A full-lifetime planetary simulation: from stellar birth cluster evolution to planetary destruction around white dwarfs

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Objective:
To simulate the structure of a 40–1000 au annulus of asteroids/comets/planetesimals larger than 100 km orbiting inside of a Solar system analogue that is itself initially embedded within a stellar cluster environment throughout all phases of the parent star’s evolution.

Findings:
The orbital distribution of 100 km exo-Kuiper belt objects at the end of stellar cluster dissipation is just a scaled-down version of the evolved form of this distribution during the white dwarf phase unless a strong gravitational instability (amongst major planets or with a passing star) occurred in-between. These asteroids/comets/planetesimals effectively retain their primordial post-cluster eccentricity and inclination profiles while inflating their semimajor axes by an amount that is inversely proportional to the stellar mass lost. The 40–1000 au range represents a ‘sweet spot’ where other forces are ineffectual at producing significant changes, with implications for the free-floating planetesimal population and metal-polluted white dwarfs.