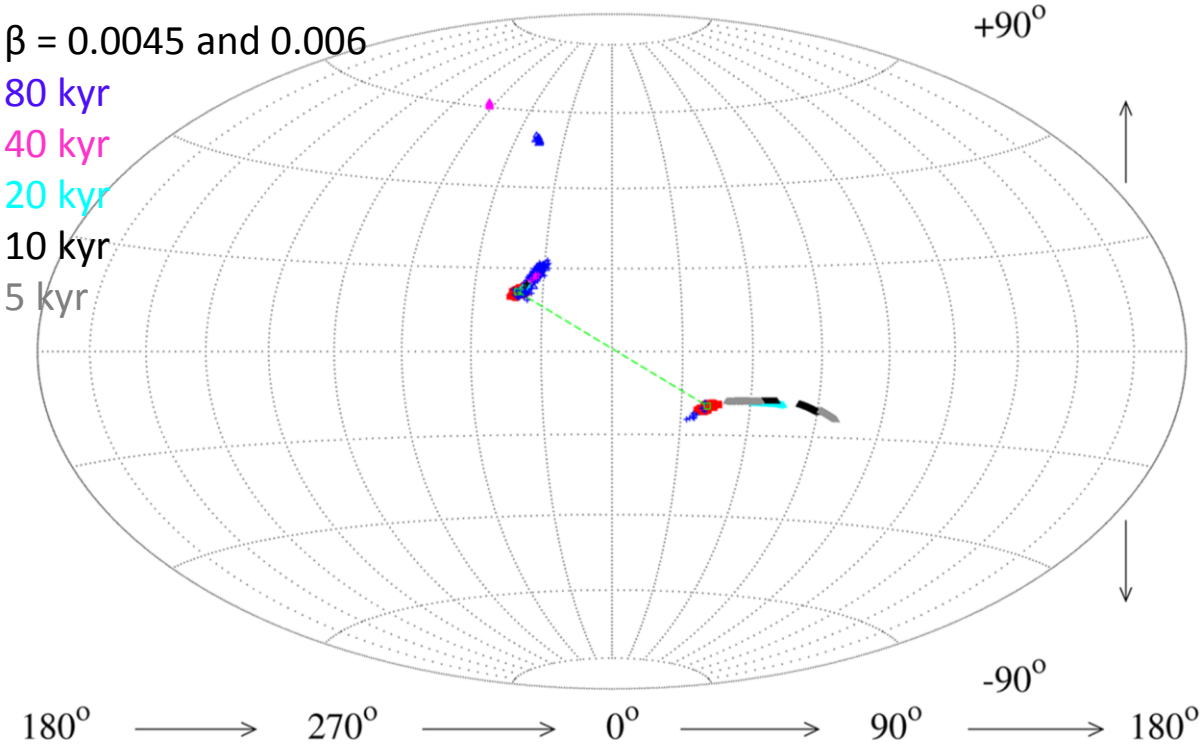
80 kyr

40 kyr

20 kyr

10 kyr

5 kyr



Regular filaments of the theoretical particles which cross the Earth's orbit occurred in each model.

Transitory filaments occurred in models with larger values of β parameter.

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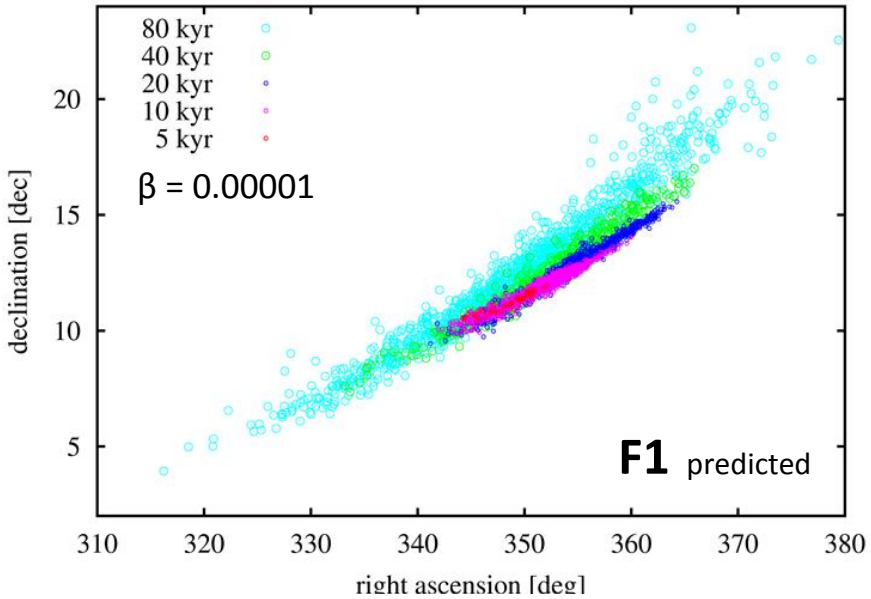
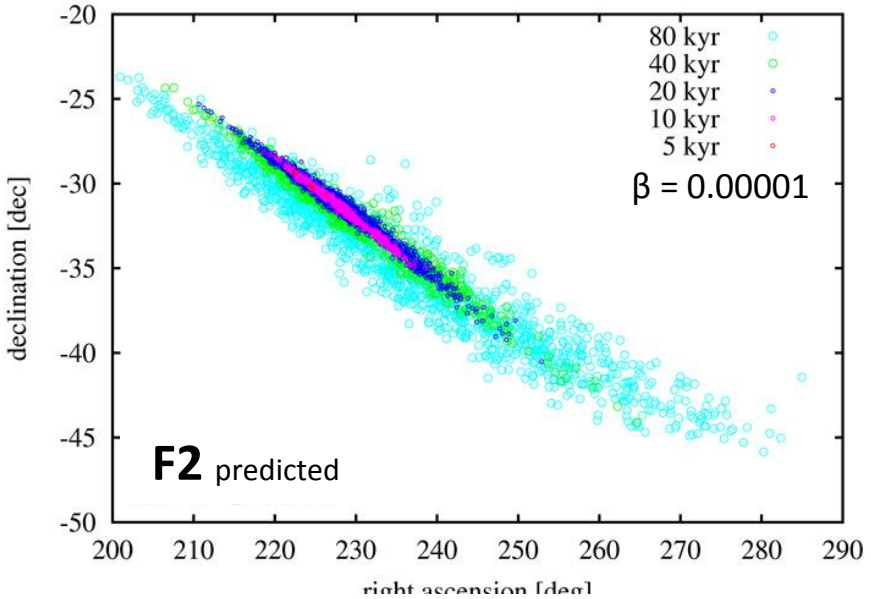
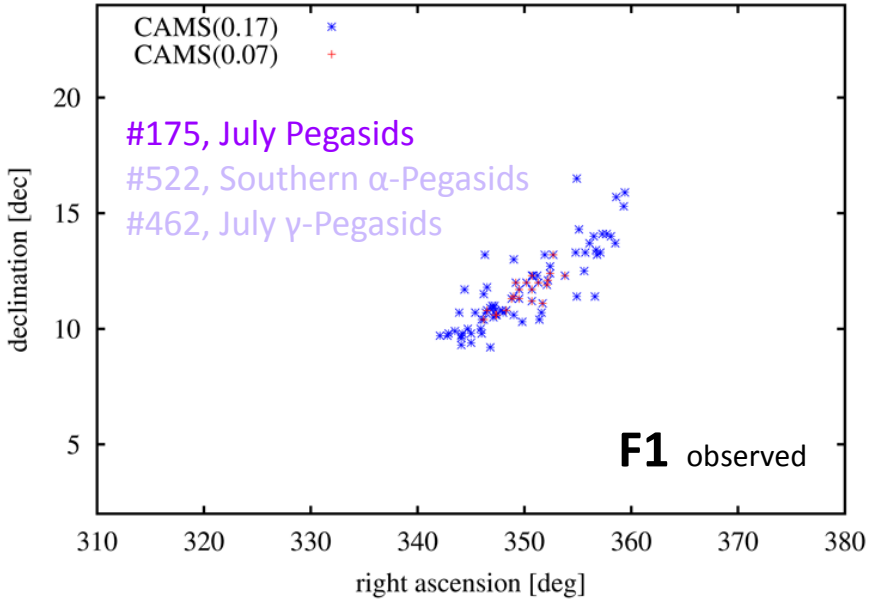
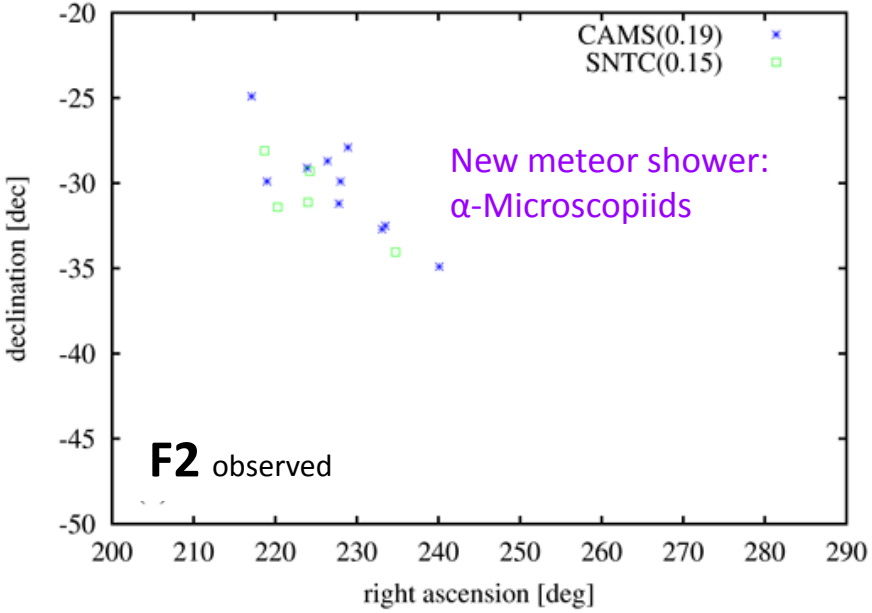
C/1979 Y1 Model vs Observations









C/1975 T2 (SUZUKI-SAIGUSA-MORI)

Hajduková, M. Jr. & Neslušan, L., A&A 627, A73 (2019)

	q (au)	e	a (au)	ω (deg)	Ω (deg)	i (deg)	P (yr)
C/1975 T2*	0.838	0.986	58.4	152.0	216.8	118.2	446

#524, λ-Ursae Majorids

C/1964 N1 (IKEYA)

Neslušan, L. & Hajduková, M. Jr., A&A 616, A162 (2018)

	q (au)	e	a (au)	ω (deg)	Ω (deg)	i (deg)	P (yr)
C/1964 N1*	0.822	0.985	53.5	290.8	269.9	171.9	391

#533, July ξ-Arietids

#023, ε-Geminids

#718, ξ-Geminids (?)

C/1979 Y1 (BRADFIELD)

Hajduková, M. Jr. & Neslušan, L., A&A 605, A36 (2017)

	q (au)	e	a (au)	ω (deg)	Ω (deg)	i (deg)	P (yr)
C/1979 Y1*	0.545	0.988	45.3	257.6	103.2	148.6	304.5

#175, July Pegasids = #522, Southern α-Pegasids = #462, July γ-Pegasids

New meteor shower: α-Microscopiids

#104, γ-Bootids

C/1963 A1 (IKEYA)

Neslušan, L. & Hajduková, M. Jr., A&A, accepted (2019)

	q (au)	e	a (au)	ω (deg)	Ω (deg)	i (deg)	P (yr)
C/1963 A1*	0.632	0.993	95.5	336.3	53.2	160.7	932

*JPL small-body browser (Giorgini et al., 1996)

C/1975 T2 (SUZUKI-SAIGUSA-MORI)

Hajduková, M. Jr. & Neslušan, L., A&A 627, A73 (2019)

	q (au)	e	a (au)	ω (deg)	Ω (deg)	i (deg)	P (yr)
C/1975 T2*	0.838	0.986	58.4	152.0	216.8	118.2	446

#524, λ-Ursae Majorids

C/1964 N21(IKEYA)

Neslušan, L. & Hajduková, M. Jr., A&A 616, A162 (2018)

	q (au)	e	a (au)	ω (deg)	Ω (deg)	i (deg)	P (yr)
C/1964 N1*	0.822	0.985	53.5	290.8	269.9	171.9	391

#533, July ξ-Arietids

#023, ε-Geminids

#718, ξ-Geminids (?)

C/1979 Y1 (BRADFIELD)

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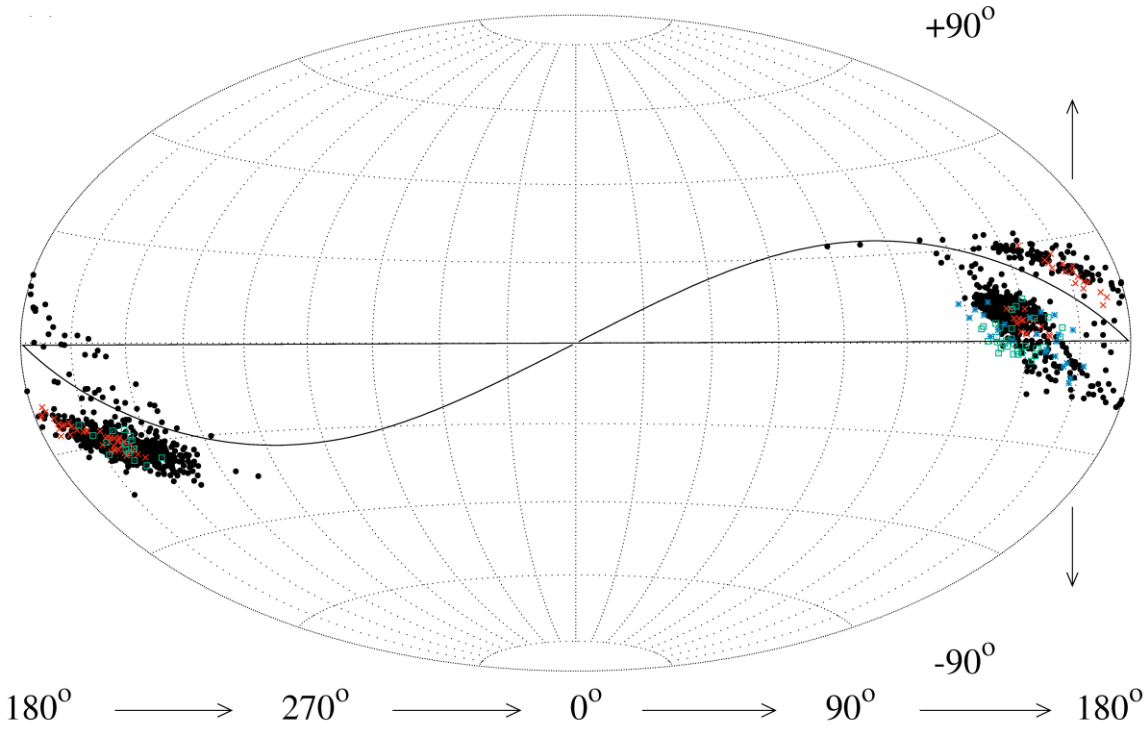
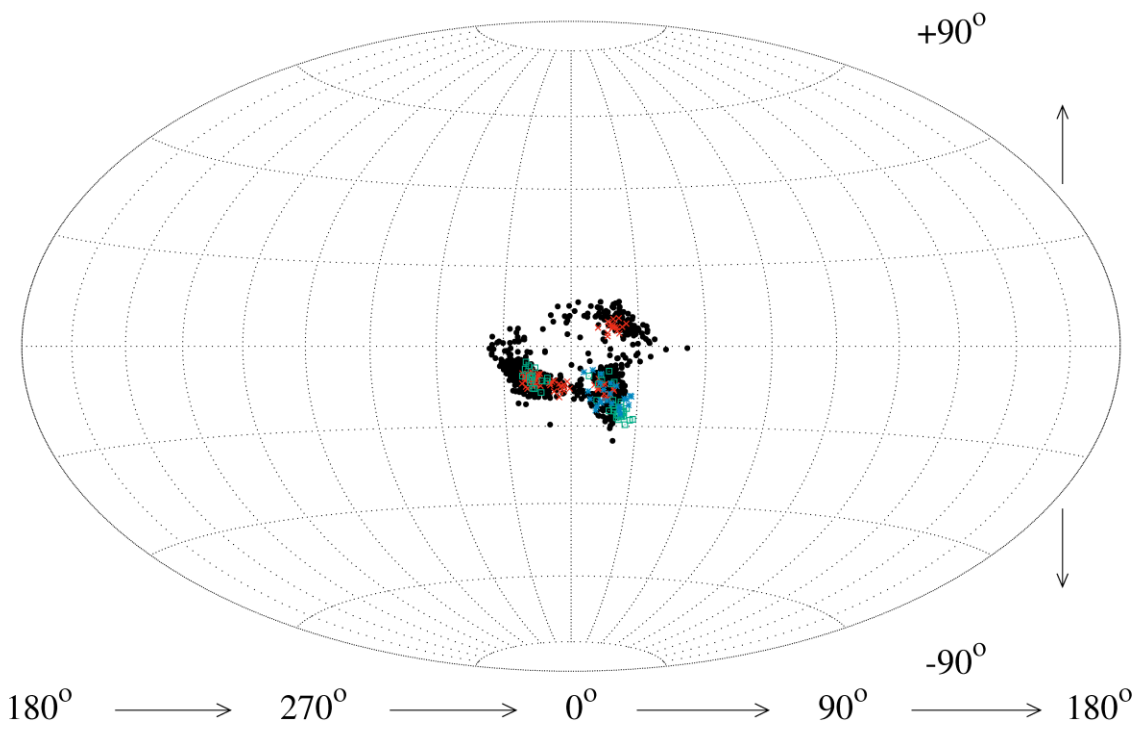
C/1963 A1 Model vs Observations

Modeled meteoroid stream of C/1963 A1 divided into (up to) five filaments that approached the Earth's orbit



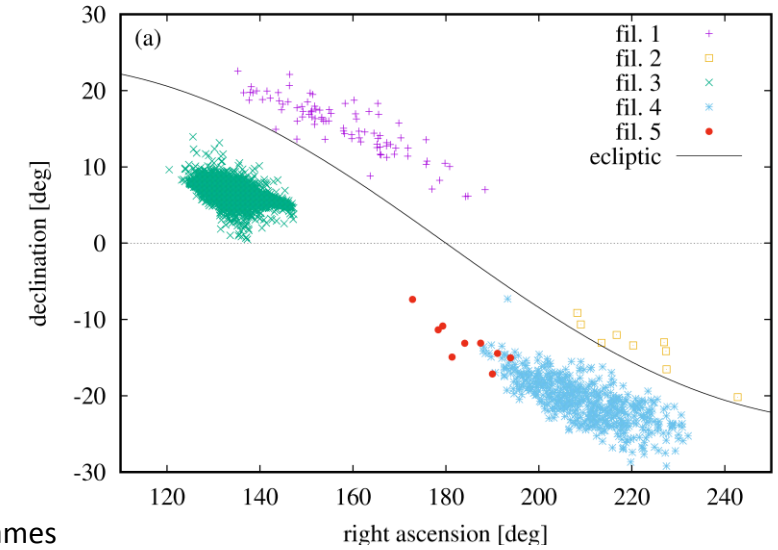
Equatorial coordinate frame

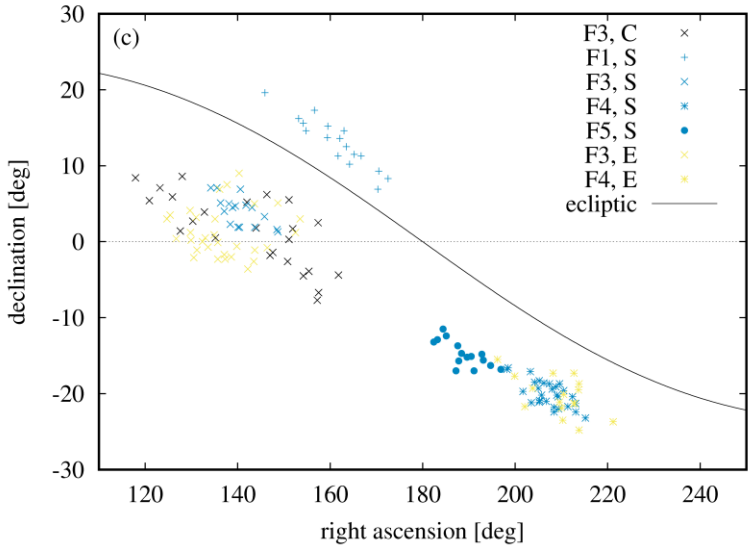


Ecliptical coordinate frame
with the center in the apex of the Earth's motion

C/1963 A1 Model vs Observations

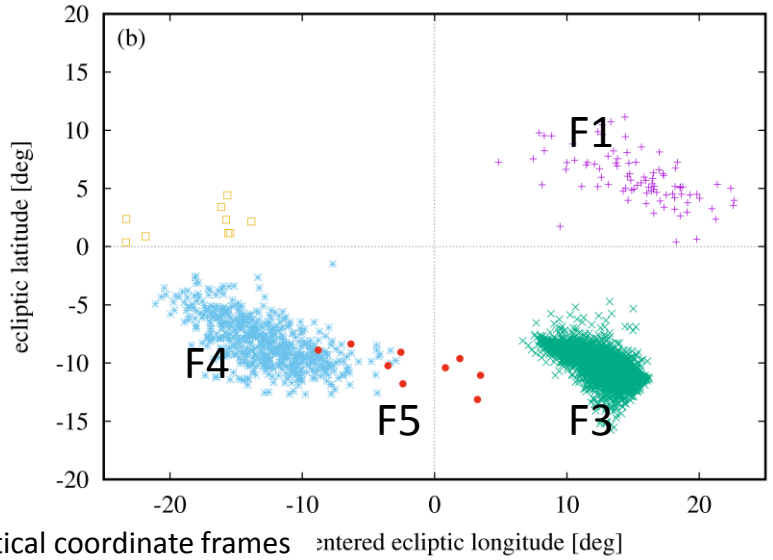
Predicted radiants

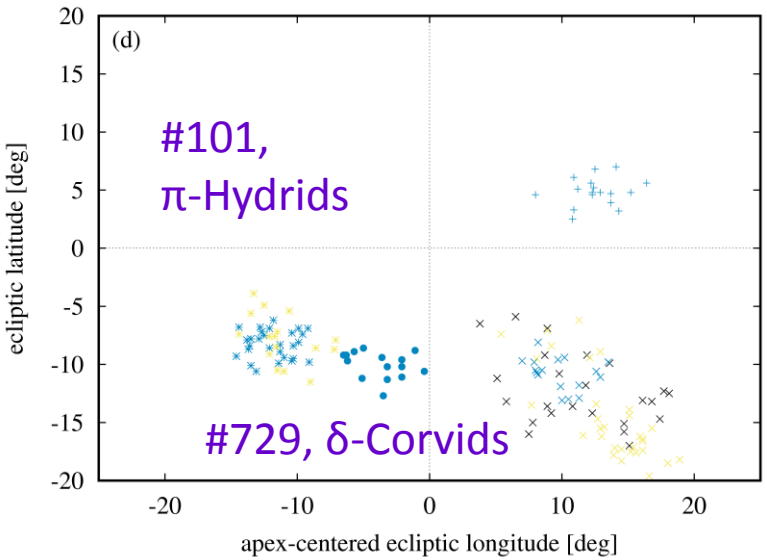




Radiants of the corresponding real meteors from video data

The equatorial coordinate frames





New meteor shower: ϑ-Leonids

#483,
α-Sextantids (?)

The Earth-apex centered ecliptical coordinate frames

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#101, π-Hydrids

#729, δ-Corvids

#483, α-Sextantids (?)

New meteor shower: ϑ-Leonids

*JPL small-body browser (Giorgini et al., 1996)