Supplementary Information relating to:

**The Formation of Uranus and Neptune in the Jupiter-Saturn Region**

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We have performed 3 series of runs, each of which sample a different region of parameter space. The results of these runs are presented in Figures S1 – S3 for Series I – III, respectively. The figures show the semi-major axis and eccentricity for each of the gas giant(s) (blue), the cores (red) and the smaller disk objects (black). Except where noted (Figure S3G), these snapshots are taken after $5 \times 10^6$ years.

In Figure 1 of the main text, we present the simulation most resembling the Solar System each of our three series. In Figures A1 — A3 we present animations[1], in the form of animated gif files, of the temporal dynamical evolution of these systems. The figures show the semi-major axis and eccentricity for each of the gas giant(s) (blue), the cores (red) and the smaller disk objects (black). In addition, horizontal bars are shown with the cores that illustrate the extent of their radial motion during each orbit.

In the main text we describe a mechanism where the secular interaction between a planet on a very eccentric, inclined orbit, with perihelion inside the disk and aphelion outside the disk, can excite the disk particles. Examples of runs in which this process occurred are shown in Figures S1C, S2C, and S3B. An animation of the dynamical evolution of the system in Figure S1C, similar to those described above, is presented in Figure A4.

[1] See `http://www.boulder.swri.edu/~hal/un-scat.html` for the animations.

At 5 million years, two of the cores of the system shown in Figure S3G were still on crossing orbits. Since the system had not yet settled down close to its final configuration, the integration was continued to $1.5 \times 10^7$ years.

FIGURE S1

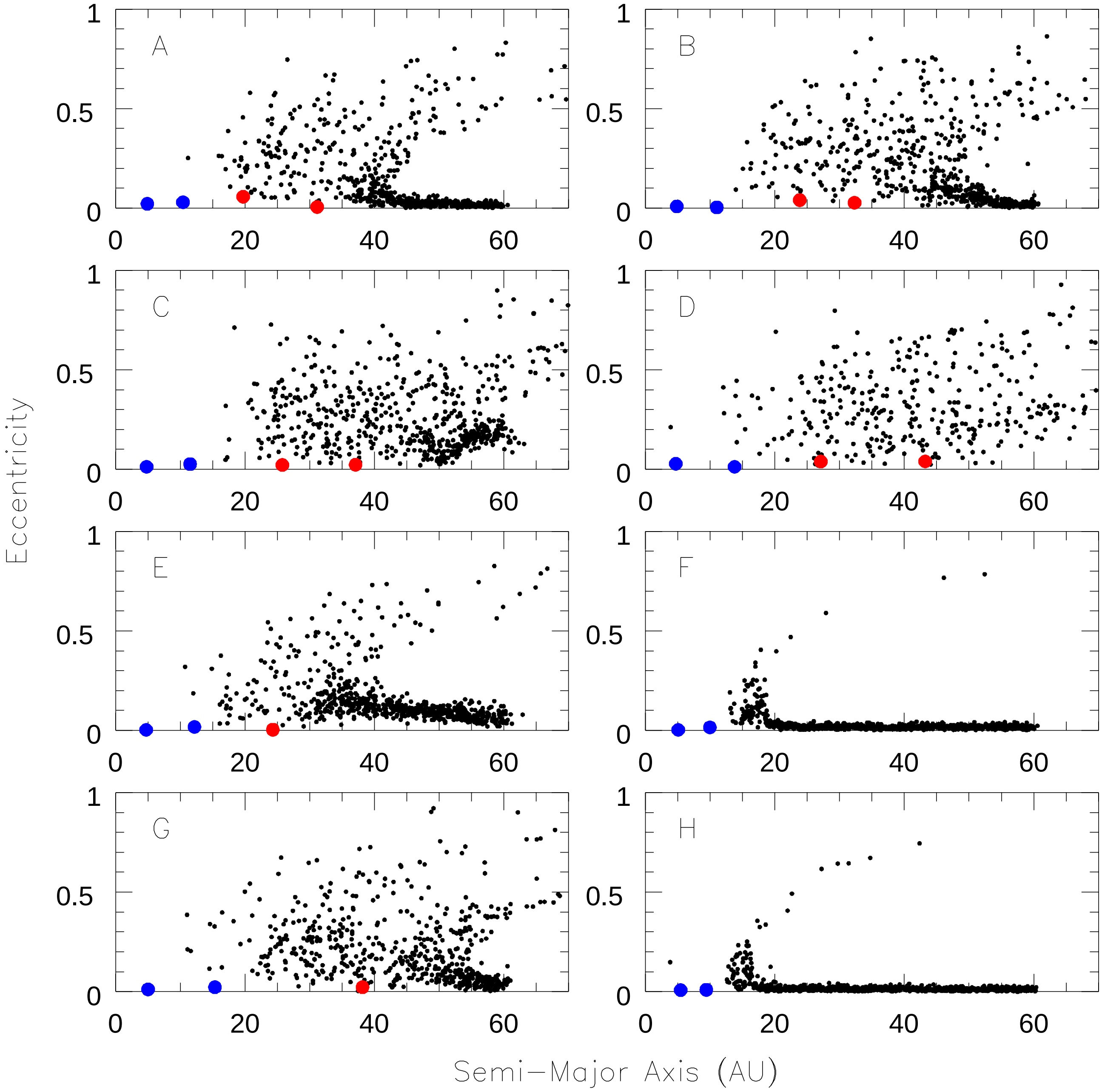


FIGURE S2

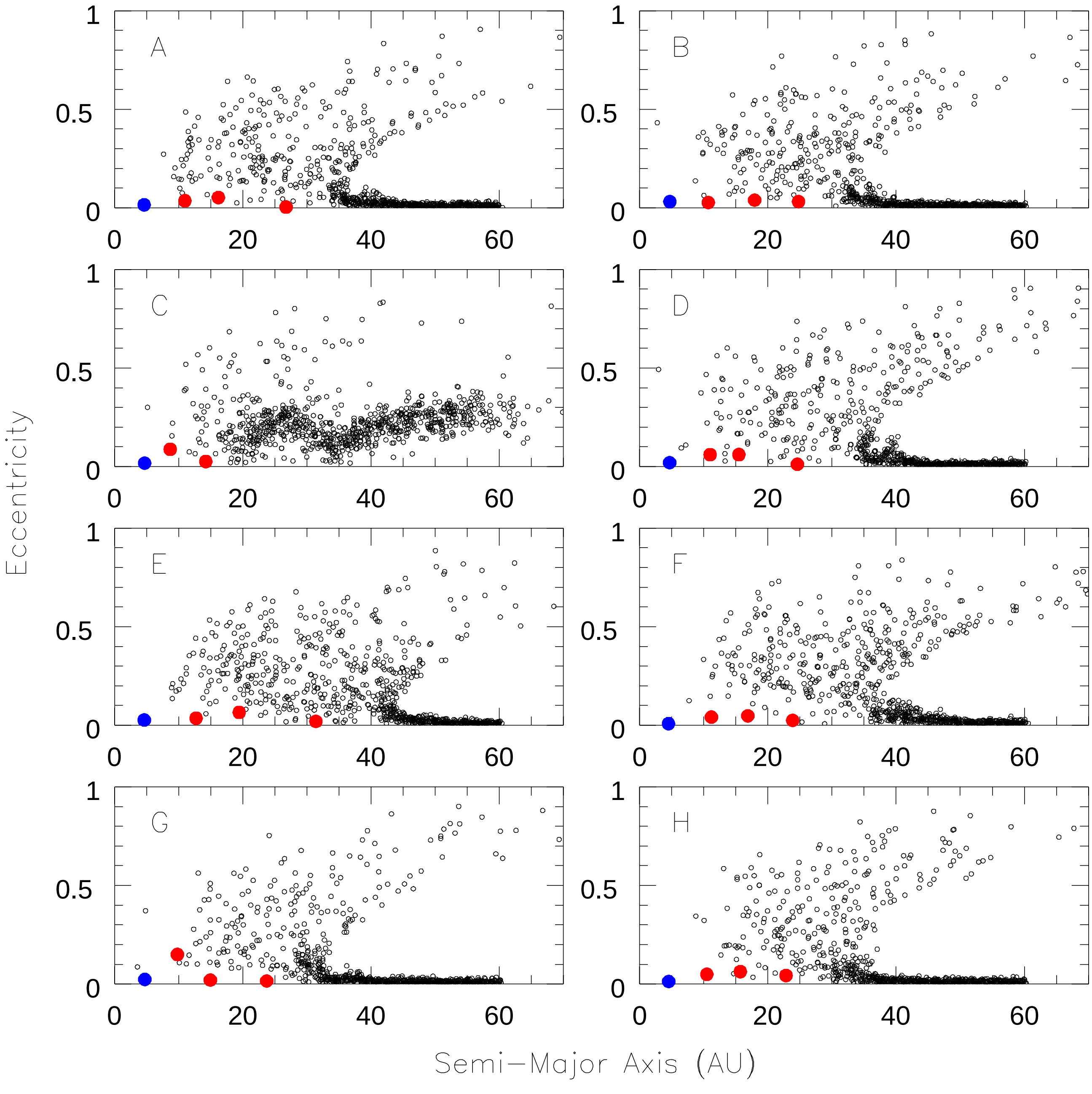
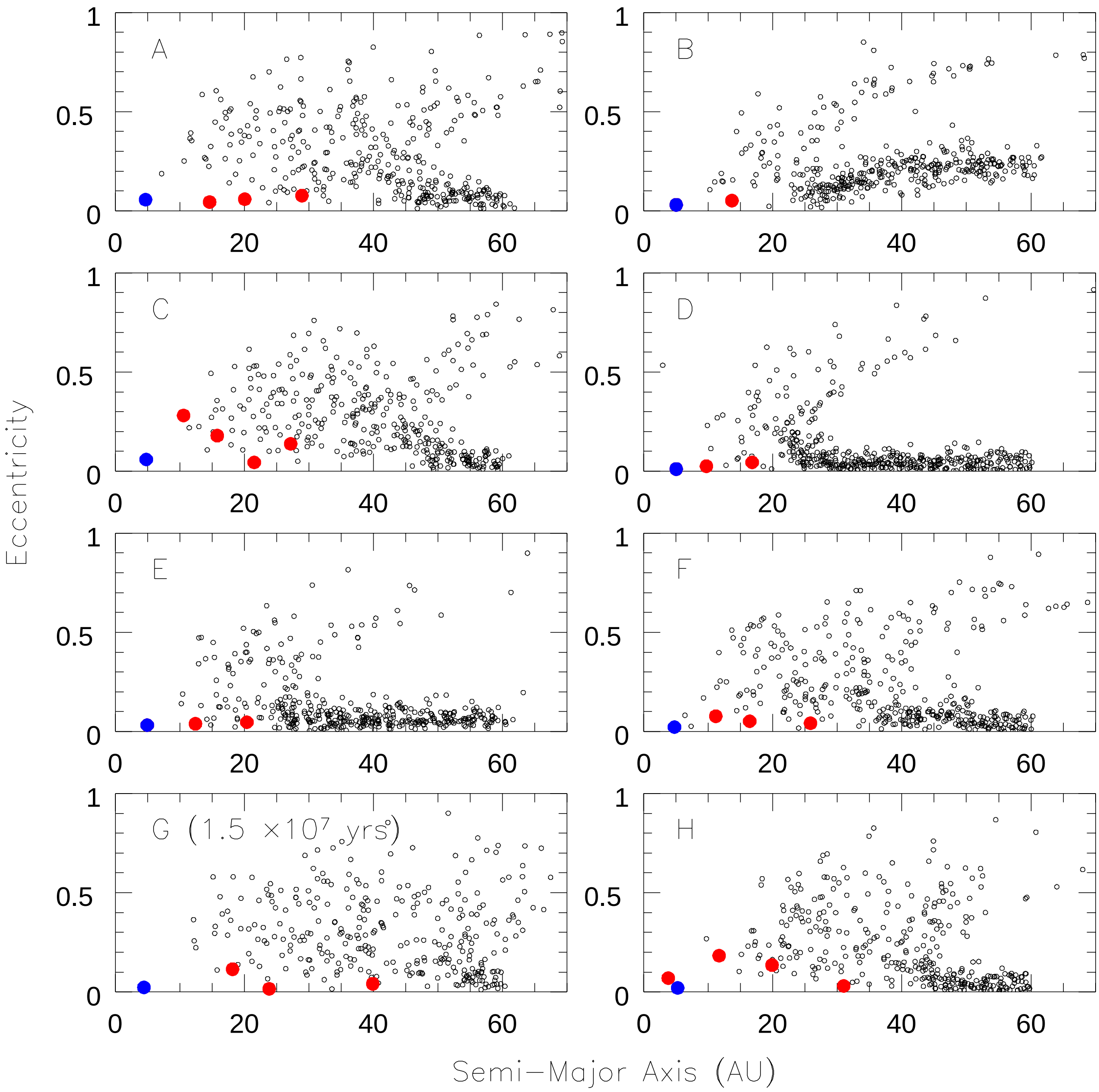


FIGURE S3


A
B
C
D
E
F
G (1.5 ×10^7 yrs)
H
Eccentricity
Semi−Major Axis (AU)
0
0.5
1
0
20
40
60