PRISMA DAYS 2022
TORINO, NOVEMBER 26

FROM THE OBSERVATIONS OF

METEORS

TO THE ORIGIN OF

METEOROIDS

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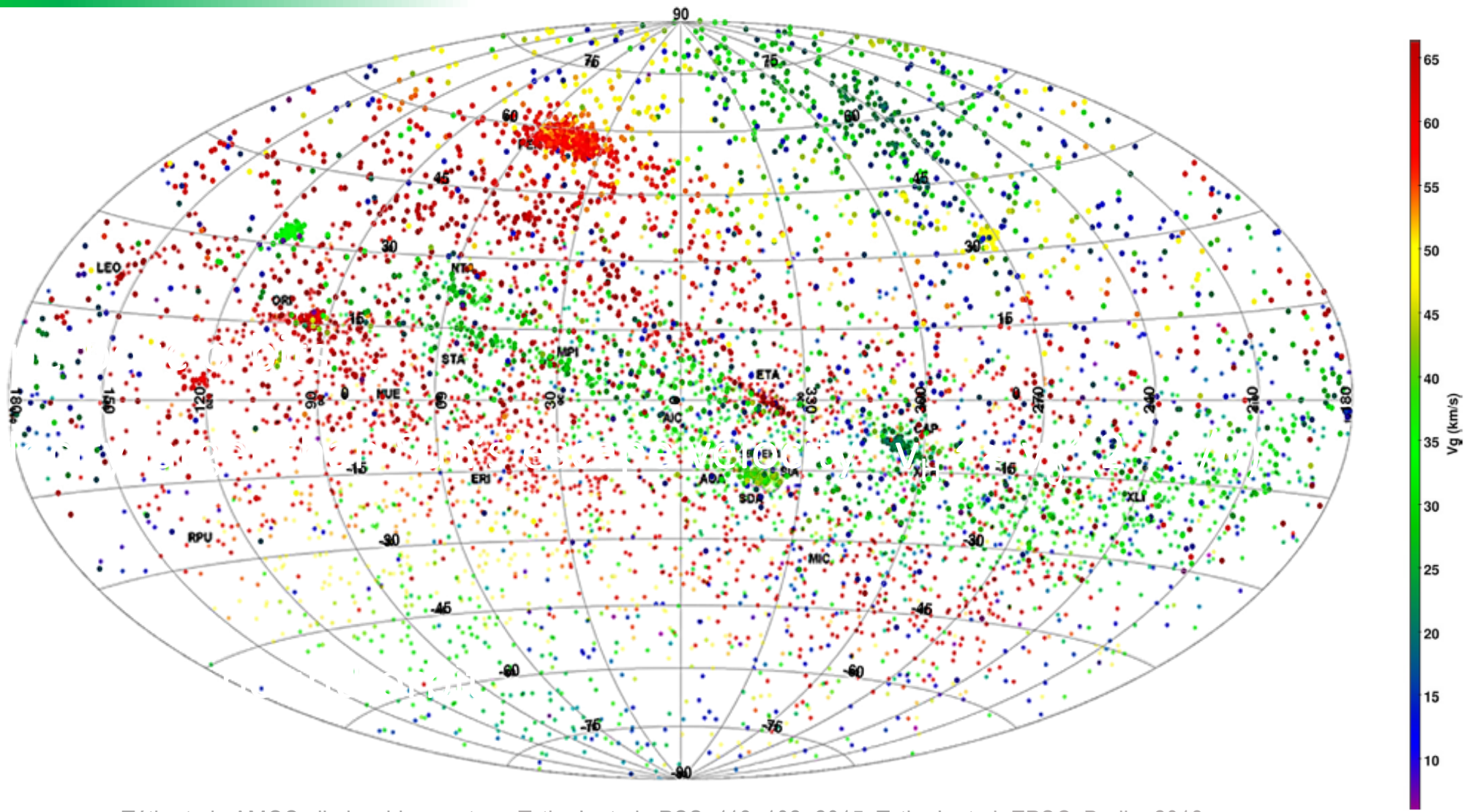
v_{inf} and α, δ METEOR RADIANTS v_G

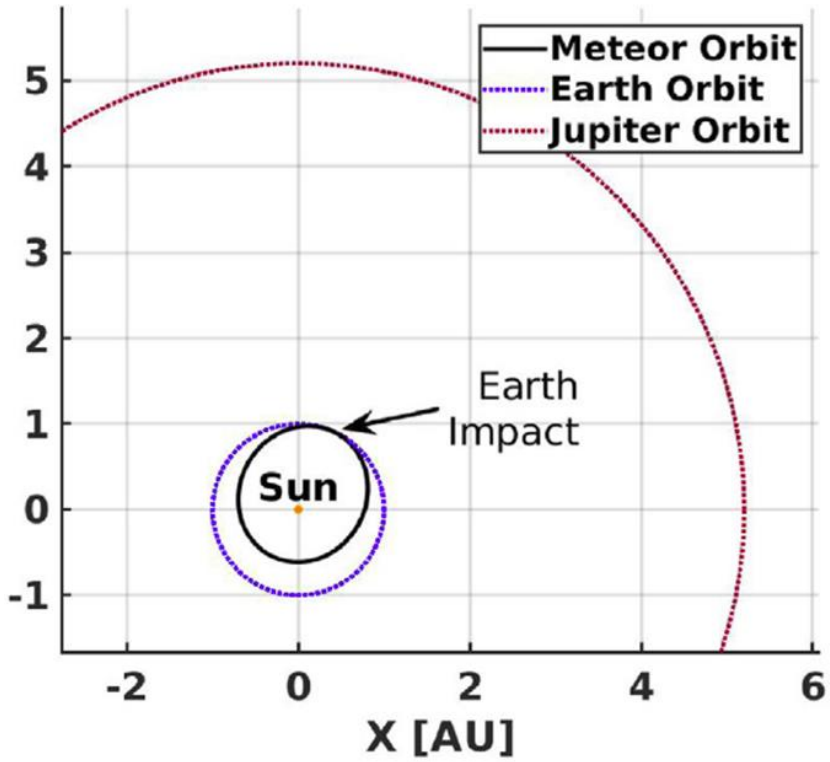


Tóth et al., AMOS all-sky video system, Toth, J. et al., PSS, 118, 102, 2015; Toth, J. et al, EPSC, Berlin, 2018

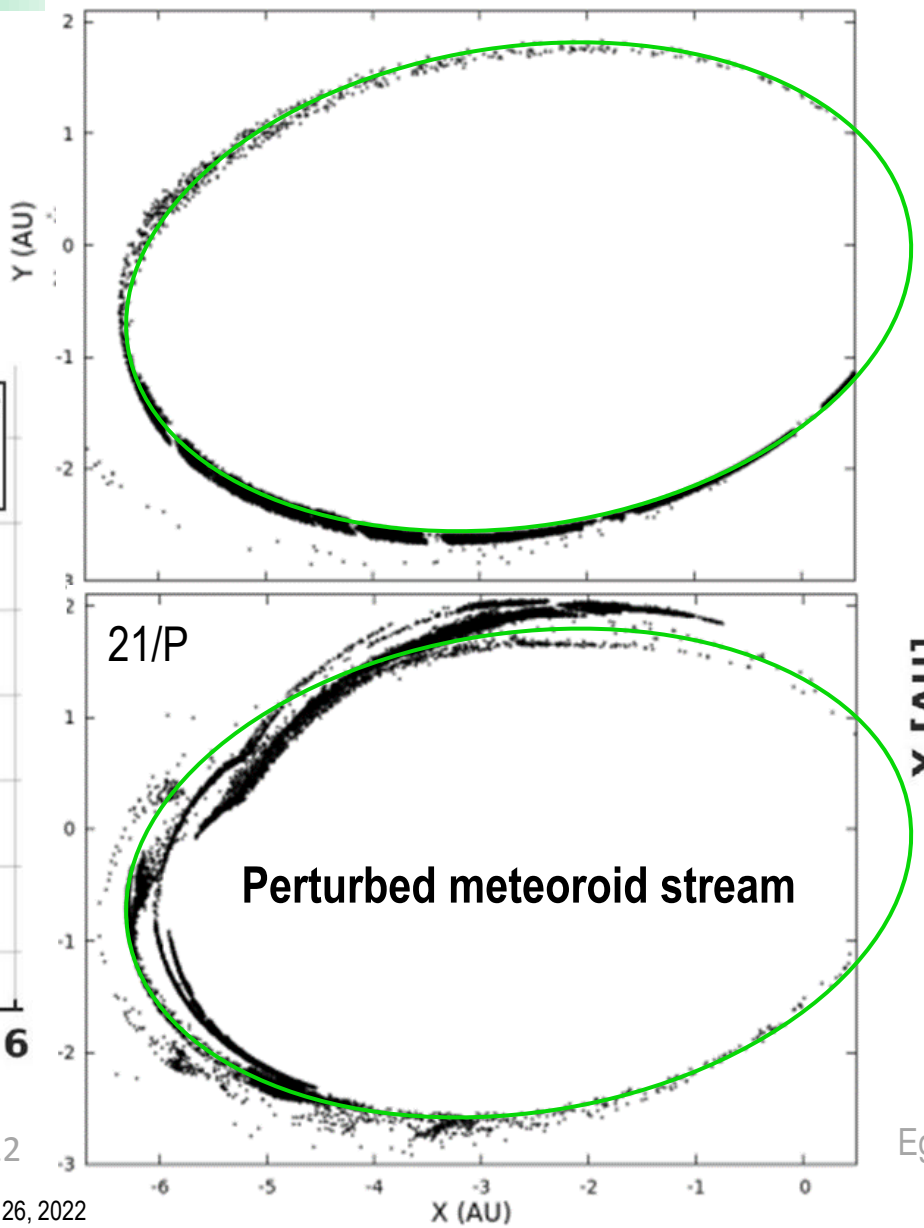
$a, e, q, \omega, \Omega, i, T$ METEOROID ORBITS

ELLIPTIC ORBIT

Local meteoroids, meteoroid streams

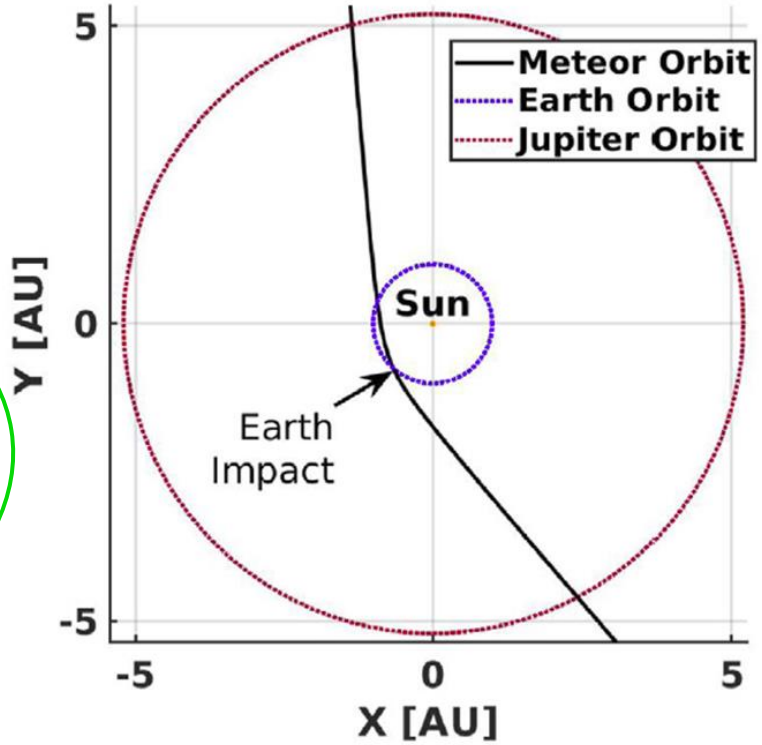


Blanchard et al., Icarus 386, 115144, 2022



HYPERBOLIC ORBIT

Interstellar meteoroids

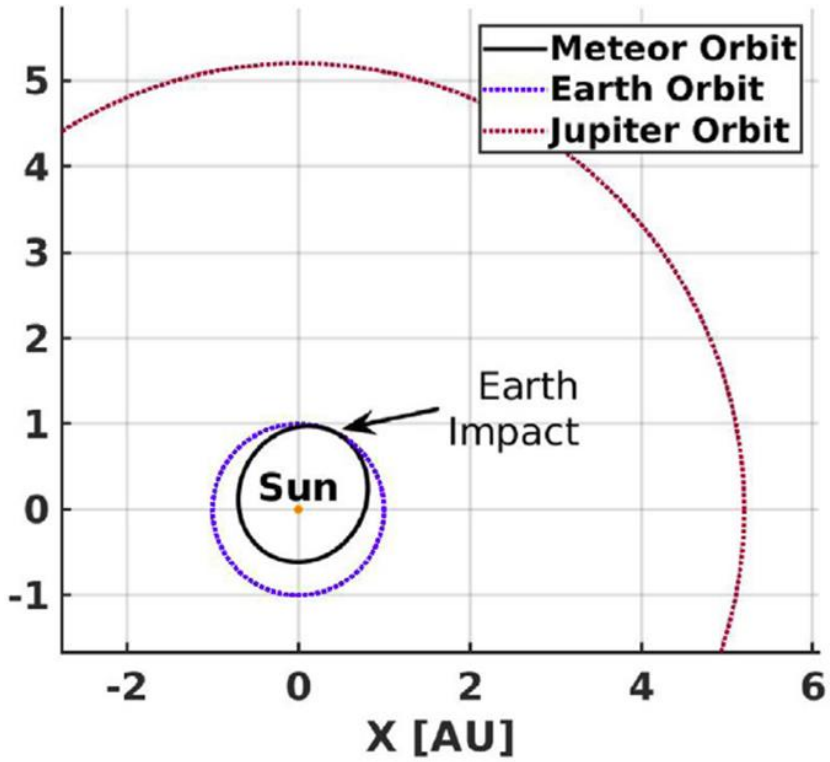


Egal, A., PSS, 185, 104895, 2020

THE ORIGIN OF METEOROIDS

ELLIPTIC ORBIT

Local meteoroids, meteoroid streams



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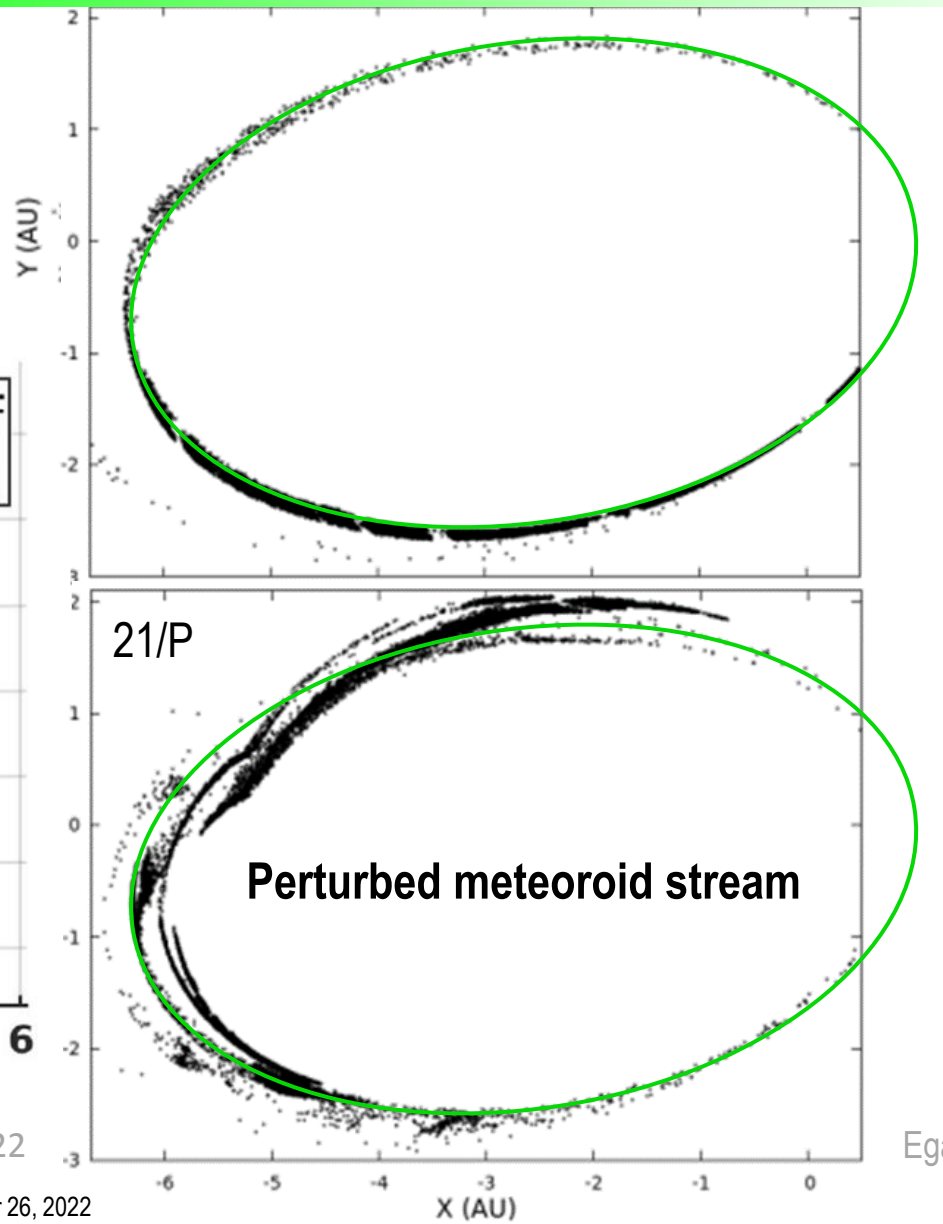


Egal, A., PSS, 185, 104895, 2020

- in the solar system: $1/a > 0$ (bound orbit)
- parent bodies – comets, asteroids
- D-criteria for orbital similarity

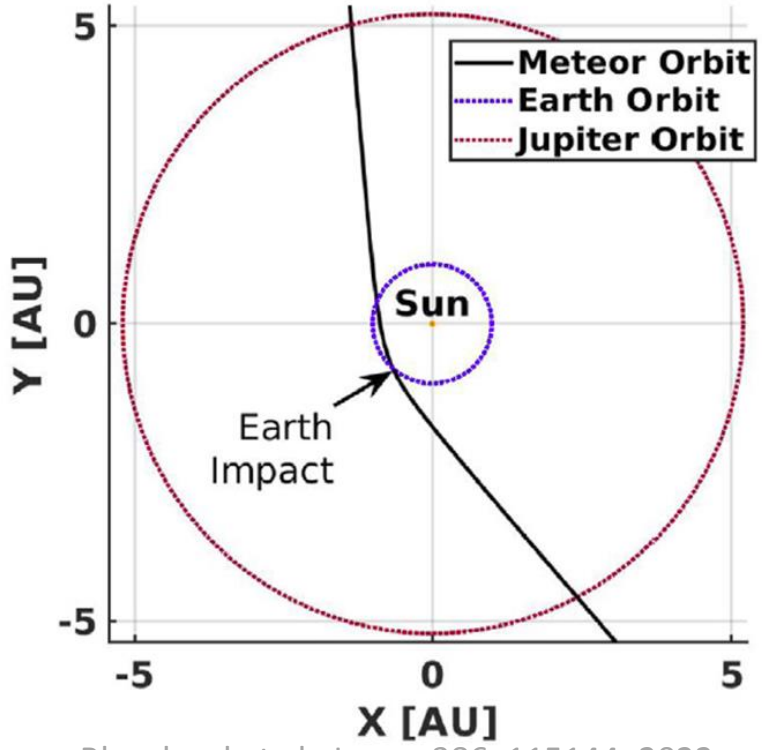
  Southworth, Hawkins, 1963
  Drummond, 1980
  Jopek, 1993
  Valsecchi, Jopek, Froschle, 1999
  Kholshevnikov et al, 2016
- Modeling

THE ORIGIN OF METEOROIDS

- outside the solar system: $1/a < 0$ (unbound orbit)
- LIC, exoplanetary systems
- velocities larger than Sun's escape velocity
- expected excess velocities
  $v_H \sim 49$ km/s (for $v_a = 25$ km/s)

HYPERBOLIC ORBIT

Interstellar meteoroids



Blanchard et al., Icarus 386, 115144, 2022

PROBLEMS

ELLIPTIC ORBIT

too many minor showers reported, which do not exist (about 400 in the last 15 years)

HYPERBOLIC ORBIT

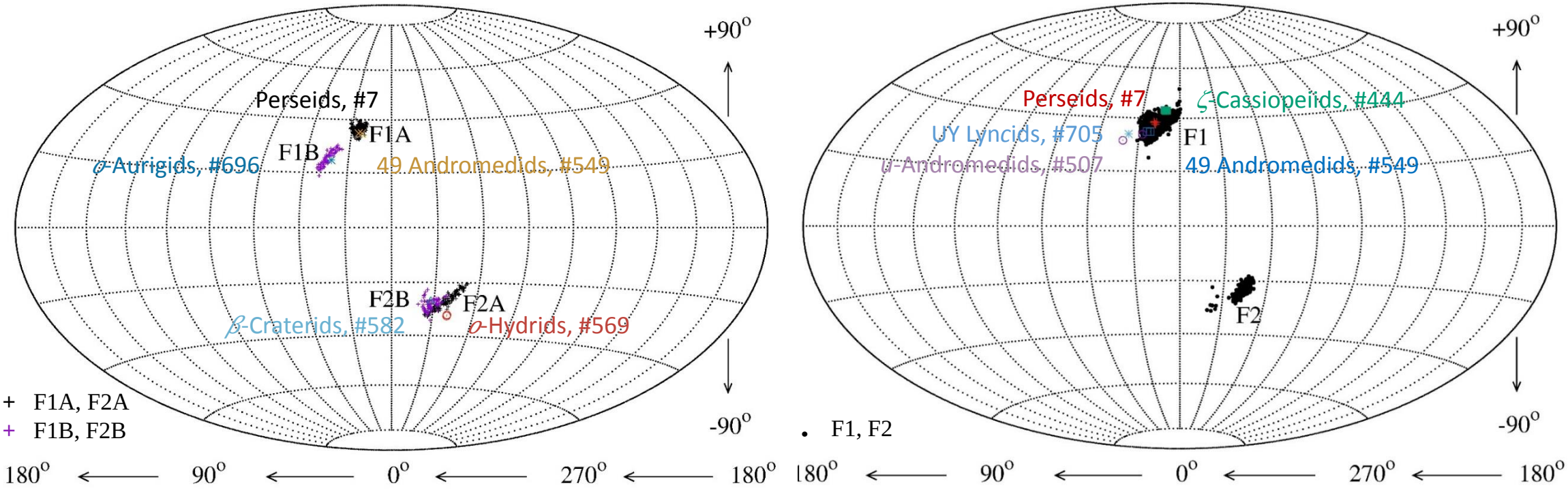
too many hyperbolic meteors observed, which are not interstellar (about 10%)

PROBLEMS

MINOR METEOR SHOWERS

Comet 109P/Swift-Tuttle

Models based on the nominal and cloned comet orbit of 109P

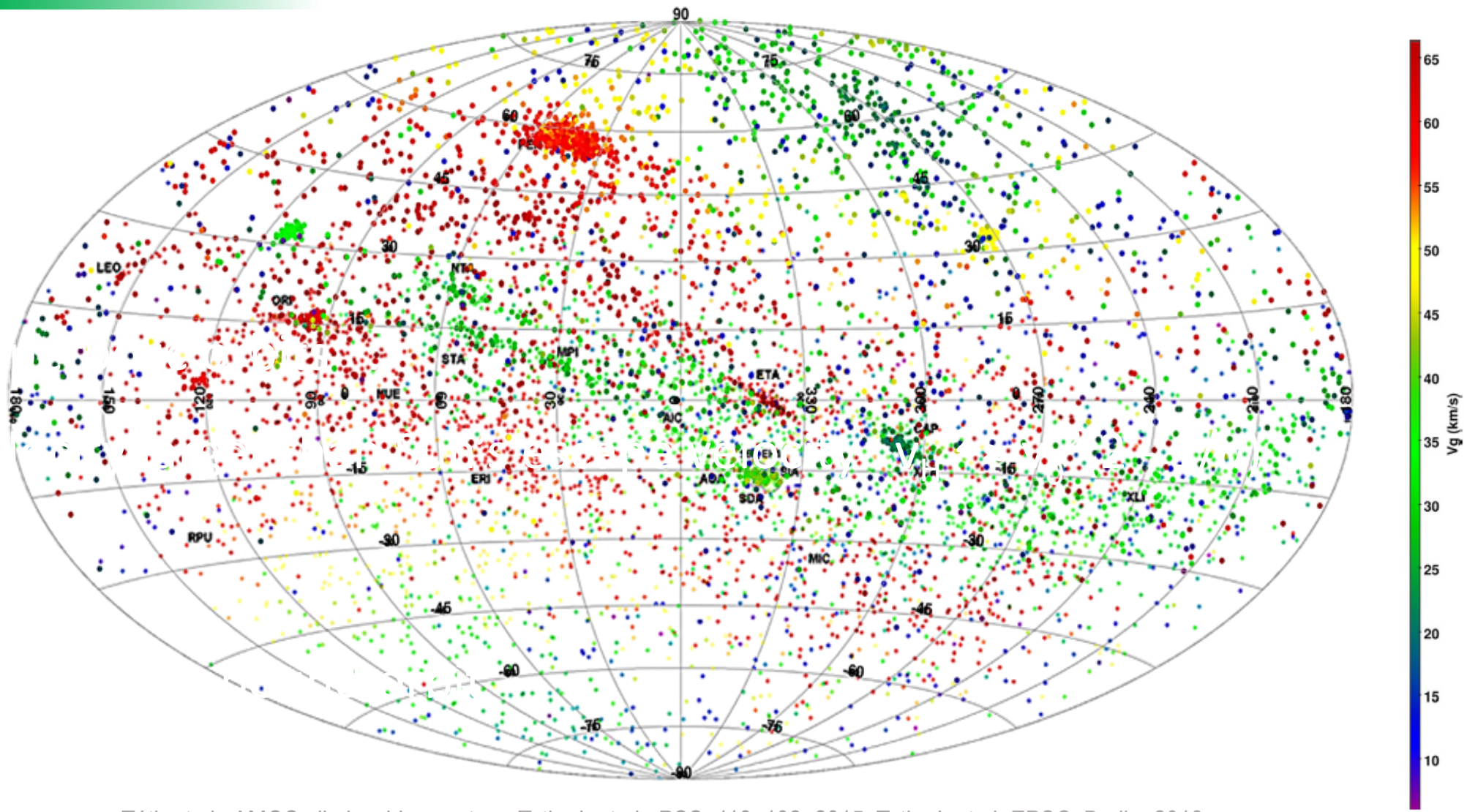


predicted showers

mean radiants of the IAU MDC showers

Neslušan, L., Hajduková, M., Icarus, 382, 115015, 2022
Hajduková, M., Neslušan, L., Icarus, 387, 115175, 2022

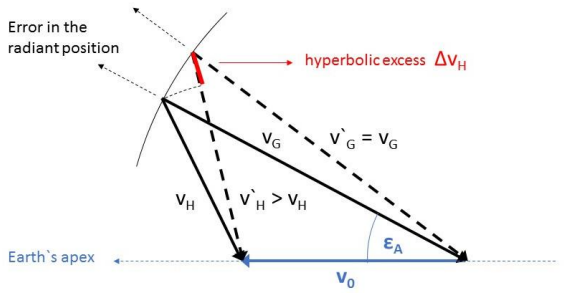
v_{inf} and α, δ METEOR RADIANTS v_G



Tóth et al., AMOS all-sky video system, Toth, J. et al., PSS, 118, 102, 2015; Toth, J. et al, EPSC, Berlin, 2018

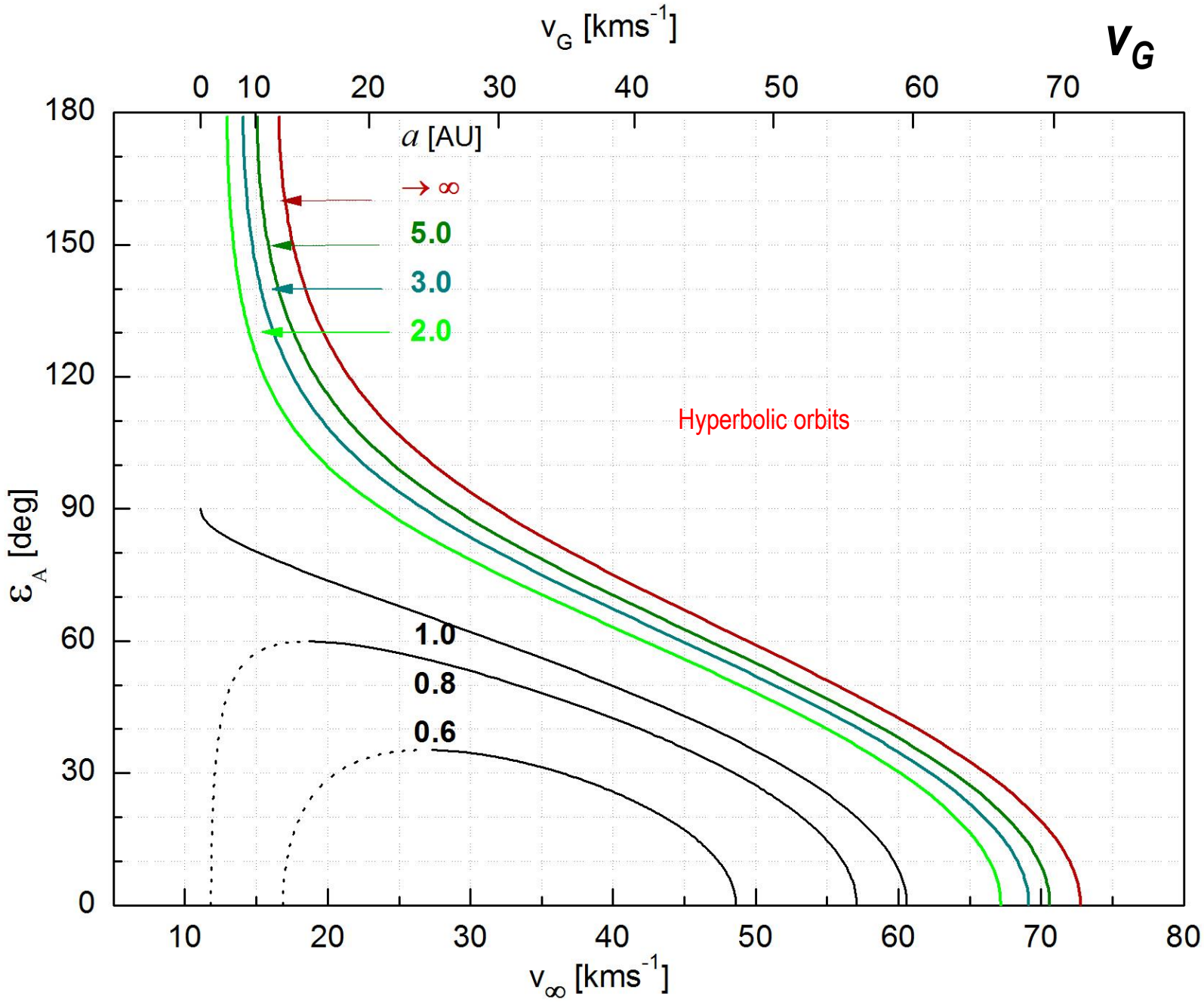
v_{inf} and α, δ

ε_A



Kresák, L. and Kresáková, M., BAC, 27, 106, 1976

Hajduková , M., Sterken, V., Wiegert, P., Meteoroids CAP, 235, 2019



v_{inf} and α, δ

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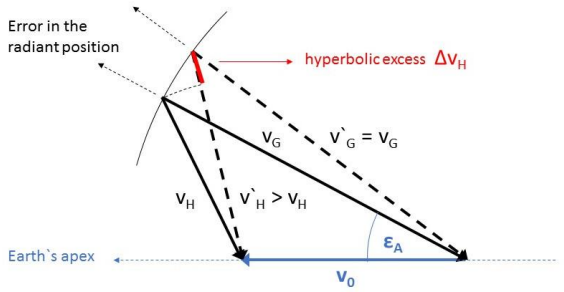

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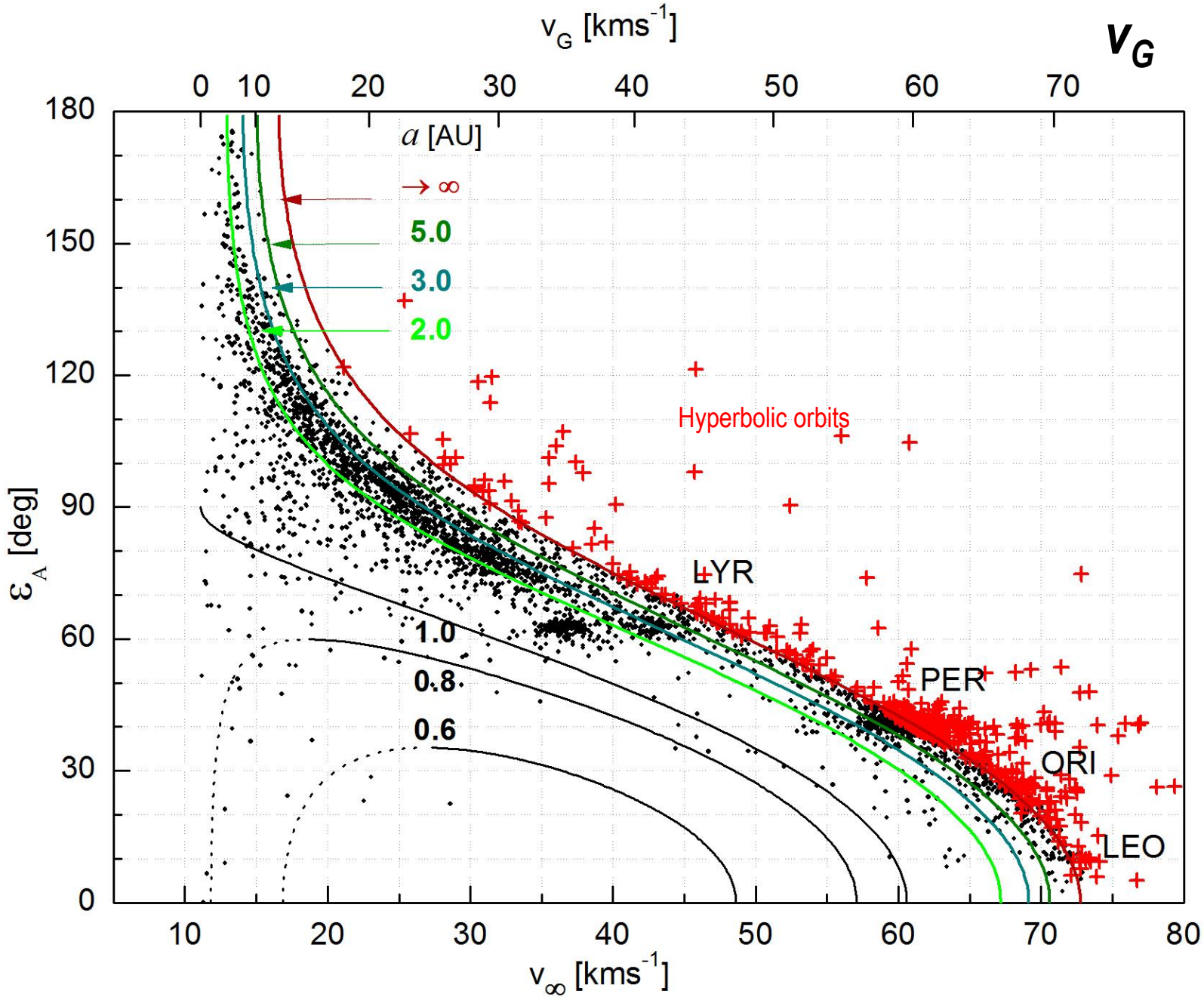
Photographic meteors from Lindblad, B. A., et al., *EM&P*, 93, 249, 2005

v_G

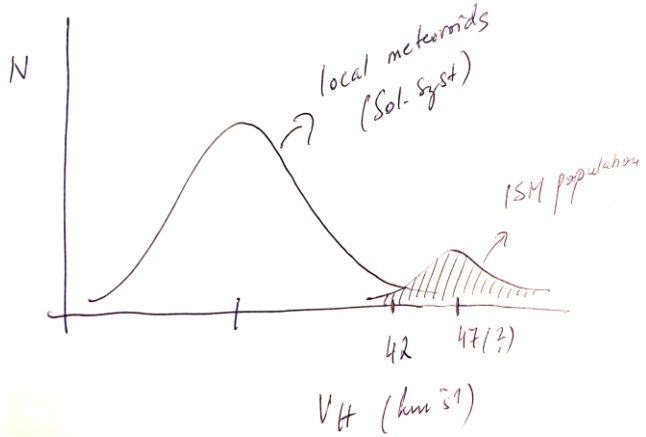


v_{inf} and α, δ → $a, e, q, \omega, \Omega, i, T$

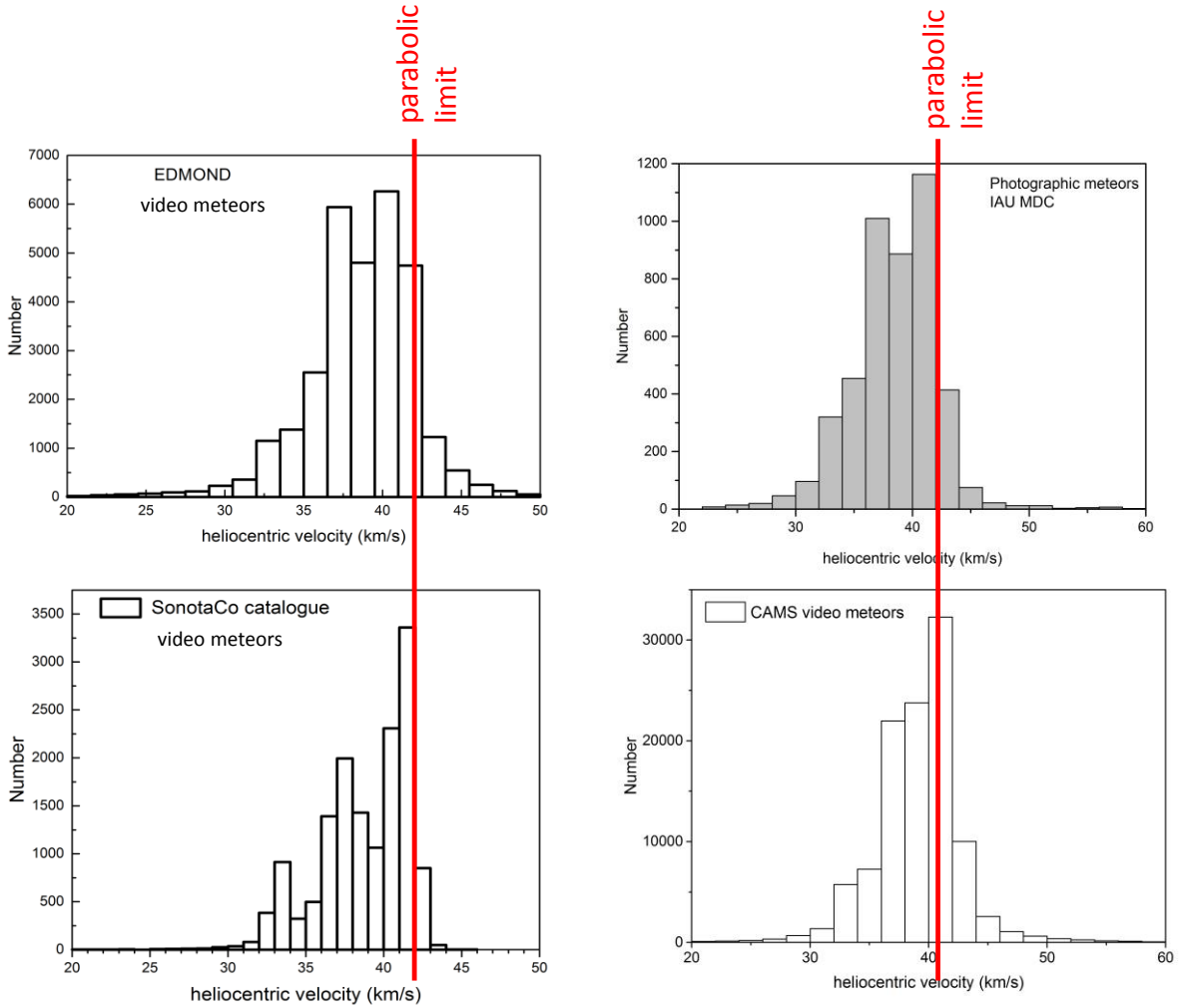
WHY IS IT A CONSEQUENCE OF ERRORS?

1. Distributions of the heliocentric velocity

$$v_H^2 \approx v_0^2 (2 - 1/a)$$



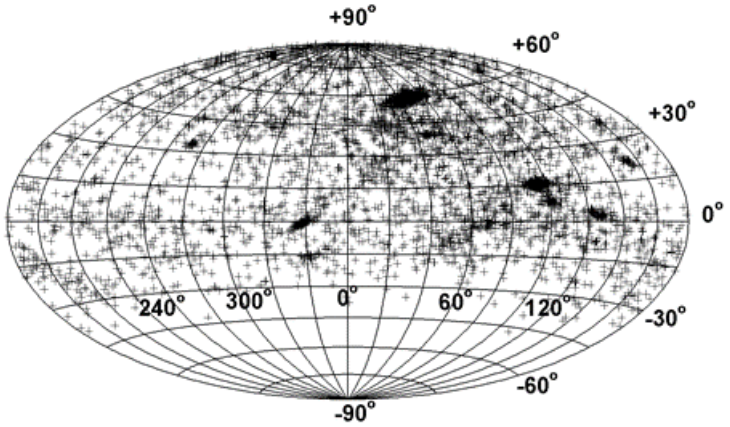
2 peaks should be observed but they are not !



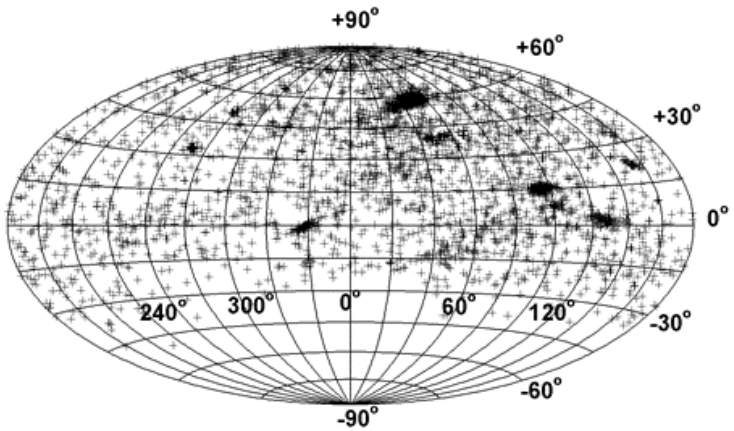
$N_{e>1}/N = f(v_H)$

WHY IS IT A CONSEQUENCE OF ERRORS?

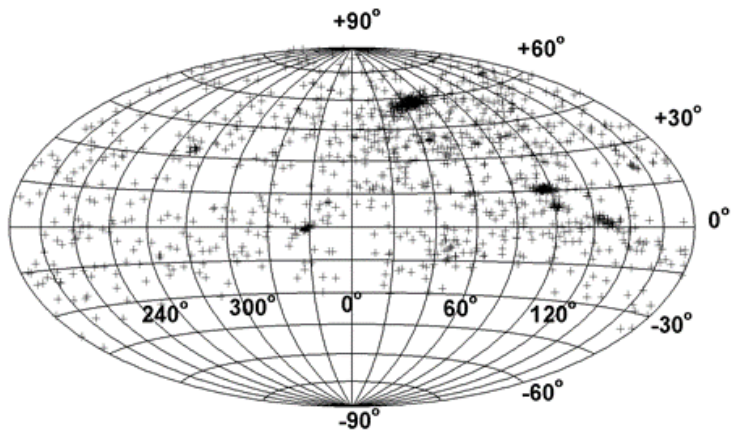
2. Hyperbolic orbits of shower meteors



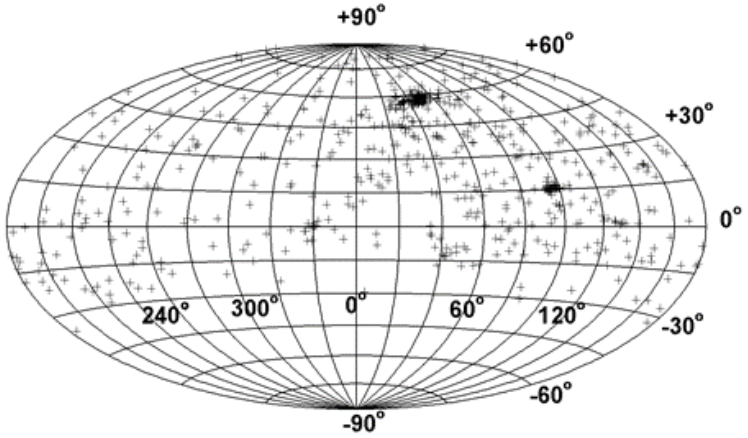
0.2 < 1/a < 0.1



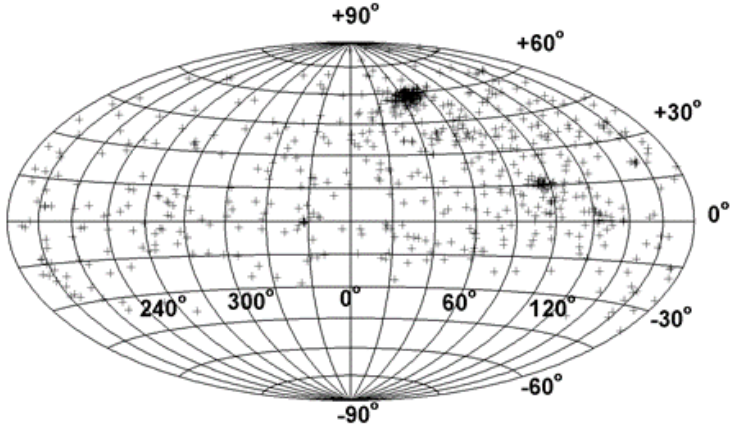
0.0 < 1/a < 0.1



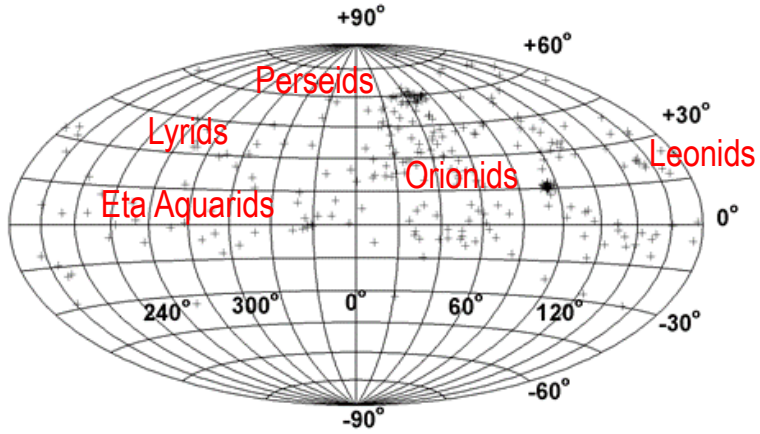
-0.1 < 1/a < 0.0



-0.2 < 1/a < -0.1



-0.5 < 1/a < -0.2



1/a < -0.5

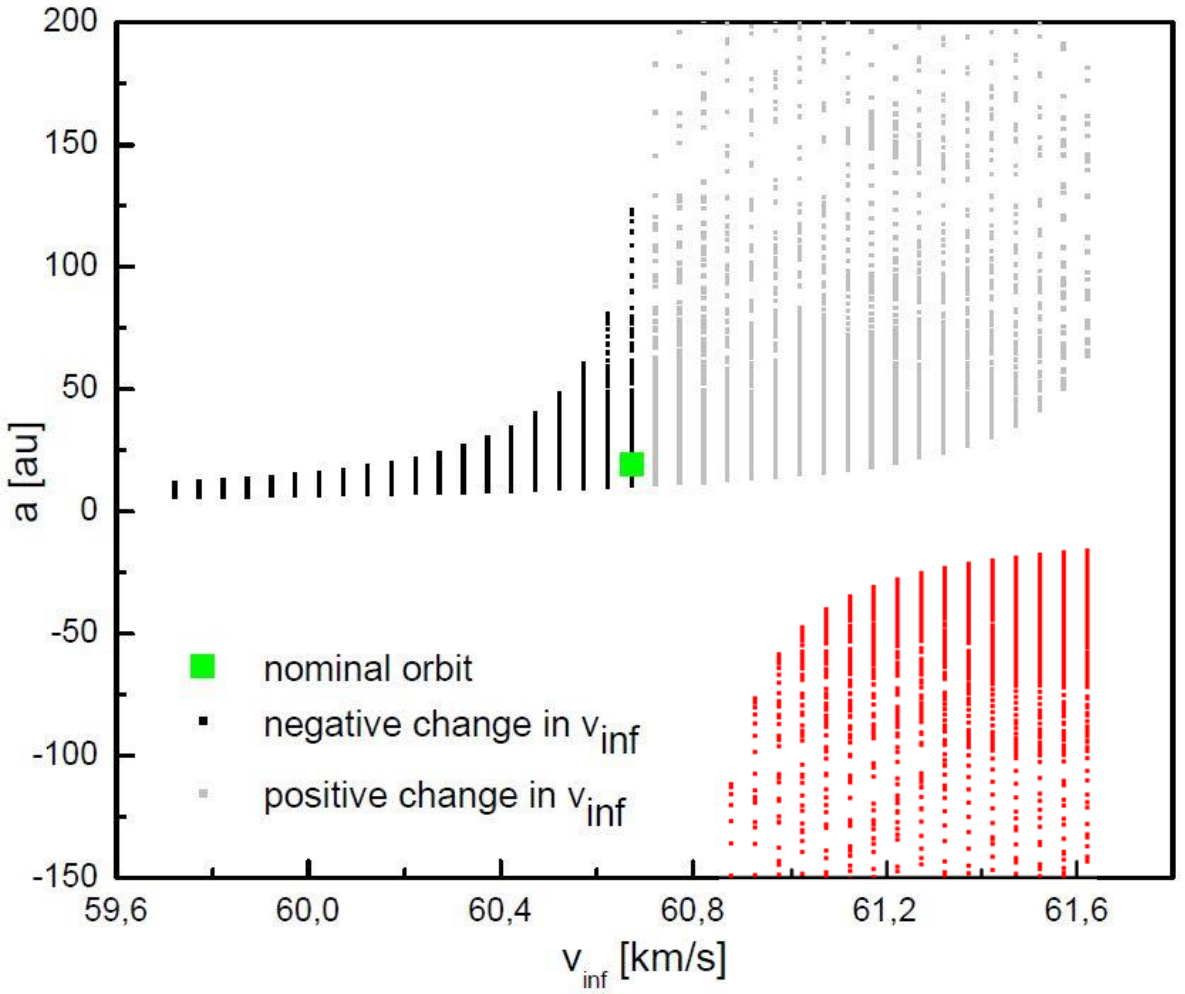
v_{inf} ±1 km/s
radiant ±1°

WHY IS IT A CONSEQUENCE OF ERRORS?

3. Modeling the influence of errors

Nominal orbit

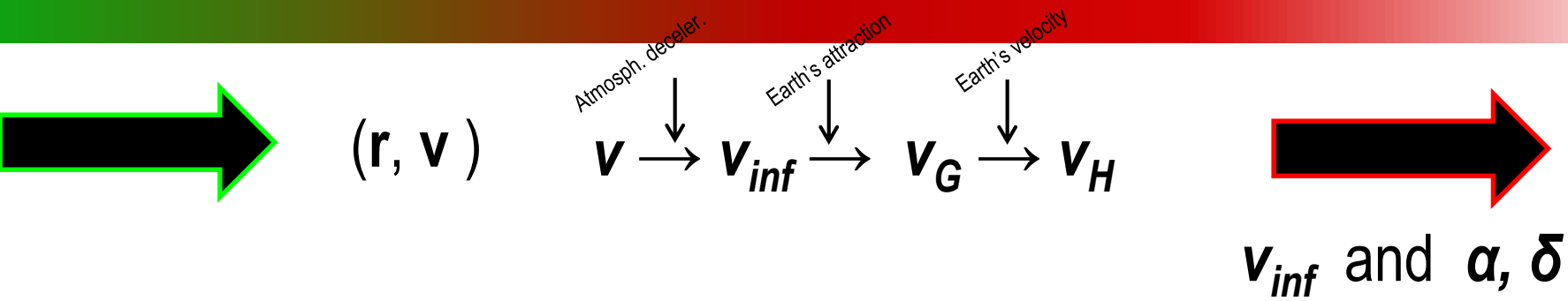
q = 0.945 au
a = 19 au
e = 0.95
Q = 37 au
i = 113°



1/3 of orbits changed to hyperbolic

Hajduková, M., Kornoš, L., *PSS*, 190, 104965, 2020

PROBLEMS



underestimation of measurement errors

small number of members → mean parameters dispersed → the match of a given shower with a predicted counterpart is not clear

problems with the → duplicity of showers

→ identity if showers

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