

MCMC orbital fitting using Universal Keplerian Variables

Hervé Beust, IPAG

April 8, 2026

I present here a newly realized MCMC package designed to fit orbits of exoplanets and/or companions in multiple systems, able to handle various types of data, namely relative High Contrast Imagine (HCI) astrometric measurements, stellar radial velocity and relative radial velocity data, and absolute astrometric data. It will eventually be included in the DIVA+ database (part of HC_DC service) for free use. The code is parallelized with OPEN-MP, each walker running on a dedicated thread. It naturally works in Jacobi coordinates, allowing to fit several nested orbits simultaneously and to fit individual masses. It has the possibility to run using Universal Keplerian Variables (Danby J.M.A., 1987, *Celest. Mech.* 40, 303; Beust H., 2016, *A&A* 587, A89), a reformulation of Kepler's equation that keeps the same form irrespective of the nature of the orbit (elliptic, parabolic, hyperbolic). This formulation appears to be particularly relevant to fit long orbits that are only partially monitored on one side of the orbit only, as this is often the case for long period companions. I show that the use of standard elliptic variable leads to a long computing time mostly dedicated to finding a extended tail of the posterior distribution where the observed part corresponds to periastron. Conversely, the use of Universal Variables allows to resolve this issue much more quickly, resulting in better convergence. I show a few application examples, namely concerning the GG Tauri triple system.