

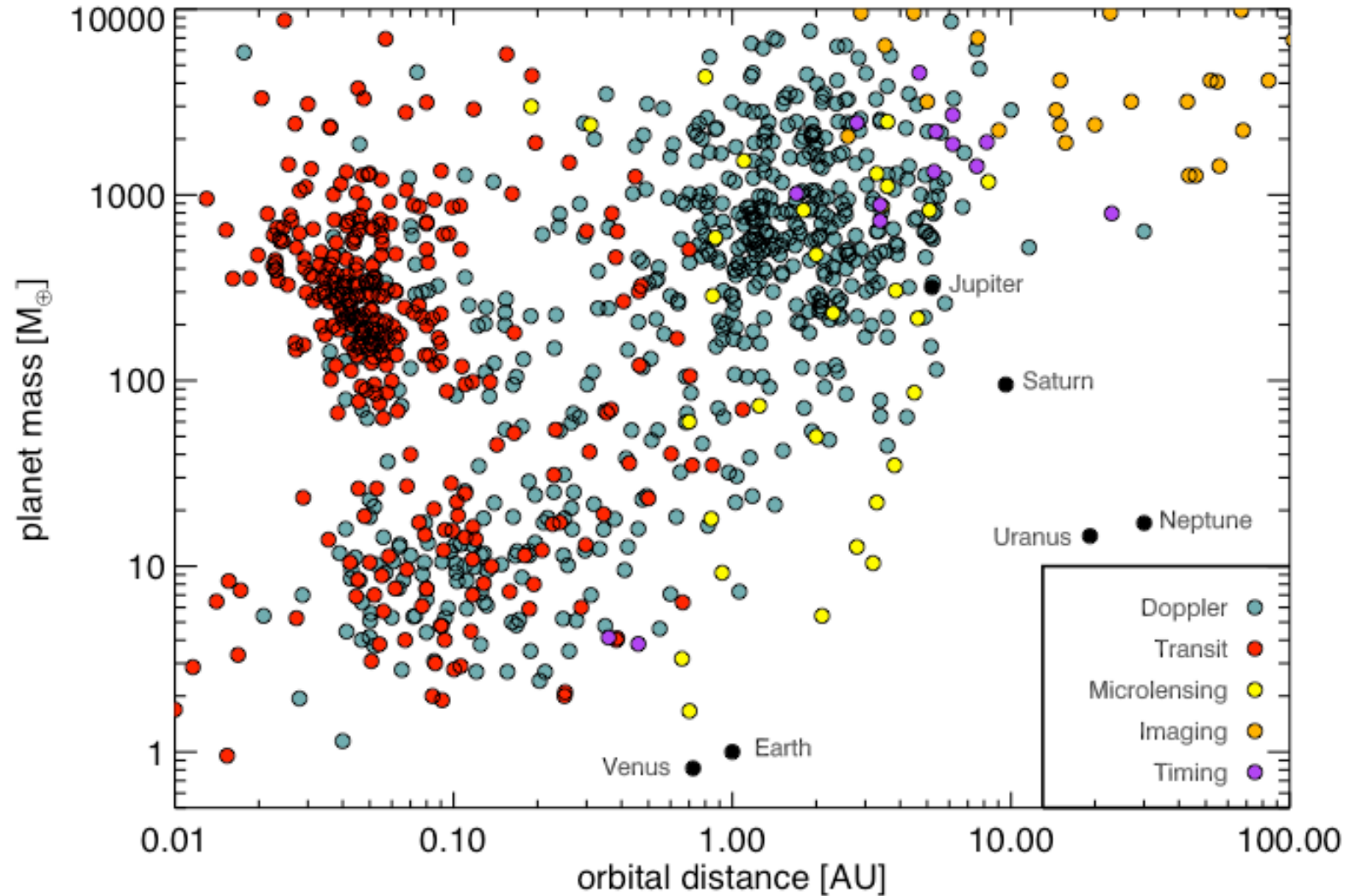
*Exoplanetary systems
dynamics
and habitability*

Melvyn B. Davies

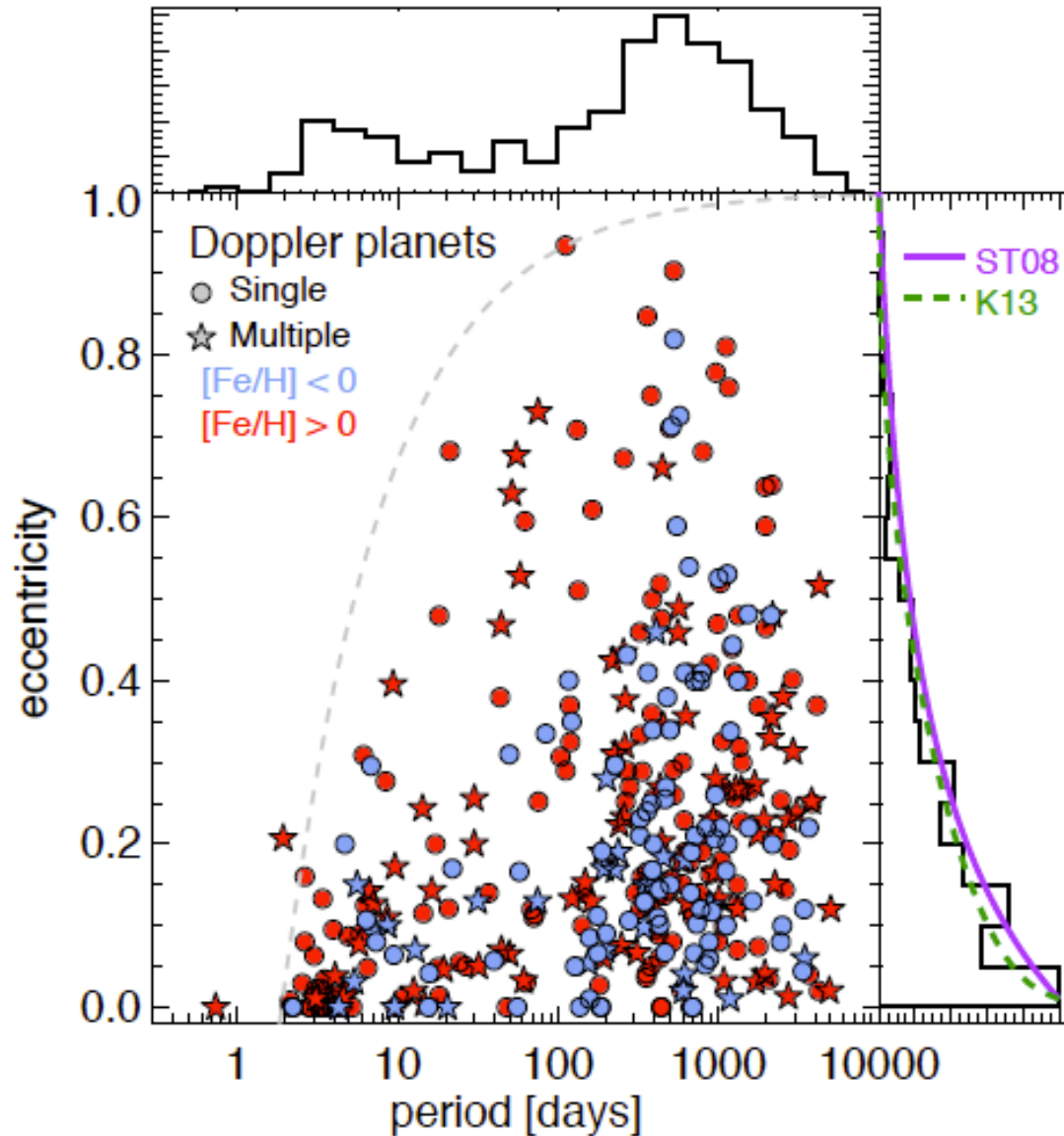
Department of Astronomy and Theoretical Physics
Lund University

www.astro.lu.se

The Solar System is not like the others

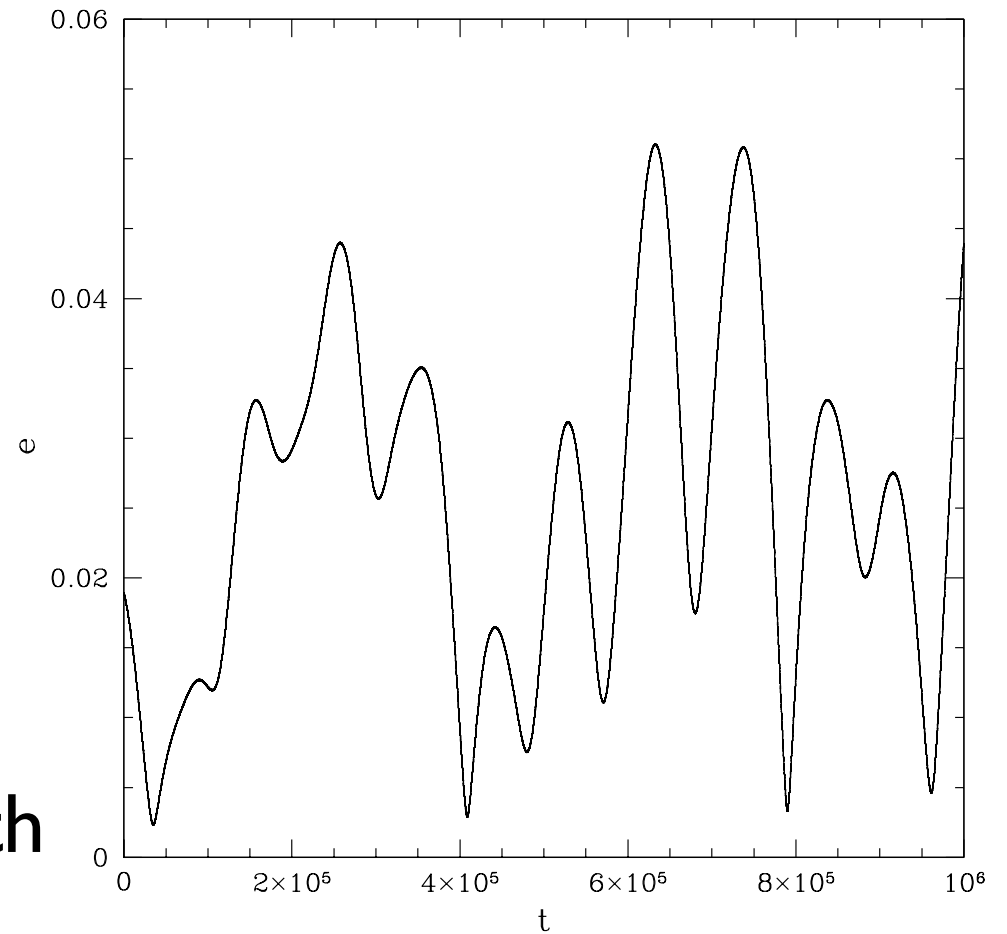
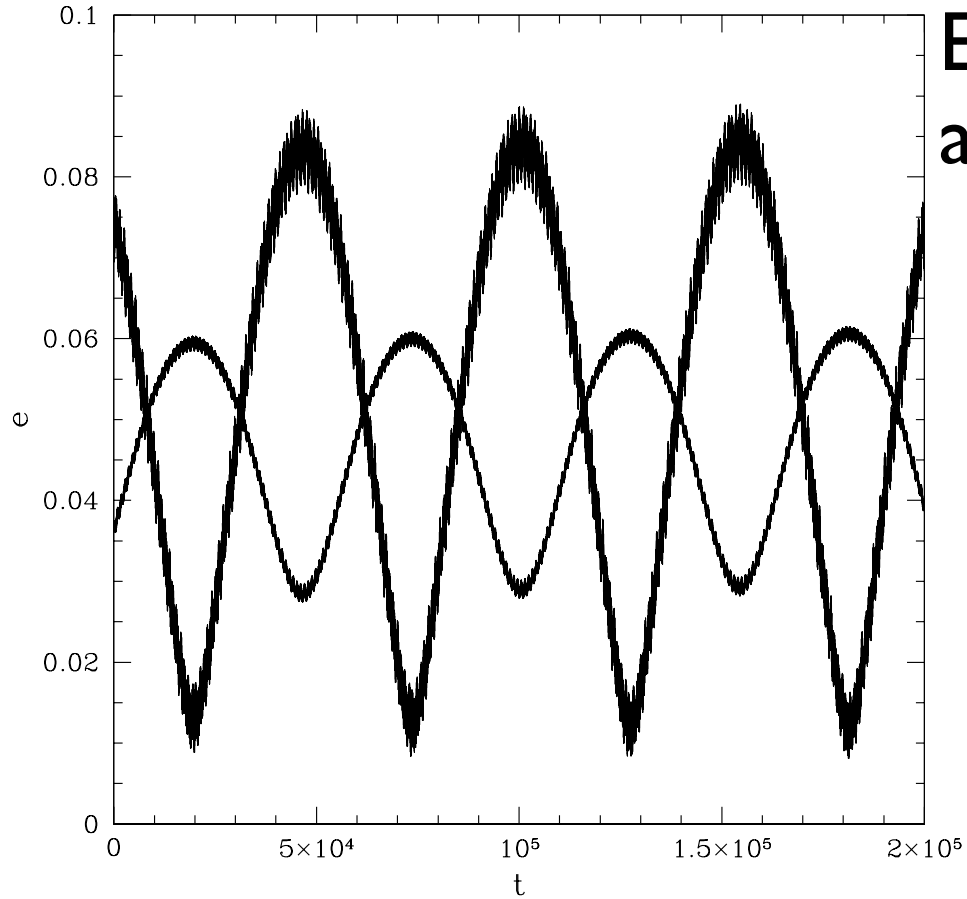


Exoplanet systems



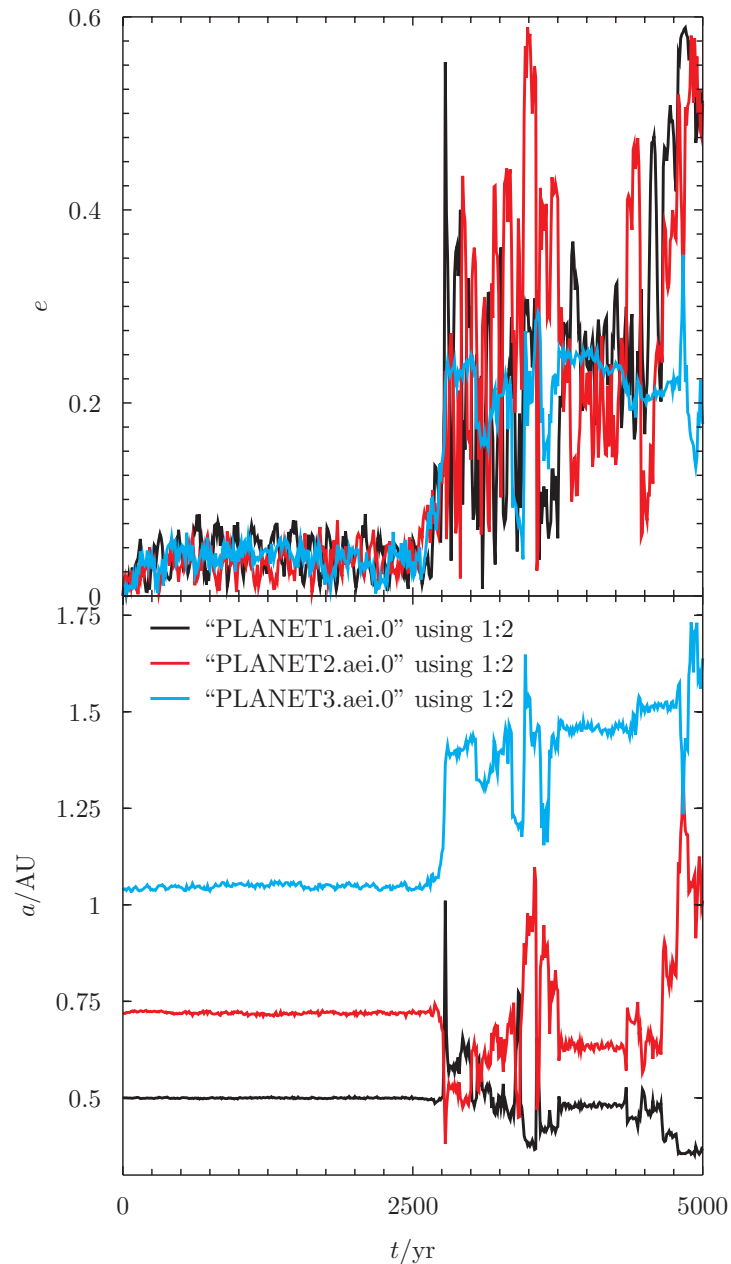
Stability of the Solar System

Eccentricity of Jupiter and Saturn

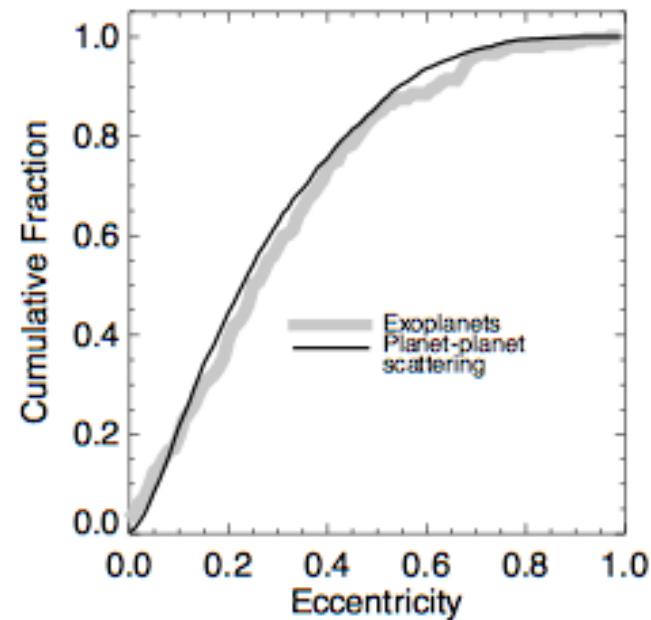


Eccentricity of Earth

An unstable system

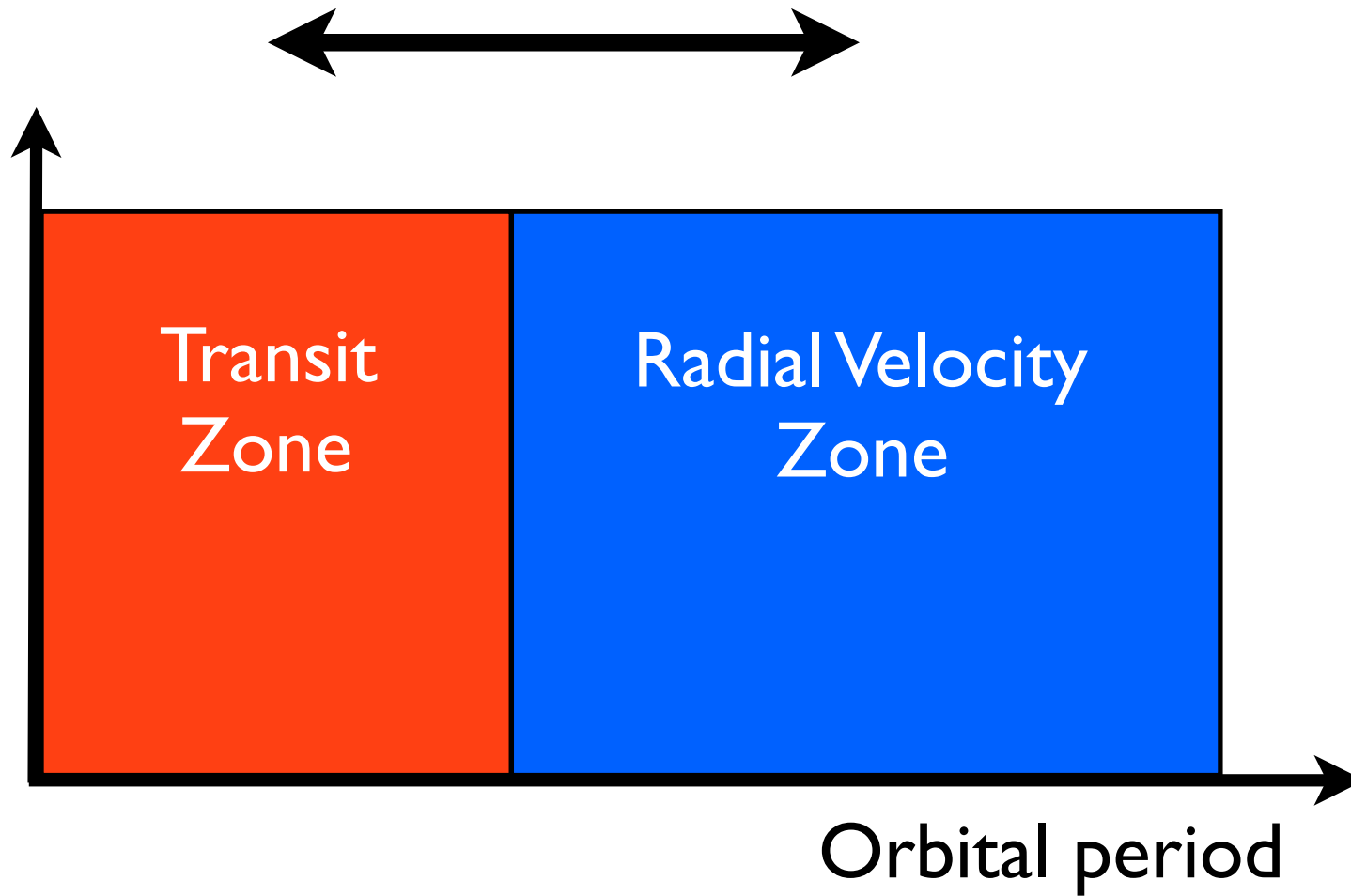


Scattering is seen to reproduce the observed eccentricity distribution.



e.g. Davies *et al.* 2014

A way to connect the two zones

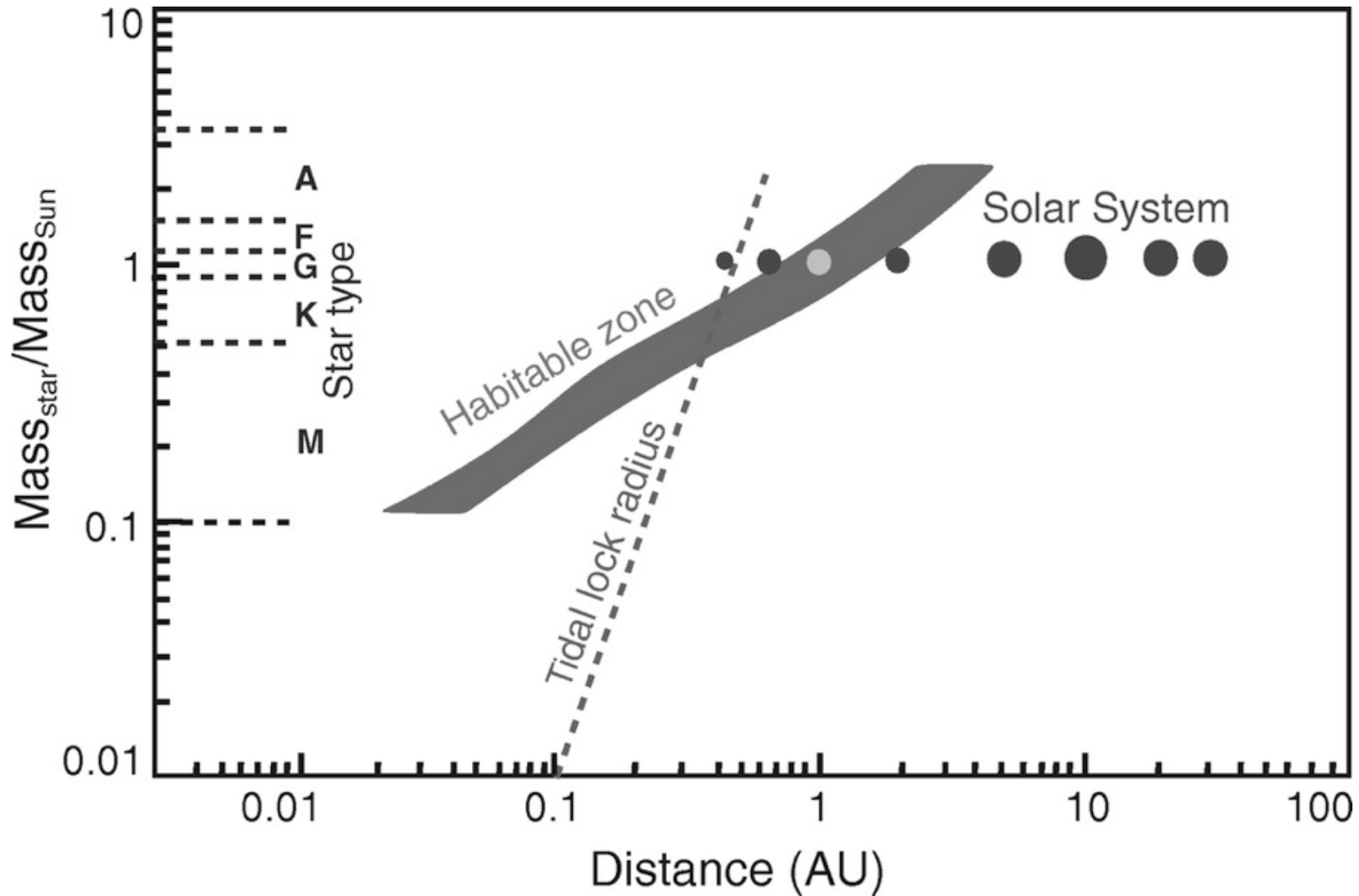


Mustill, Davies & Johansen 2015; 2017

THE QUESTION:

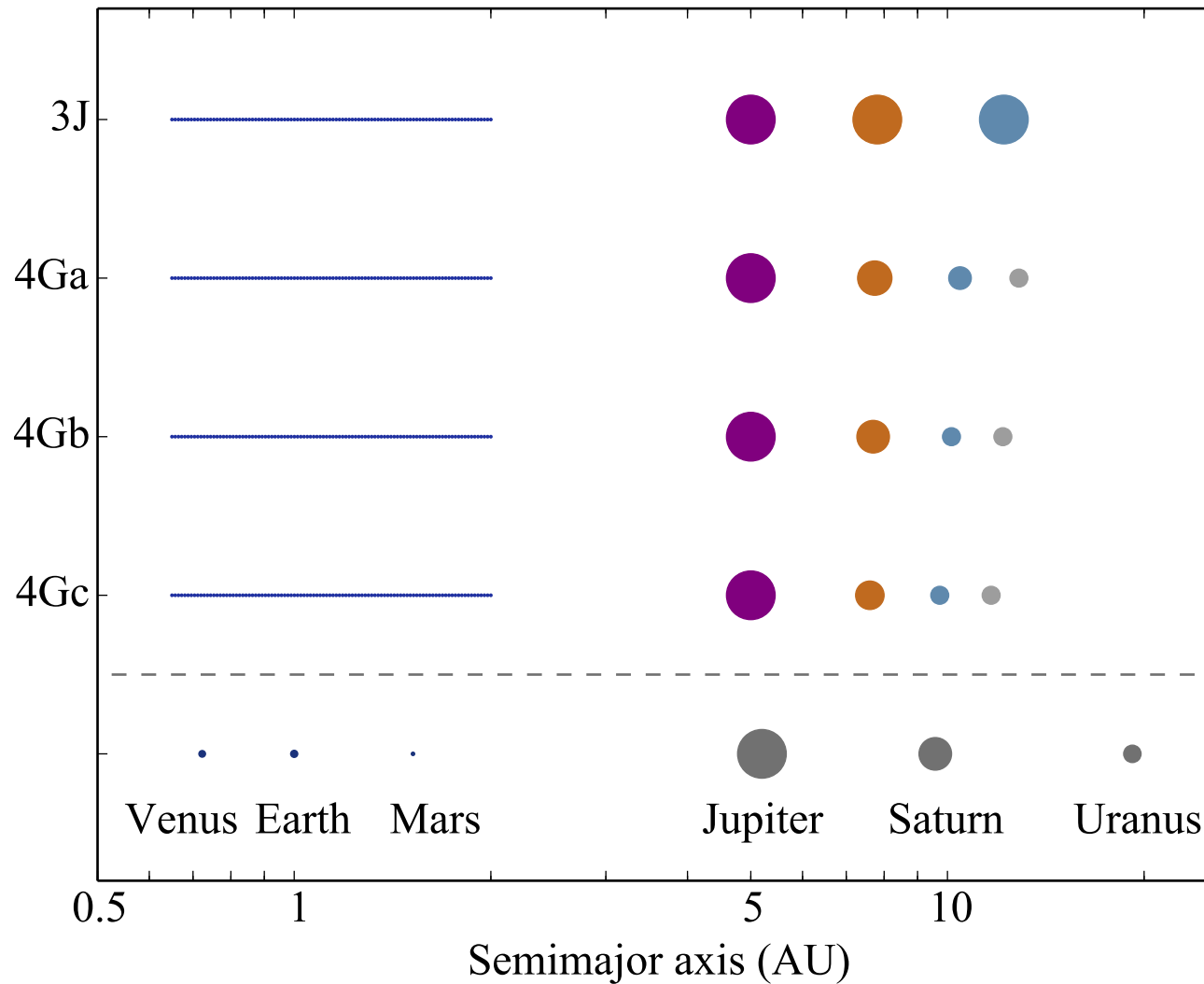
What happens to habitable planets in systems which have gone through an unstable phase?

Habitable zones

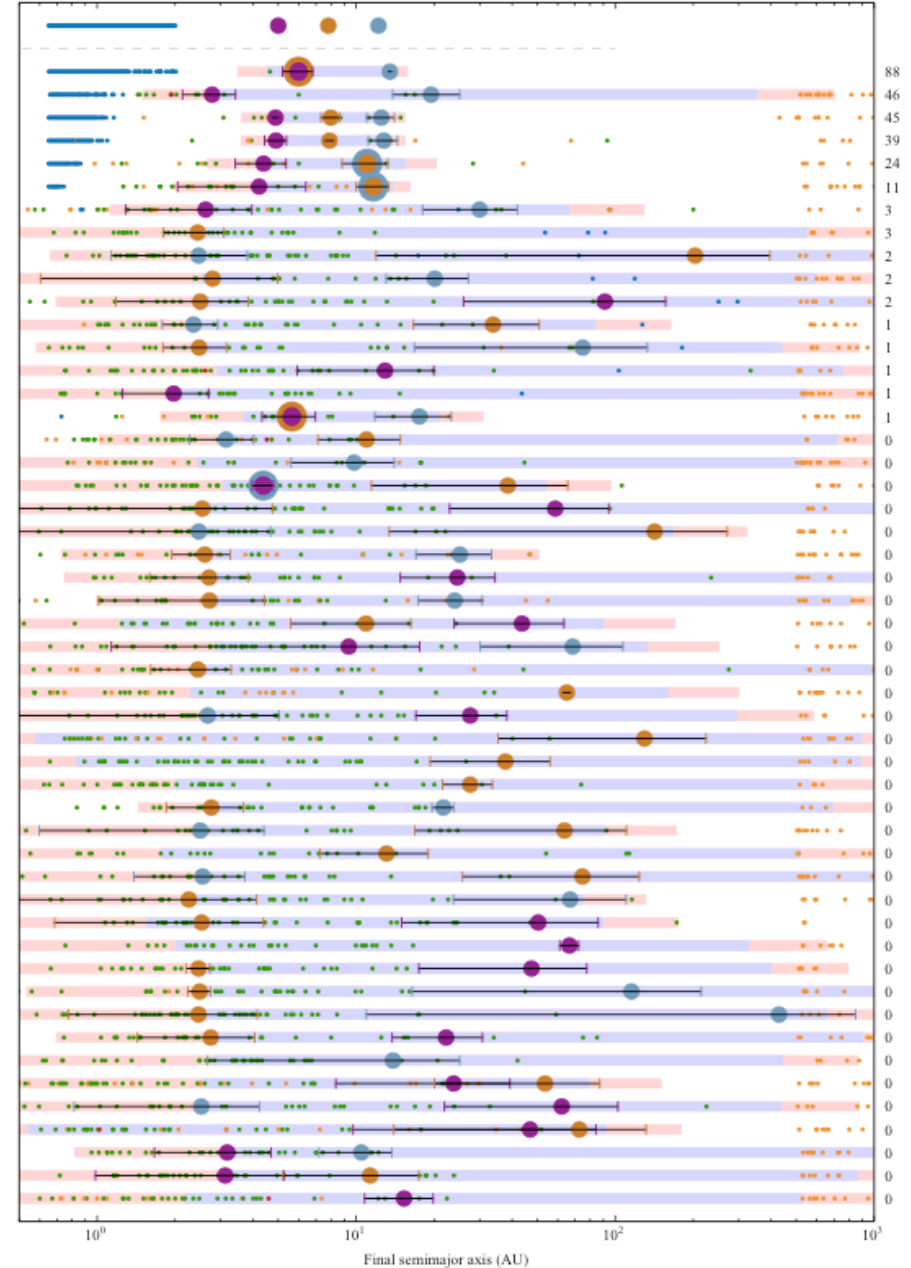
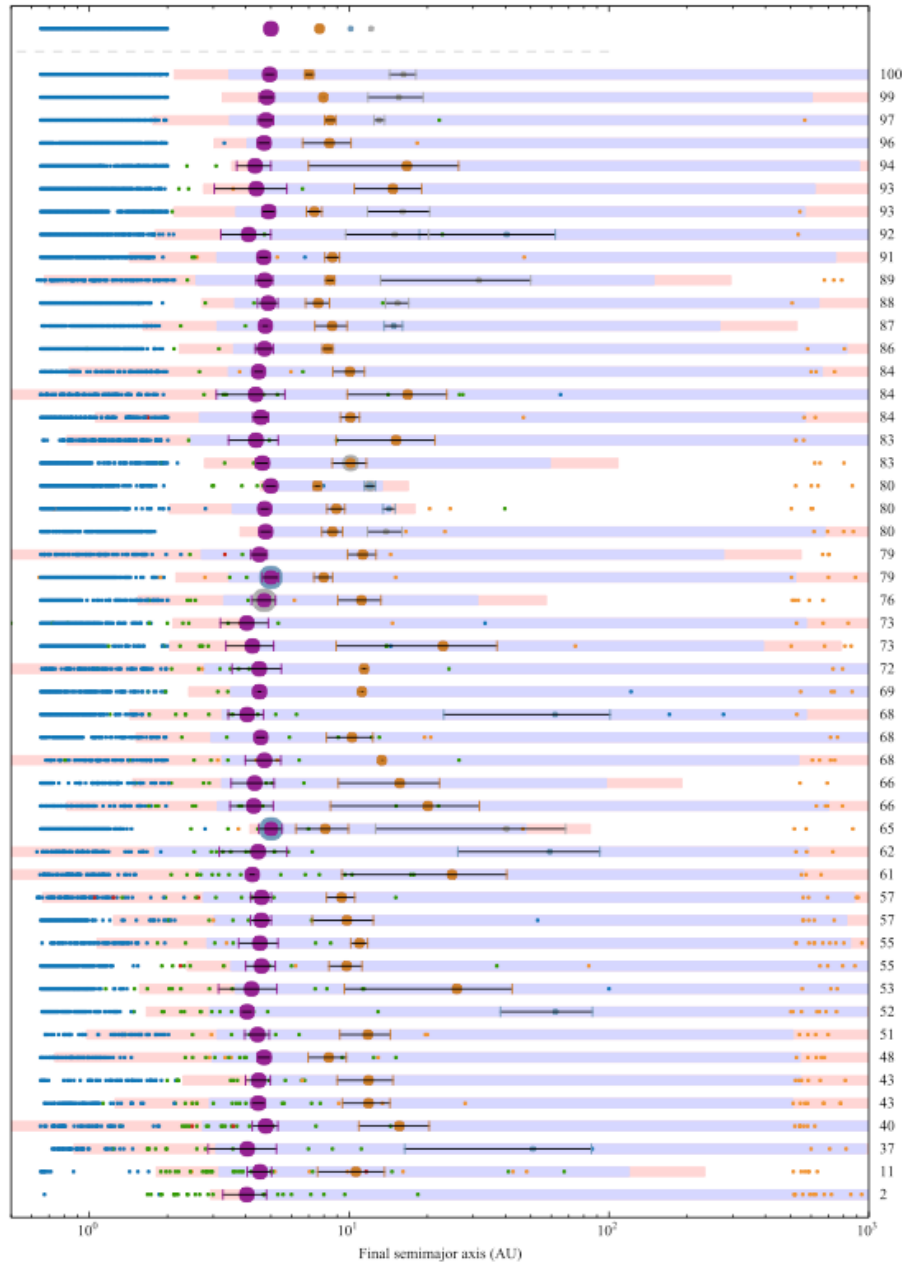


Cockell *et al.* 2016; after Kasting *et al.* 1993

Do giant instabilities affect habitability?

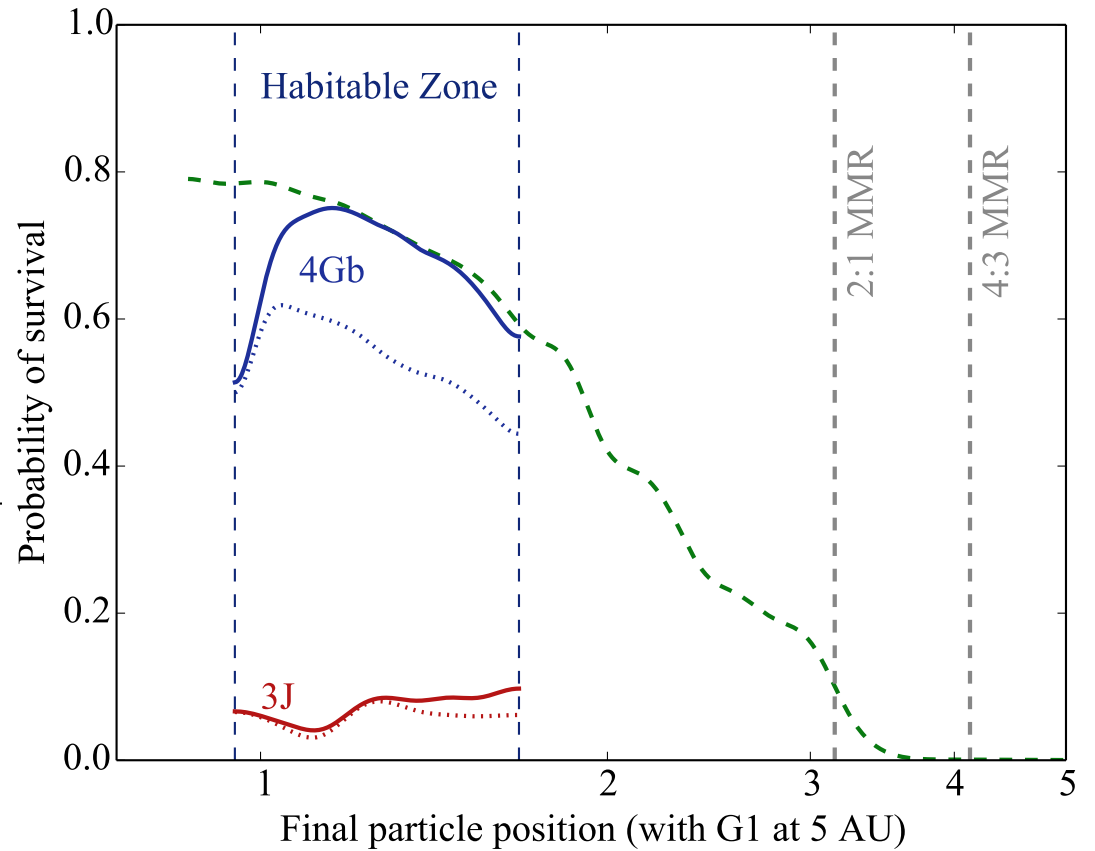
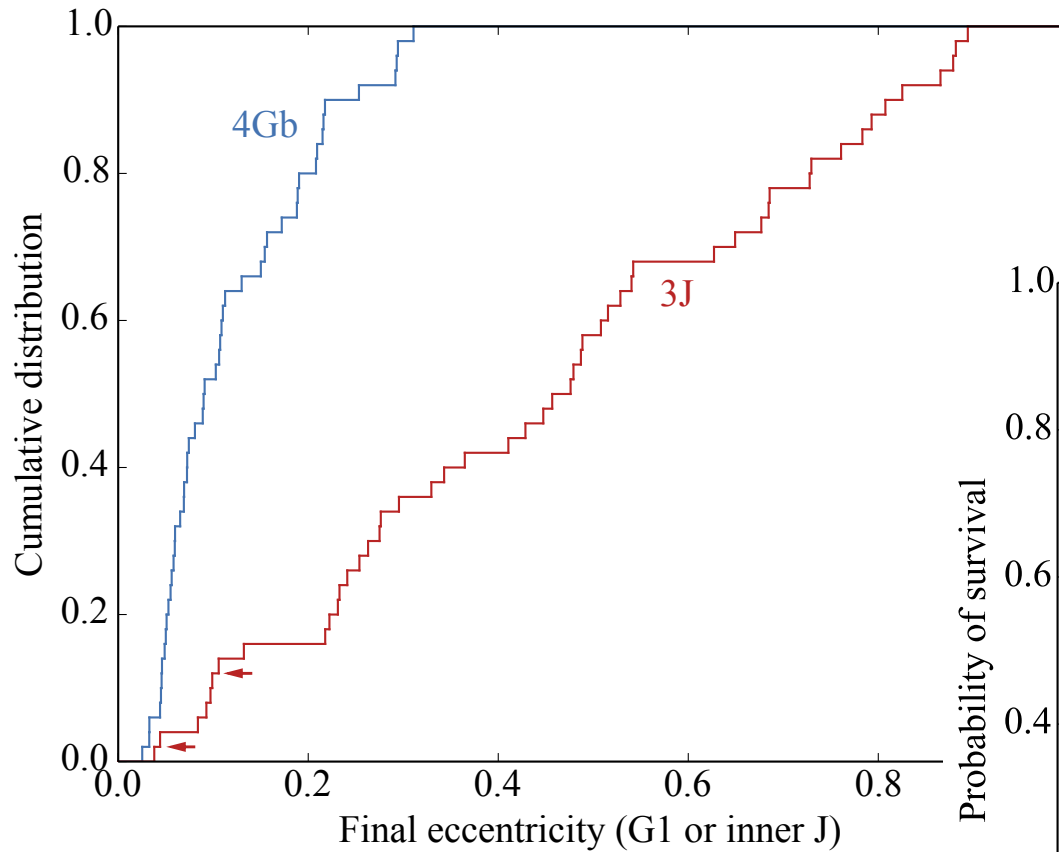


Four giants OK, three Jupiters bad

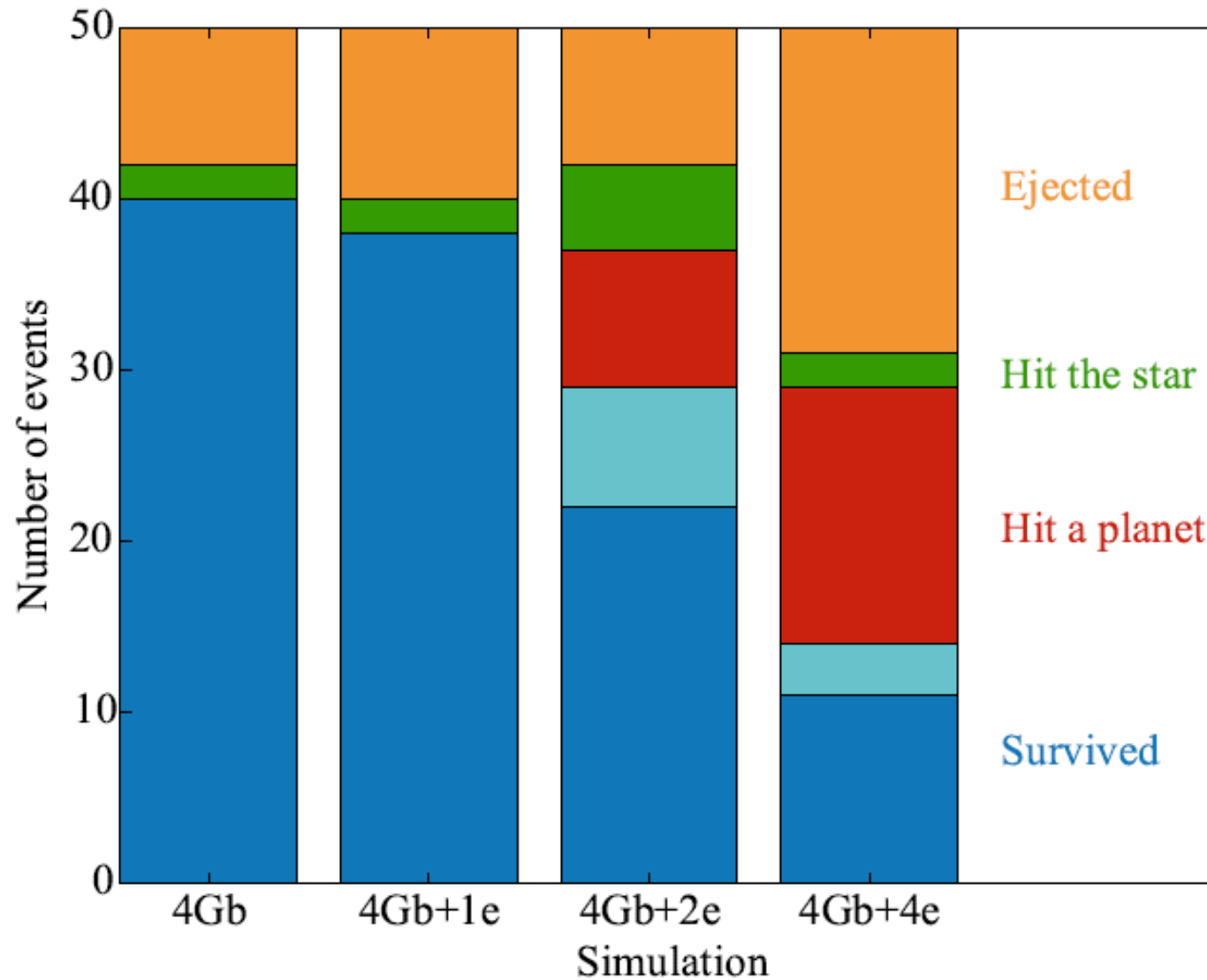


Carrera, Davies & Johansen 2016

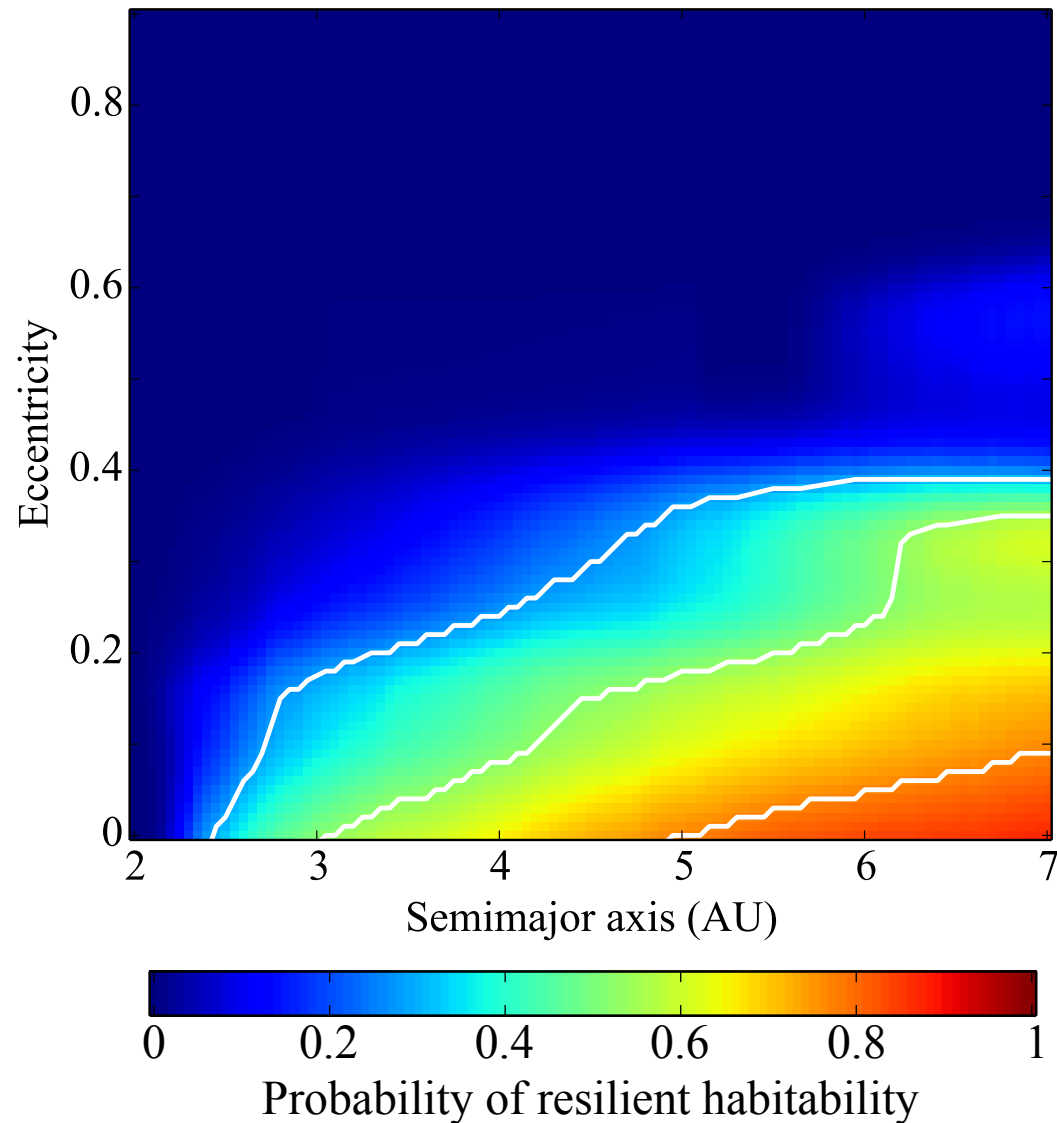
Four giants OK, three Jupiters bad



Adding planets lowers survival rate

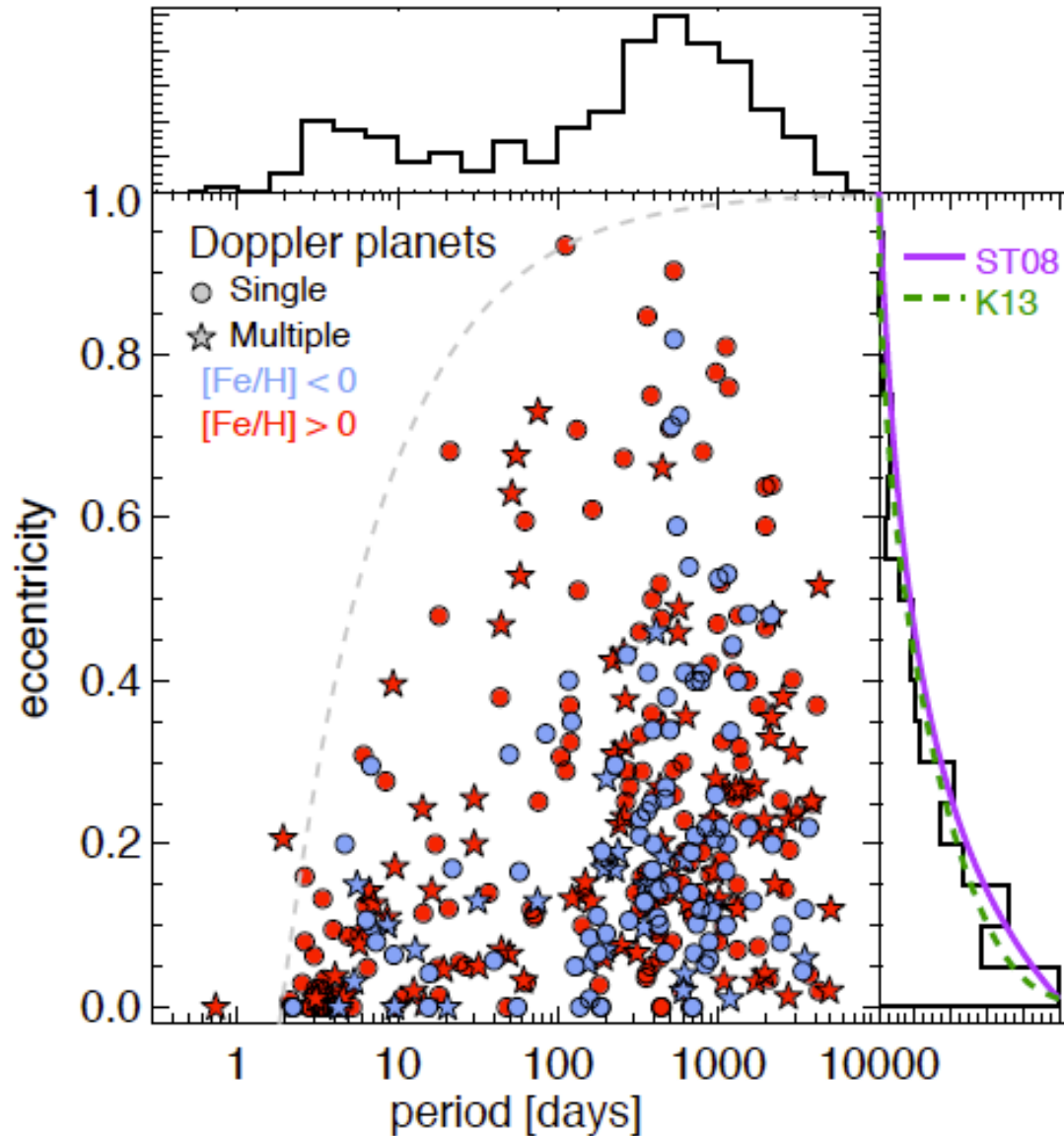


More eccentricity implies lower resilience



Carrera, Davies & Johansen 2016

Exoplanet systems



Summary

1. The solar system is not like the others
2. Planet-planet scatterings occur in unstable systems: some planets are ejected
3. 3J systems leave planets on eccentric orbits
4. In 4G systems the Jupiter left behind is more often on lower-eccentricity orbits
5. Resilient habitability is much more common in 4G than 3J: *eccentric orbits = bad for Earths*