

STARDUST

PUSHING THE BOUNDARIES OF
SPACE RESEARCH TO SAVE OUR FUTURE



The Hoffmeister asteroid family: the role of Ceres

Georgios Tsirvoulis

B. Novakovic, C. Maurel, Z. Knezevic

Overview

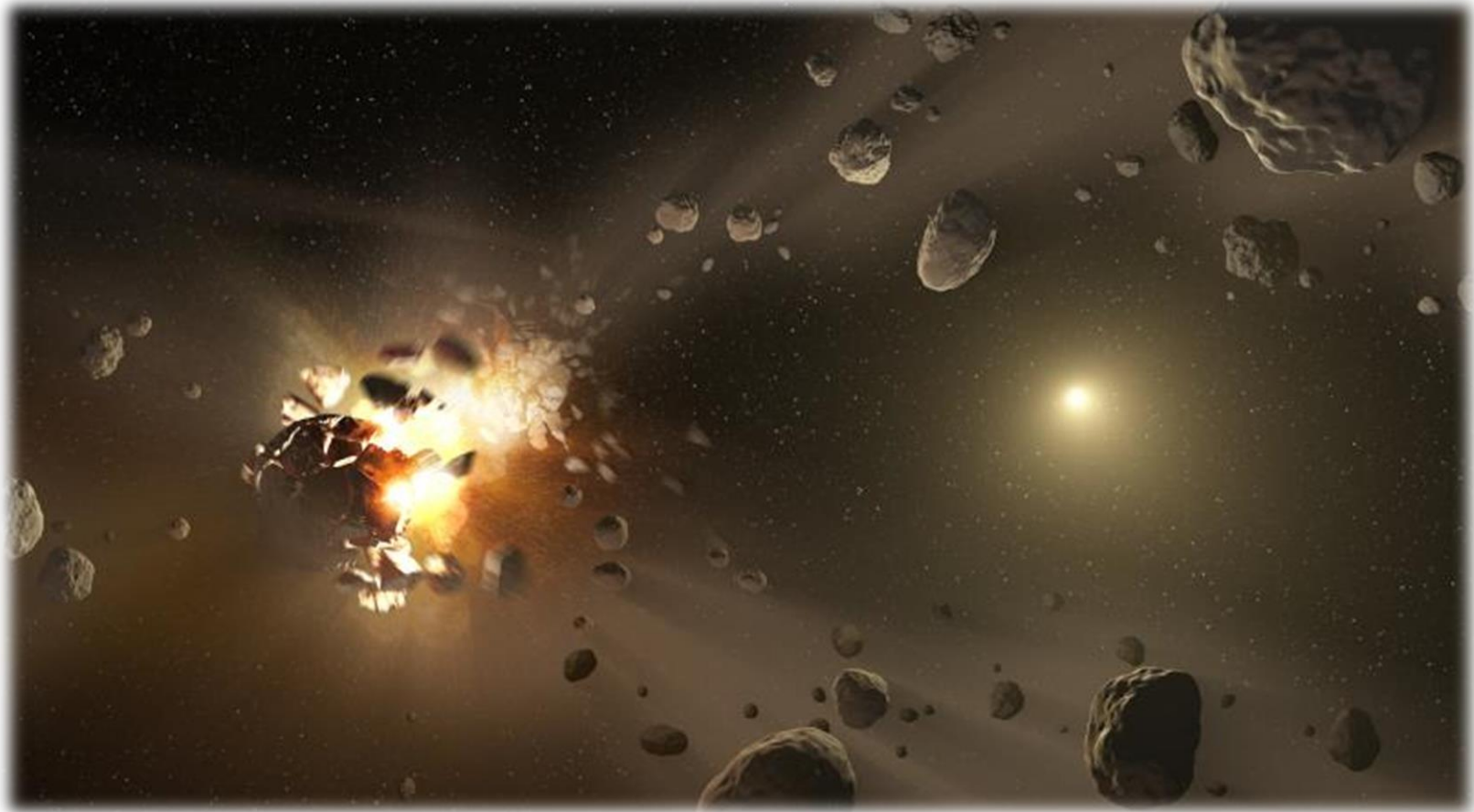
- Introduction
- Motivation
- Methods & Results
- Concluding remarks

Introduction

- What is an asteroid family?

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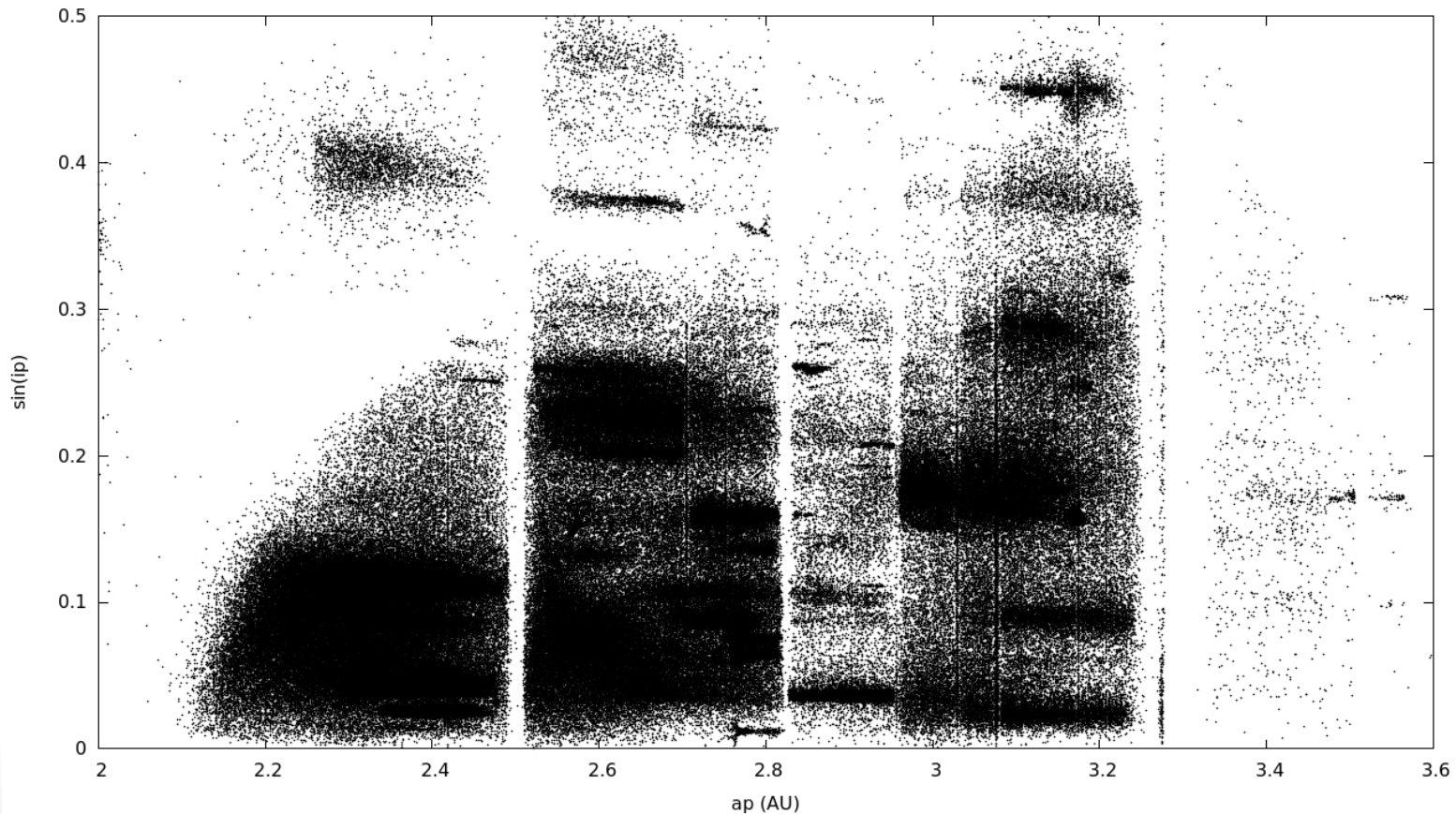


Introduction

- What is an asteroid family?
- Identified in the space of proper elements (Knezevic & Milani)

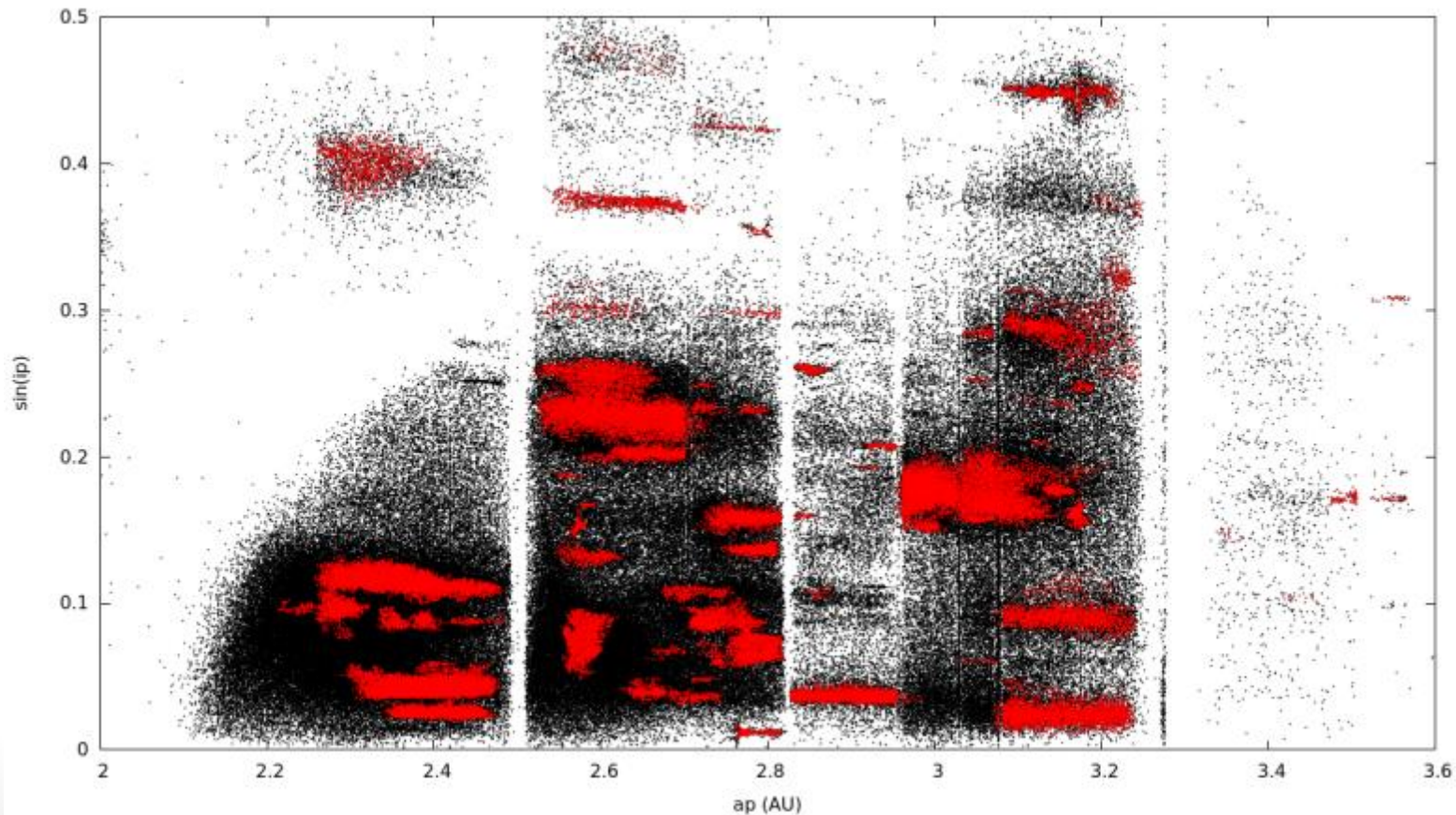
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- Identified in the space of proper elements (Knezevic & Milani) using the HCM (Zappala et al. 1990)



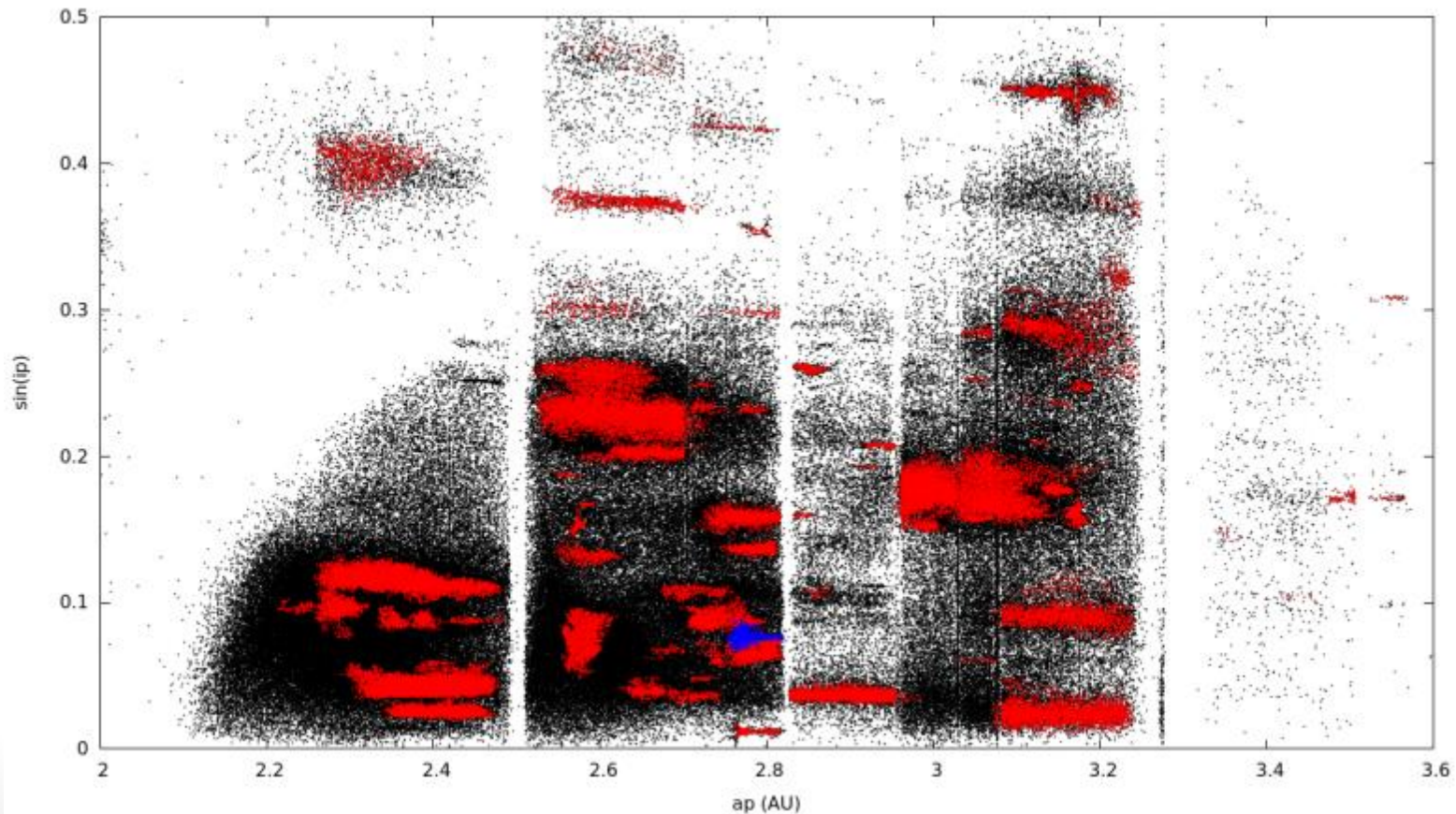
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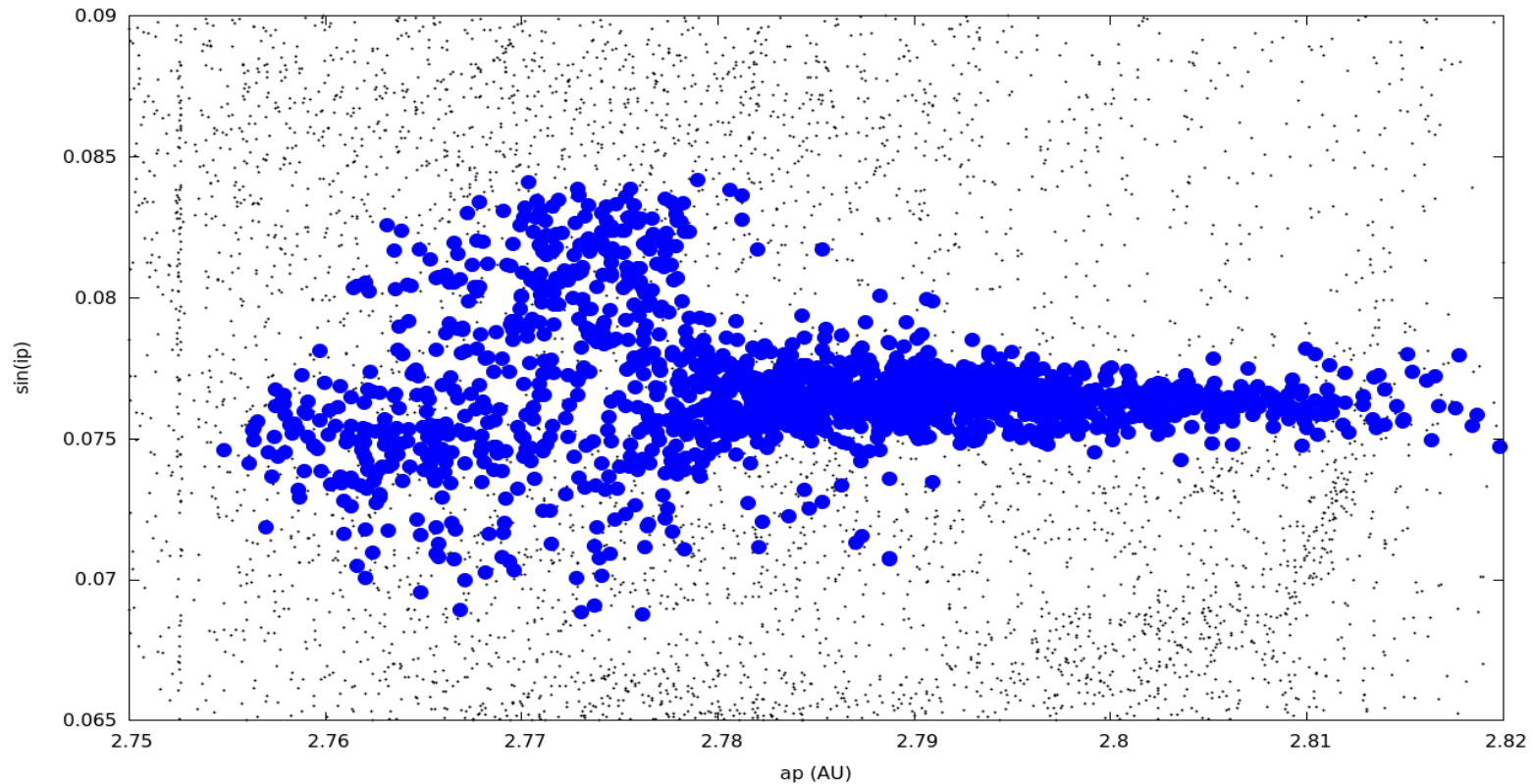


Introduction

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Motivation



- Asymmetric shape of the family in the a_p vs. $\sin(i_p)$ plane
- Yarkovsky is the causes evolution in a
- What causes the evolution in I of the left part?

Methods

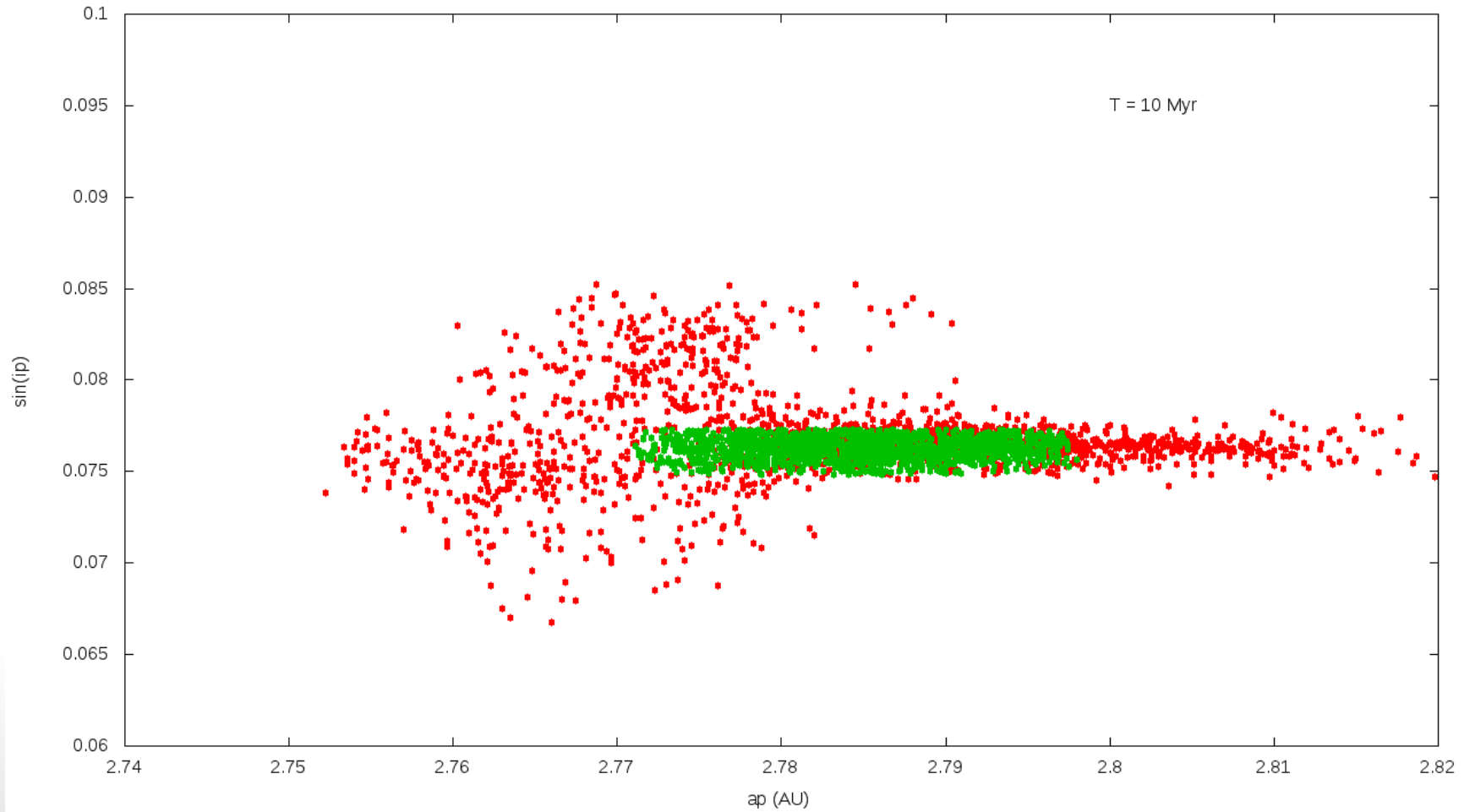
- We perform numerical simulations of fictitious family fragments

Methods

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 - ~1620 test particles
 - 4 giant planets as perturbers
 - Integrate for 300 Myrs (age estimated by Spoto et al. 2015)
 - Yarkovsky effect calibrated by WISE albedo data (Masiero et al. 2011)

Methods

- Evolution of the fragments:



Methods

- Result:
 - No evolution in inclination at all!

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 - TRY AGAIN!

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 - Still nothing...

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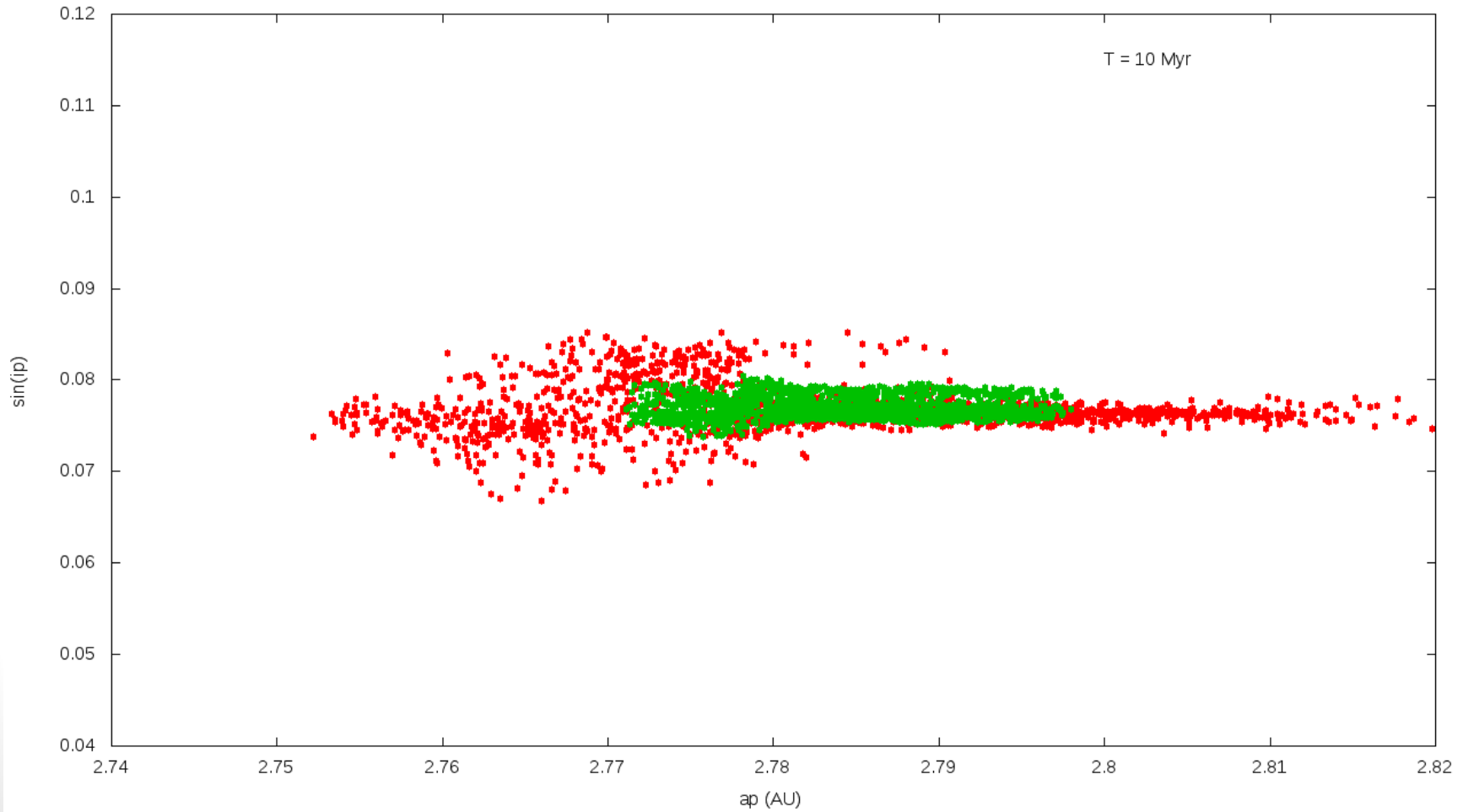
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 - 4 planets + **CERES**

Methods

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Results

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Results

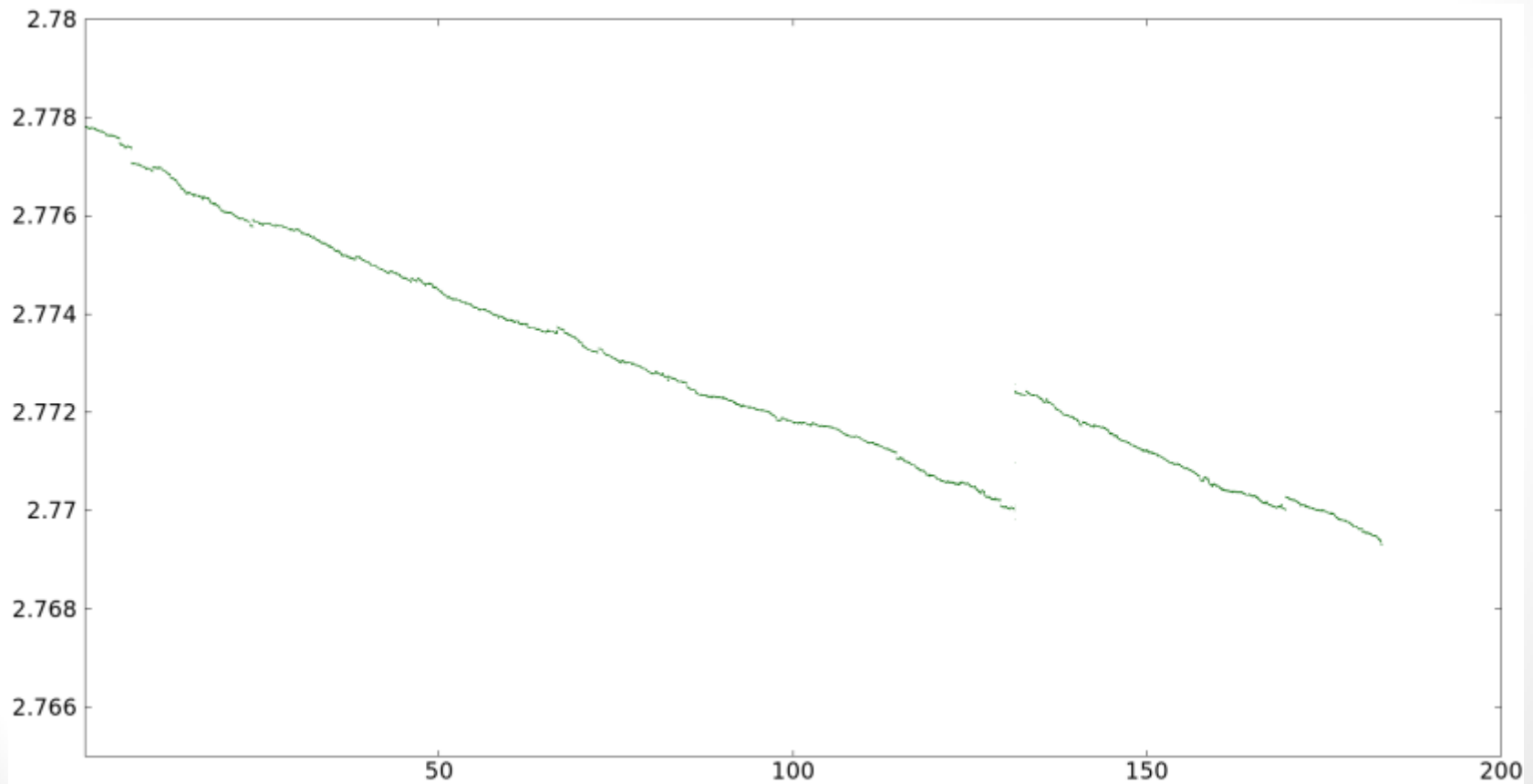
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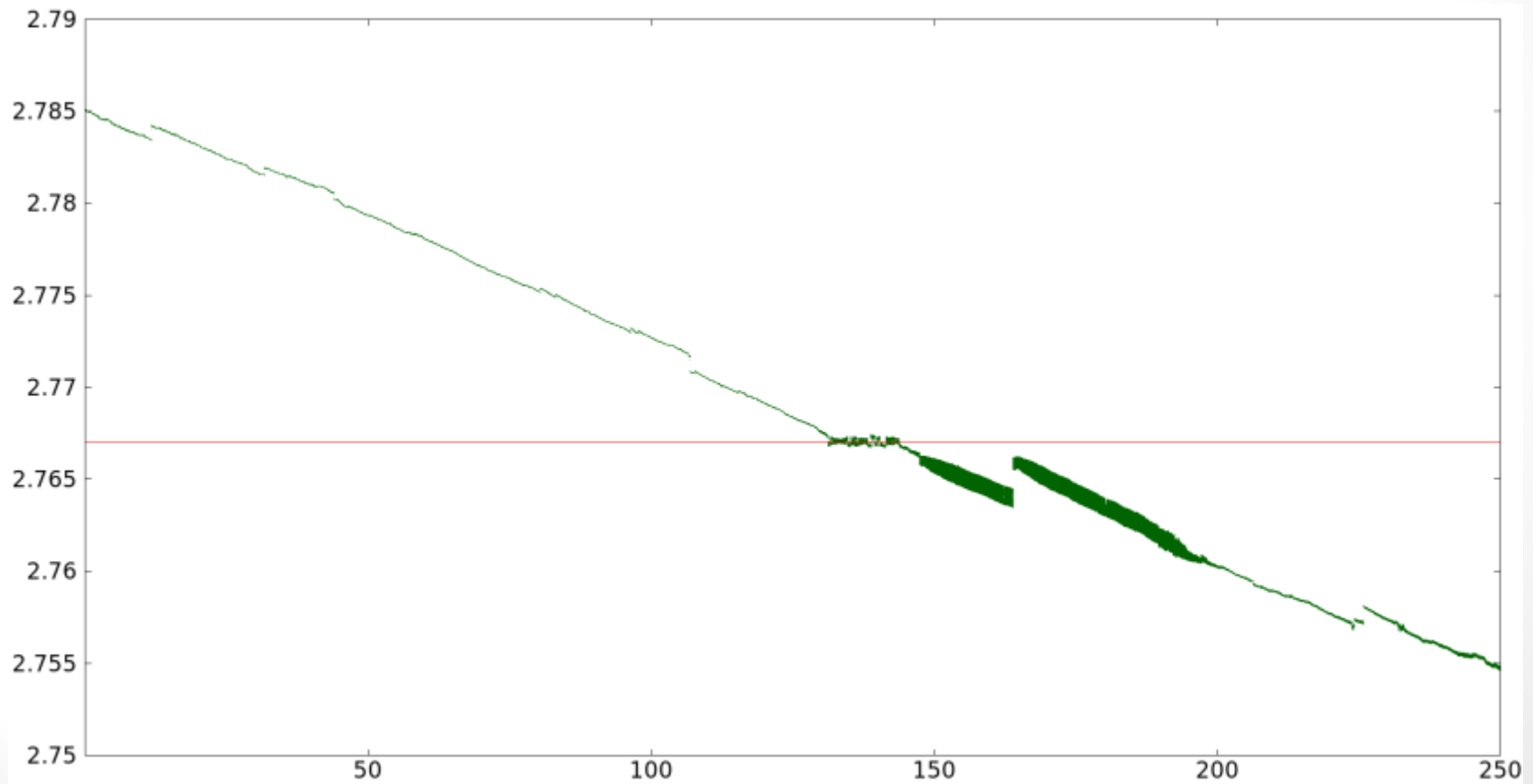
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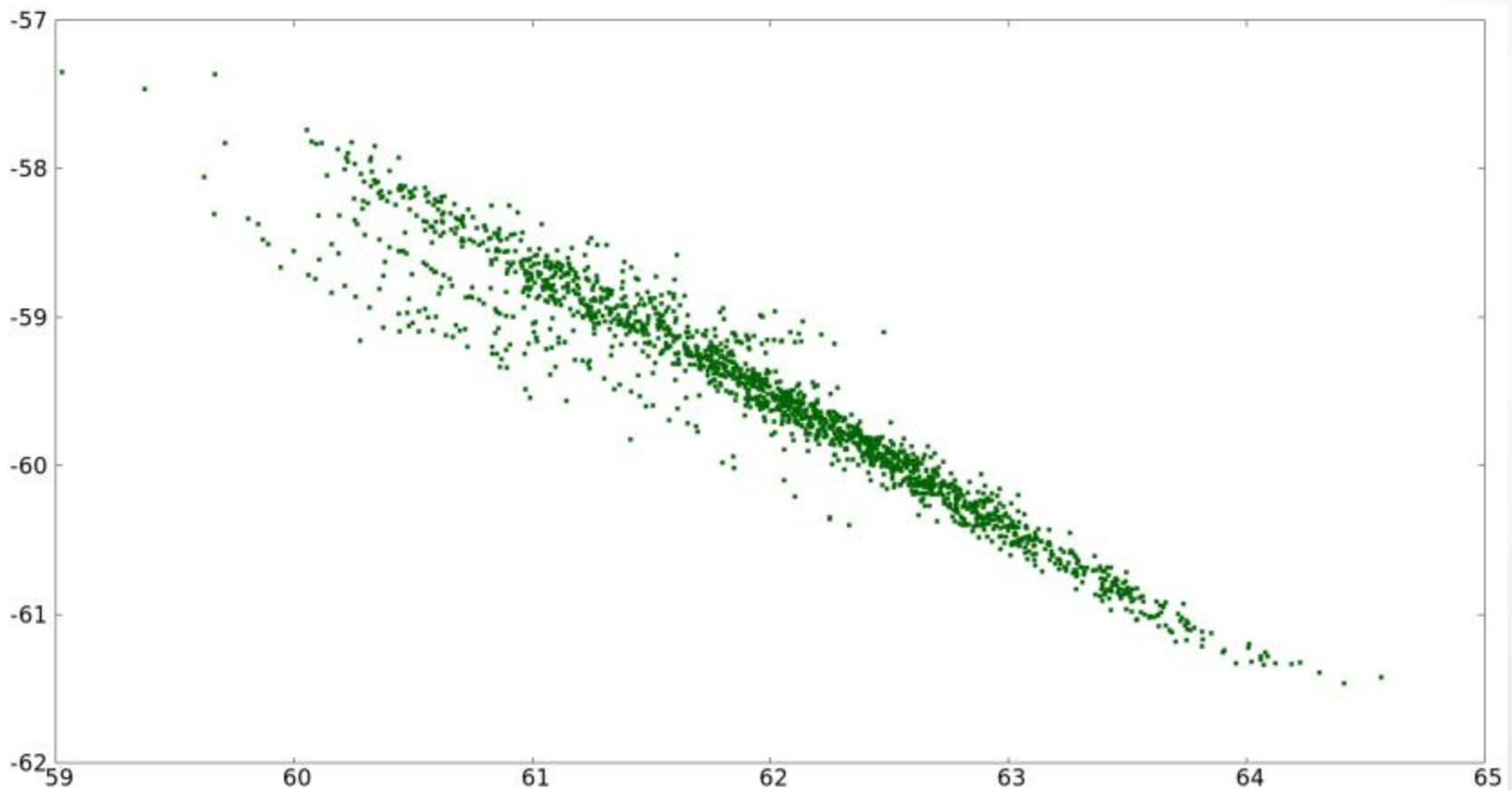
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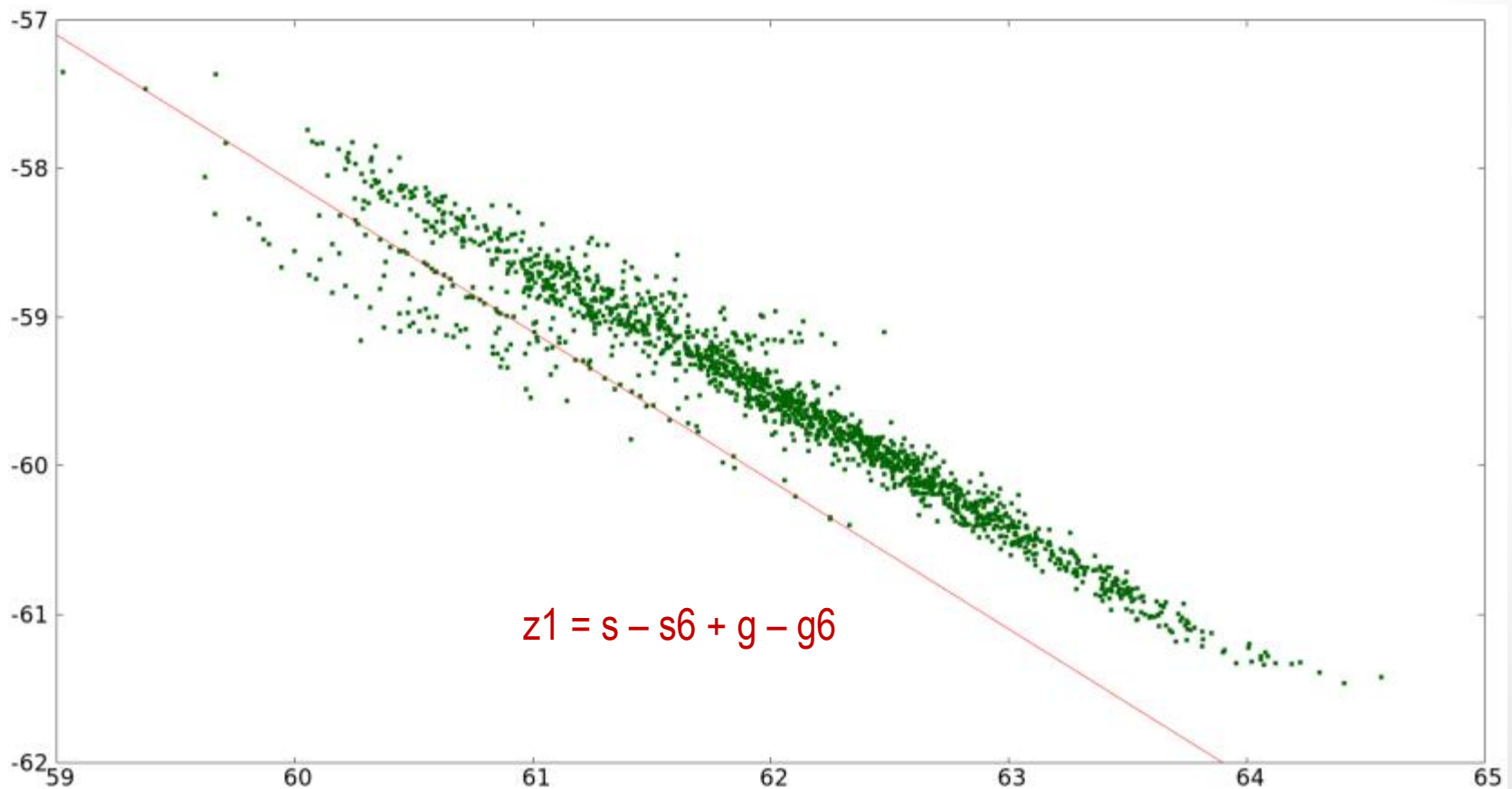
Proper frequencies of the test particles:



Results

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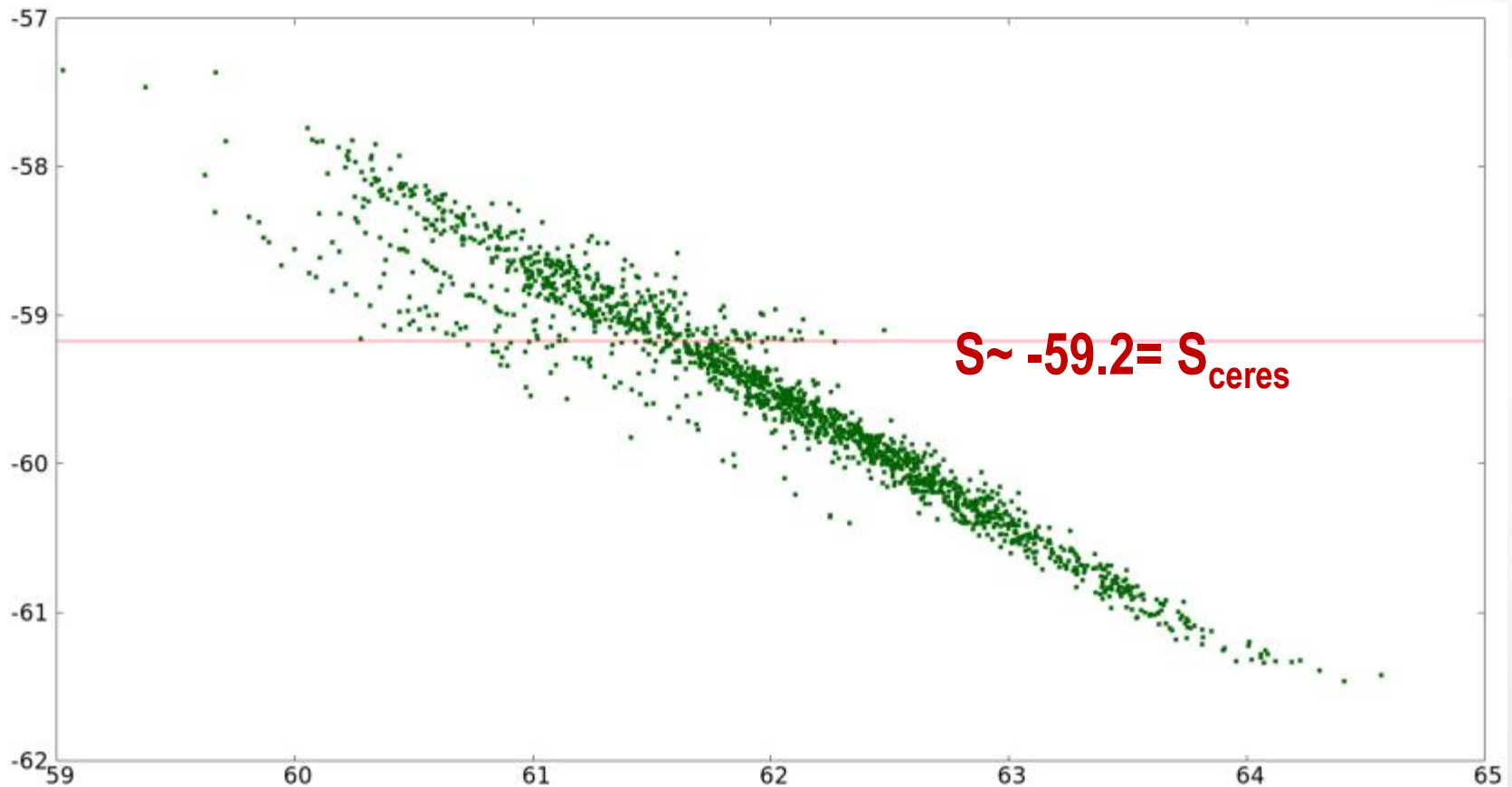
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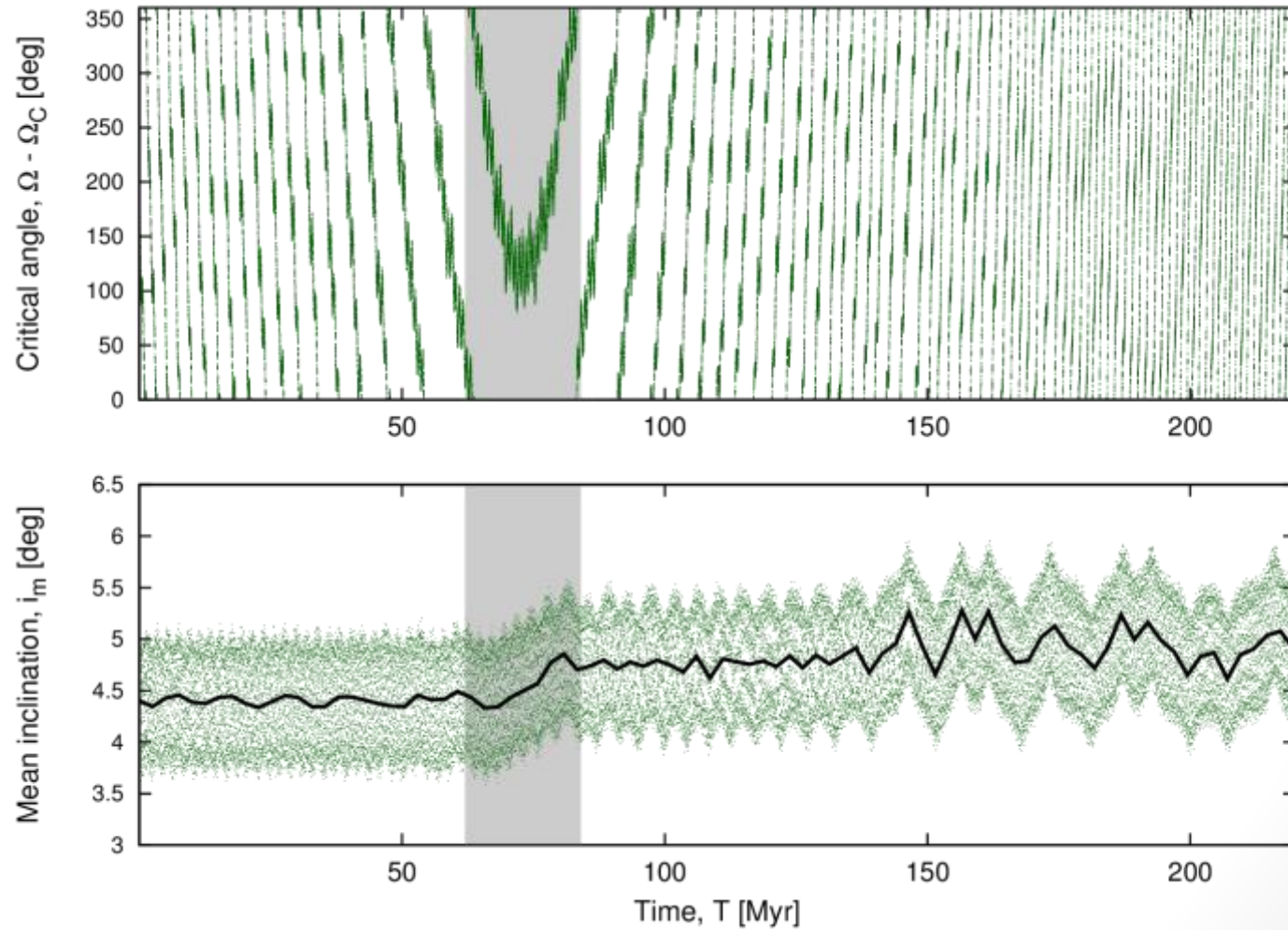


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 - Let's draw the frequency space
 - Could a secular resonance with Ceres be responsible for the jump in i ?

Results

- Could a secular resonance with Ceres do the trick?



Conclusions

- The linear nodal secular resonance with Ceres (S-Sc) is responsible for the asymmetrical distribution of the Hoffmeister family fragments

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The Astrophysical Journal Letters, Volume 807, Issue 1, article id. L5, 5 pp. (2015).

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- More asteroid families with similar characteristics verify the mechanism
- Secular resonances with massive asteroids are important for the dynamical evolution of smaller asteroids

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Thank you