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Ages of resonant families by means of (e, H) analysis

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ABSTRACT
We introduce a new method of age determination for asteroid families, based on the analysis of eccentricity vs absolute magnitude plot, which is similar to Vokrouhlický et al. (2006), but suitable for resonant asteroids, which are driven by the Yarkovsky effect and evolve mainly in eccentricity, not in semimajor axis, due to a strong coupling with Jupiter (Brož et al. 2008). We apply this method to two asteroid families located inside the J3/2 mean motion resonance; we obtain the age ??? Myr for the Schubart family and ??? Myr for the Hilda family.

We interpret the dispersion in semimajor axis as an imprint of the original velocity field after the disruption event, which gave rise to the family observed today. We compare it to a new-born Karin cluster.

We perform also collisional modelling of the J3/2 population by means of CoDDEM model (Bottke et al. 2005). The shallow size distributions of both asteroid families inside the J3/2 evolve quite slowly ??? and may persist for up to ??? Myr. This is in agreement with the dynamical results.

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Key words: celestial mechanics – minor planets, asteroids – methods: N-body simulations.

1 INTRODUCTION

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2 CURRENT ASTEROID POPULATION IN THE J3/2 RESONANCE

based on the previous paper Brož et al. (2008)

(a, H), (e, H) and (i, H) plots of families

'ears' (i.e., the concentration of small asteroids at the outskirts of the family and their depletion in the centre)

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3 MODELLING OF THE EVOLUTION IN THE (E, H) PLANE

???

for Hilda the dependence $\Delta e(\Delta a)$ is NOT so nice (purely linear) — some asteroids drift in a opposite sense — what does it mean?! What these orbits look like?

shall I perform averaging over 10 Myr, instead of 1 Myr?

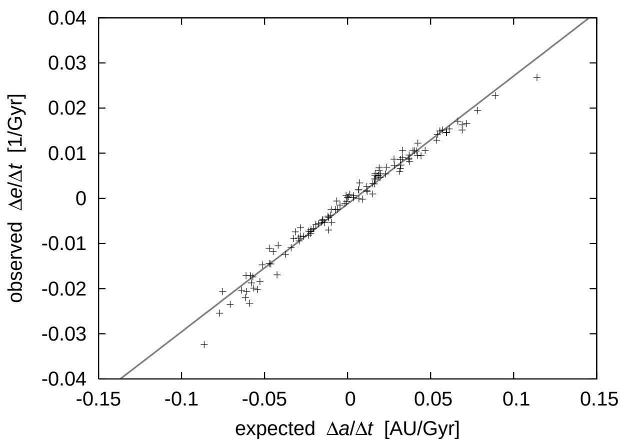

Figure 3. The Schubart family, fit $\left[\frac{\Delta e}{\Delta t}\right]_{\rm Gyr^{-1}} = (0.283 \pm 0.004) \left[\frac{\Delta a}{\Delta t}\right]_{\rm AU\cdot Gyr^{-1}} - (0.0012 \pm 0.0002)$???

4 VELOCITY FIELDS OF THE SCHUBART AND HILDA COMPARED TO KARIN

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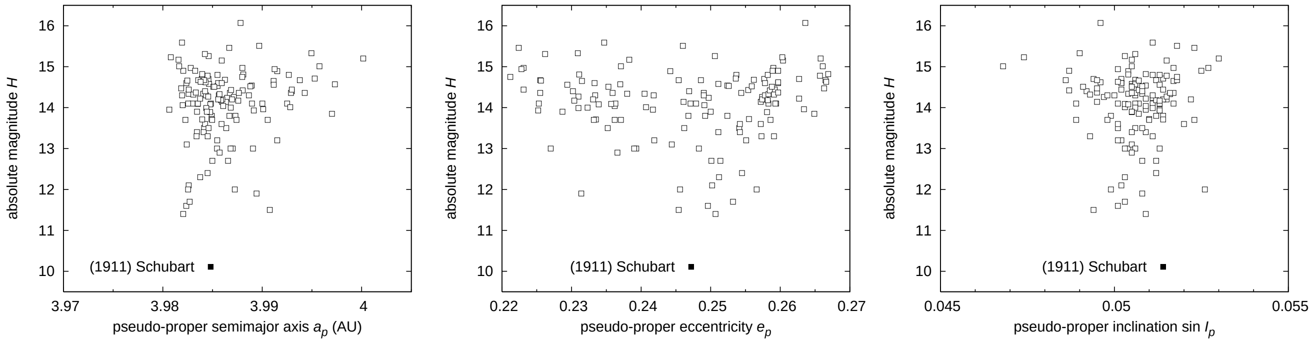

Figure 1. The Schubart family, 'ears' in the (e, H) plot are visible, but they are not as prominent as for the Hilda family (see Fig. 2), 139 members ???

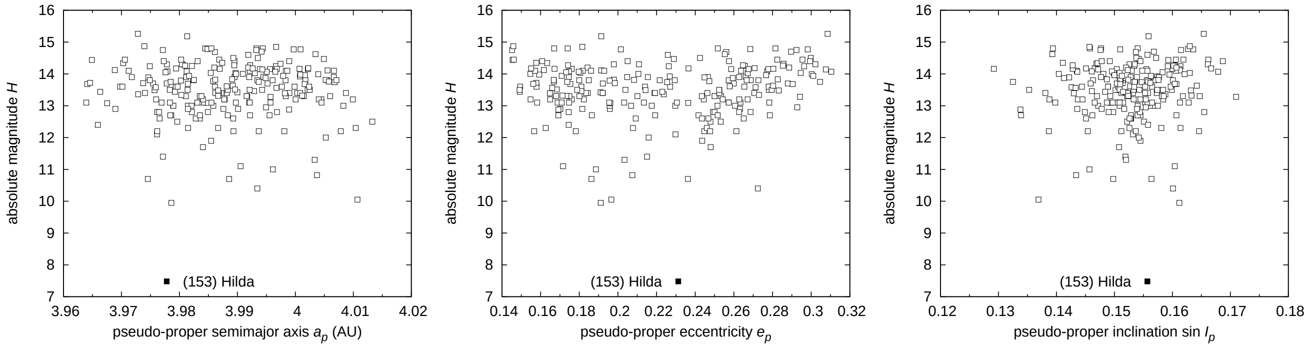

Figure 2. The Hilda family, 'ears' (i.e., the concentration of small asteroids at the outskirts of the family and their depletion in the centre) in (e, H) are very prominent here, 233 members ???

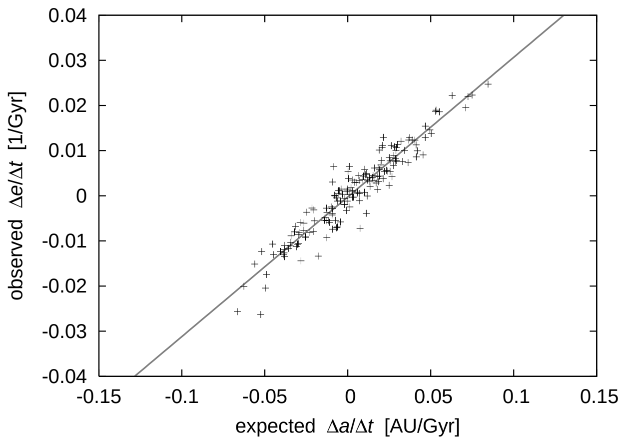

Figure 4. The Hilda family, fit $\left[\frac{\Delta e}{\Delta t}\right]_{\mathrm{Gyr}^{-1}} = (0.309 \pm 0.008) \left[\frac{\Delta a}{\Delta t}\right]_{\mathrm{AU\cdot Gyr}^{-1}} - (0.0003 \pm 0.0002)$???

$$\delta v = na\sqrt{\frac{5}{4}\left(\frac{\delta a}{a}\right)^2 + 2(\delta e^2) + 2(\delta \sin I)^2}$$

5 COLLISIONAL MODELS OF THE J3/2 POPULATION

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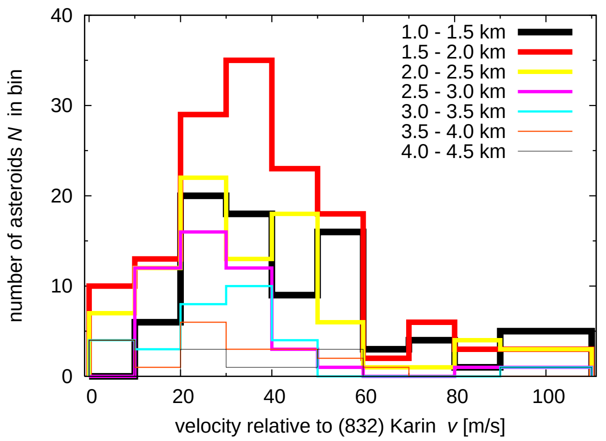

Figure 6. Karin cluster, histograms of velocities for 7 different bins in sizes D ???

6 CONCLUSIONS AND FUTURE WORK

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REFERENCES

This paper has been typeset from a TEX/ LATEX file prepared by the author.

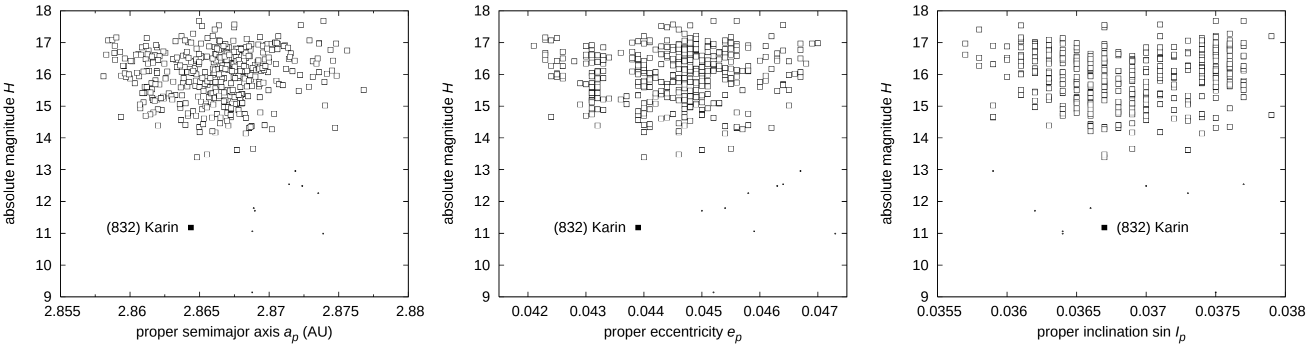

Figure 5. The Karin cluster, small dots are interlopers excluded from our analysis (this is based on an exceedingly large distance from Karin members on the (a, H) plot), 441 members ???

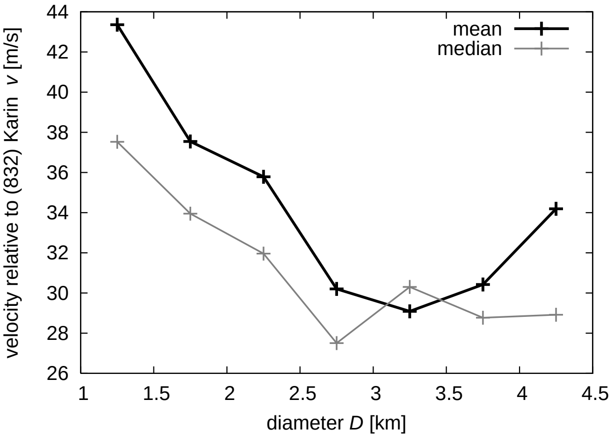

Figure 7. Karin cluster, mean and median velocity (relative to the asteroid (832) Karin for 7 different bins in sizes D) ???