PLANET(ARY) NEBULAE

EVA VILLAVER (UNIVERSIDAD AUTÓNOMA DE MADRID)

SUMMARY

Over the last 20 years planetary searches have revealed a wealth of planets orbiting stars on the main sequence. Most of these stars will eventually evolve into the Giant phases before entering the Planetary Nebulae (PNe) stage. We have explored the conditions of planet survival under the effects of stellar mass-loss, radius expansion, tidal orbital decay, and evaporation along the several stages that lead to the PNe formation phase. We have investigated as well the chemical trends in the host star possibly associated with either planet formation or with planet engulfment. In all, we have acquired a theoretical understanding on how an evolving star influence the survival of planets that we apply to explore how the presence of a planet might alter the evolution of a star and with that the PN formation.

FOR MORE INFORMATION SEE:

"Can Planets Survive Stellar Evolution?" Villaver & Livio 2007,ApJ

"The Orbital Evolution of Giant Planets around Giant Stars" Villaver & Livio 2009,ApJ Letters

"Foretellings of Ragnarök: World-engulfing Asymptotic Giants and the Inheritance of White Dwarfs", Mustill & Villaver 2012, ApJ

" BD+48 740–Li Overabundant Giant Star with a Planet: A Case of Recent Engulfment?" Adamow, Niedzielski, Villaver, Nowak & Wolszczan 2012, ApJ Letters

"The metallicity signature of evolved stars with planets" Maldonado, Villaver & Eiroa 2013, A&A

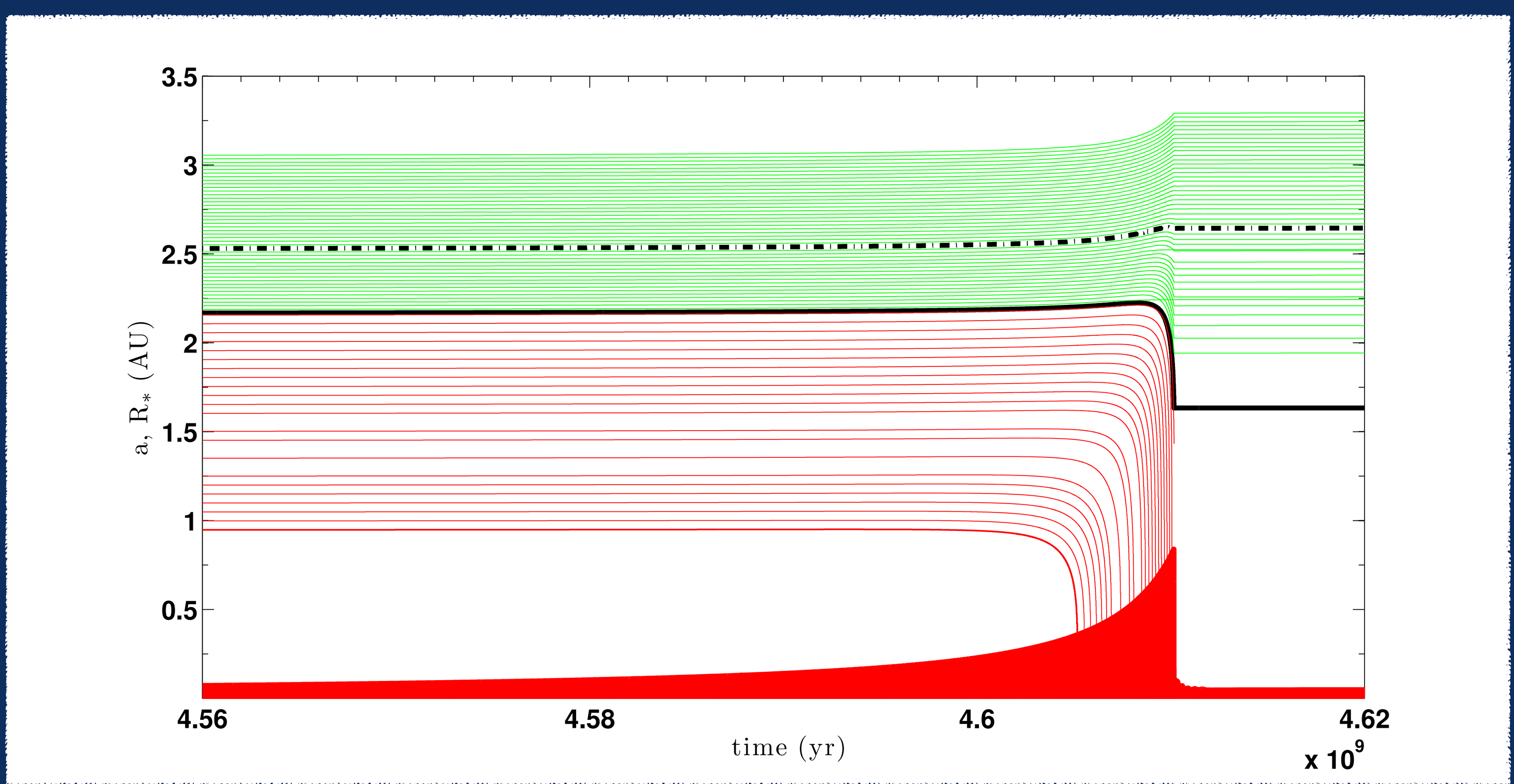
"Long-term evolution of three-planet systems to the post-Main Sequence and beyond", Mustill, Veras & Villaver 2013, MNRAS

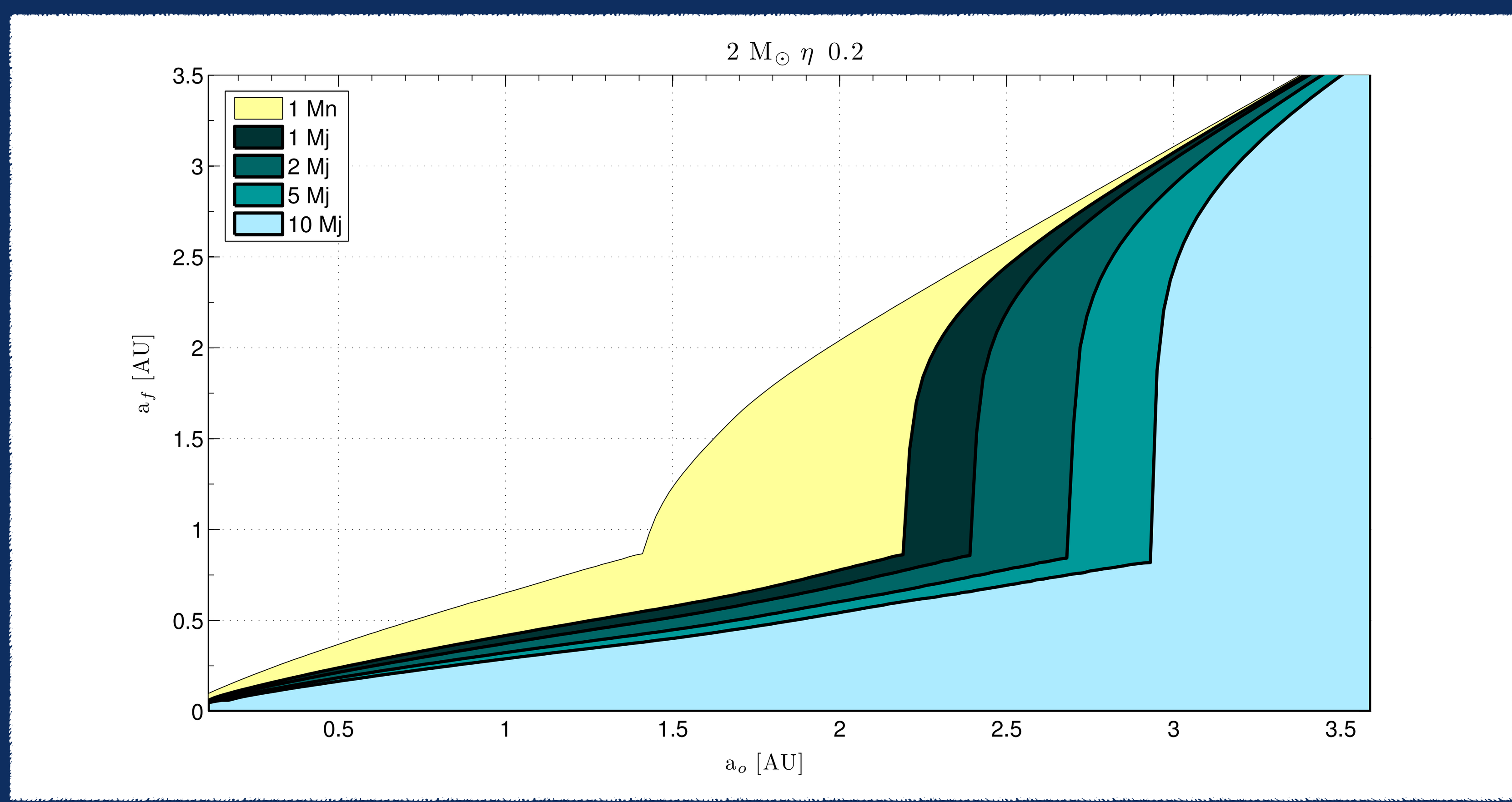
"Hot Planets and Cool Stars" Villaver, Livio & Siess 2013, in prep

RED GIANT BRANCH: ORBITS

LEFT: Evolution of a set of orbits of a planet with Jupiter mass are shown with the red lines representing a set of initial orbital distances for which the planet ends inside the stellar radius and the green lines are those for which the planet avoids engulfment. The solid black line is the minimun initial orbit for which the planet avoids the stellar surface and the dashed black lines marks the initial orbit beyond which the planet does not experience the tidal forces.

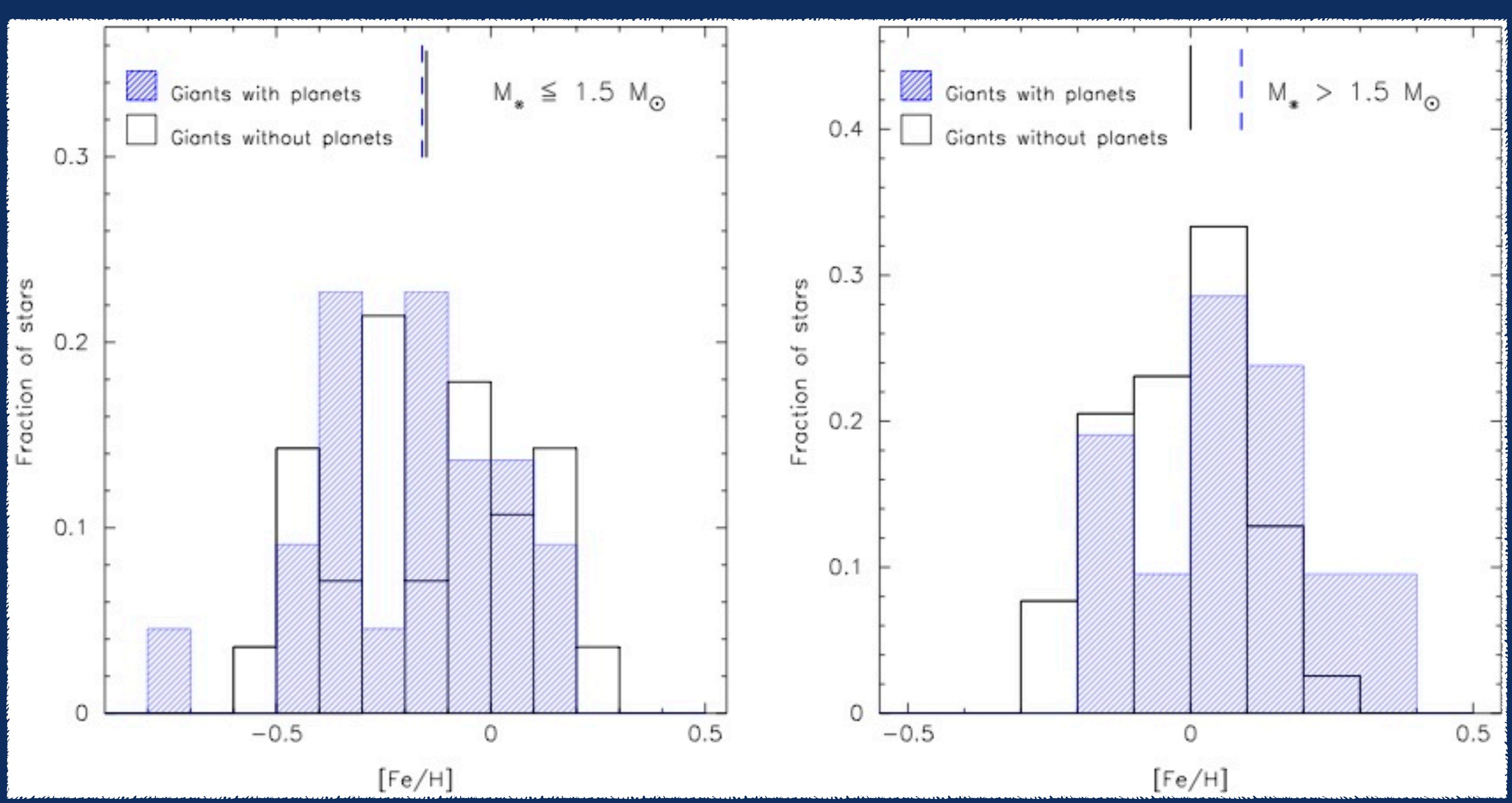
RIGHT: Initial (a_o versus final a_f) orbit reached by planets of different masses from Neptune to 10 Jupiter mass at the end of the RGB for stellar models with mass 2 Mso.





RED GIANT BRANCH: METAL SIGNATURE

We have found,a very strong relation between the metallicity distribution and the stellar mass within this sample. We show that the less massive giant stars with planets (M < 1.5 Msun) are not metal rich, but, the metallicity of the sample of massive (M > 1.5 Msun), young (age < 2 Gyr) giant stars with planets is higher than that of a similar sample of stars without planets.



AGB ORBITS

Same as left above for an AGB of 2.5 Msun