

# Source regions for near-Earth objects

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in collaboration with

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BACKGROUND


# Efficiency equation

$$n(a, e, i, H) = \varepsilon(a, e, i, H) N(a, e, i, H)$$


observed  
population (*this is  
what we see*)



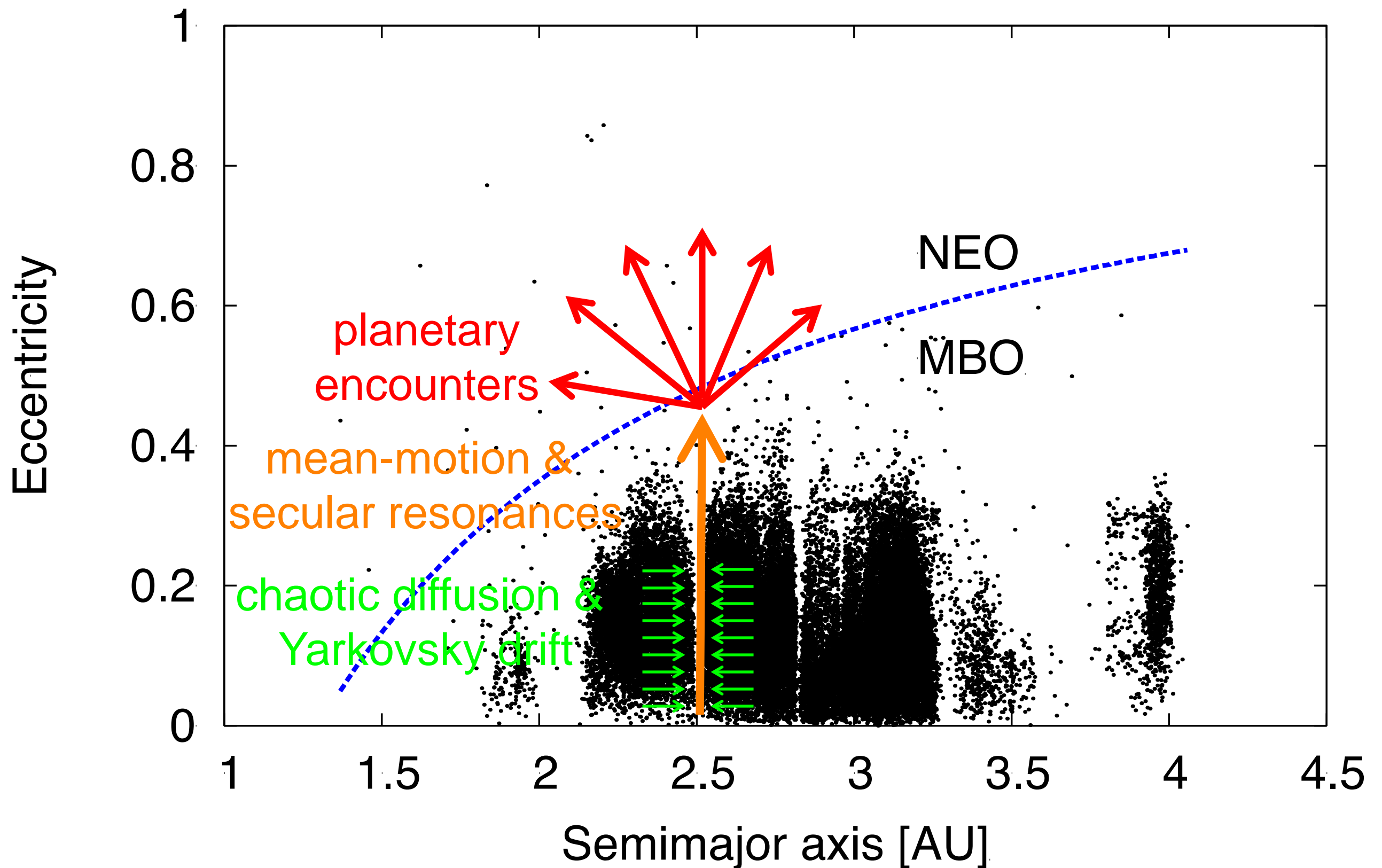
discovery  
efficiency  
(*this is  
estimated  
numerically  
for each  
survey*)



true population  
(*this is what we  
want to know*)

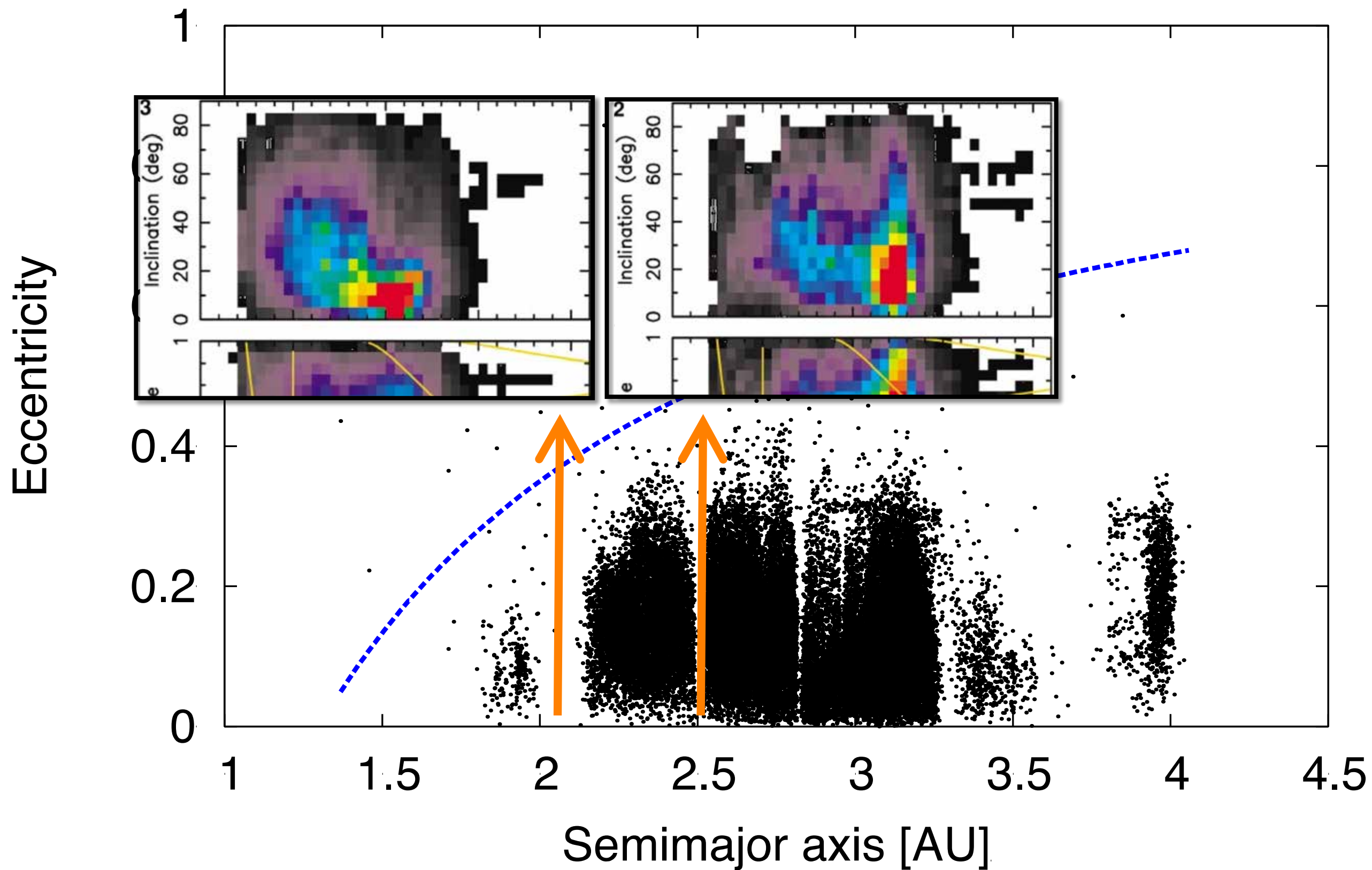


# Known asteroids with $D > 3\text{km}$



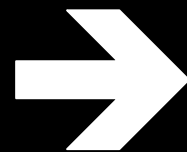


# Known asteroids with $D > 3\text{km}$



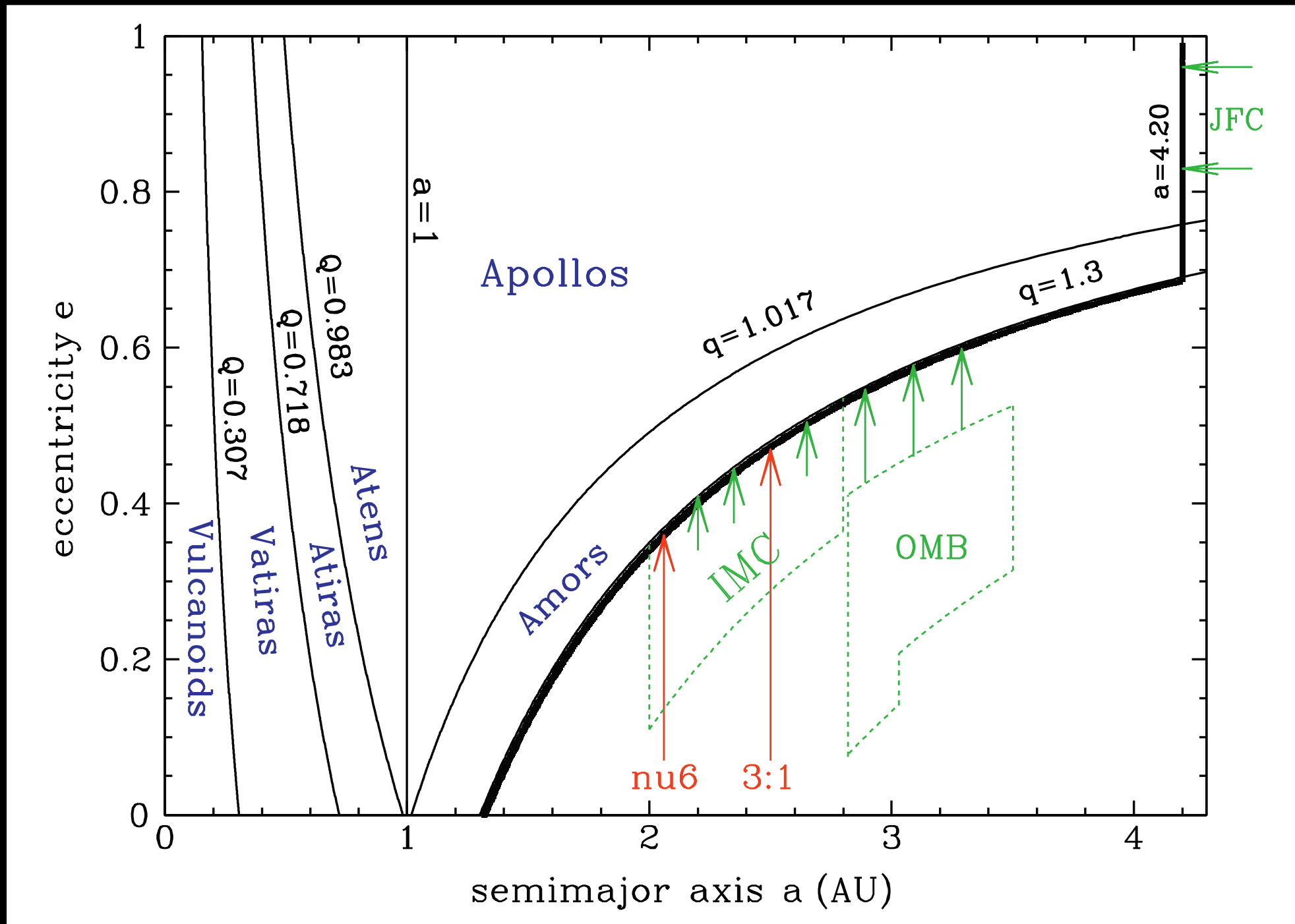
# Modification of the Bottke approach (to source-dependent SFD):

$$n(a, e, i, H) = \varepsilon(a, e, i, H) N(H) \sum_{i=1}^{N_S} f_i R_i(a, e, i)$$



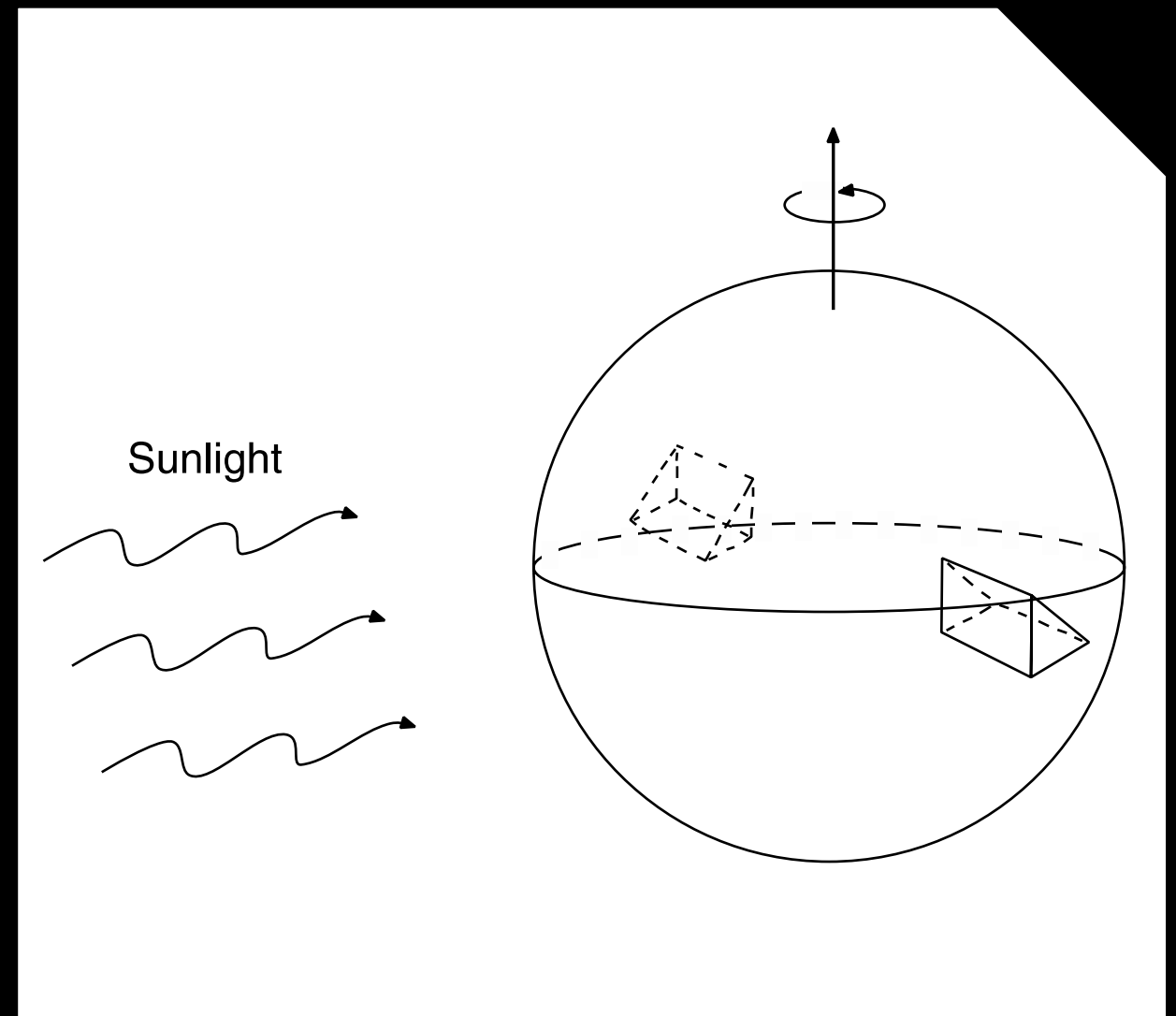
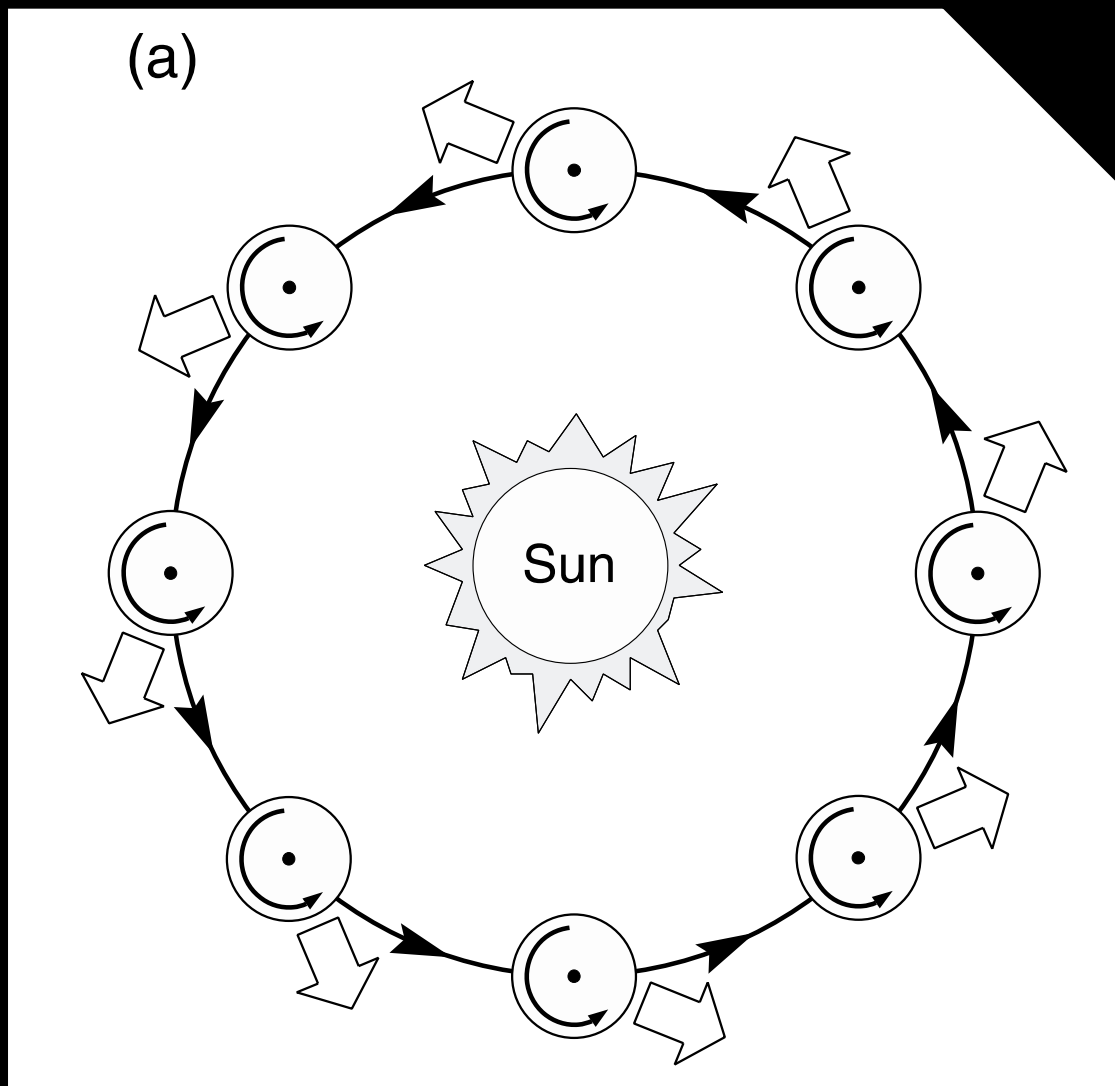
$$n(a, e, i, H) = \varepsilon(a, e, i, H) \sum_{i=1}^{N_S} f_i N_i(H) R_i(a, e, i)$$

# Initial conditions for orbital integrations used by Bottke et al.



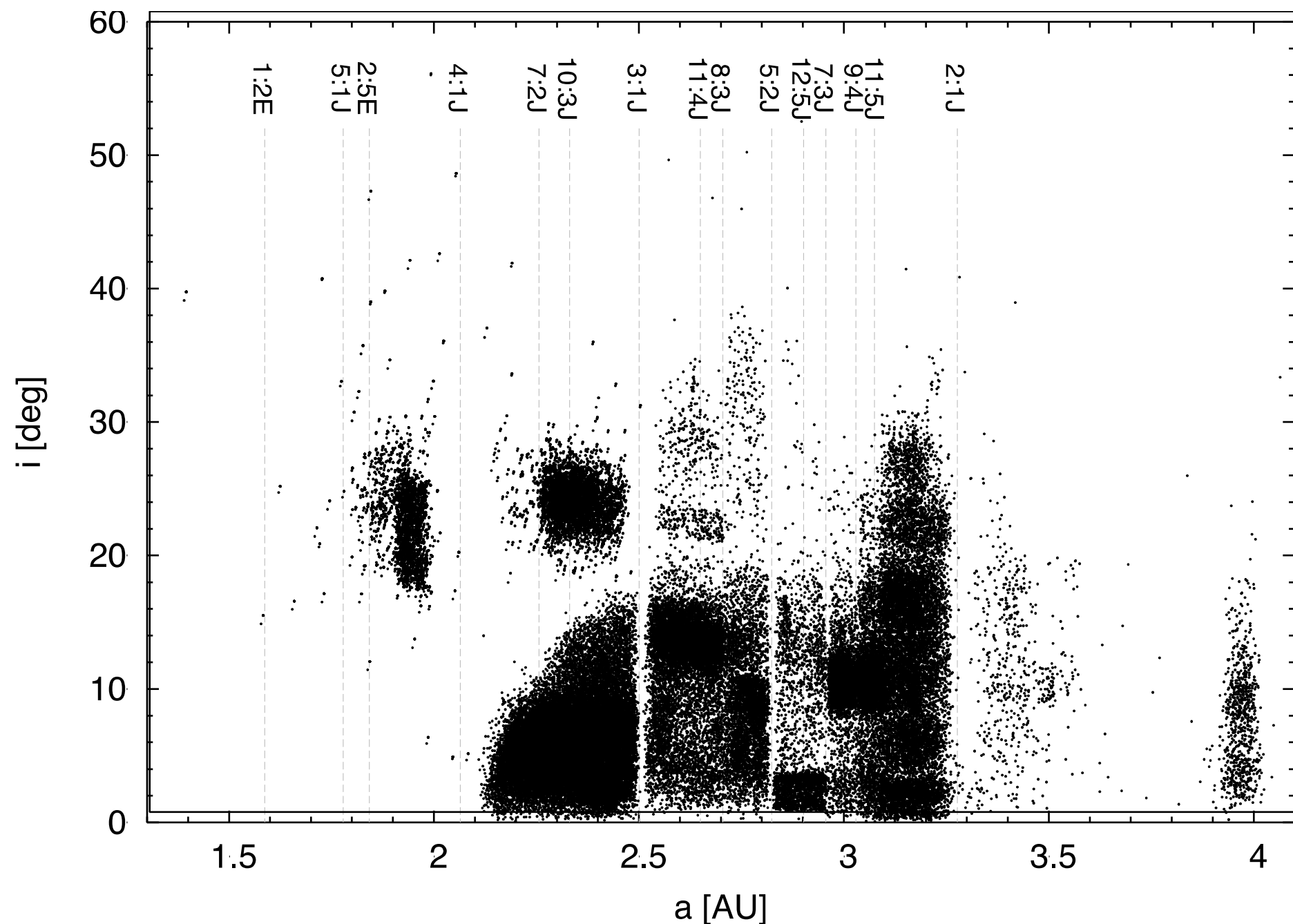
Greenstreet et al. (2012)

# Yarkovsky & YORP thermal forces



ALL RELEVANT  
NEO SOURCE REGIONS IN THE  
MAIN ASTEROID BELT  
&  
REALISTIC INITIAL  
CONDITIONS FOR RESIDENCE-  
TIME INTEGRATIONS

# Initial conditions for orbital integrations



Ratio of small vs large MBOs

$$\frac{N(14.5 < H < 15)}{N(H < 14)}$$

6  
5  
4  
3  
2  
1  
0

1.5

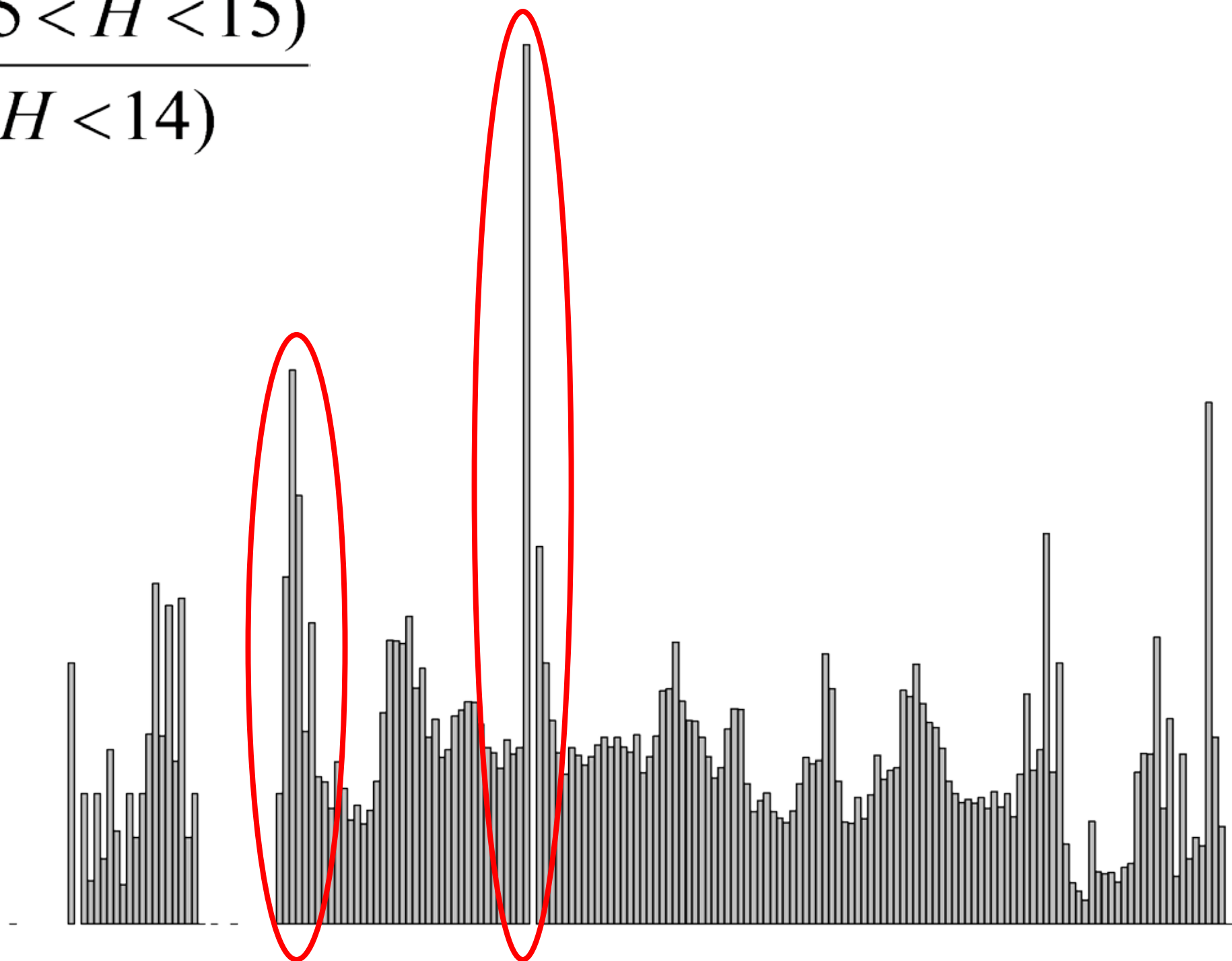
2.0

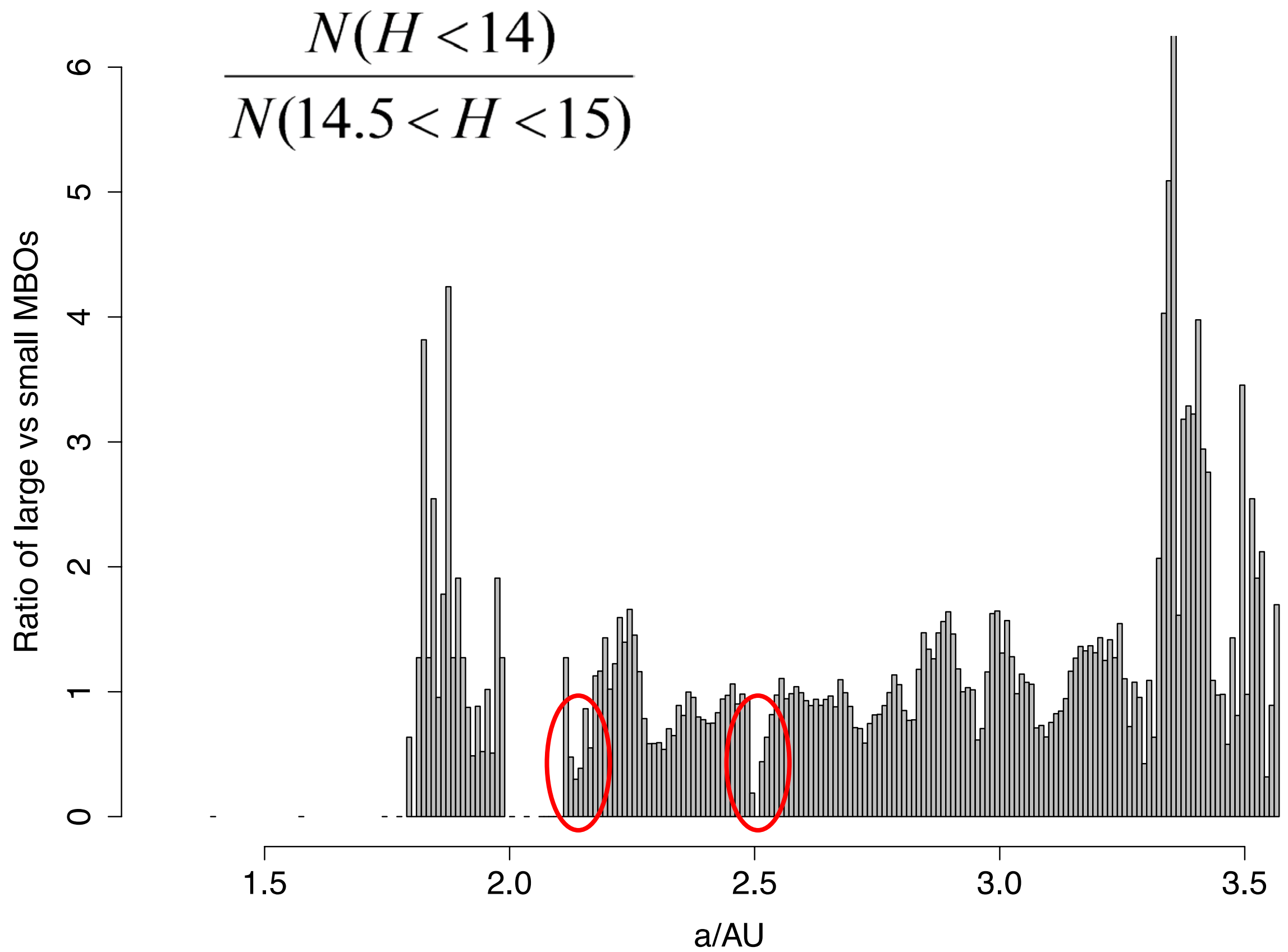
2.5

3.0

3.5

$a/\text{AU}$

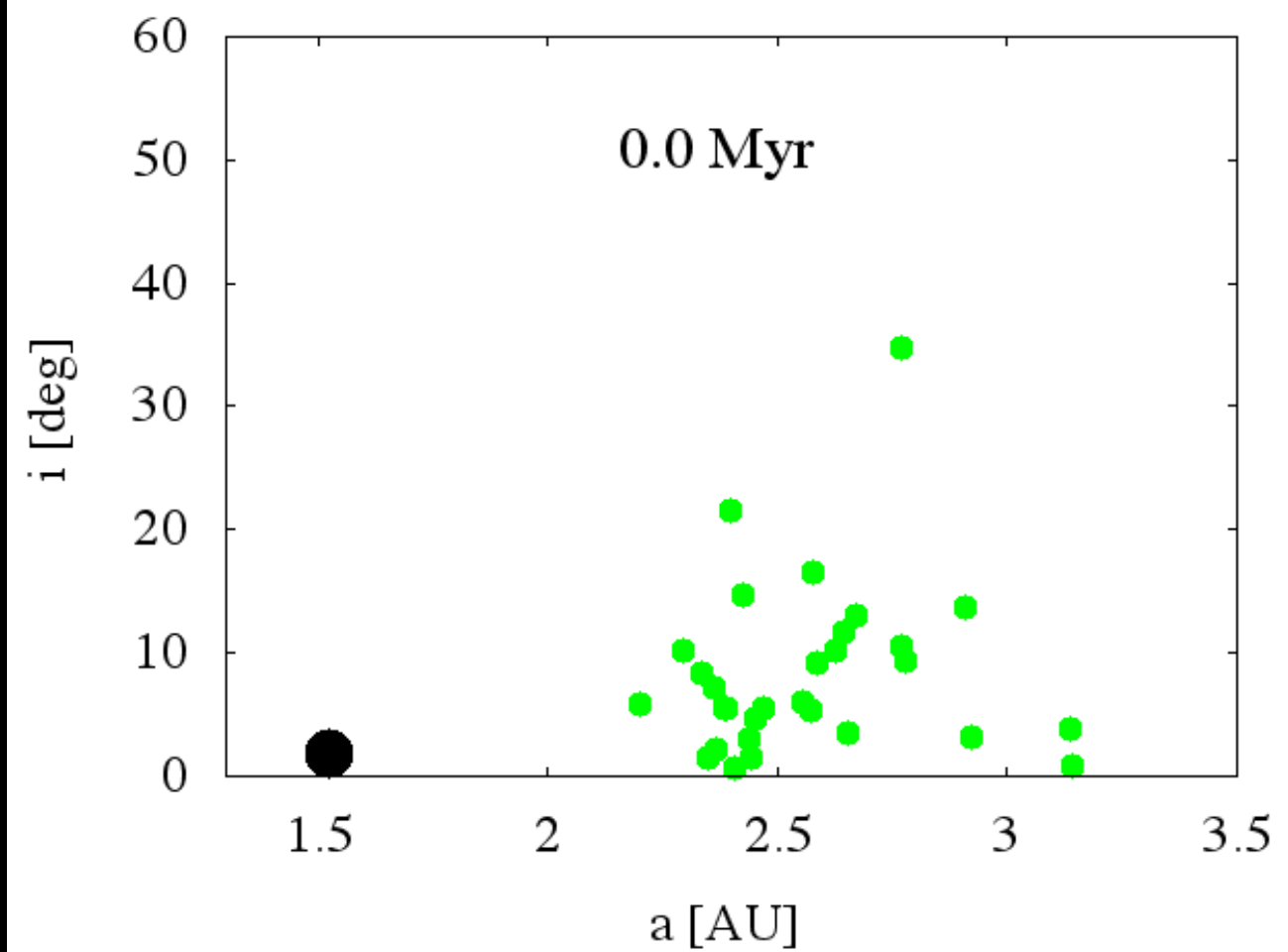
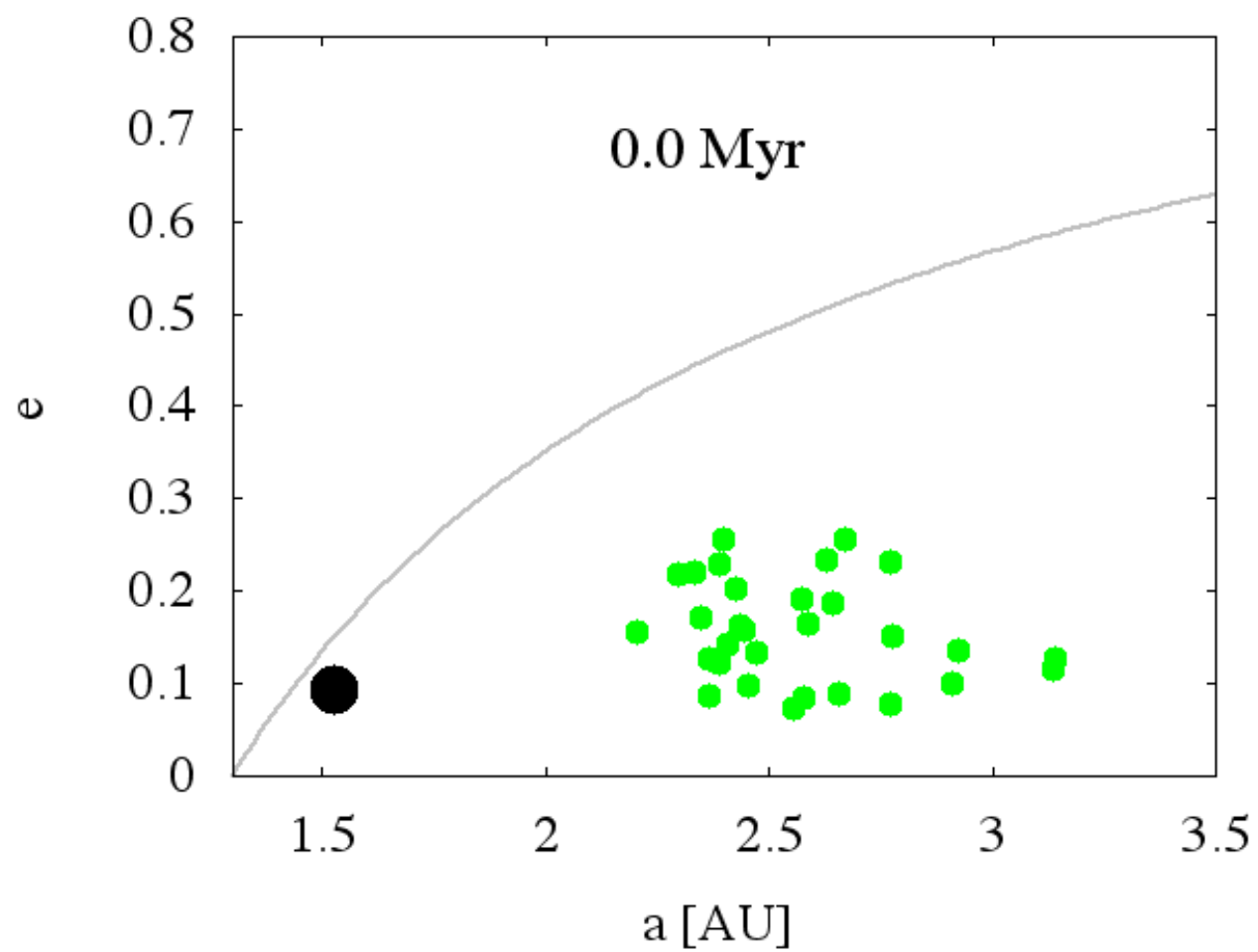






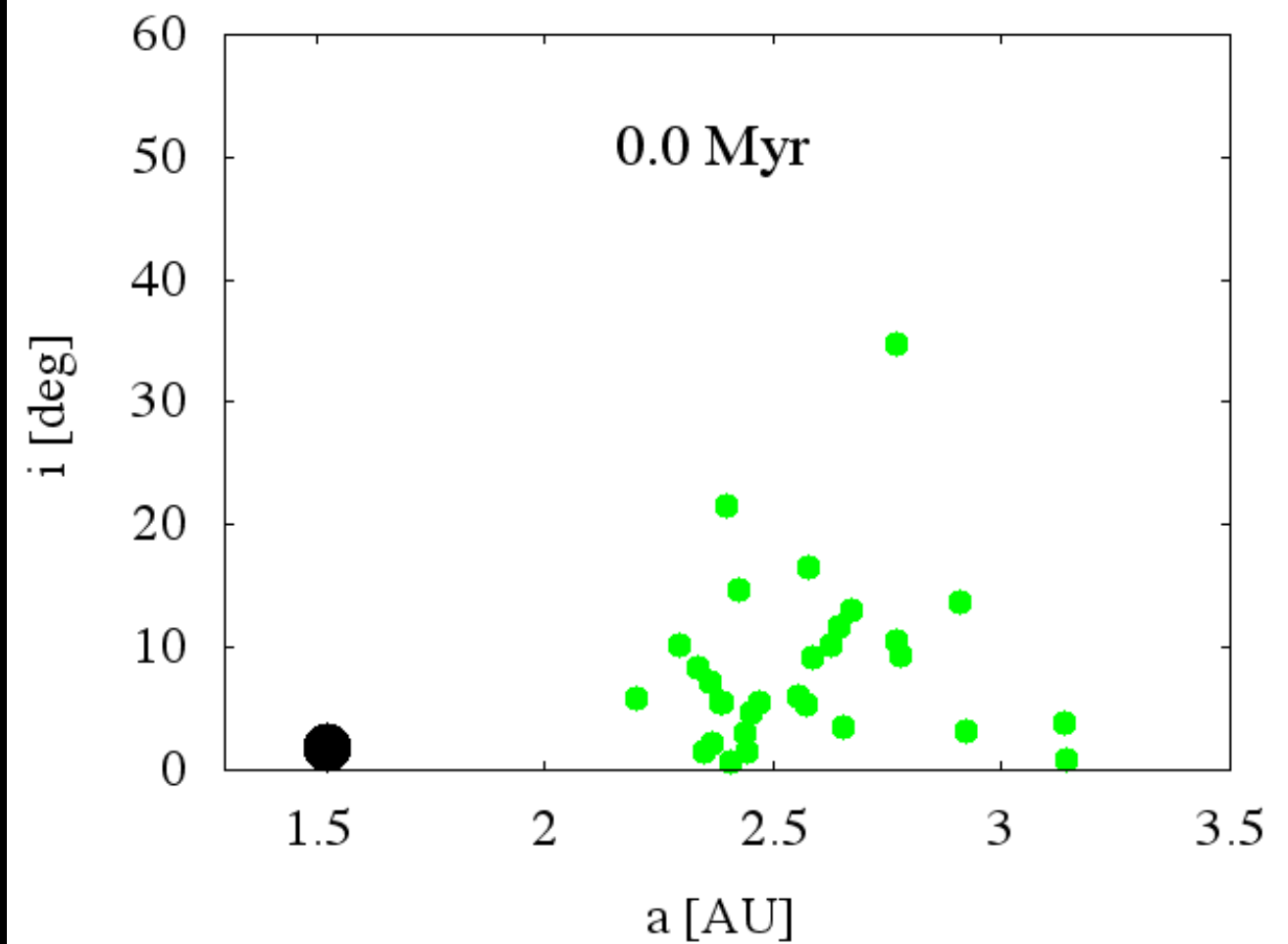
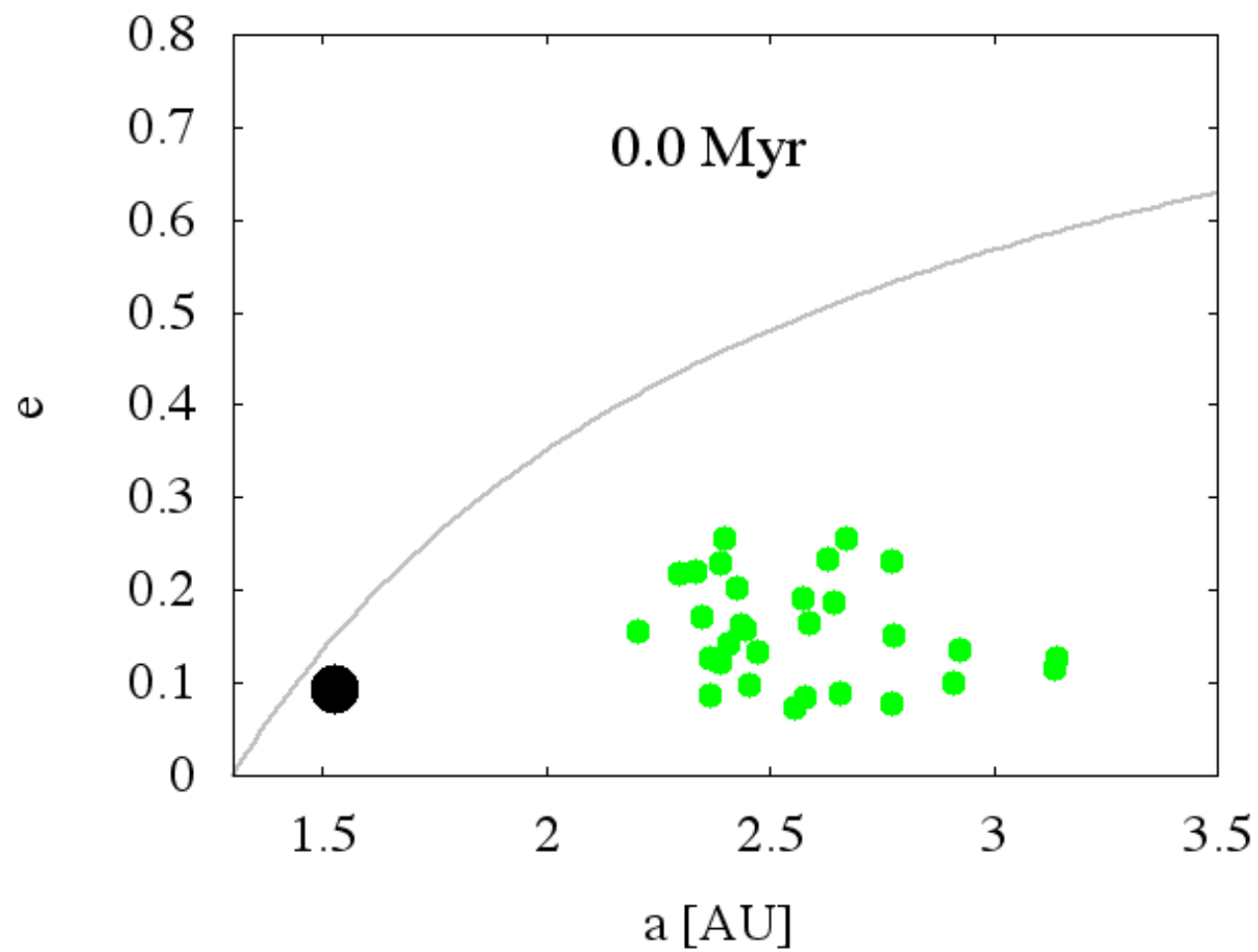
# MB integrations

$D=0.1\text{ km}$

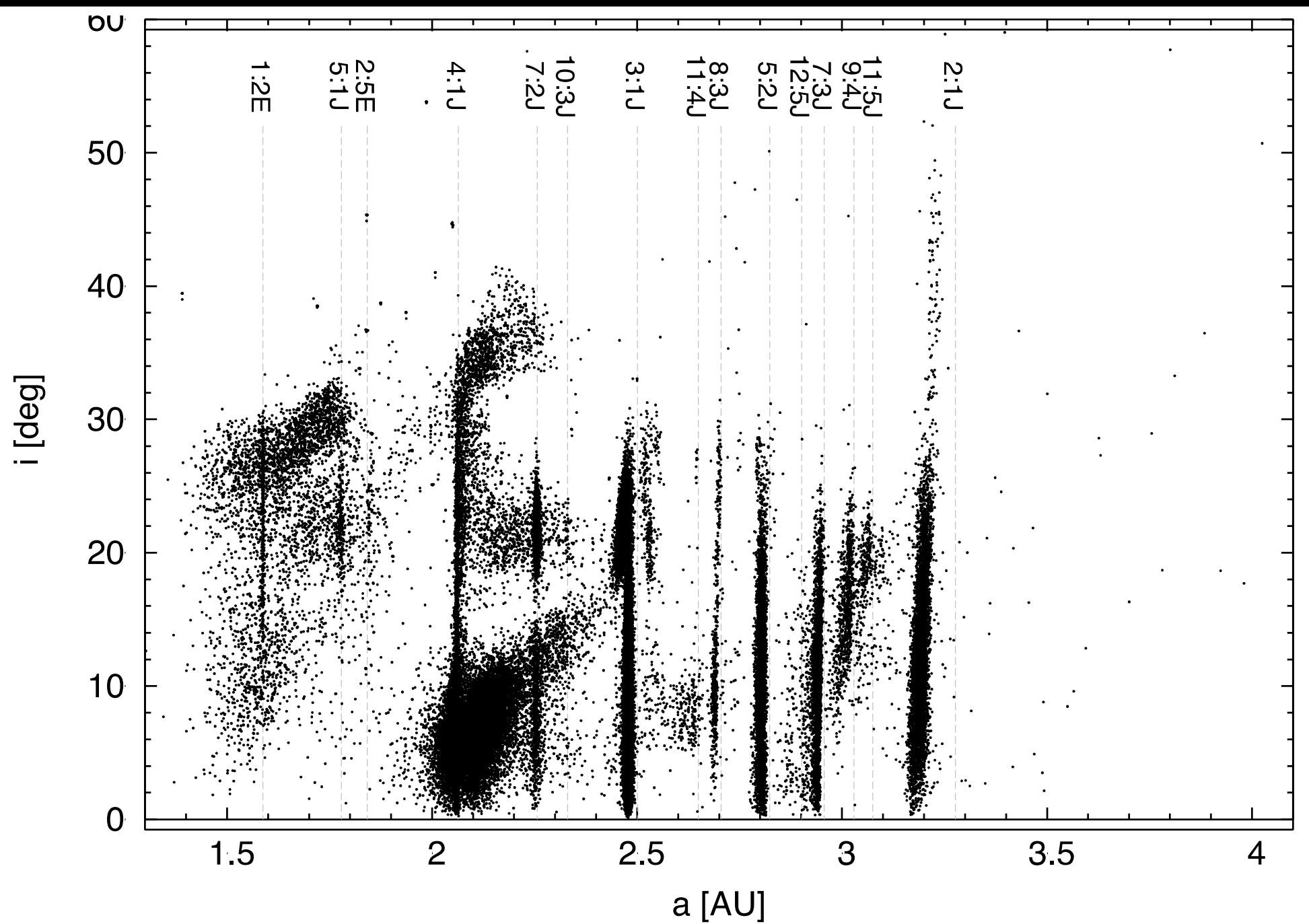


# MB integrations

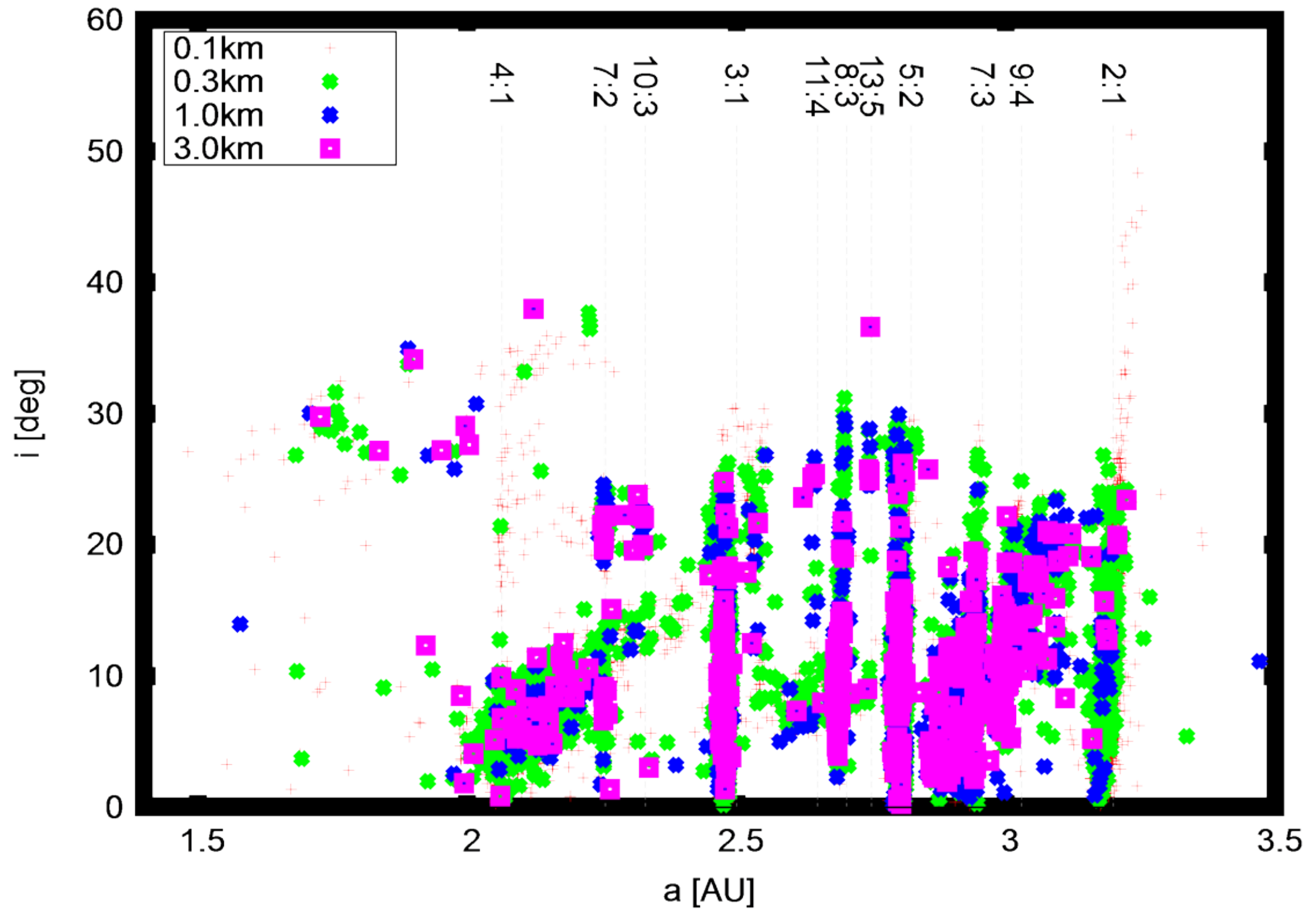
$D=0.1\text{ km}$



# Orbital elements when entering the NEO region

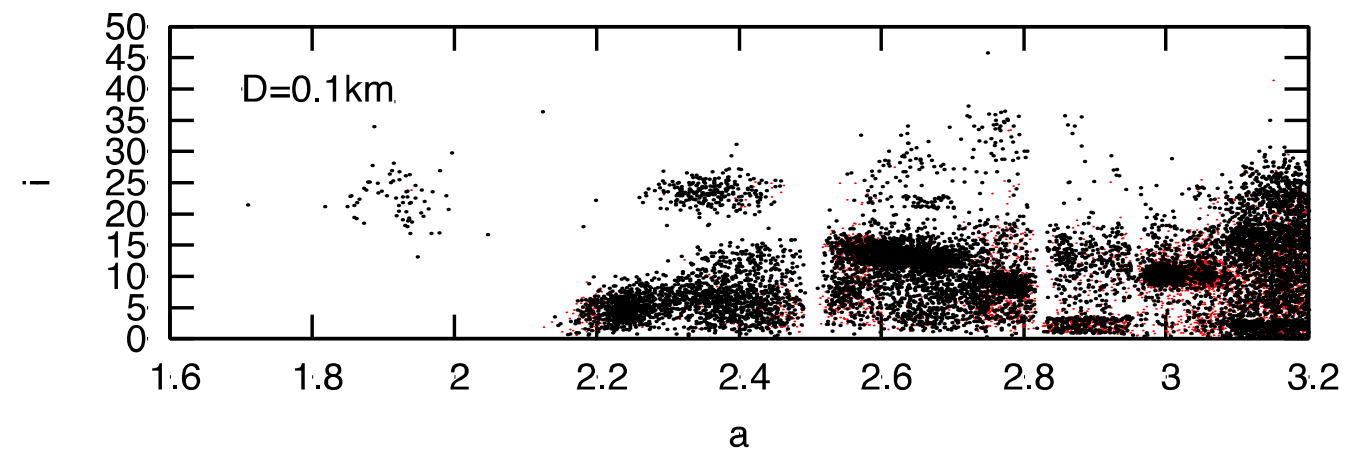
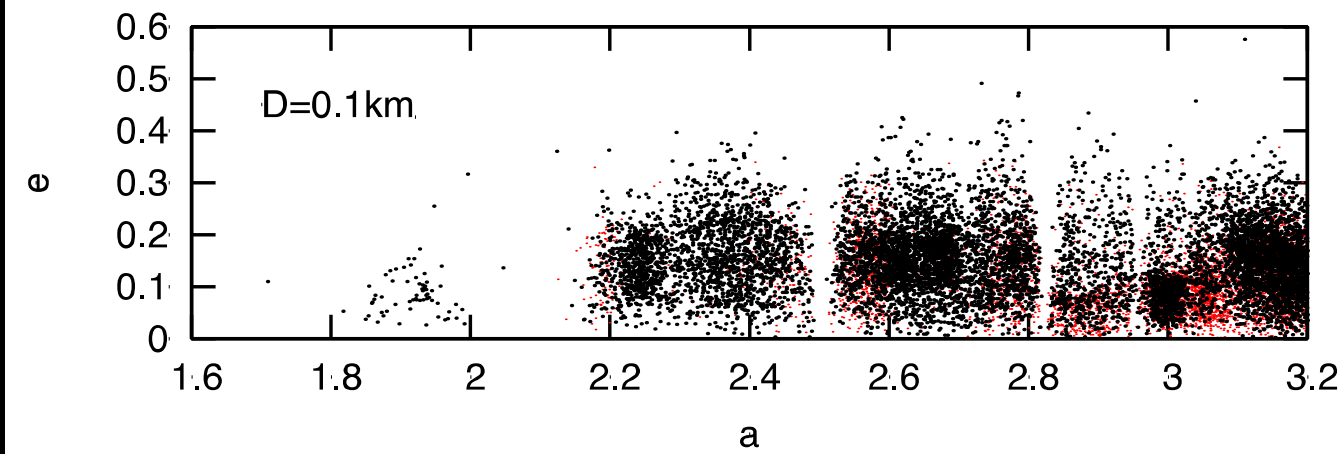
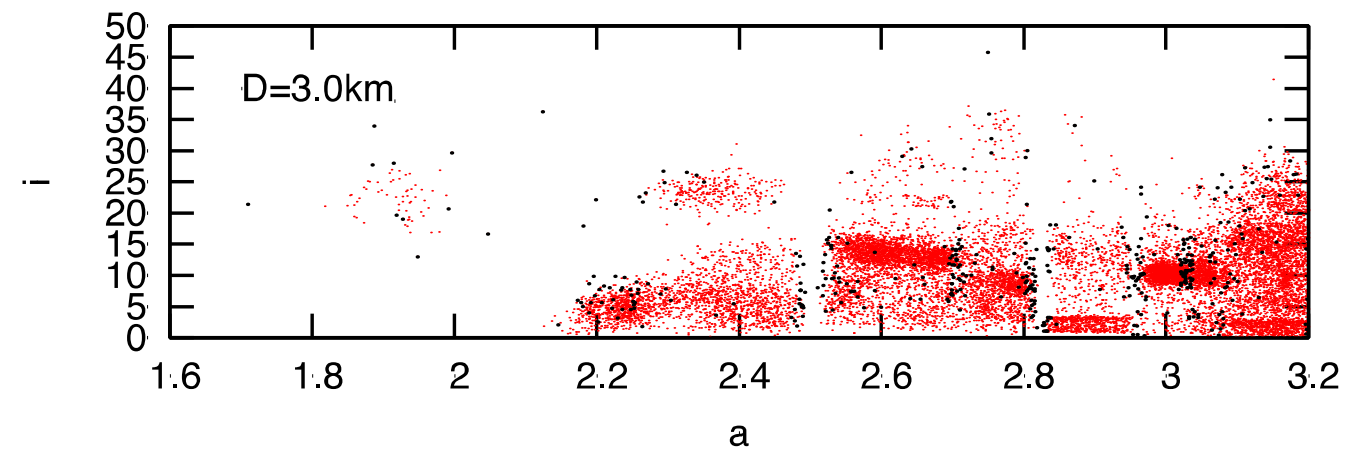
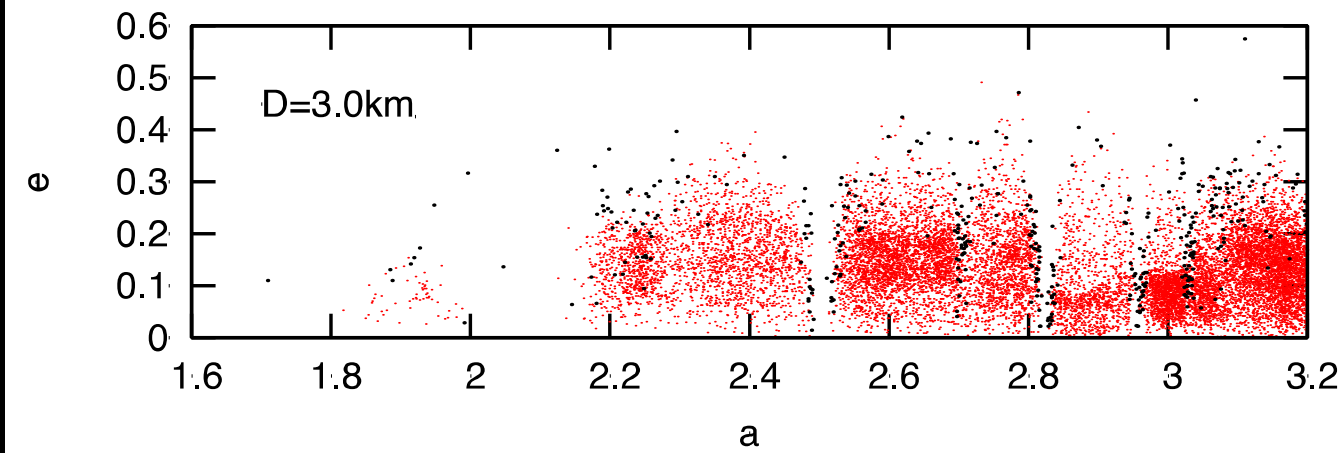


# NEO sources as a function of semimajor-axis drift rate

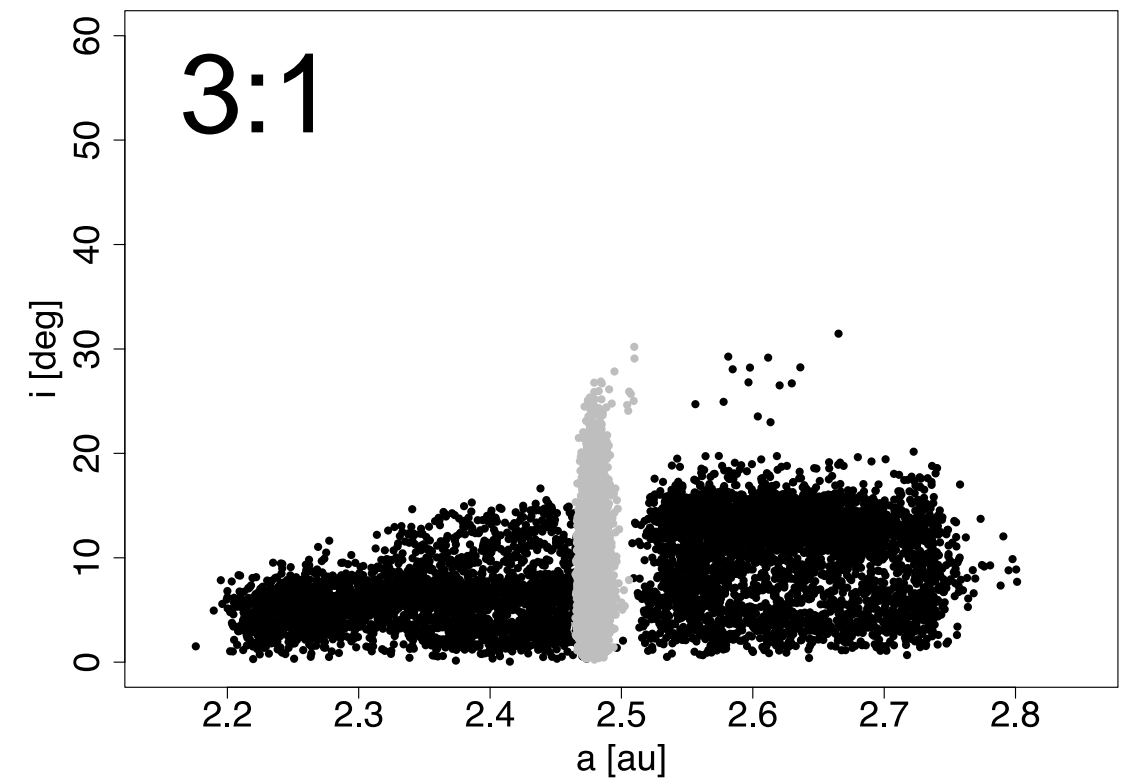
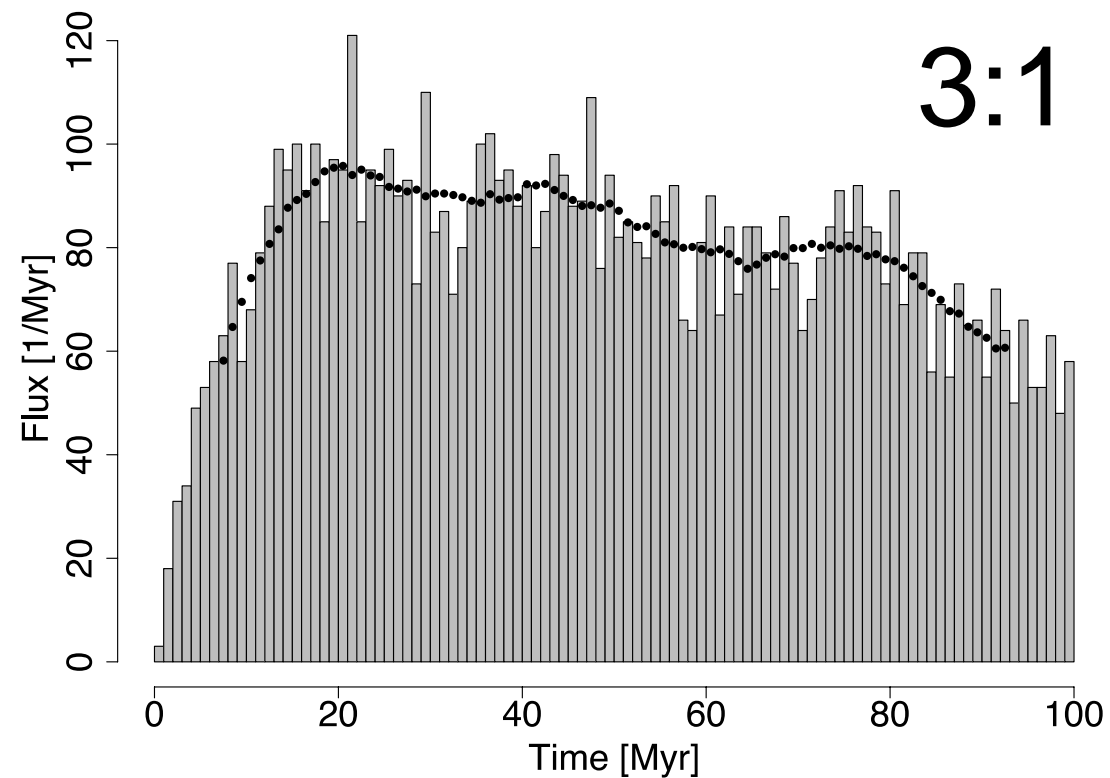
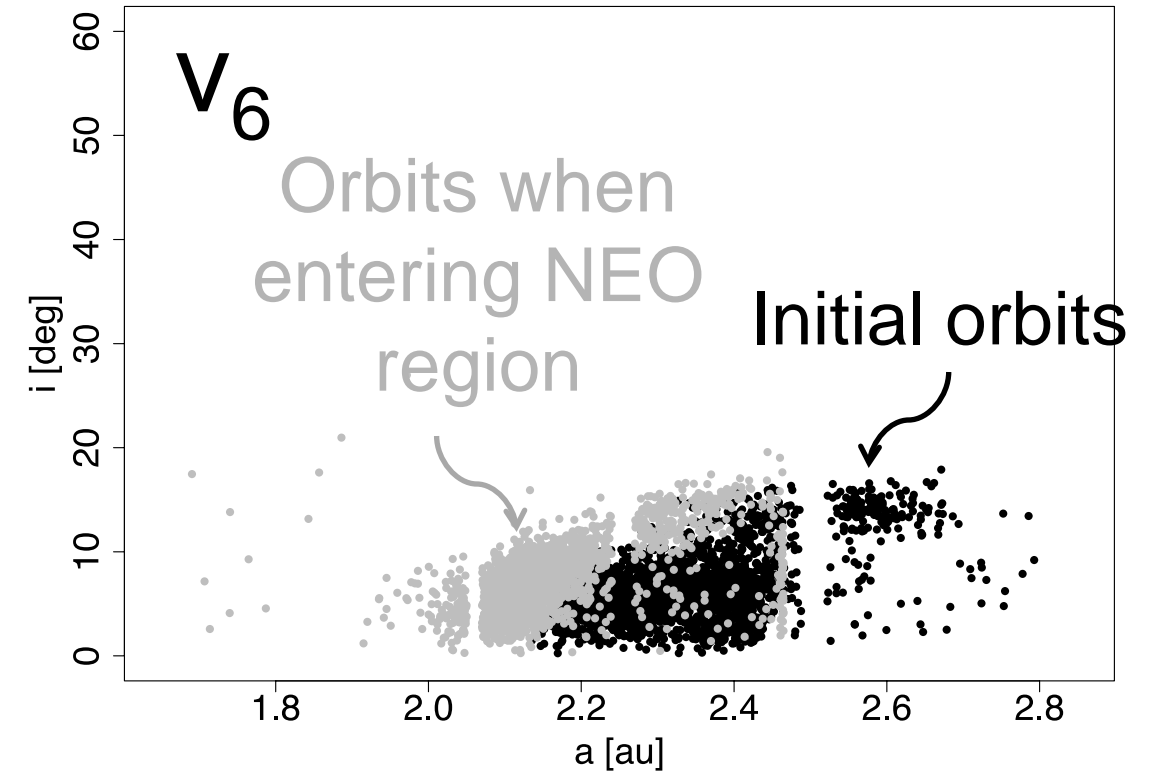
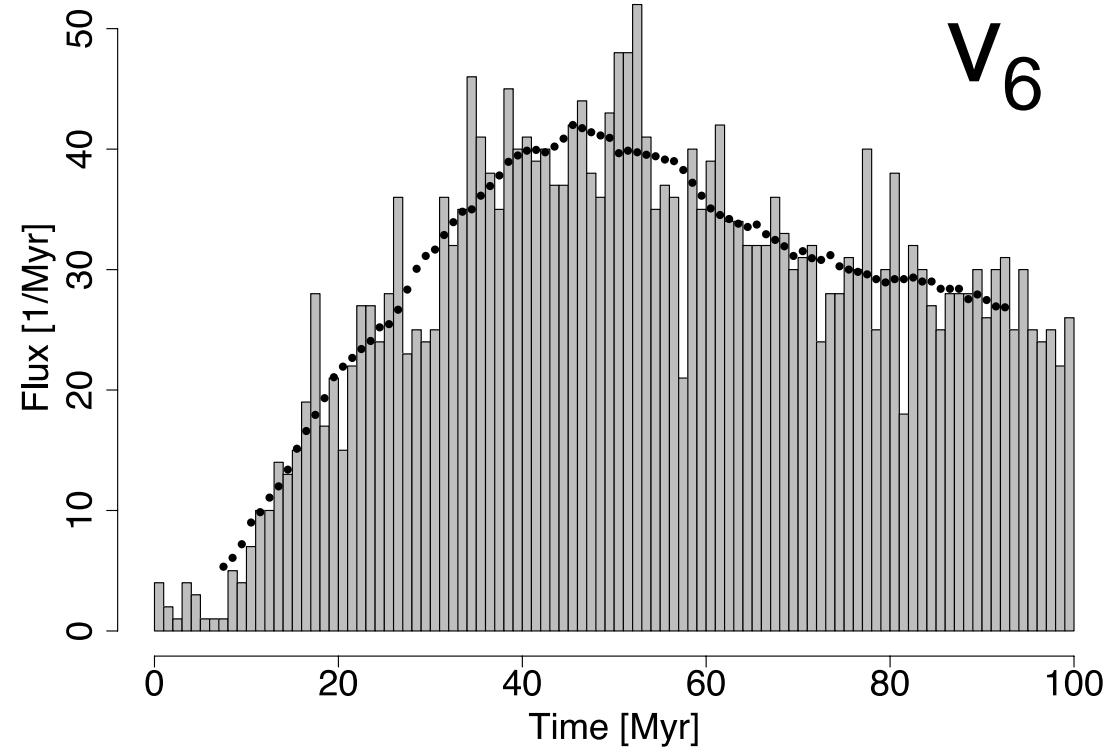


NEO FLUX

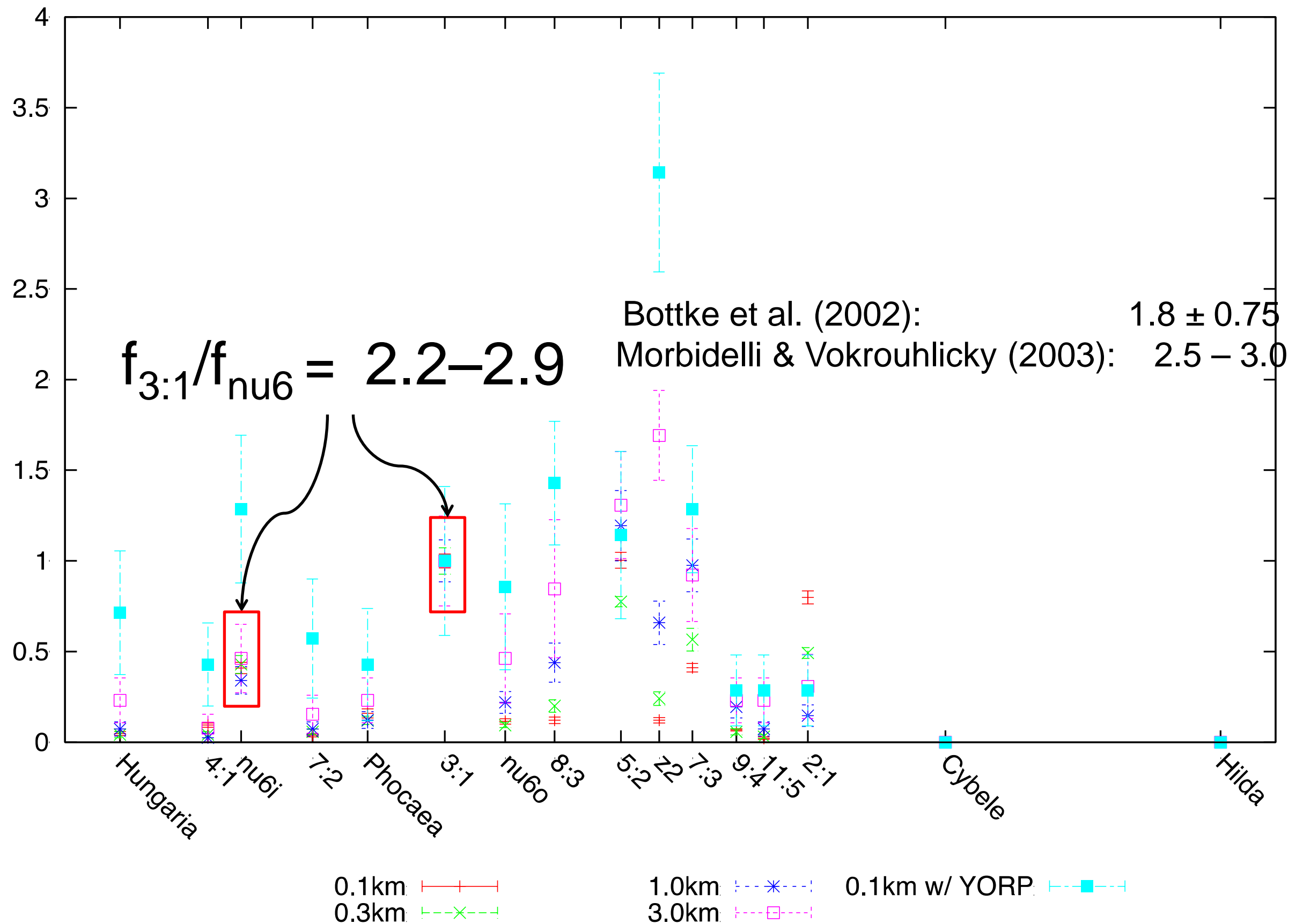
# Will Yarkovsky remove all small MBOs?



# Arbitrarily normalized fluxes

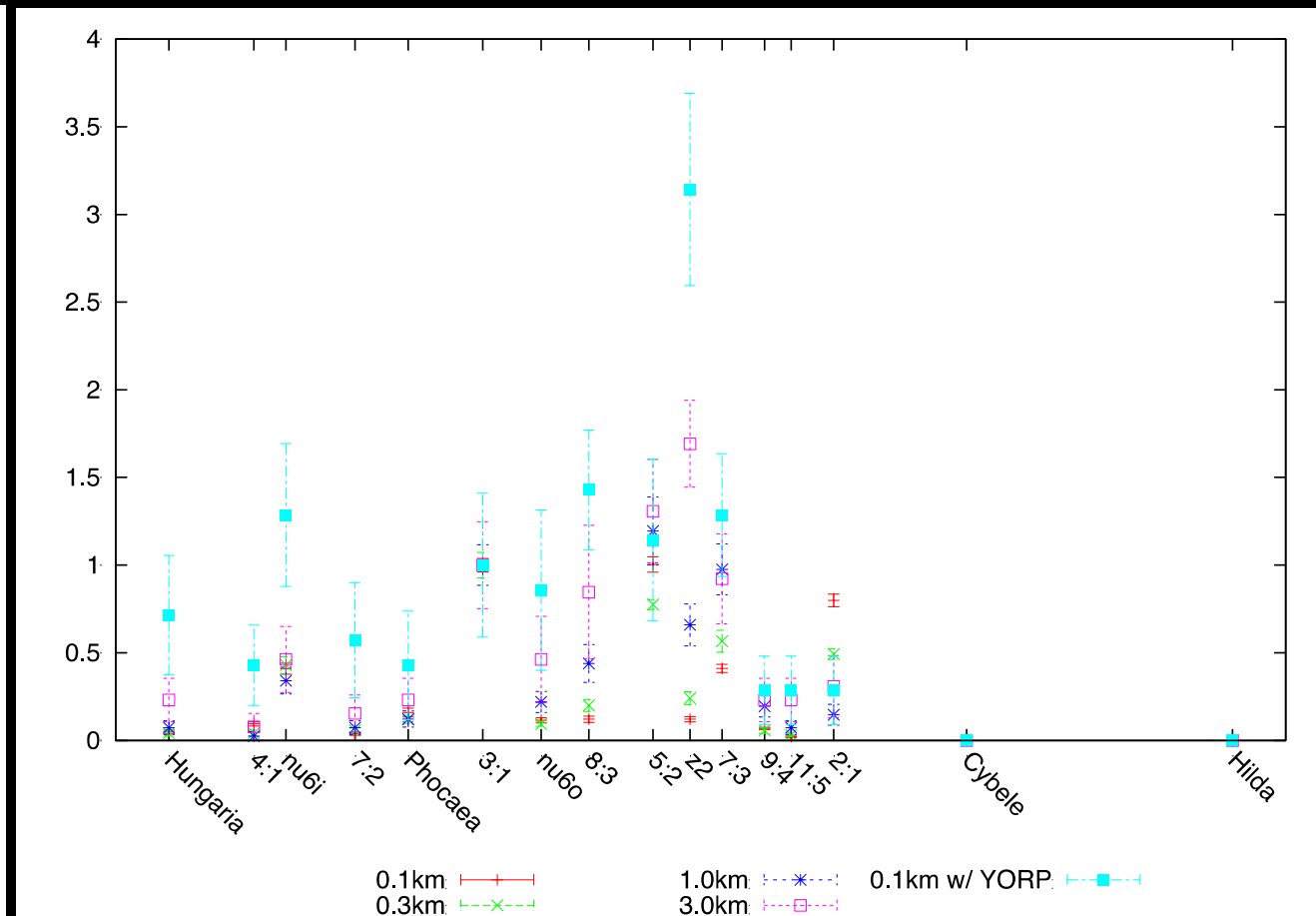
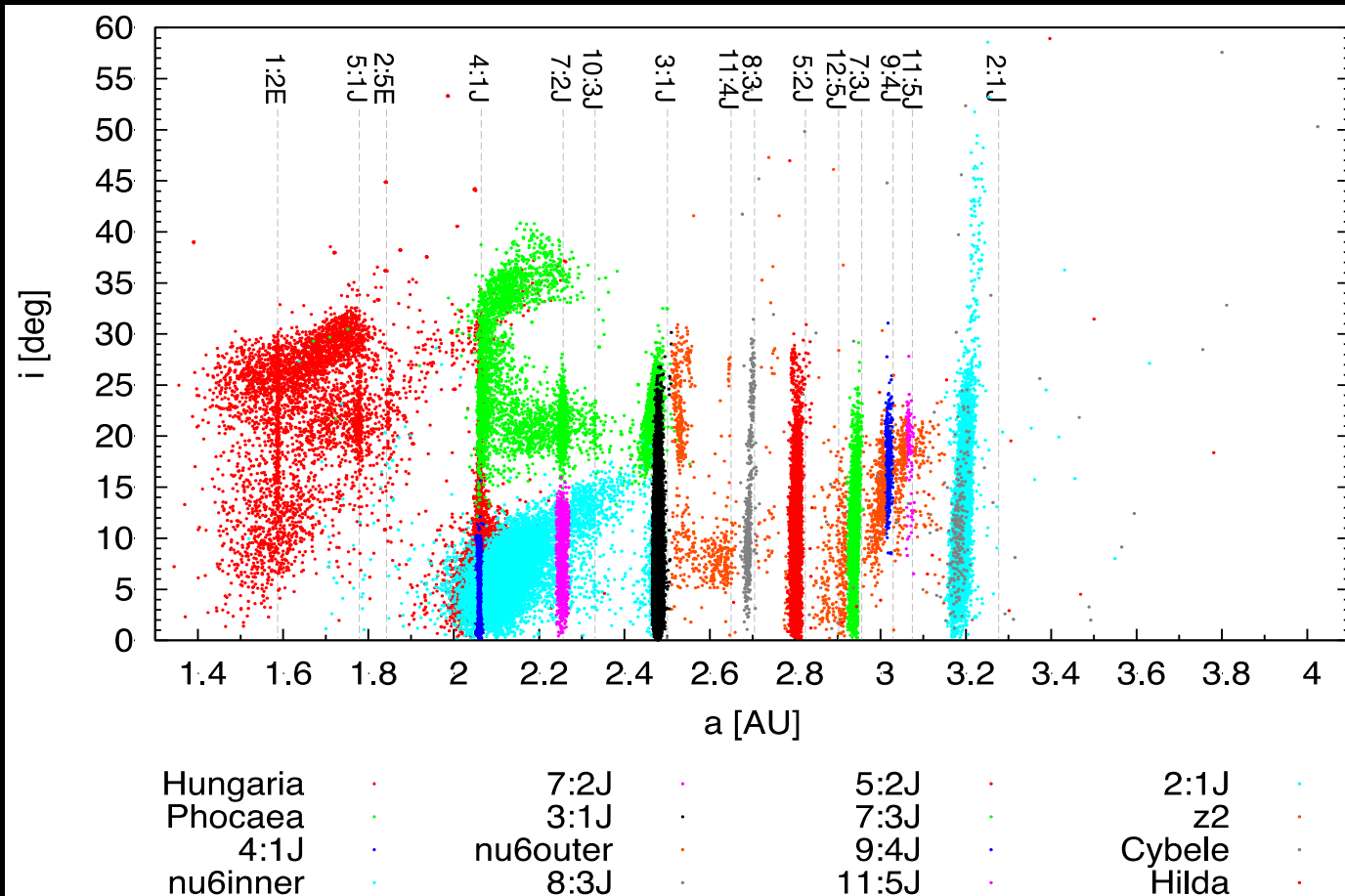


# Relative fluxes





# Summary



## Acknowledgements:

Academy of Finland	CSC – IT Centre for Science Ltd
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# ADDITIONAL SLIDES

