Understanding the origin of metal pollution in white dwarf atmospheres through dynamical evolution of planetary systems

Raúl Maldonado[1,2], Eva Villaver[1,3], Alexander Mustill[4], Miguel Chávez[2], Emanuele Bertone[2]

[1] *Universidad Autónoma de Madrid, Madrid, Spain*
[2] *National Institute of Astrophysics, Optics and Electronics, Puebla, Mexico*
[3] *Centro de Astrobiología (CAB, CSIC-INTA), Madrid, Spain*
[4] *Lund Observatory, Lund University, Lund, Sweden*

Nowadays, it is well established that 25-50% of white dwarfs (WDs) show metal pollution in their atmospheres. Based on observational evidence, the current paradigm to explain this phenomenon involves planets surviving the evolution of their host star and the scattering bodies to closer WD distances. In this work, we perform thousands of N-body simulations of systems dynamically analogous to the observed exoplanetary systems, having two to six planets orbiting main-sequence stars which are evolved to the WD phase. The exploration of the parameter space, although not exhaustive, is guided by the properties of the observed systems. Our simulations show that the more planets the system has, the more it will become dynamically unstable when the stellar host becomes a WD and the fraction of four- to six-planet unstable systems is comparable to the prevalence of polluted WDs. Furthermore, simulations with a high multiplicity of planets produce planet-planet scattering events that send a non-negligible number of planets toward the WD crossing the WD's Roche radius and even causing some of them to collide with the WD. Dynamical instabilities in systems with high planet multiplicity may explain the existence of close-in WD planets, as the recently discovered WD 1856 b.