Meteor astrometry

What accuracy do we need?

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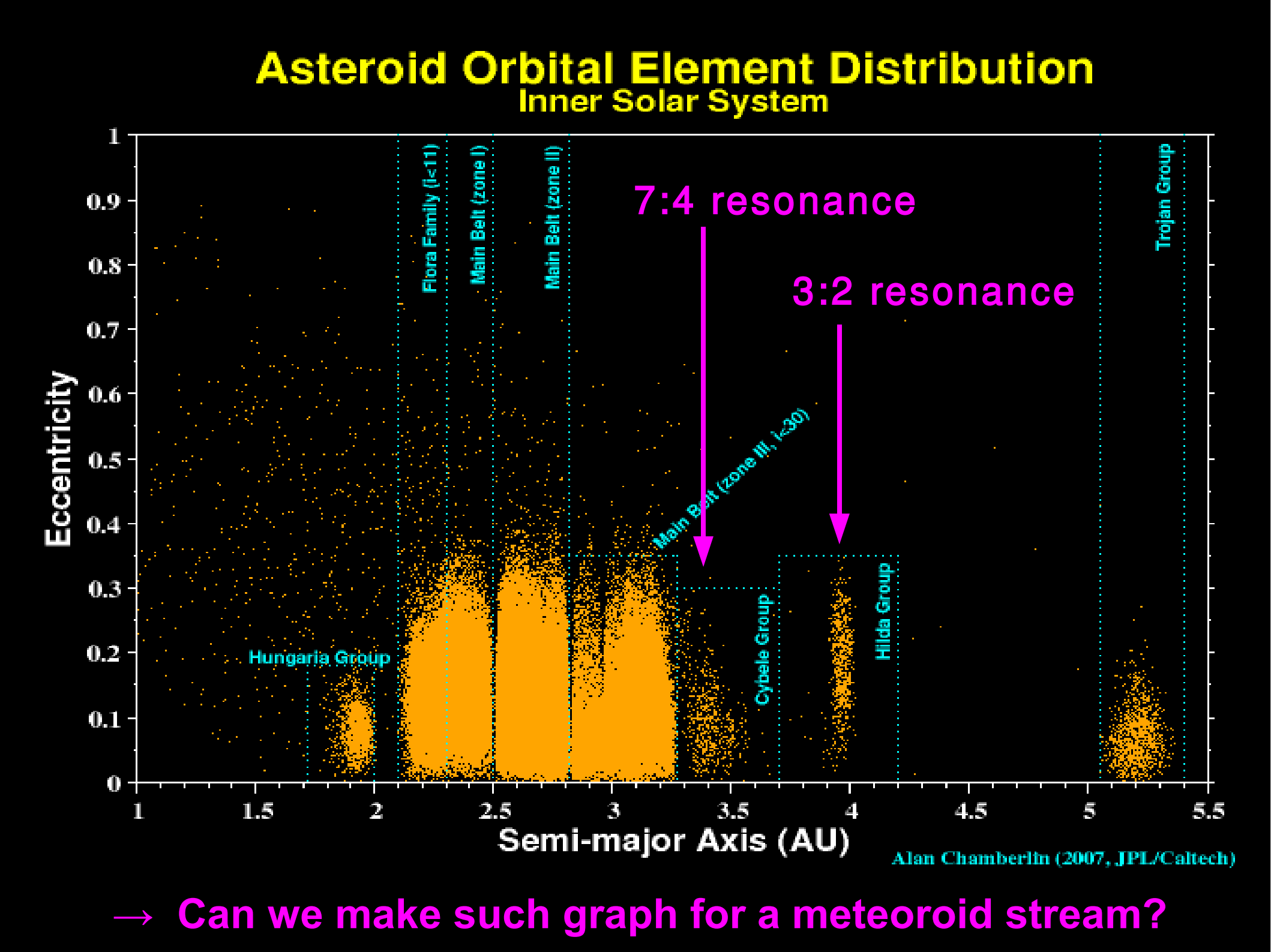
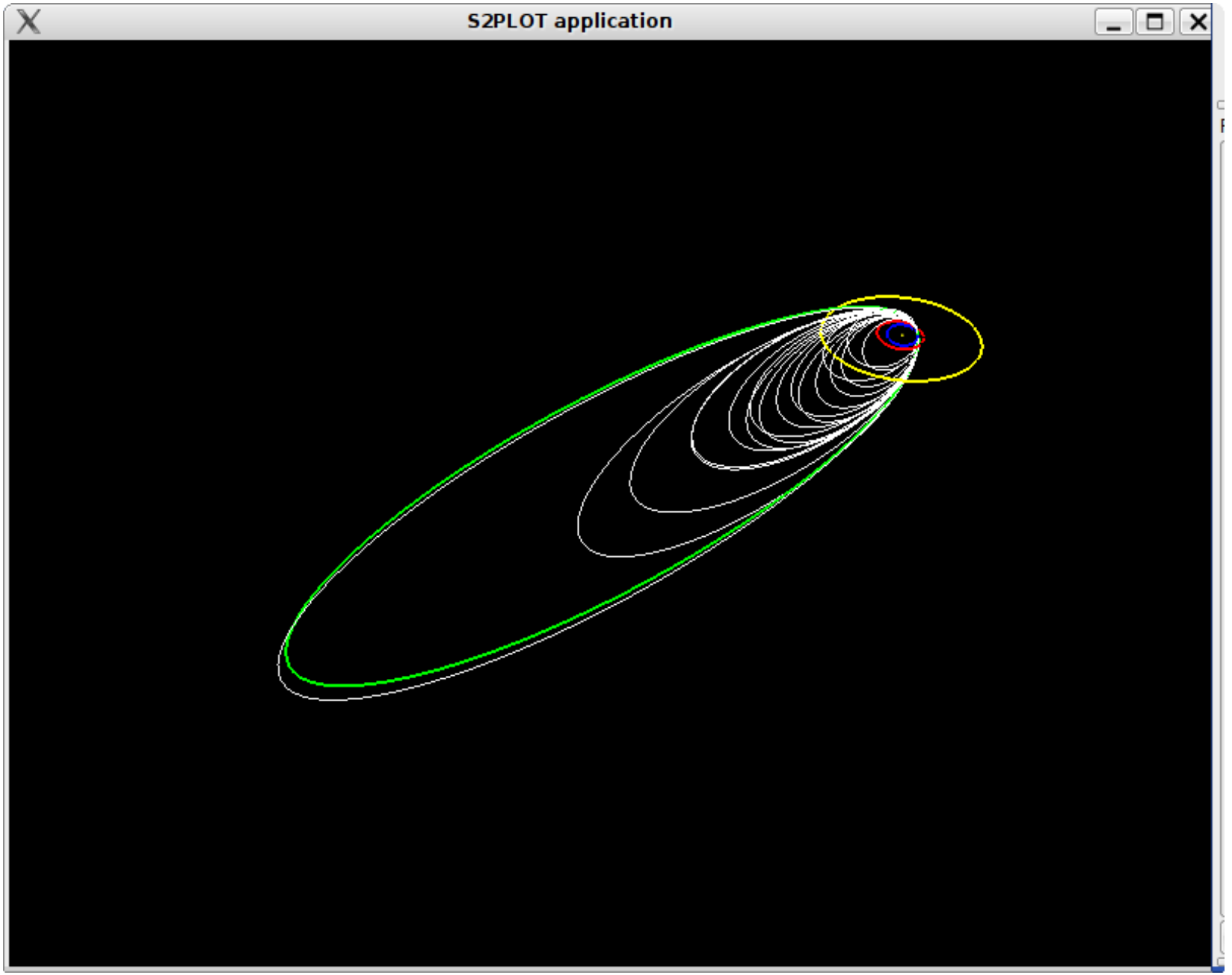
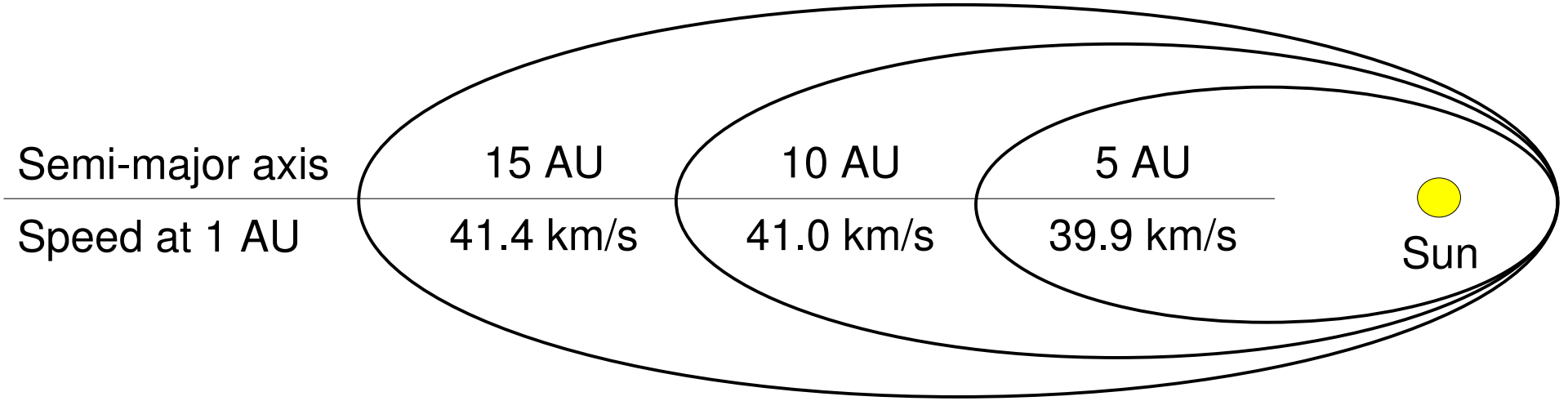
IMC Croatia 2009



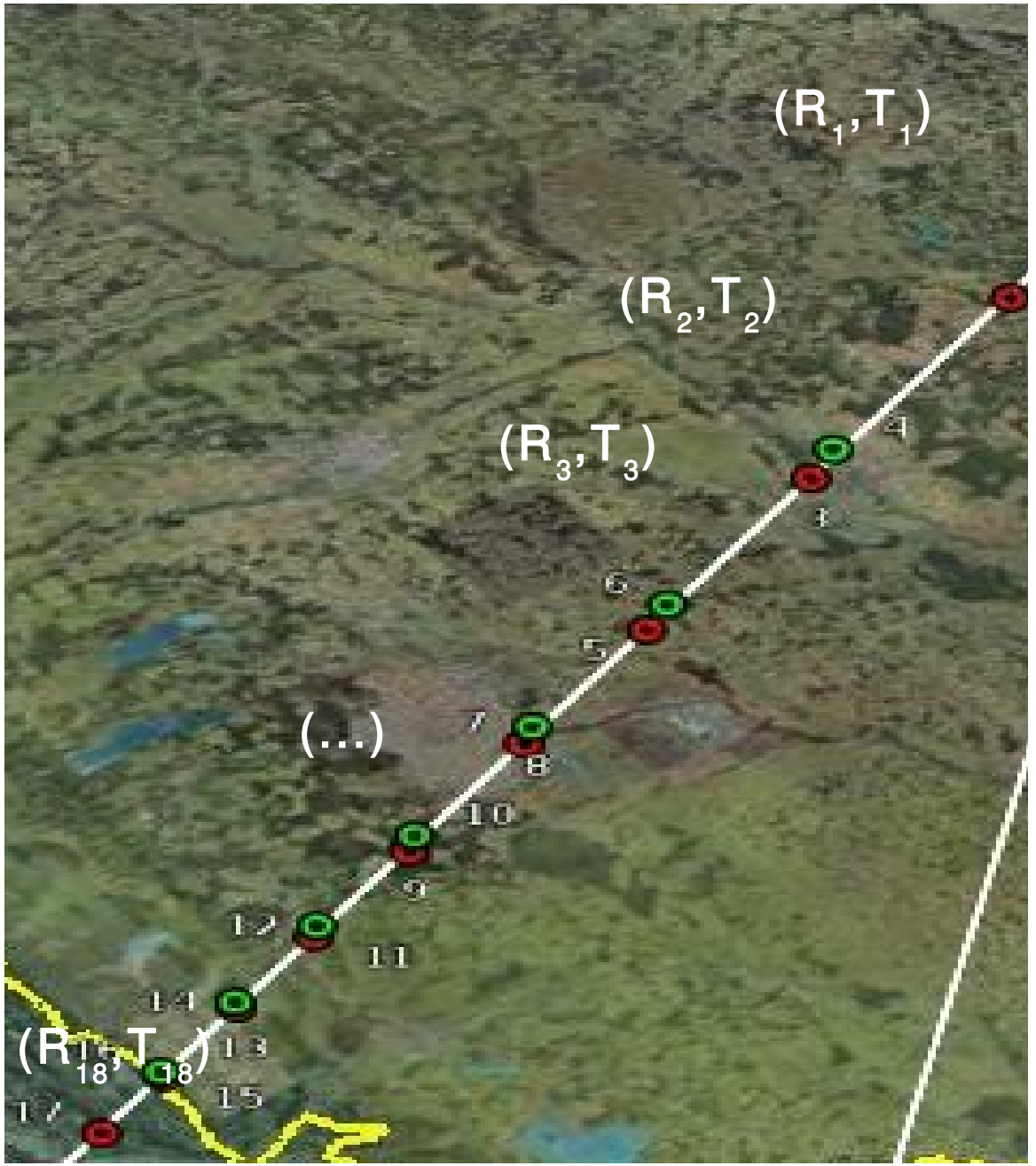
→ **Can we make such graph for a meteoroid stream?**

Perseids 2007 (ESA/RSSD Campaign)





$$v = \sqrt{\mu \left(\frac{2}{r} - \frac{1}{a} \right)}$$



→ $|v| = (R_{18}-R_1) / (T_{18}-T_1)$

$= \mathbf{59.3\ km/s}$

→ $|v| = (R_{16}-R_3) / (T_{16}-T_3)$

$= \mathbf{58.7\ km/s}$

→ $|v| = (R_{13}-R_6) / (T_{13}-T_6)$

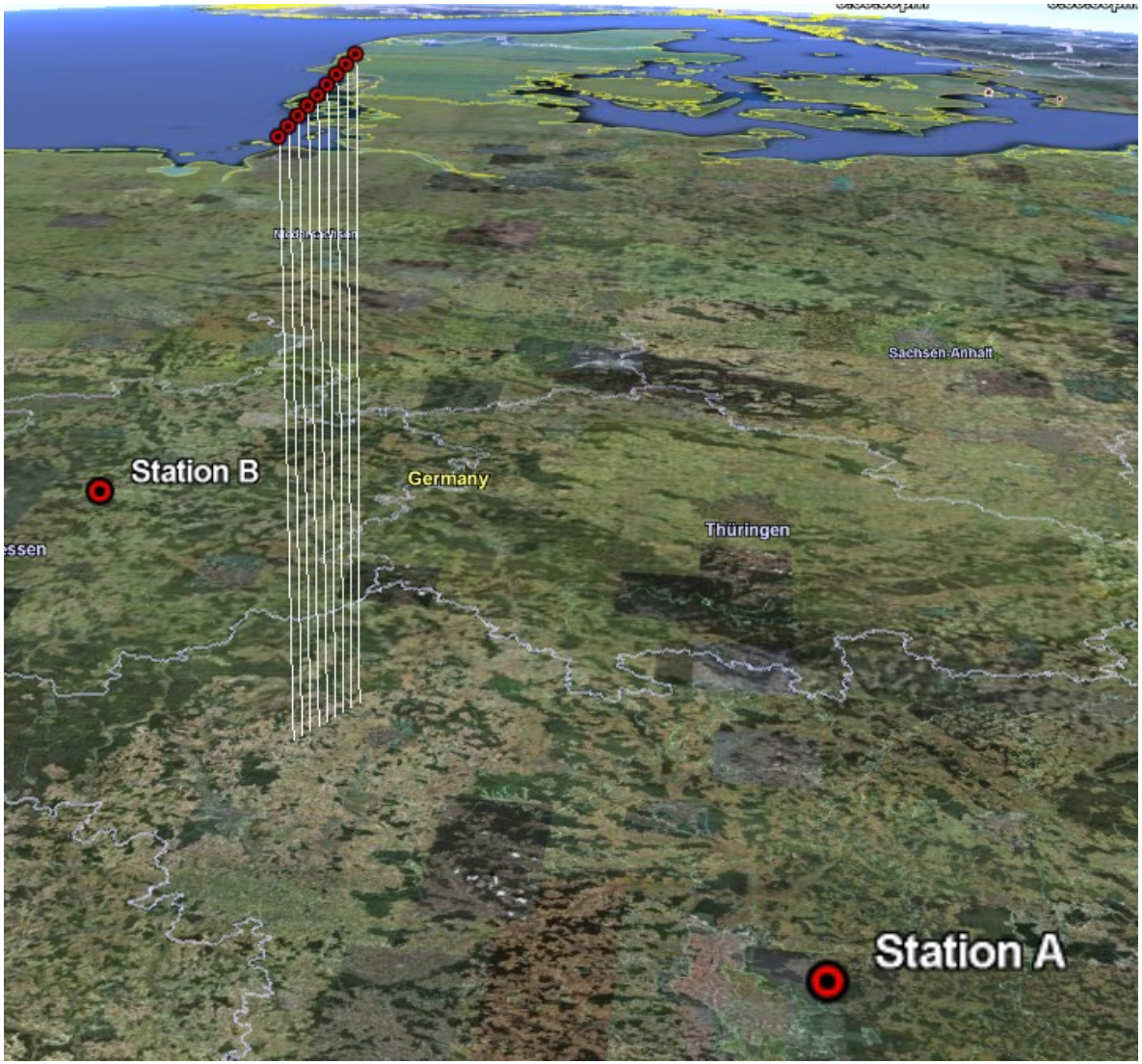
$= \mathbf{61.2\ km/s}$

→ $|v| = \text{avg}\ (R_a-R_b) / (T_a-T_b)$

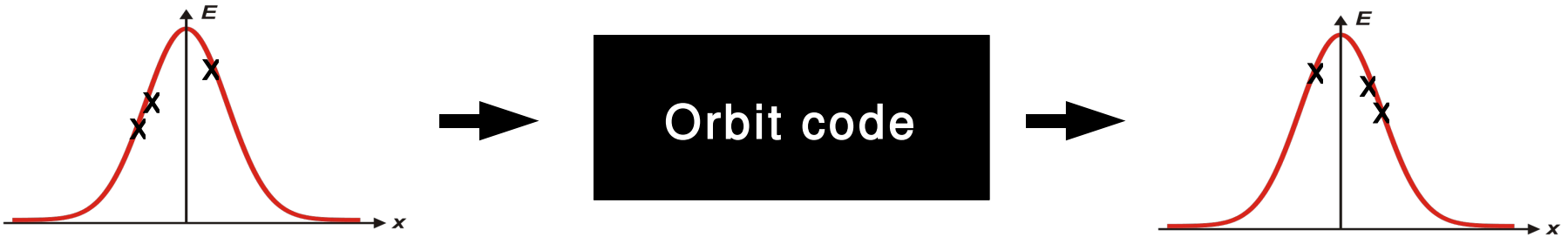
$= \mathbf{59.4\ km/s}$

Fakeor simulations

- Fakeor = **Fak**e met**eor**
- Input
  - Radiant (ra, dec, velocity)
  - Time + coordinates (100km)
- Output
  - Optimized observing stations
  - Astrometry from each station
- No need to go out in the cold :-)



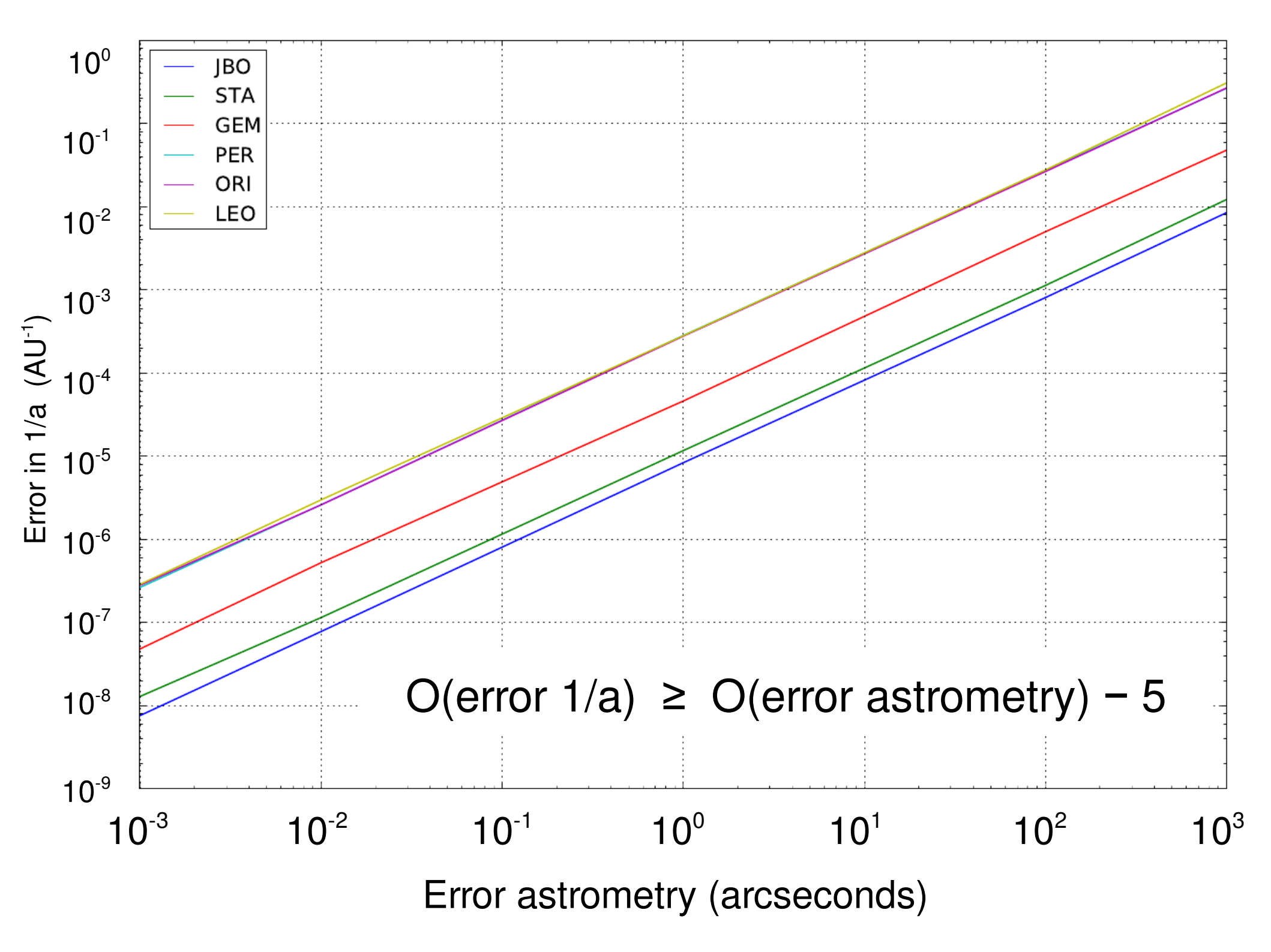
Uncertainty propagation



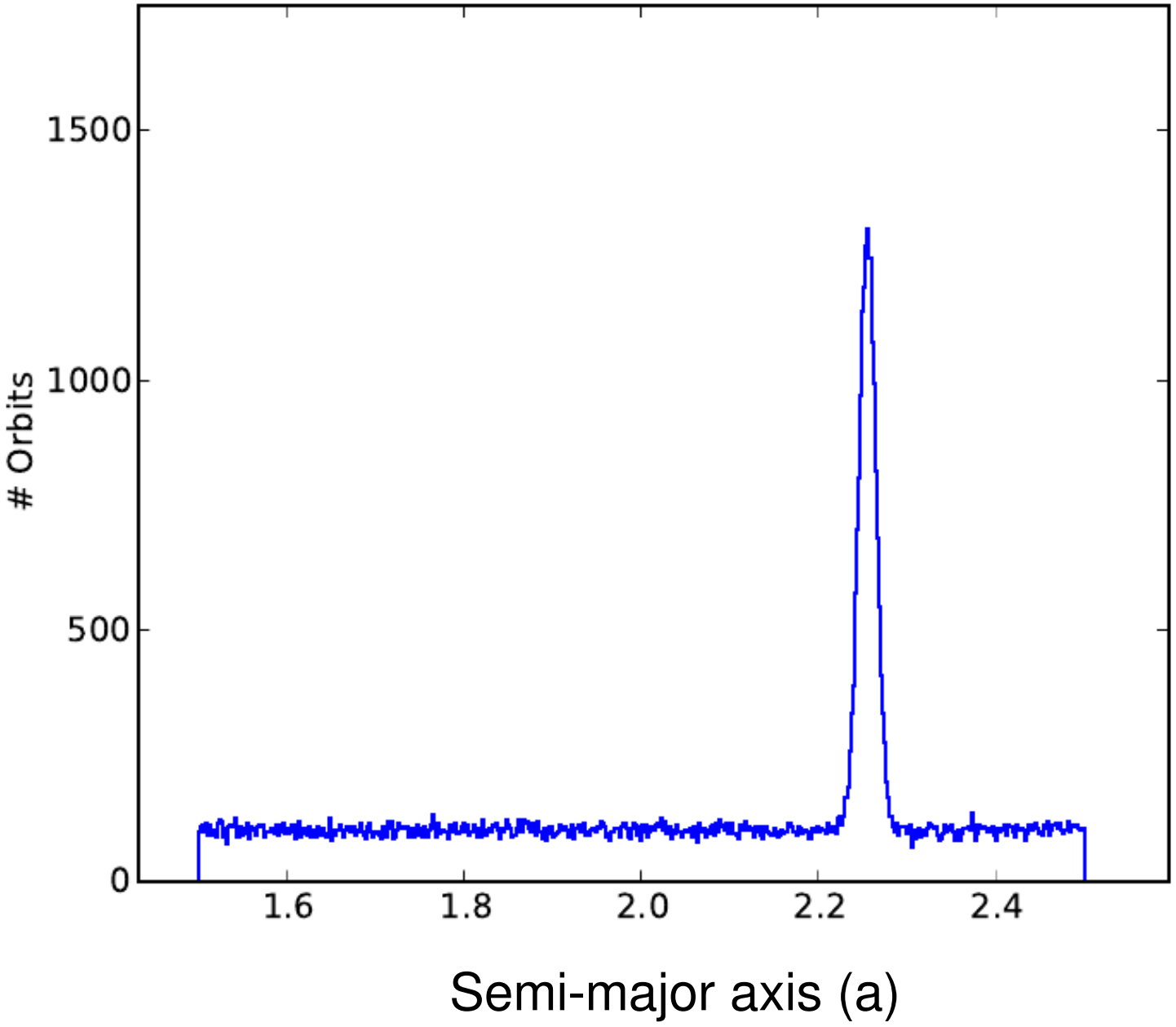
Astrometric error

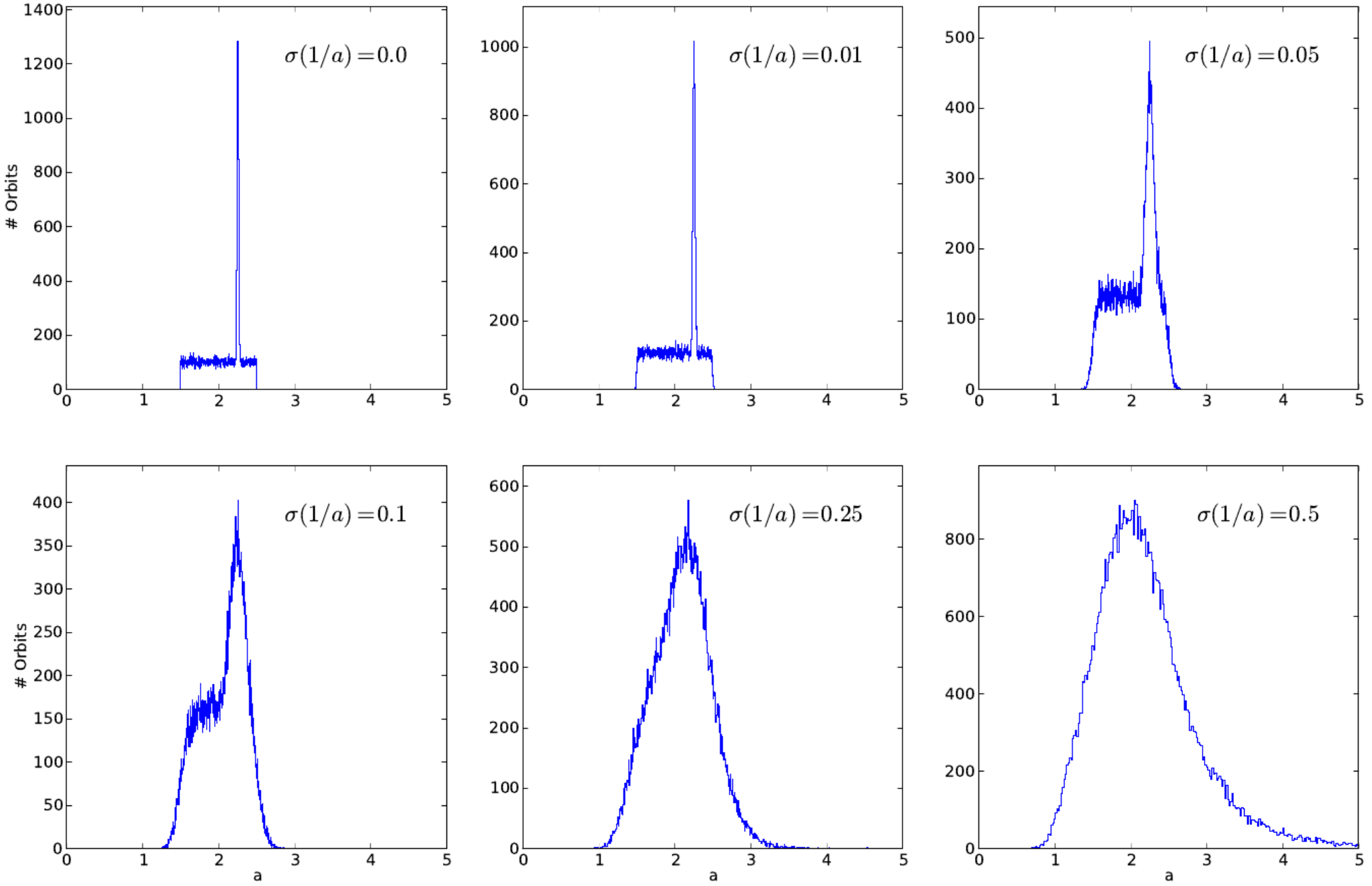
Repeat 1000x
(Monte Carlo)

1/a error

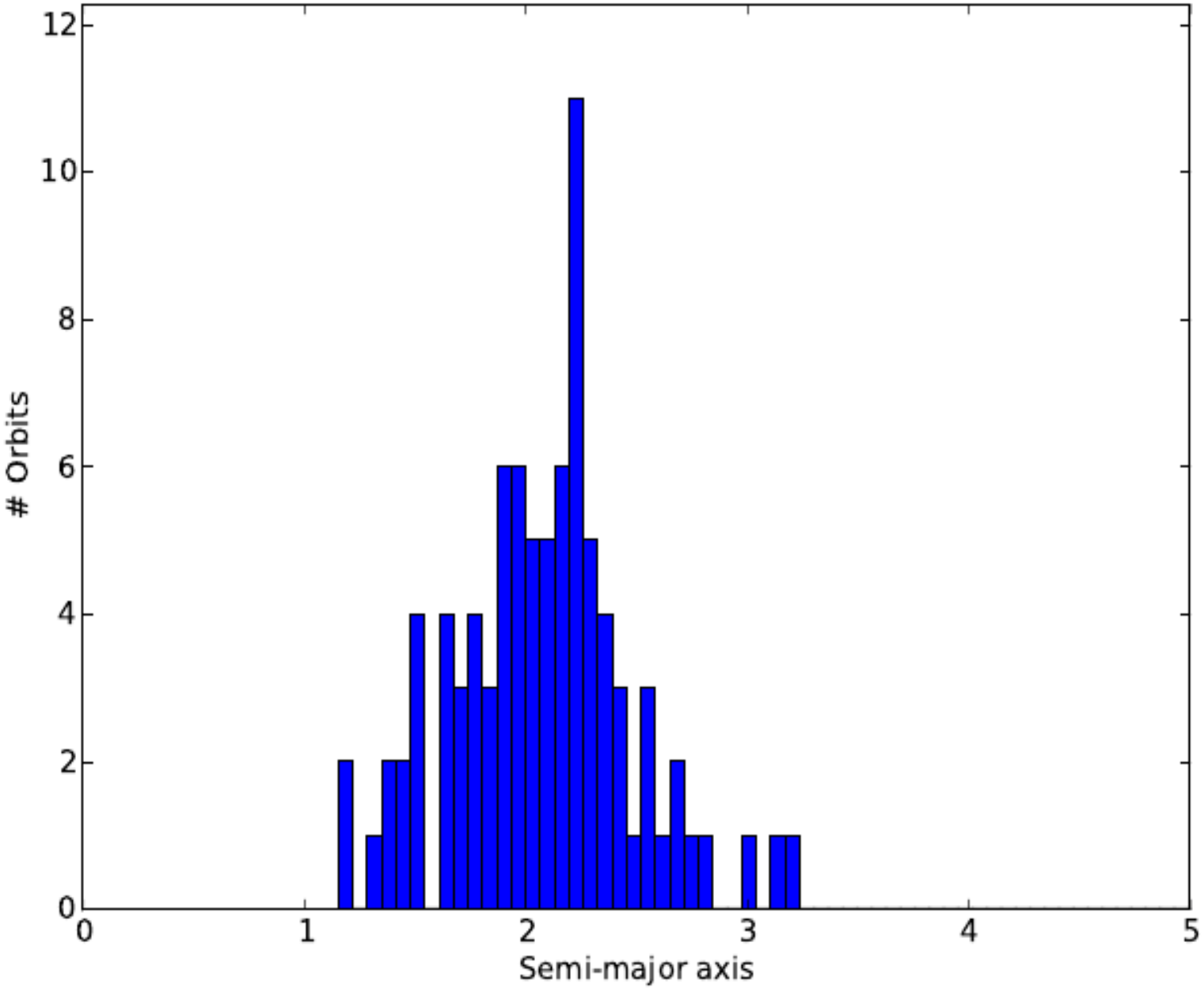

JBO
STA
GEM
PER
ORI
LEO
Error in 1/a (AU-1)
Error astrometry (arcseconds)
O(error 1/a) ≥ O(error astrometry) − 5
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
10^-7
10^-8
10^-9
10^-3
10^-2
10^-1
10^0
10^1
10^2
10^3

Taurids 7:2 resonance

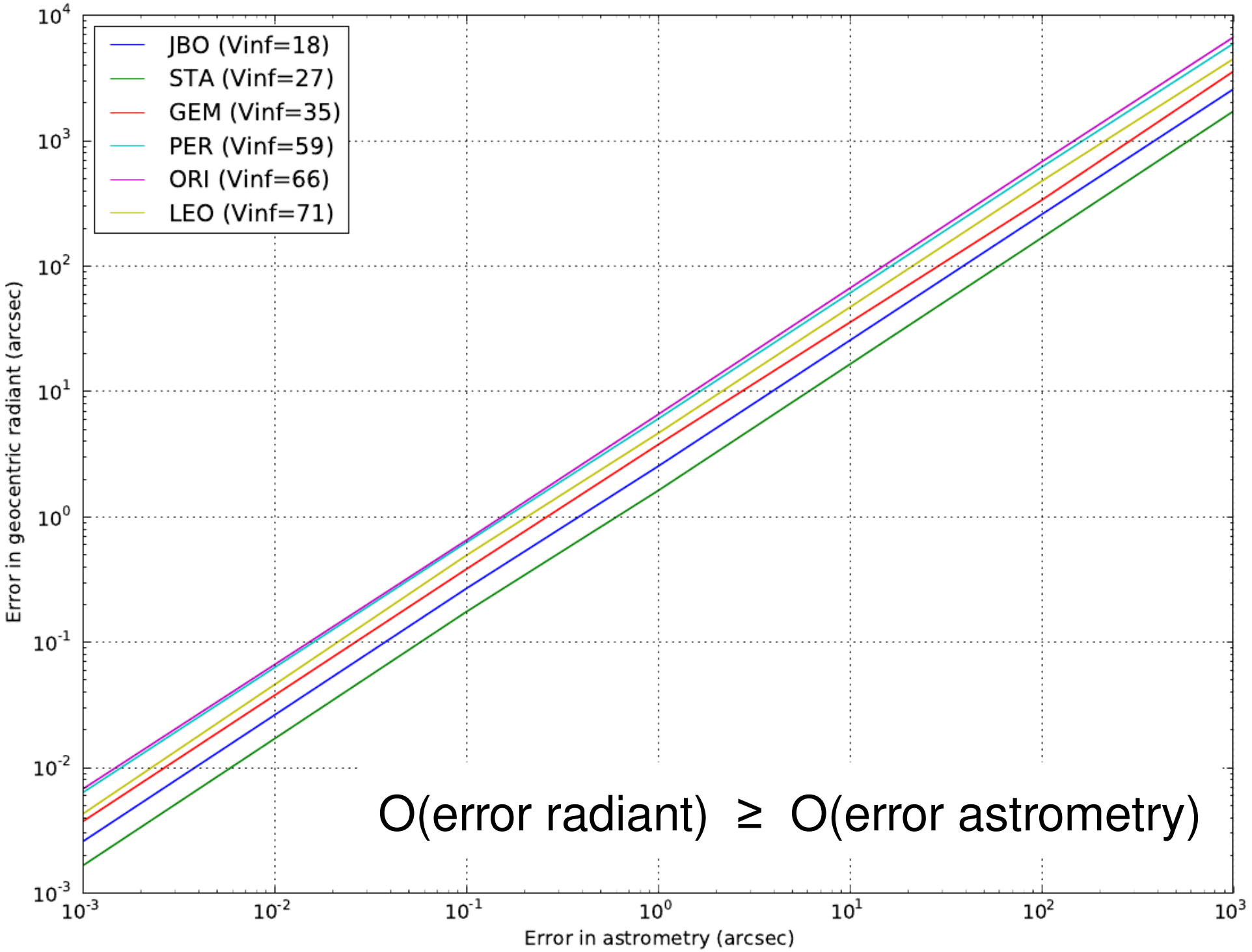




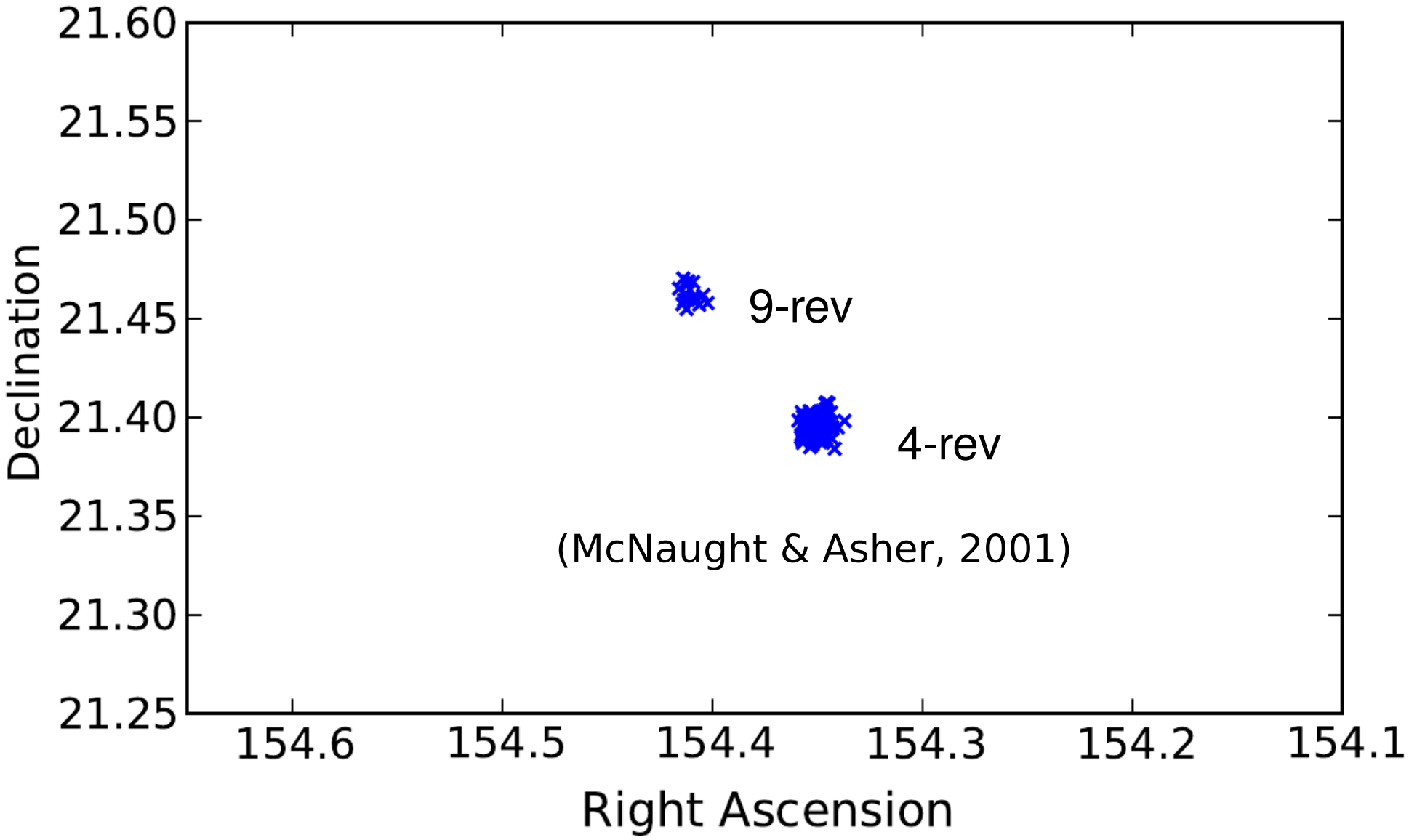
Need astrometry better than ~10 arcminutes

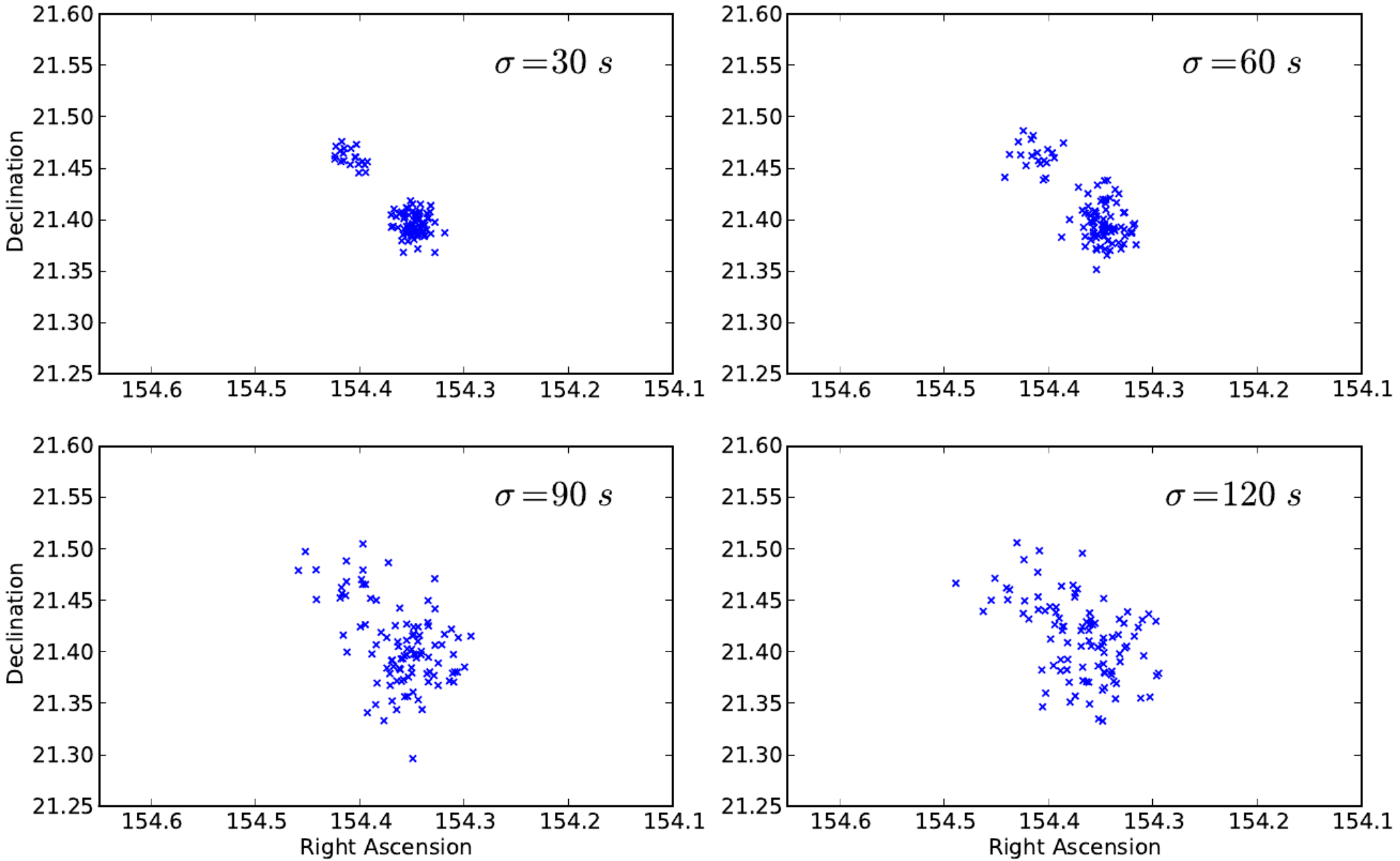


Taurids in the IAU Orbit database


JBO (Vinf=18)
STA (Vinf=27)
GEM (Vinf=35)
PER (Vinf=59)
ORI (Vinf=66)
LEO (Vinf=71)
Error in geocentric radiant (arcsec)
Error in astrometry (arcsec)
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
O(error radiant) ≥ O(error astrometry)

Leonids 2001





Need astrometry better than ~1 arcminute

My message today

- To observers

  1-10 arcminute accuracy is the upper limit required to uncover the substructure of a meteoroid stream

  - Your system may have a different goal
  - Understand your errors!

- To modelers

  Specify your needs in terms of observables