DPS 2006, Pasadena, CA, October 8–13

# The Long-Term Evolution of J2/1, J3/2 and J4/3 Resonant Asteroids During Planetary Migration and Beyond

M. Brož [1], D. Vokrouhlický [1], W.F. Bottke [2], A. Morbidelli [3], D. Nesvorný [2]

[1] Charles University, Prague

[2] Southwest Research Institute, Boulder

[3] Observatoire de la Côte d'Azur, Nice

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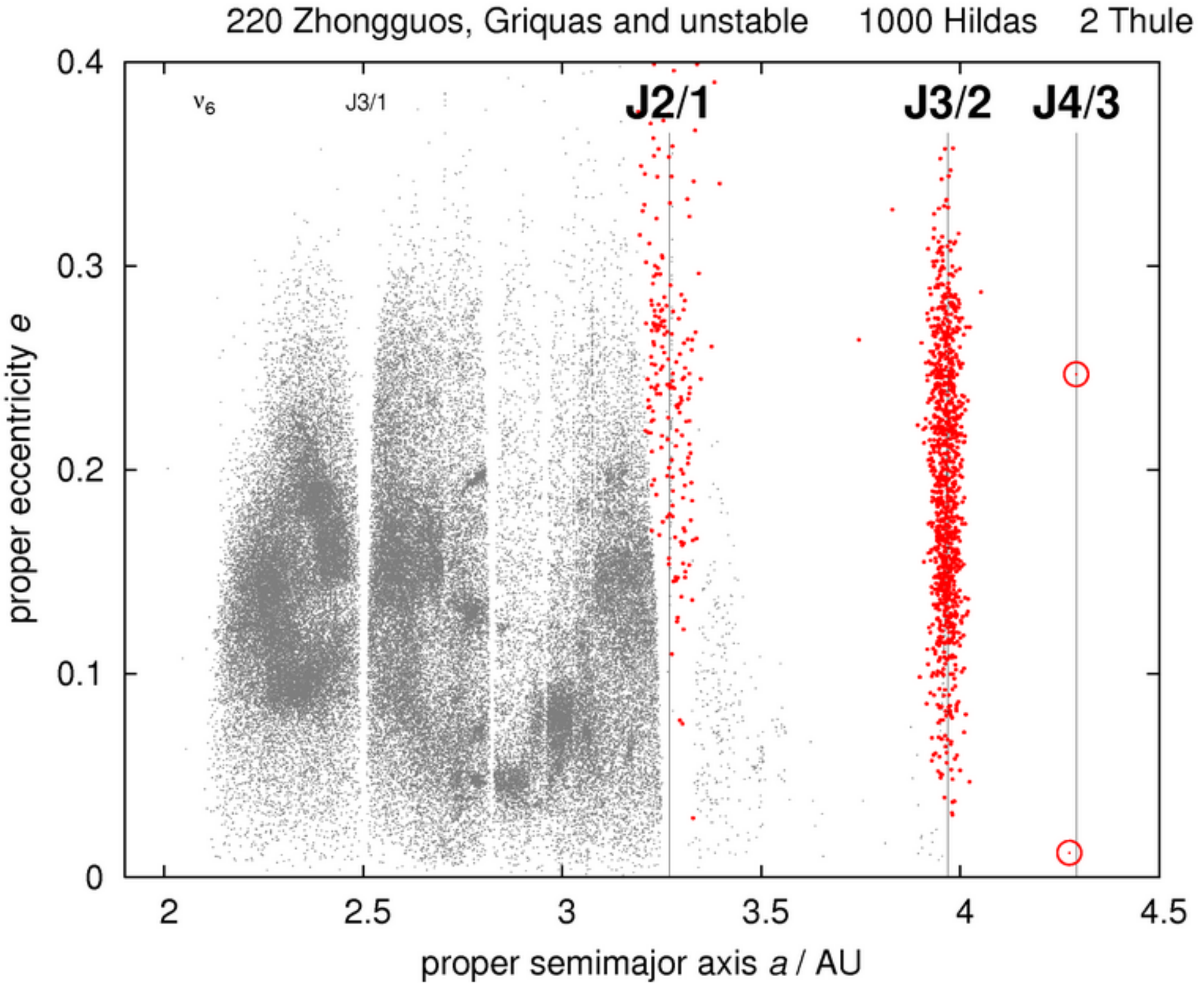
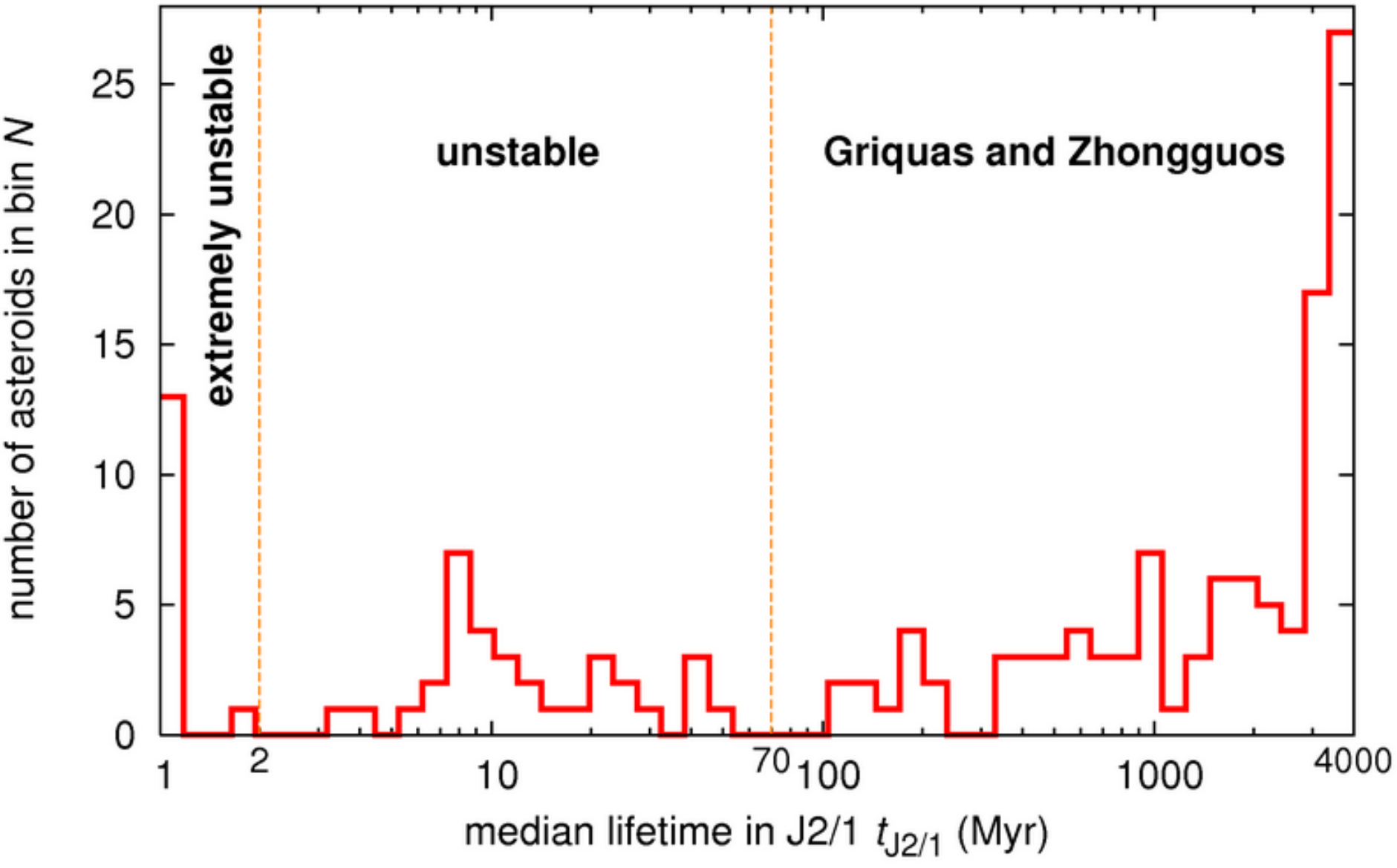
# Update of resonant populations (Jun 2006):



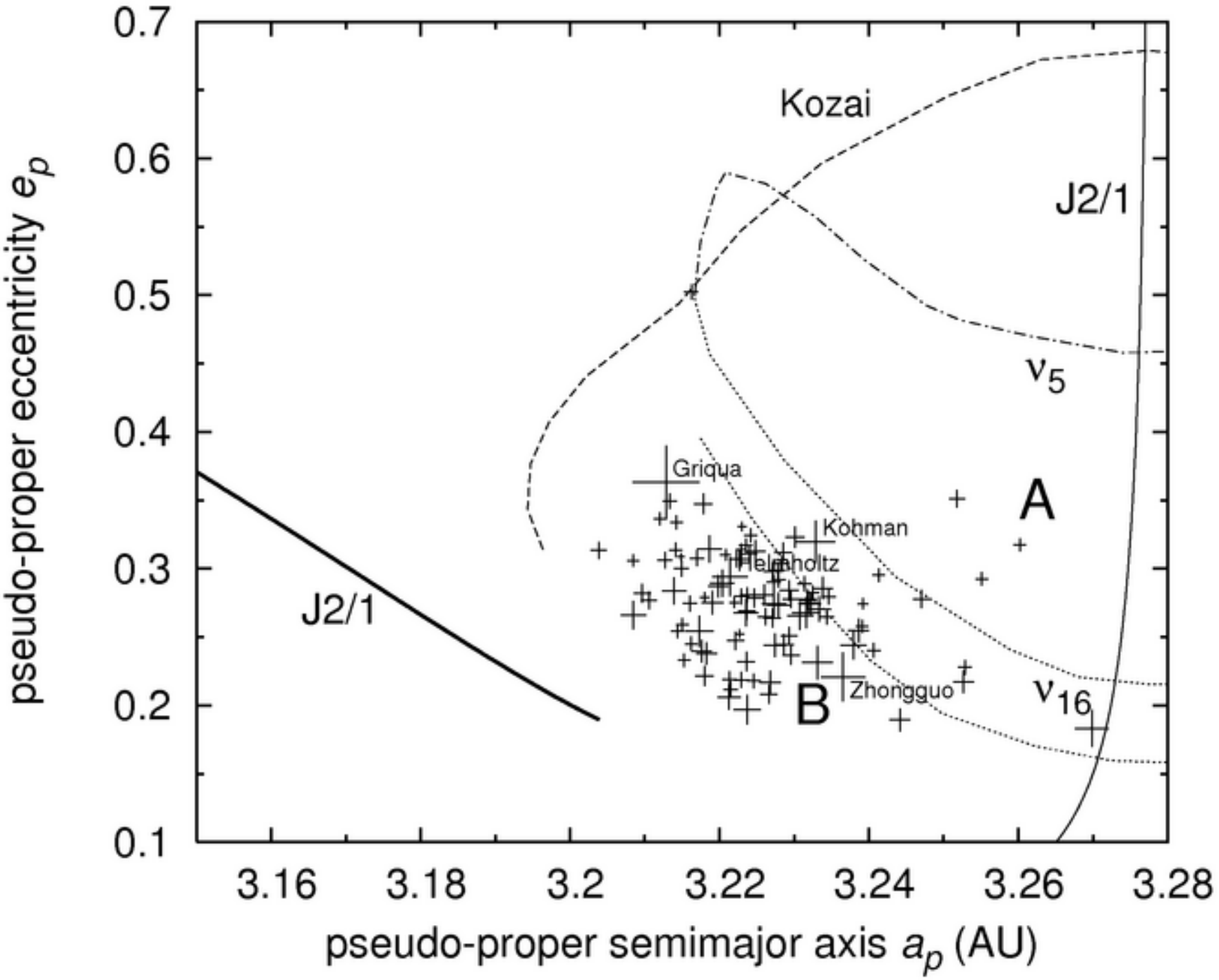
# Dynamical lifetimes:

- J2/1: one third unstable, the rest $> 100$ My



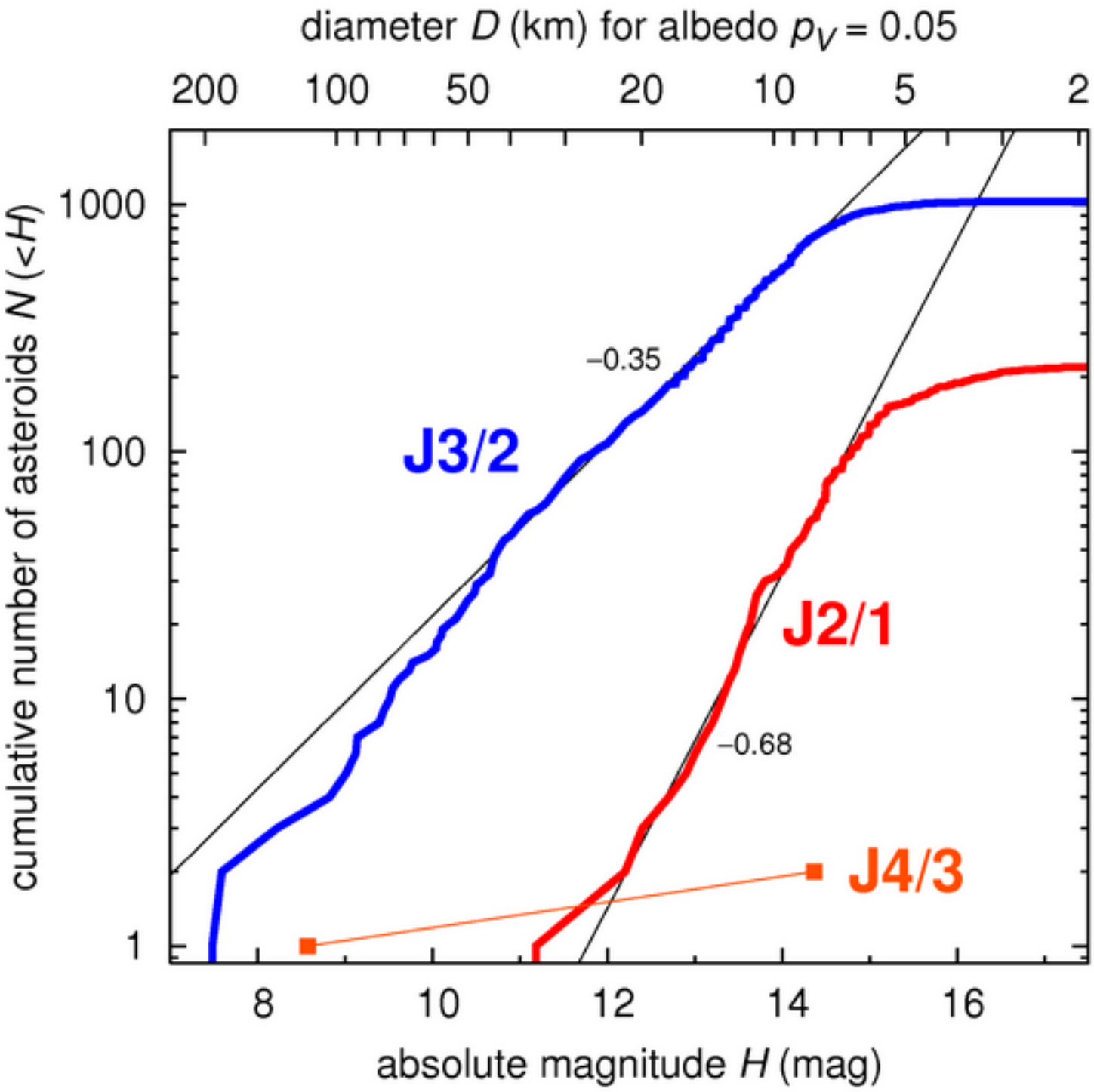

- J3/2 and J4/3: stable $\sim 1$ Gy

# Zhongguos and Griquas:



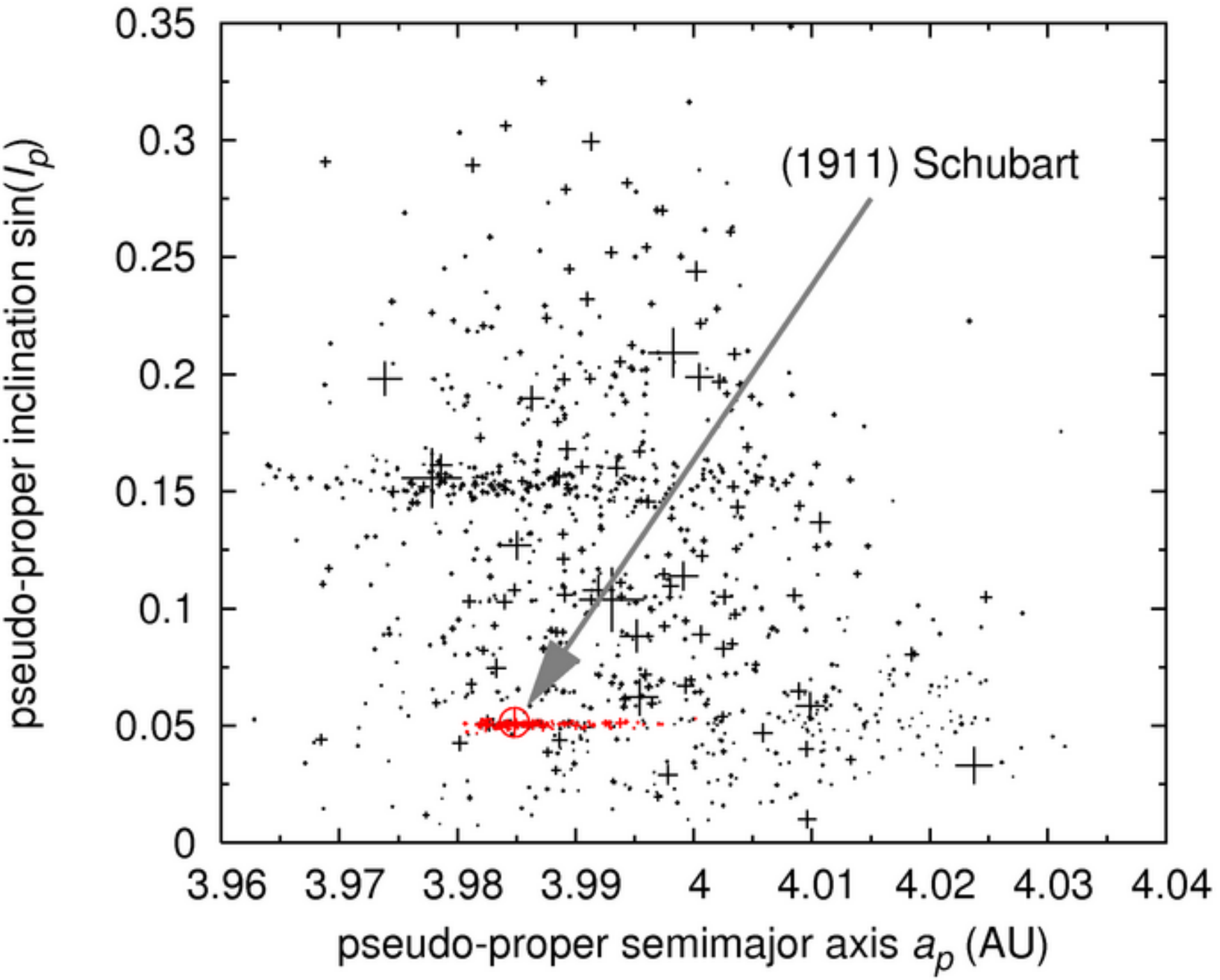

- no significant clusters
- big bodies are far from each other ⇒ not a single event?

# Absolute magnitude distributions:



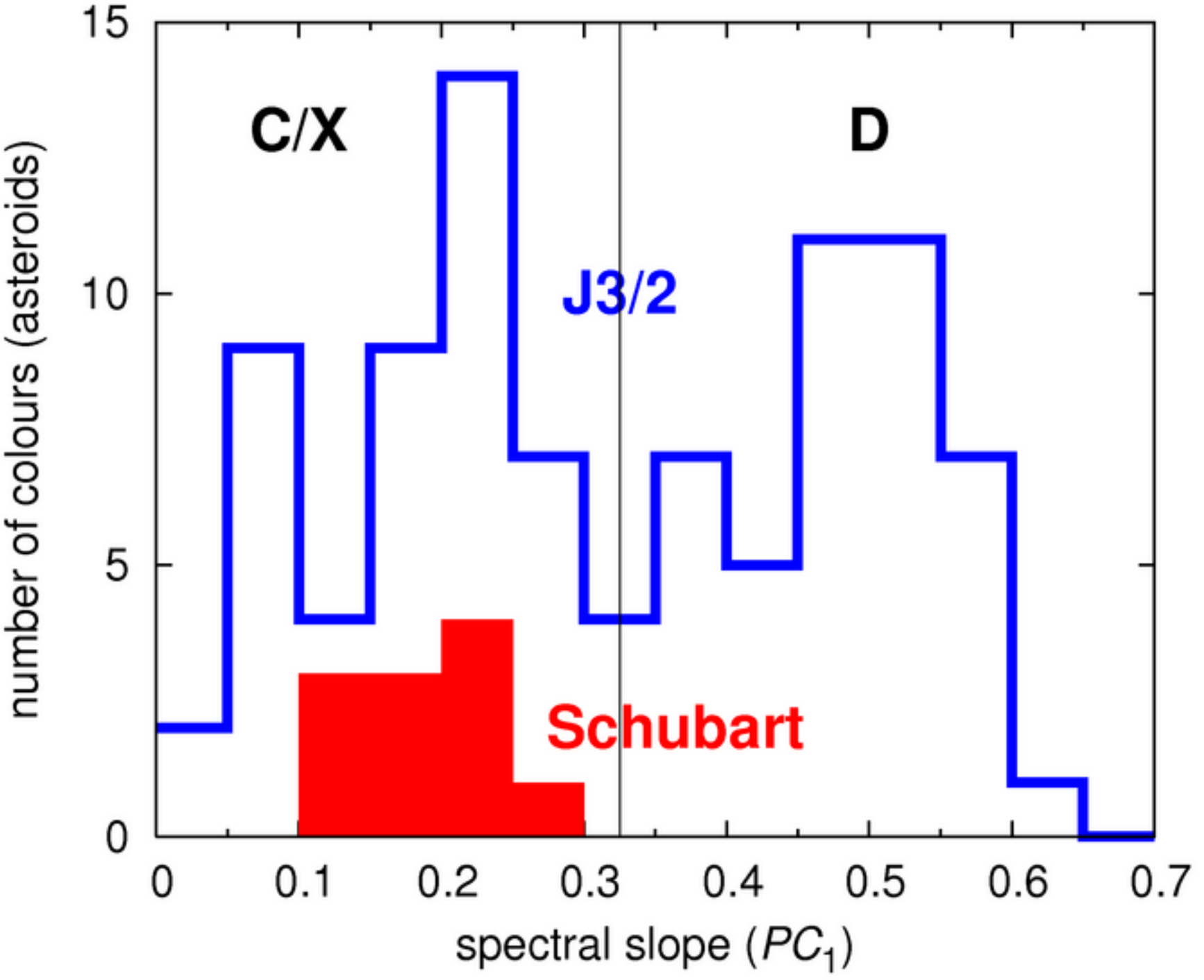

- J2/1: steeper SFD than J3/2 and Dohnanyi (−0.5)
- J3/2: even shallower than Dohnanyi

# Hildas in the J3/2:



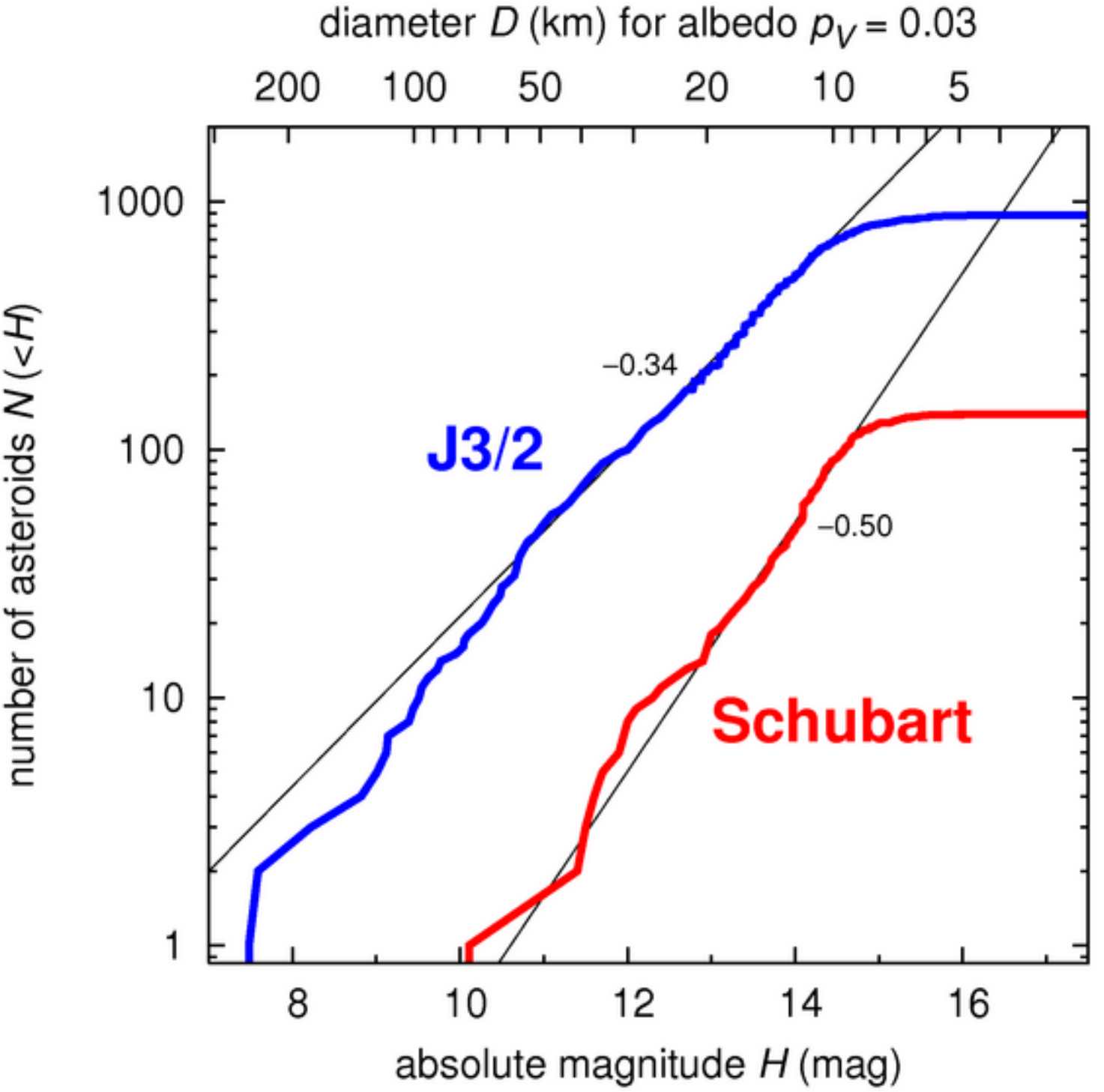

- a distinct Schubart cluster, approx. 100 km parent body (Schubart 1991)

# Schubart cluster — colours:




- SLOAN colours of Hildas are bimodal (C/X- and D-types)
- the cluster is similar to the X-types

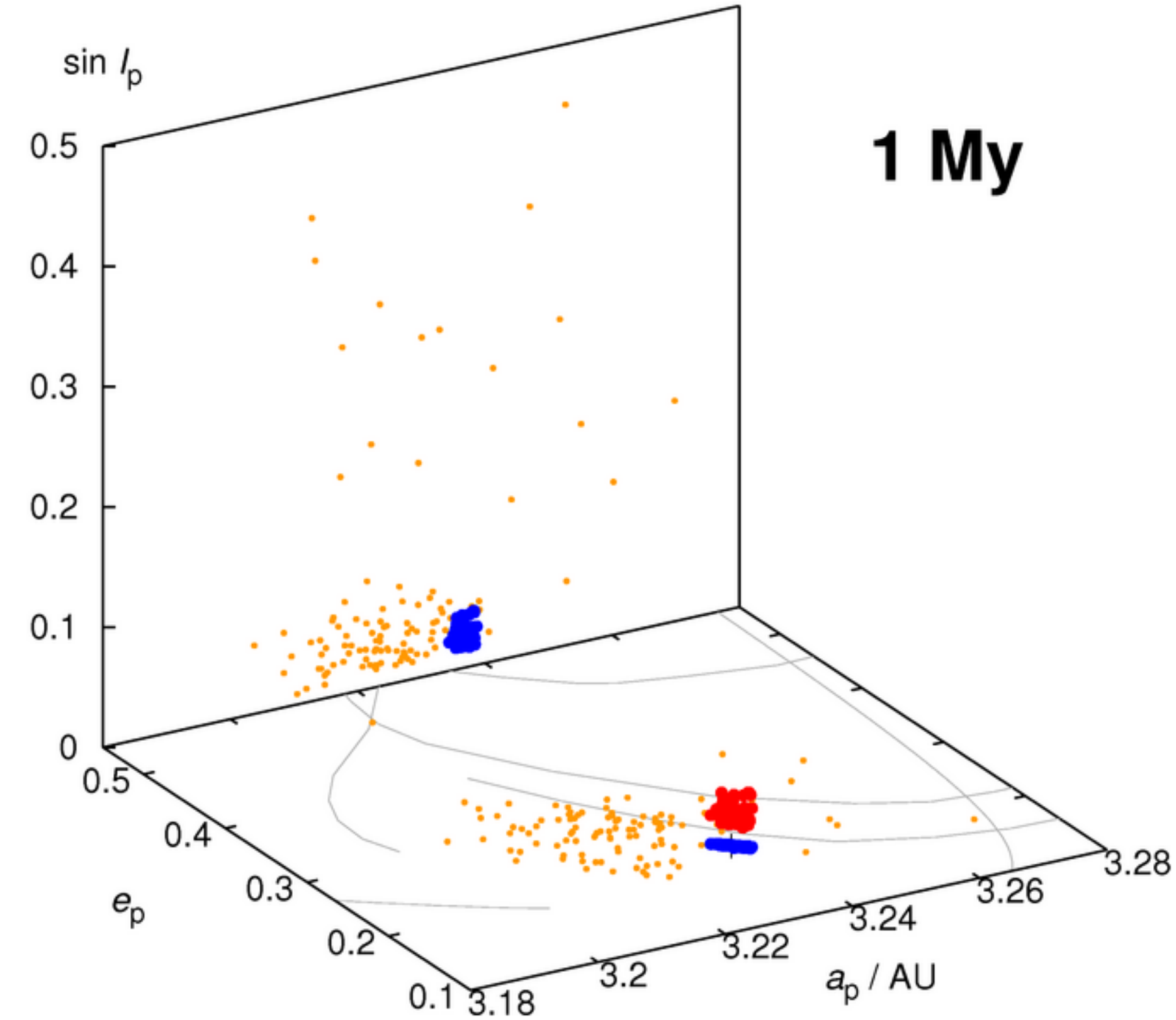
# Schubart cluster — SFD:



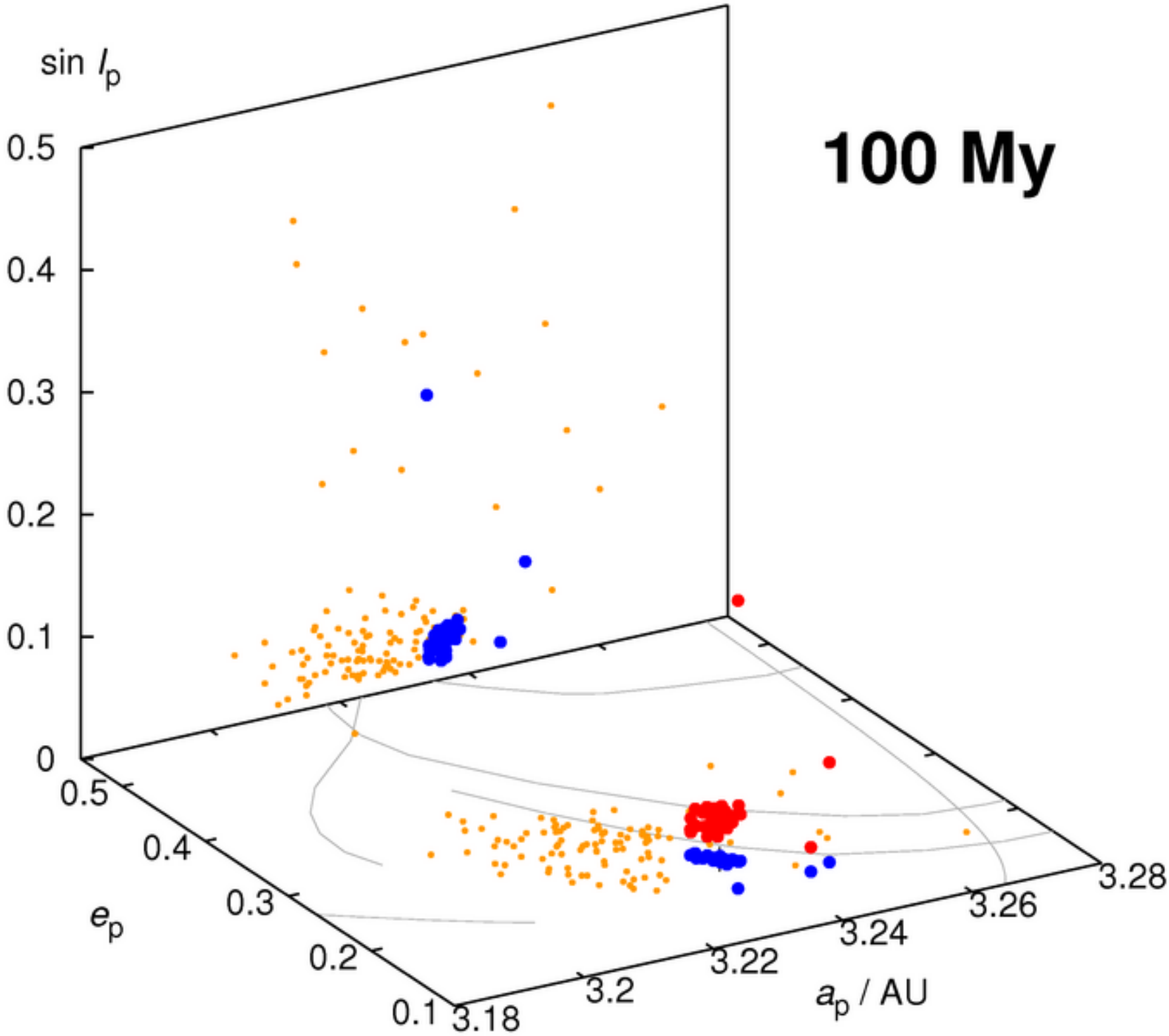

- significantly steeper than Hildas
- close to Dohnanyi for $< 20\,\mathrm{km} \Rightarrow$ collisional relaxation?

# Impact clusters in J2/1 and J3/2:

- example: a disruption of a 30-km body in the J2/1

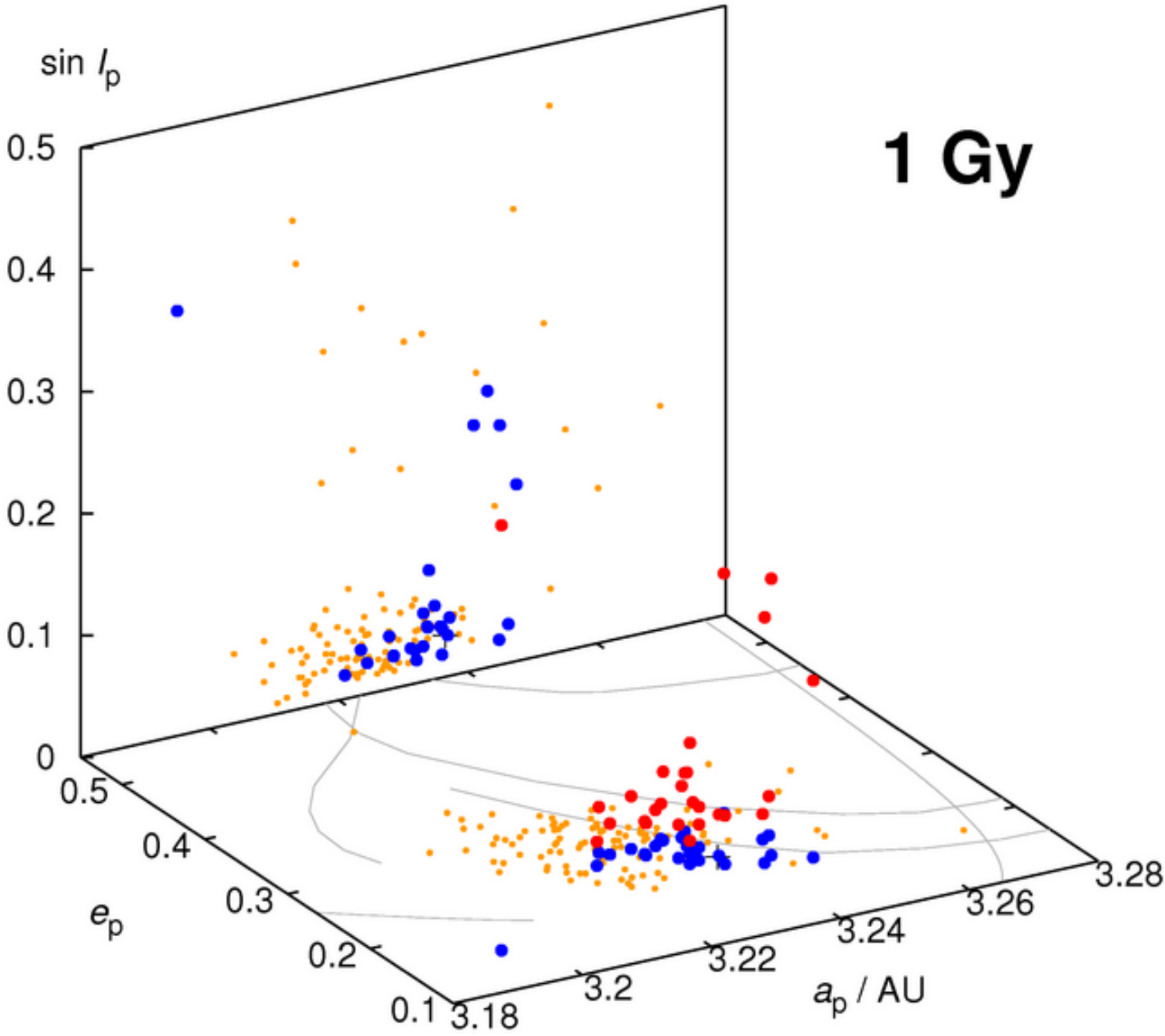


# Impact clusters (cont.):




- are stable on a 100 My timescale, but...

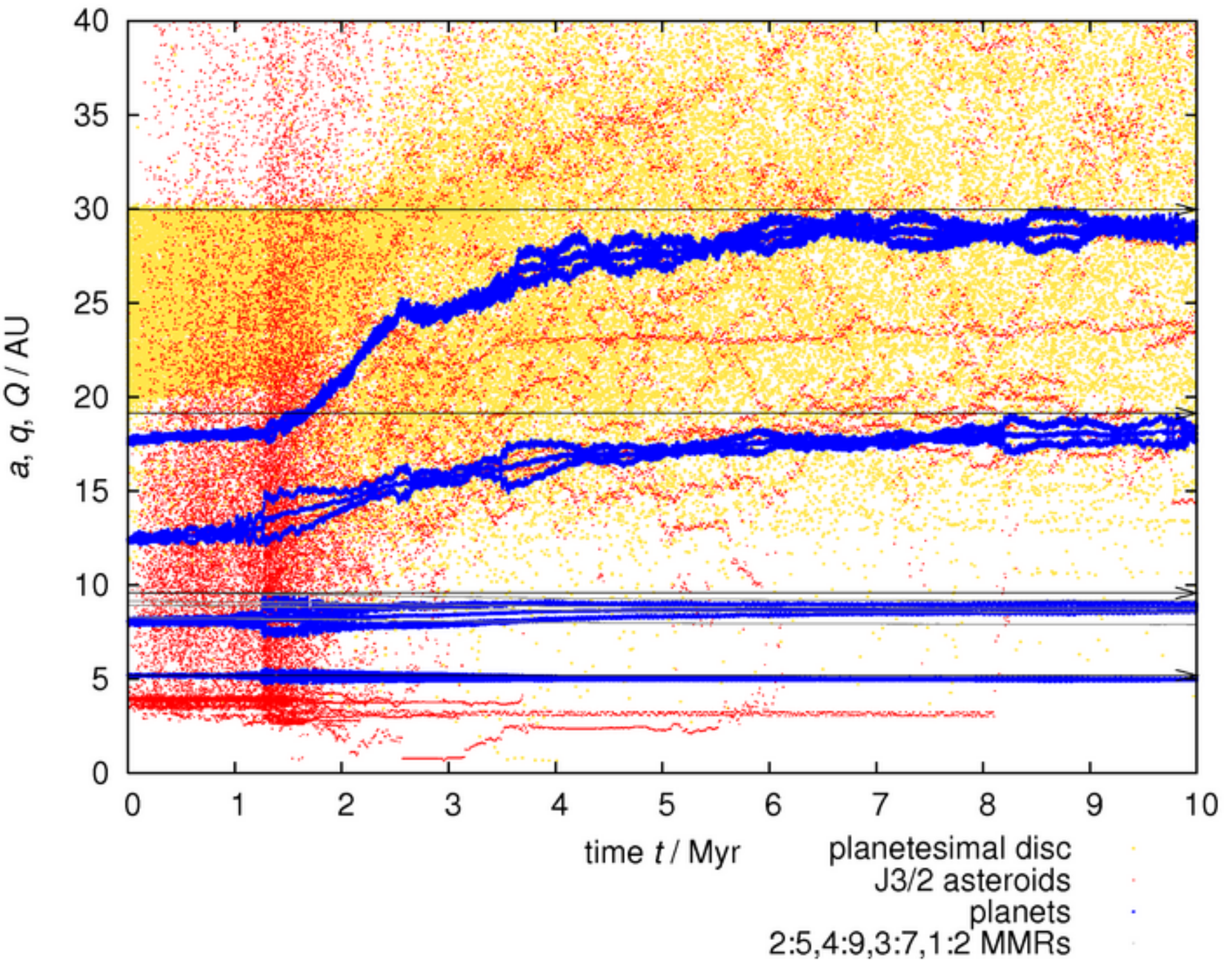
# Impact clusters (cont.):




- ... disperse in 1 Gy due to chaotic diffusion and the Yarkovsky effect ↑ J3/2 is more stable

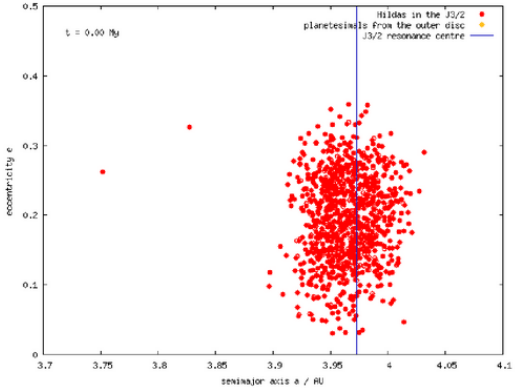
# Origin of resonant populations:

- migration of planets due to planetesimal disc 30–50 $M_\oplus$ similar to the 'Nice model' (Morbidelli *et al.*, 2005)

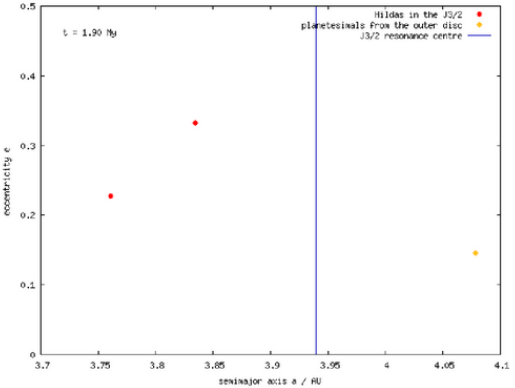


# Origin of Hildas ← captured:

original population



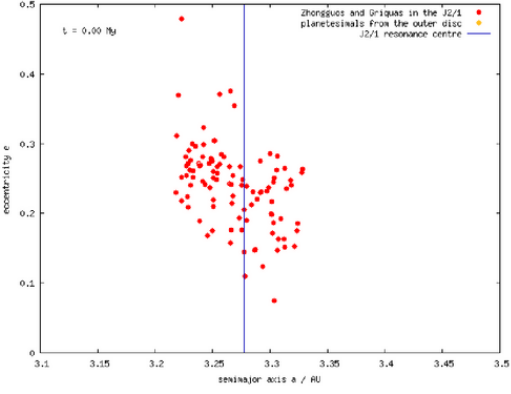

final population



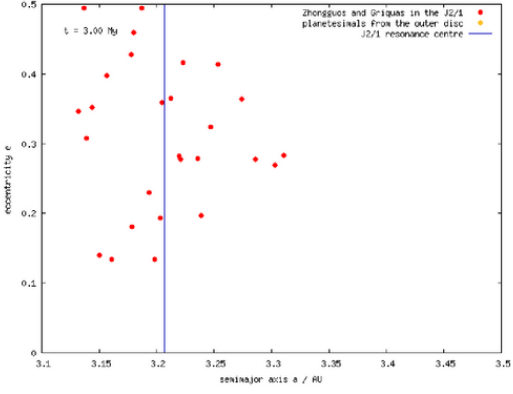

- almost no J3/2 bodies remain ⇒ must had been captured during the 1:2 crossing event (by chaotic capture) or after (by resonance sweeping)

# Origin of J2/1 asteroids ← primordial:

original population




final population




- $\sim$ half of J2/1 orbits survive $\Rightarrow$ might be primordial

# Summary:

| time | J2/1 | J3/2 | J4/3 |
|---|---|---|---|
| before present | | | |
| 4.56 Gy | LARGE PRIMORDIAL POPULATION | | |
| 4.5 Gy | excitation, 90 % depletion by embedded embryos | 100 % | 100 % |
| 3.9 Gy | | | |
| LHB | ~50 % depletion some captures | chaotic capture | low-probable ch. capture |
| 3.8 Gy | ~50 % depletion (G. I. resonance) | | |
| 3.5 Gy | several collisions | 1+ large disruptions | no collisions |
| 500 My | | Schubart cluster | |
| present | Zhongguos, Griquas | Hildas | Thule and 2001 $QG_{207}$ |