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

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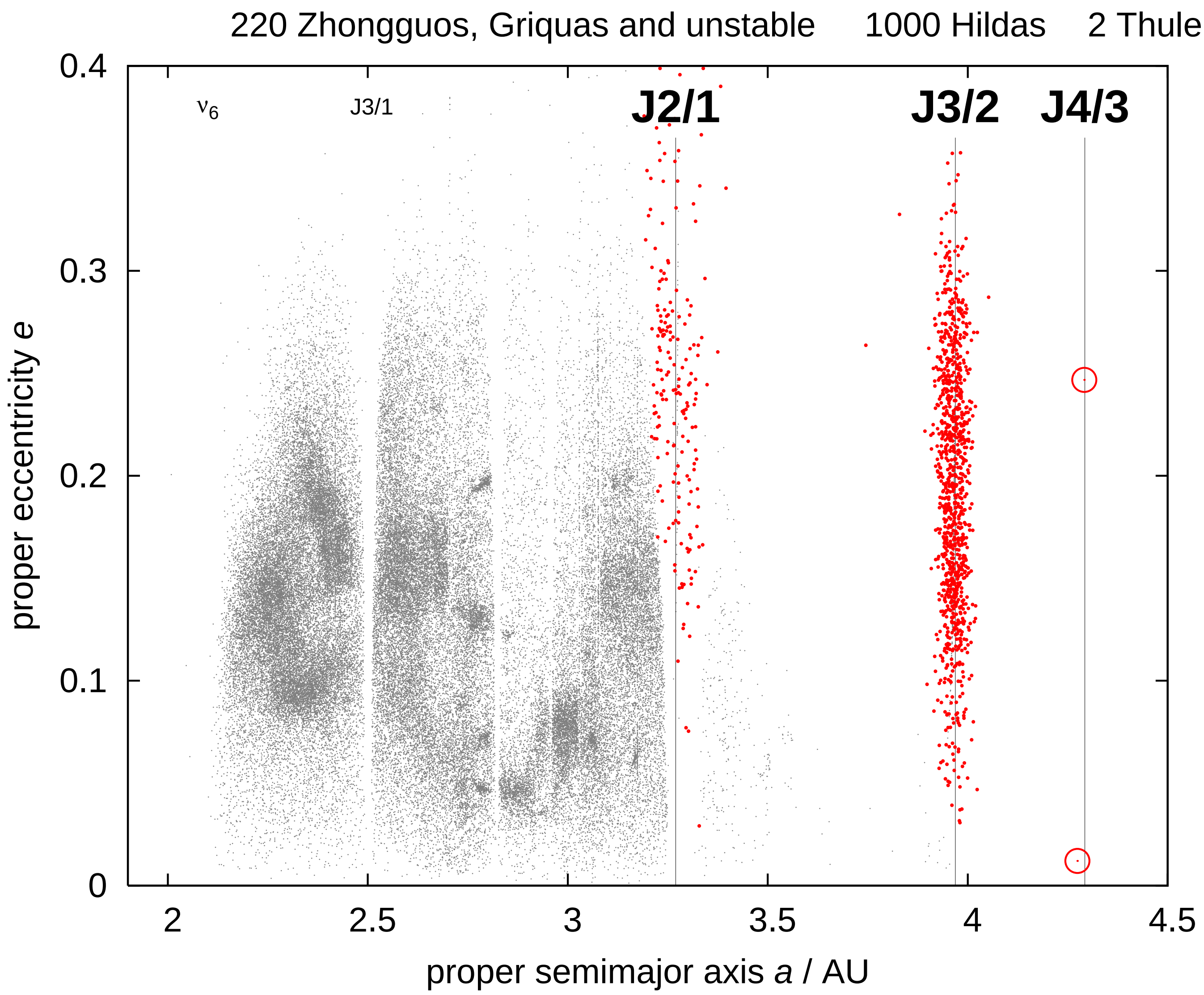
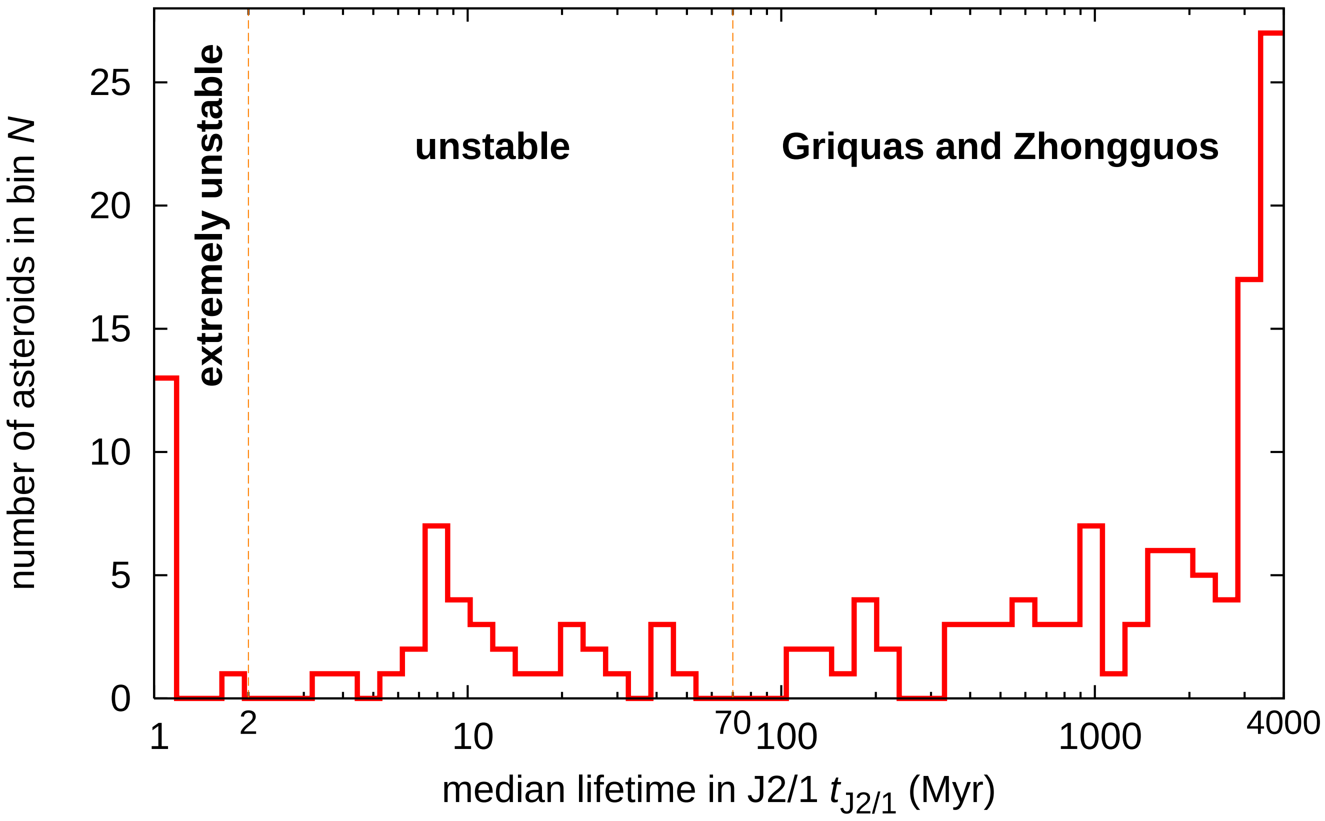
Update of resonant populations (Jun 2006):



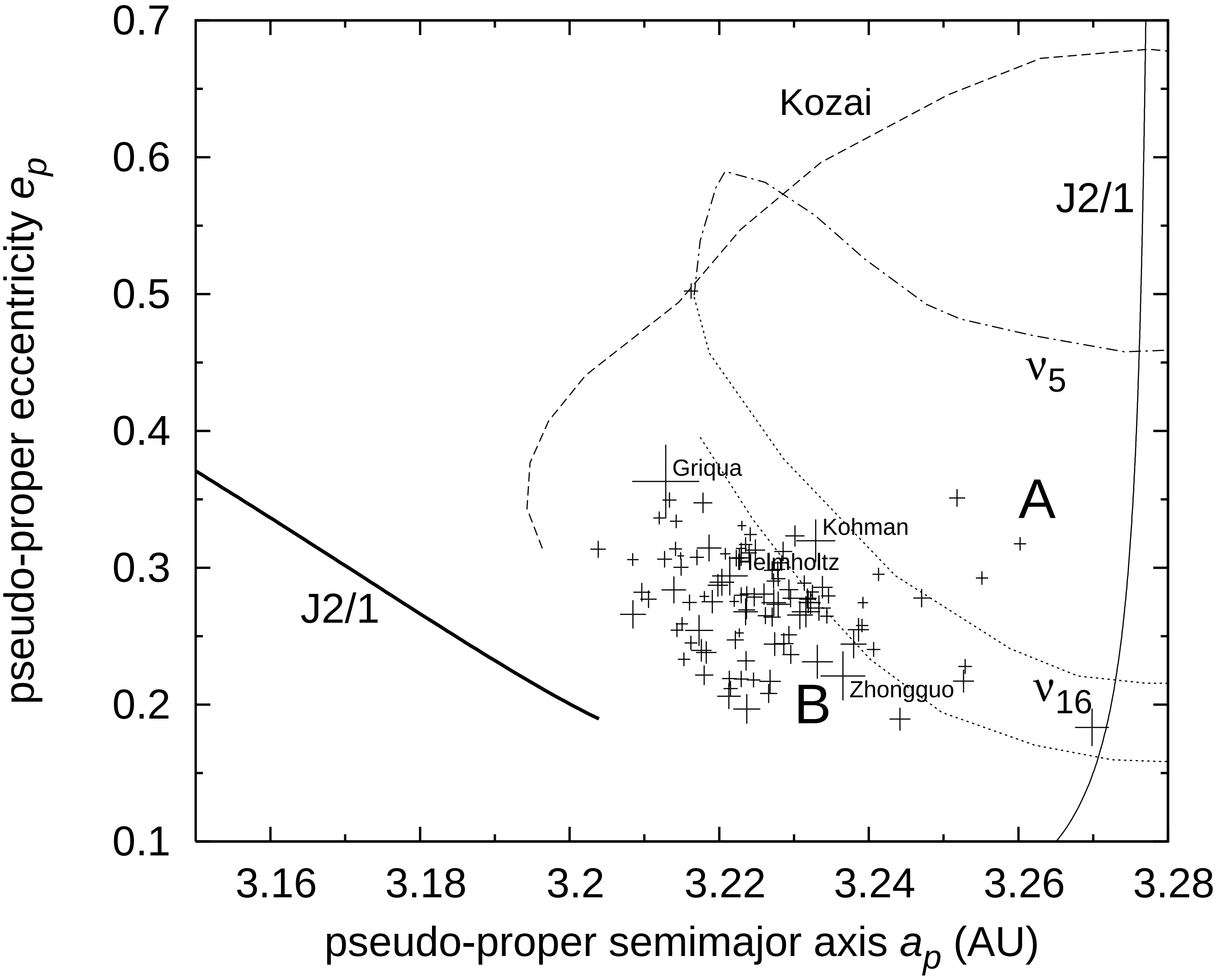
Dynamical lifetimes:

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



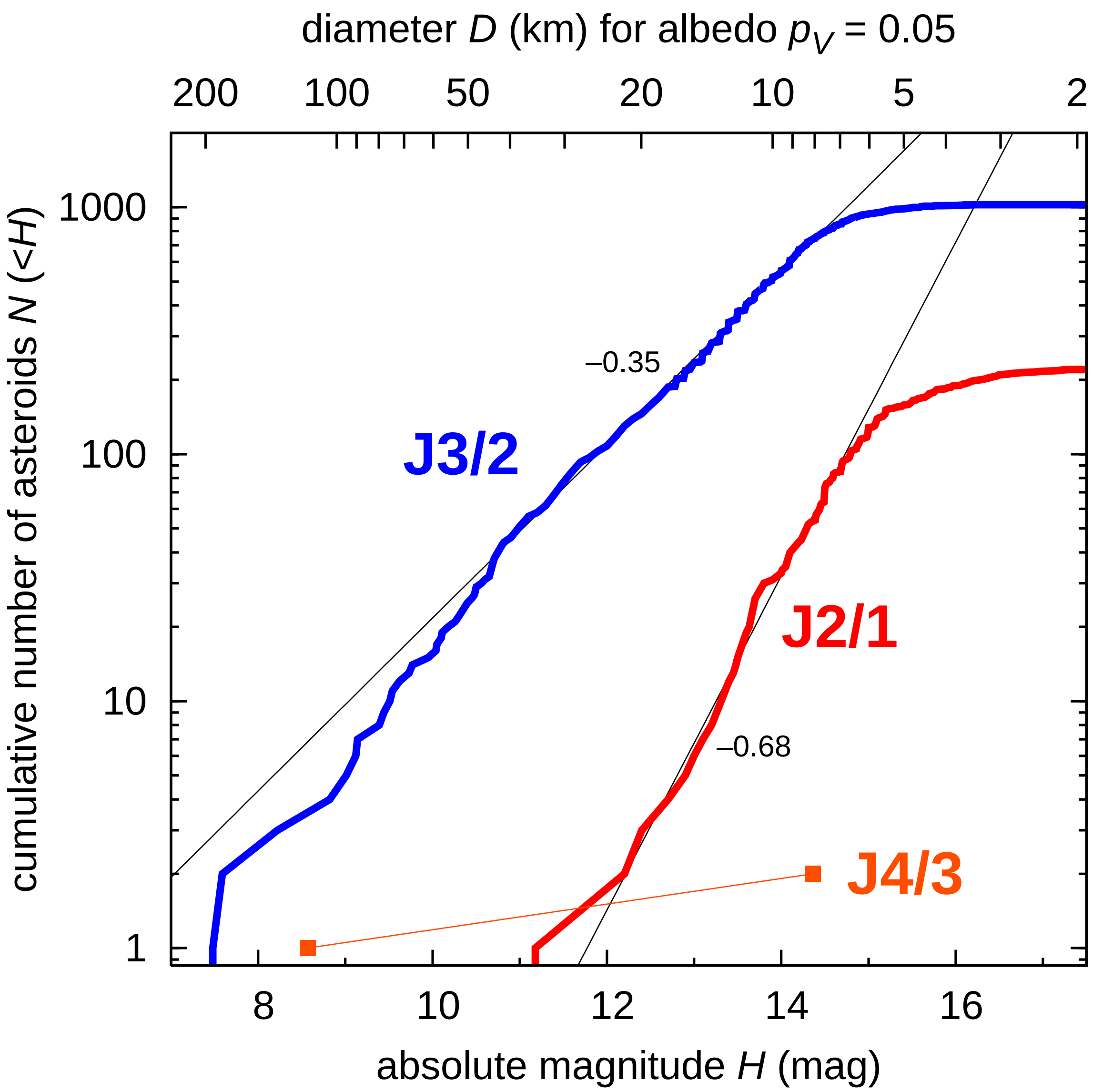
- J3/2 and J4/3: stable $\sim 1\,$Gy

Zhongguos and Griquas:



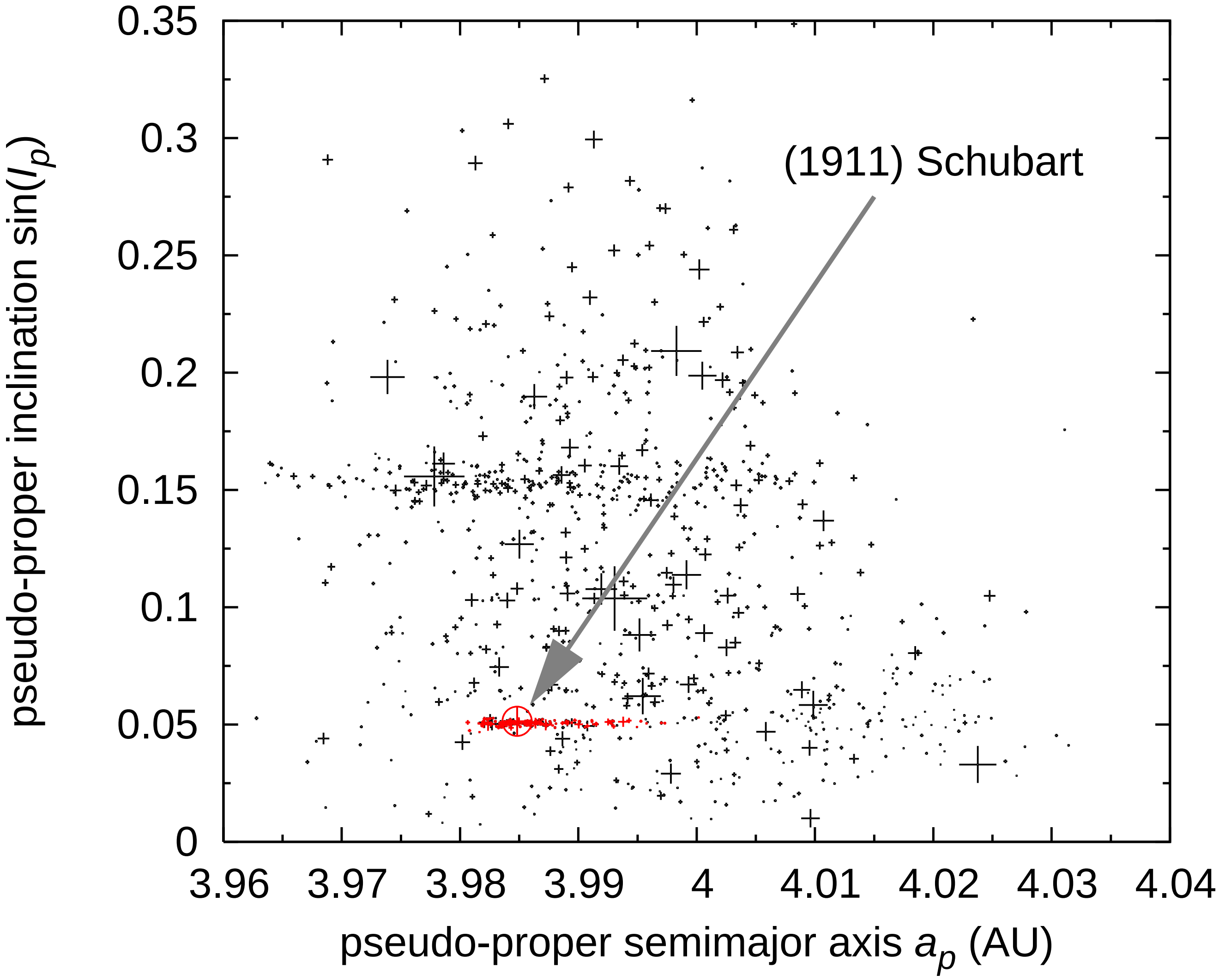
- no significant clusters
- big bodies are far from each other ⇒ not a single event?

Absolute magnitude distributions:



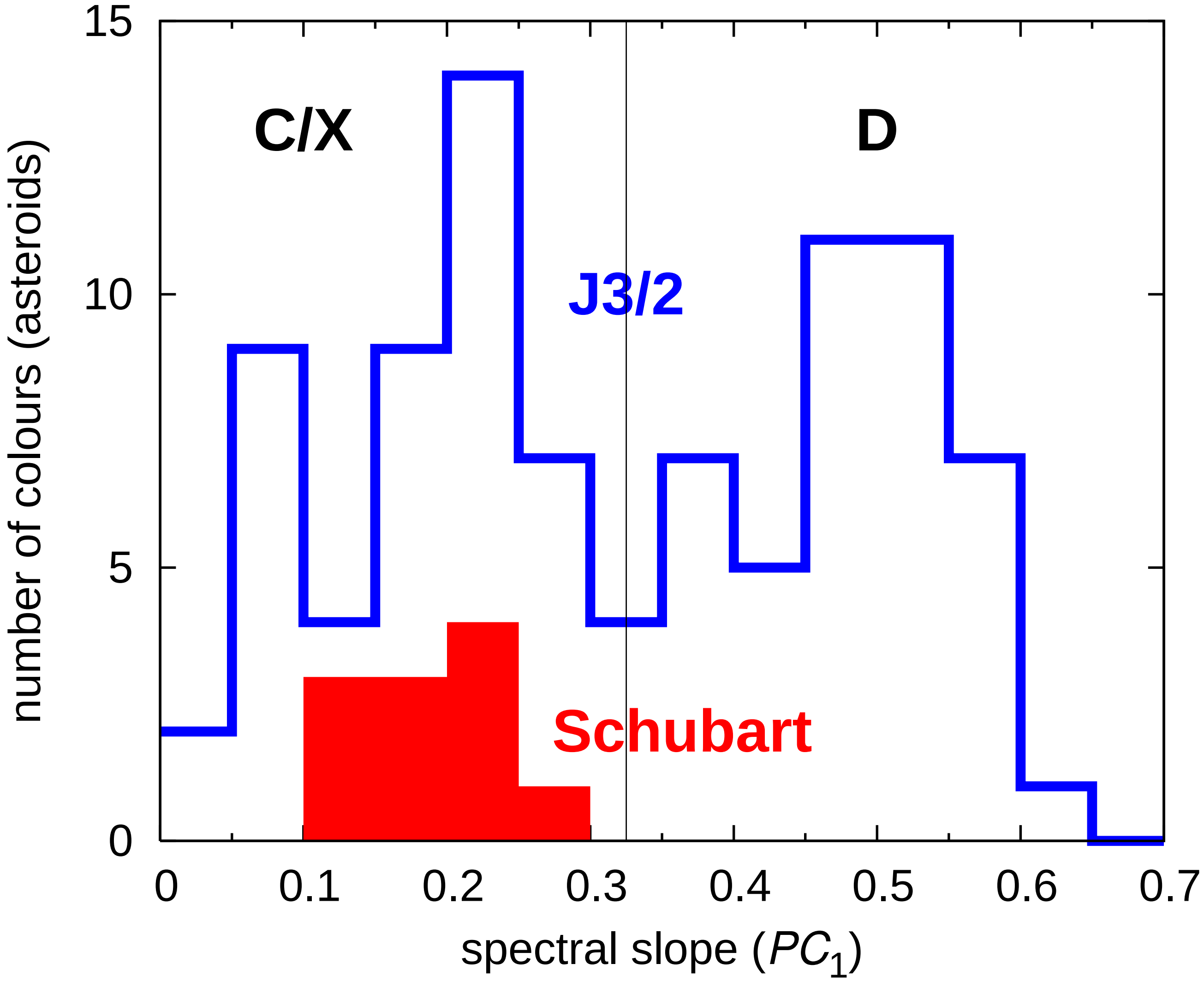
- J2/1: steeper SFD than J3/2 and Dohnanyi (−0.5)
- J3/2: even shallower than Dohnanyi

Hildas in the J3/2:



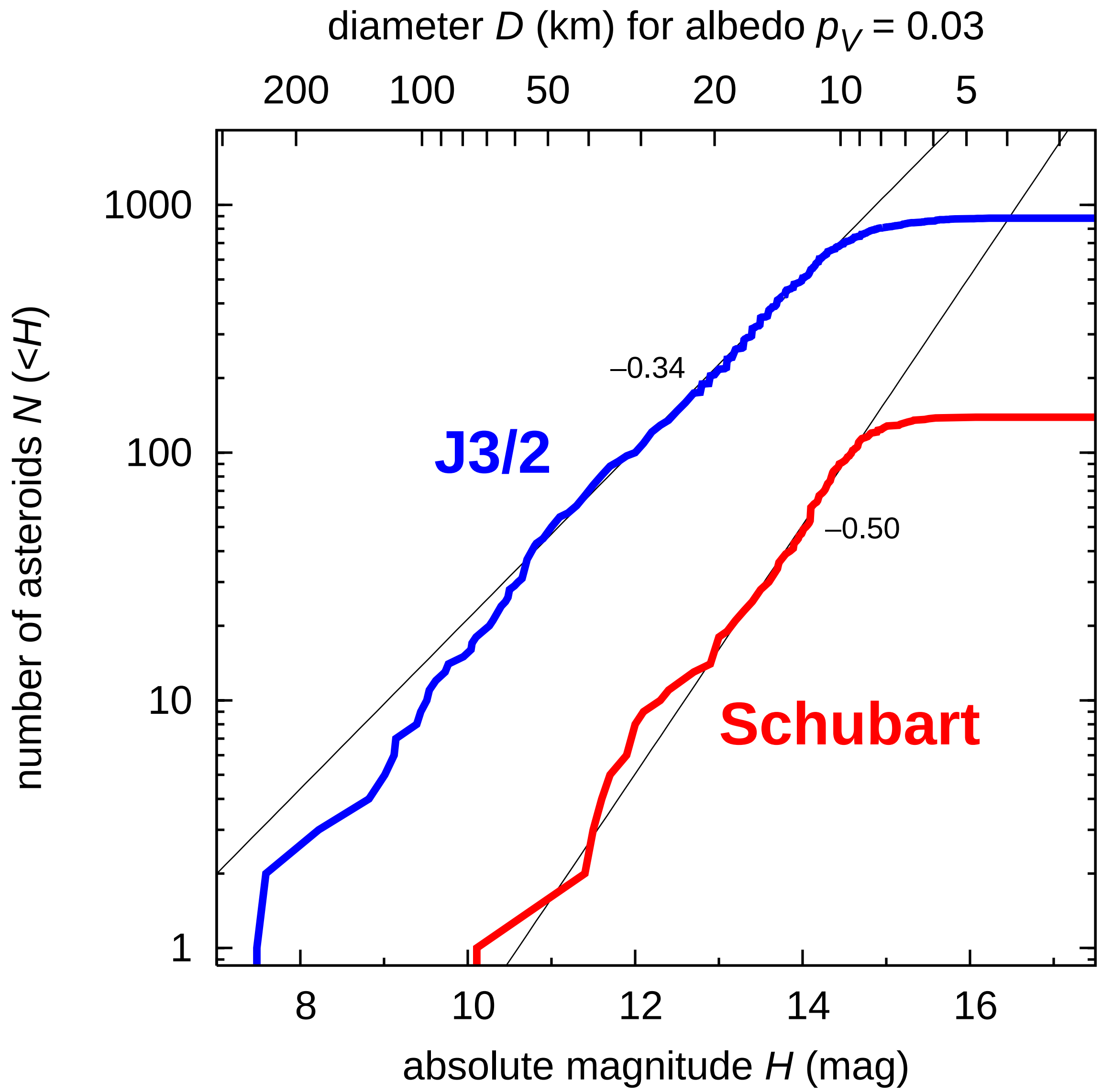
- a distinct Schubart cluster, approx. 100 km parent body (Schubart 1991)

Schubart cluster — colours:



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

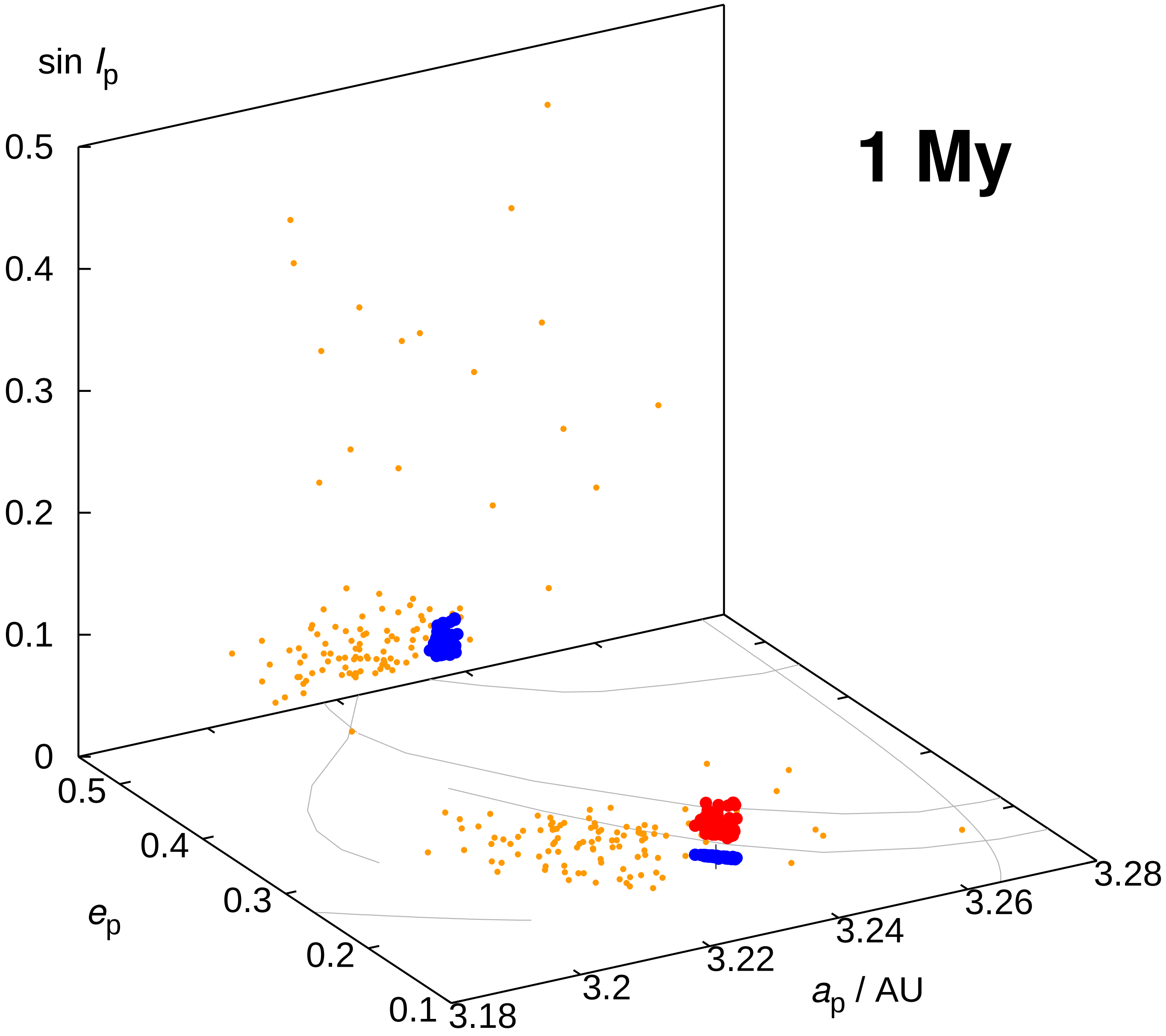
Schubart cluster — SFD:



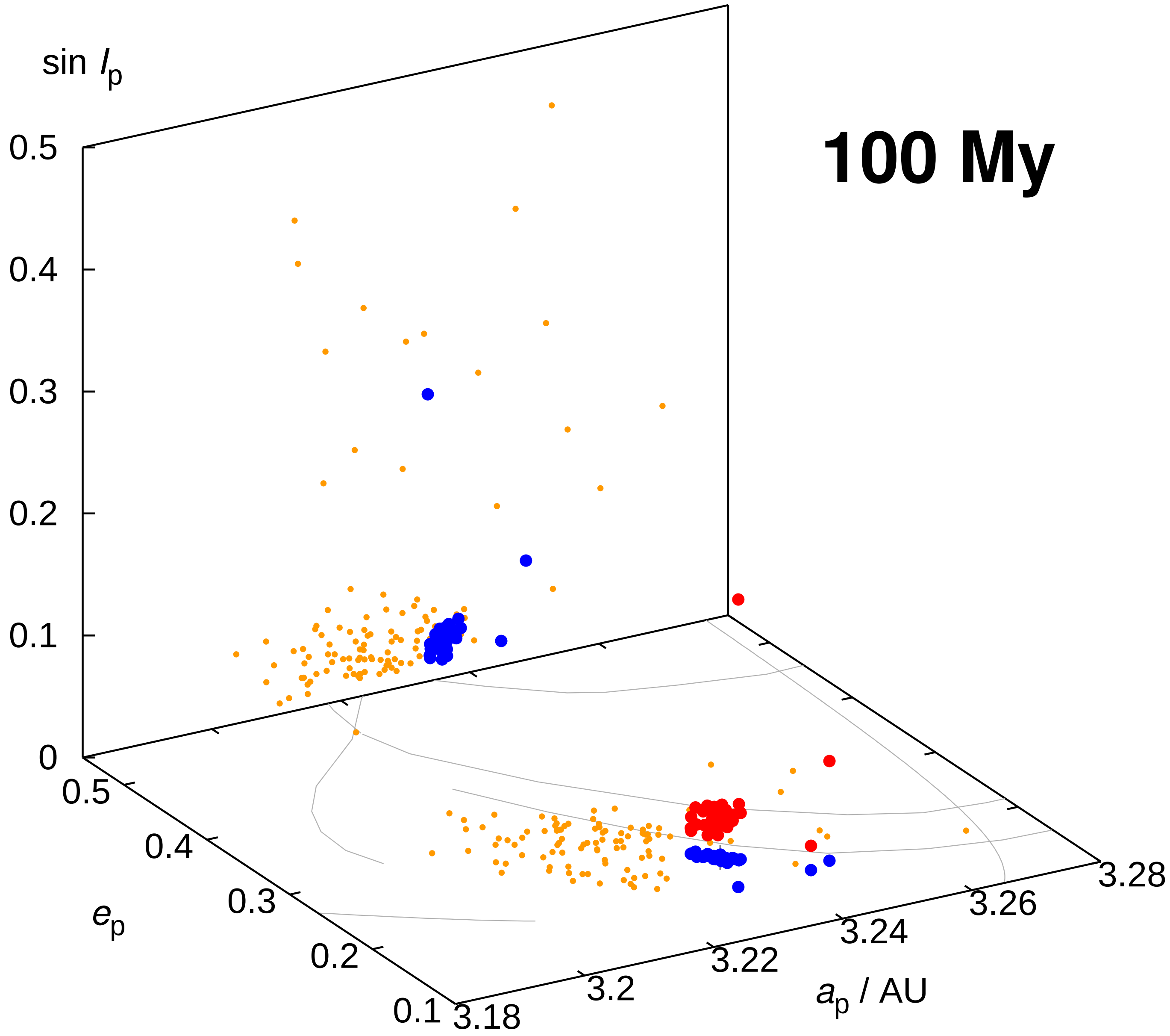
- significantly steeper than Hildas
- close to Dohnanyi for $< 20\,\mathrm{km} \Rightarrow$ collisional relaxation?

Impact clusters in J2/1 and J3/2:

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

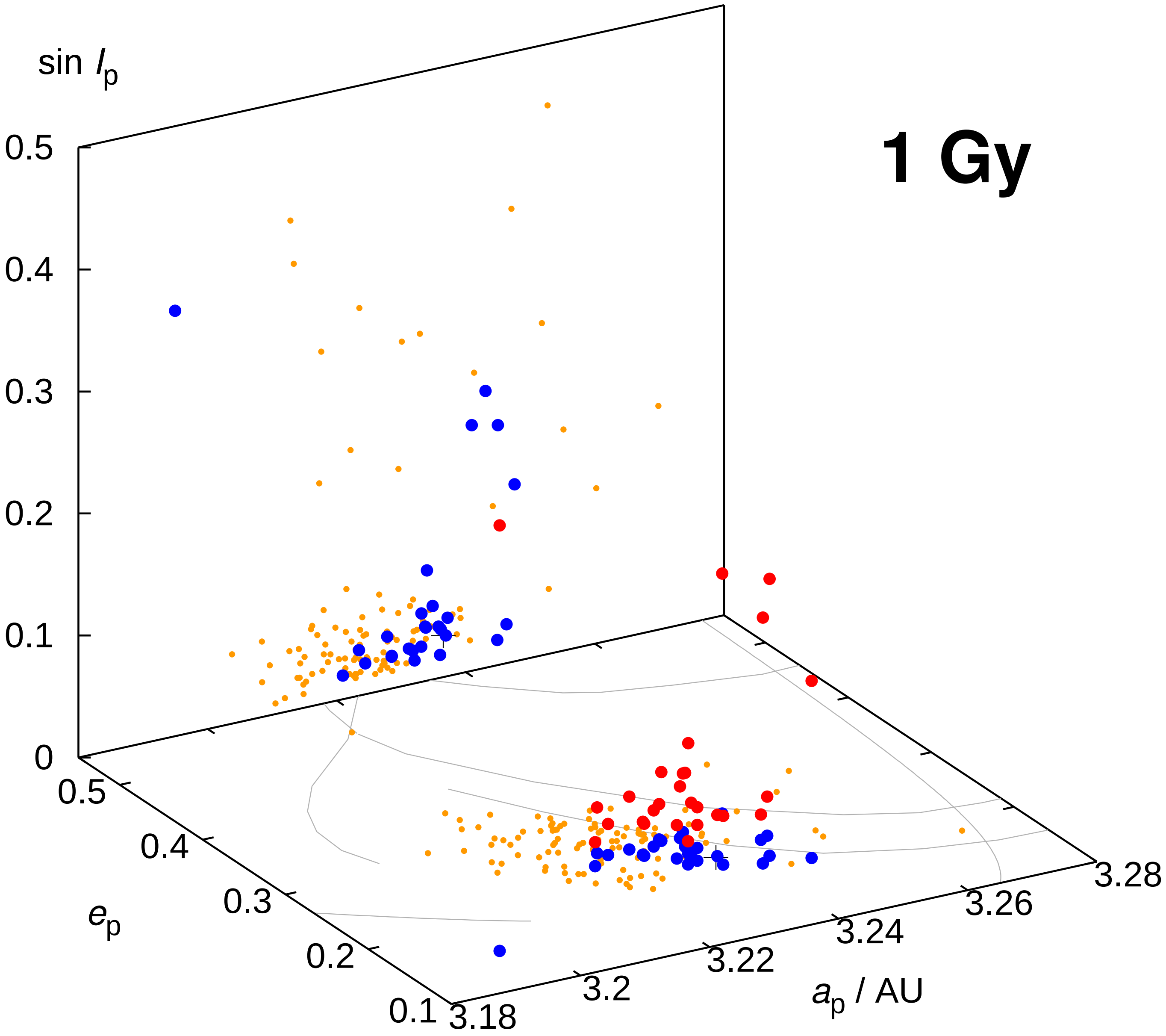


Impact clusters (cont.):



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

Impact clusters (cont.):

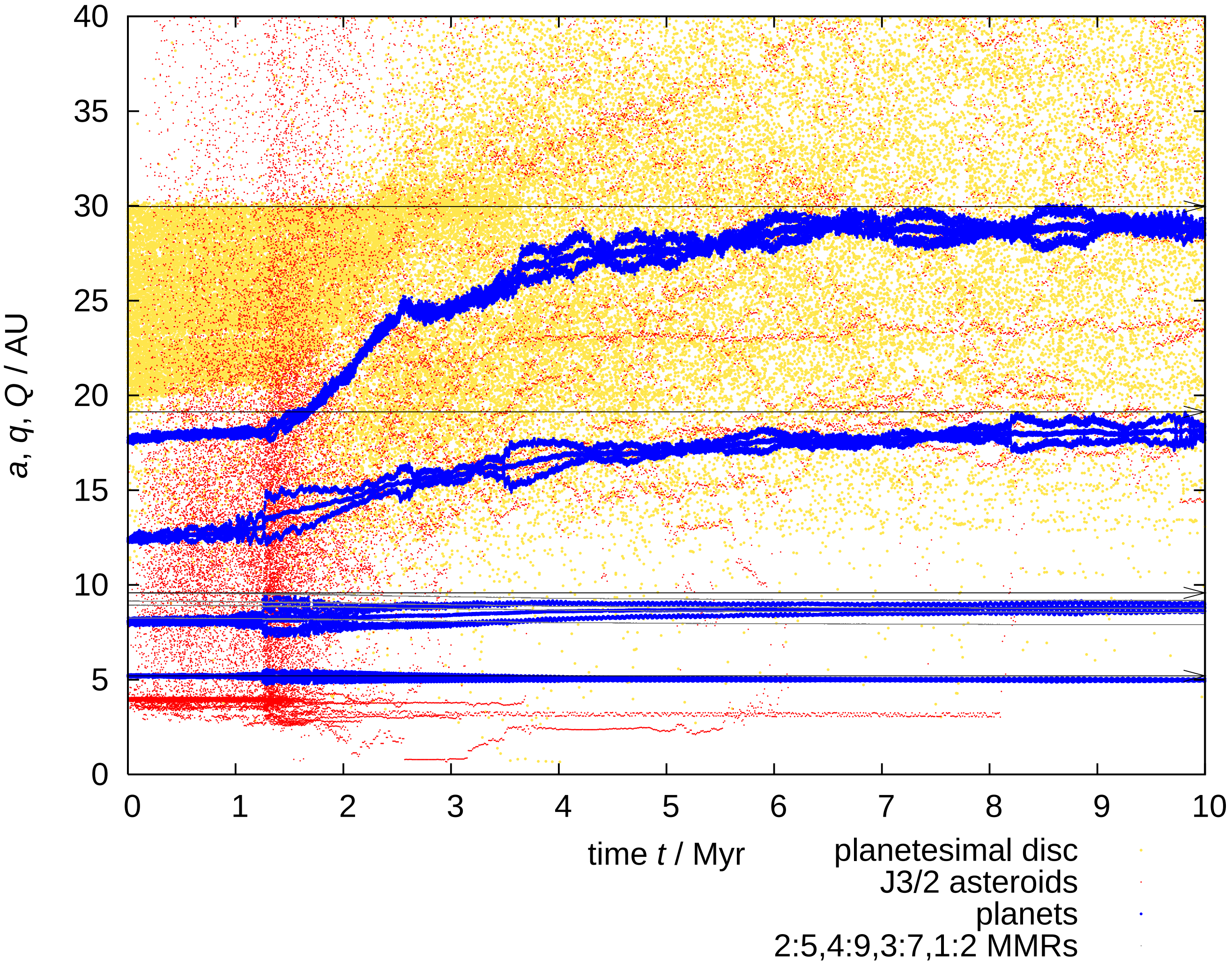


- ... disperse in 1 Gy due to chaotic diffusion and the Yarkovsky effect

↑ J3/2 is more stable

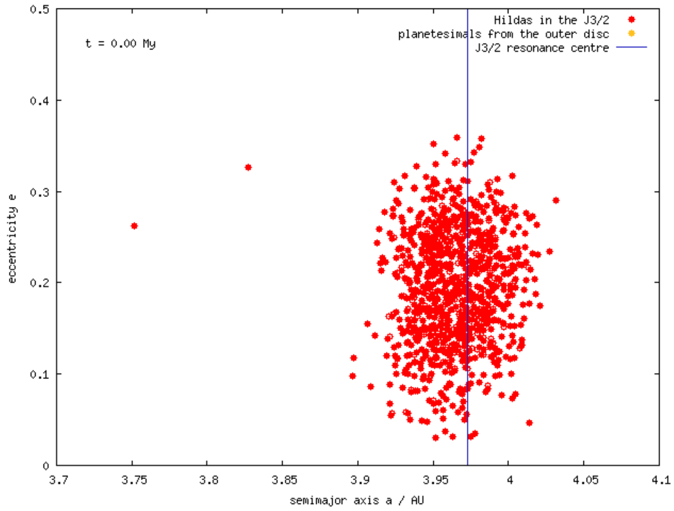
Origin of resonant populations:

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

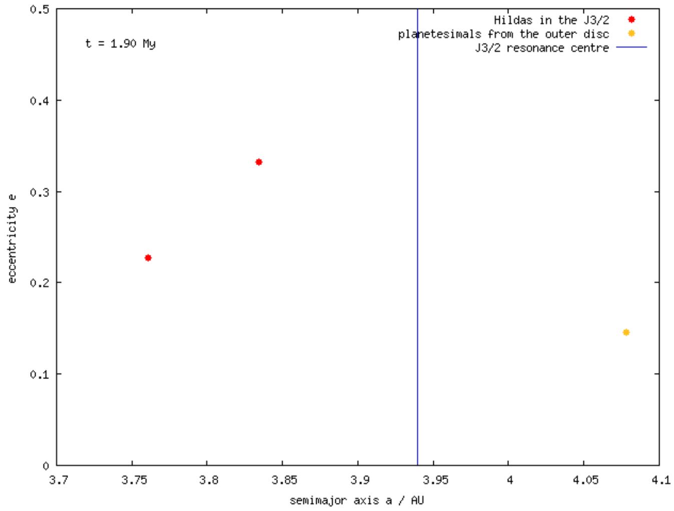


Origin of Hildas ← captured:

original population



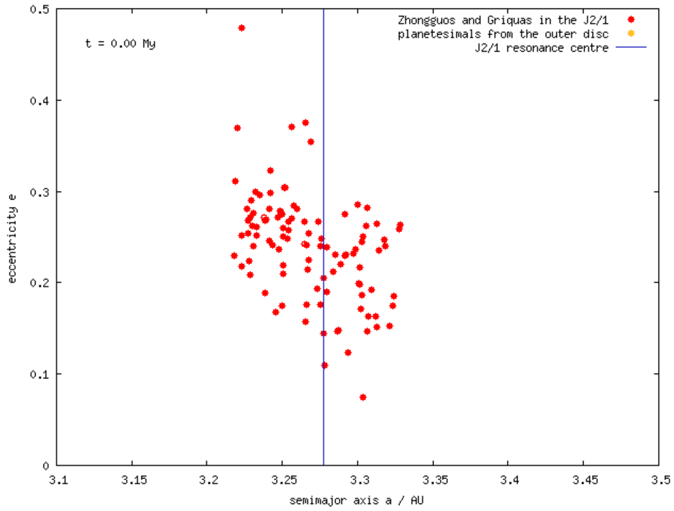
final population



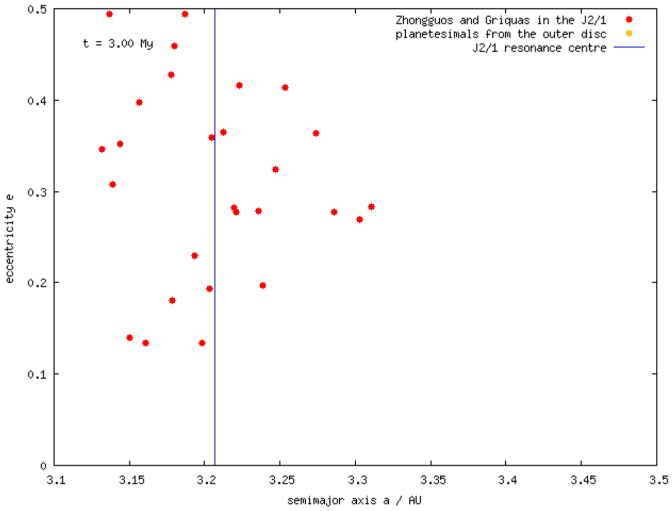
- almost no J3/2 bodies remain ⇒ must had been captured during the 1:2 crossing event (by chaotic capture) or after (by resonance sweeping)

Origin of J2/1 asteroids ← primordial:

original population



final population



- ∼ half of J2/1 orbits survive ⇒ 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}