Physics of Planetary Systems — Exercises — Set 3

Problem 3.1 *(3 points)*

You can find an RV data set for the star 51 Peg (with $\mathscr{M} = (1.16 \pm 0.05)\mathscr{M}_\odot$) here: `https://cloud.uni-jena.de/s/253iTQjiGGnt5PQ`. Use these data to derive the system velocity, as well as the likely orbital period and the minimum mass of the companion. Plot a phase-folded RV curve, including your best fit. *Hint: the linked folder also contains pieces of Python code that you can use.*

Bonus problem 3.2 *(1 extra point)*

Give the uncertainty range for the mass estimate from Prob. 3.1.

Bonus problem 3.3 *(1 extra point)*

Why is the residual scatter in Prob. 3.1 wider than the nominal measurement uncertainties?

Problem 3.4 *(1 point)*

One of the assumptions in the classical theory of viscous accretion disks is that the sound speed is much lower than the Keplerian velocity. Check this with a direct estimate.

Bonus problem 3.5 *(2 extra points)*

The (inward) flow of mass per time at distance r in a viscous accreation disk is given by $\dot{\mathscr{M}}(r) = 2\pi r \Sigma v_r$, where Σ is the common surface mass density (i. e. mass per projected disk area) and v_r the radial drift velocity. Derive the rate (and direction) of the corresponding local flow of angular momentum. *Hint: assume conservation of angular momentum.*

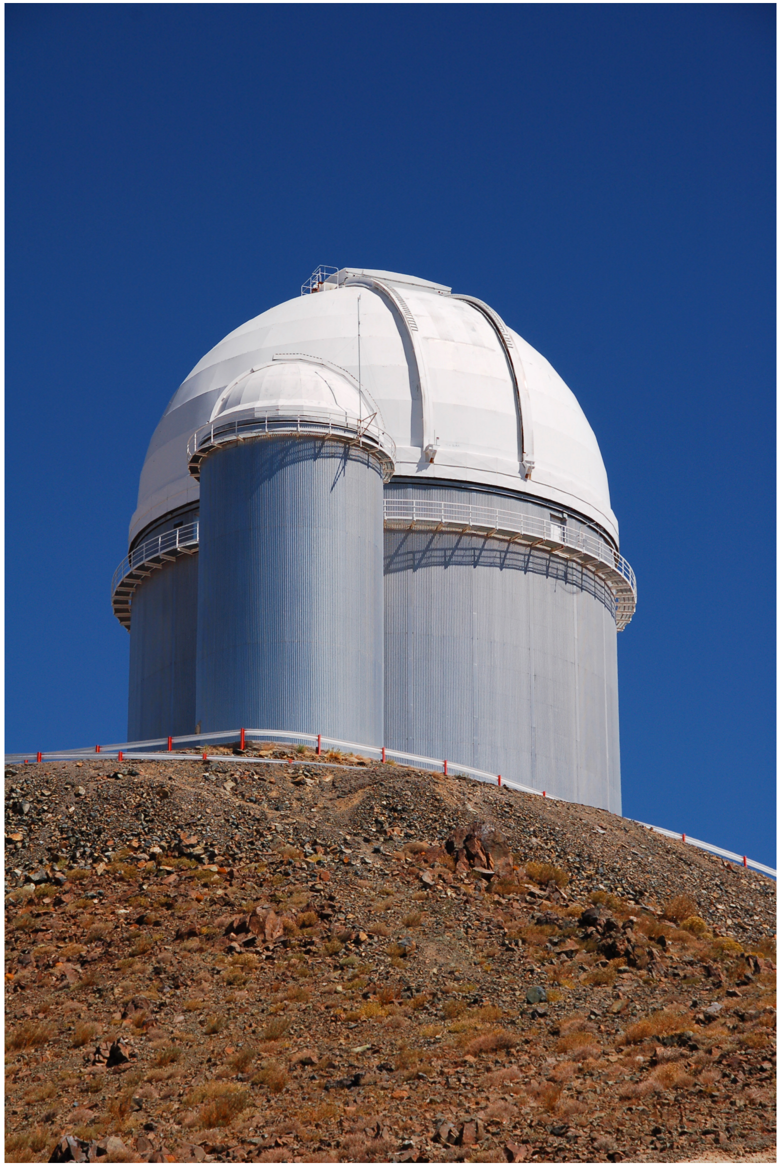

Figure 1: Host site to HARPS, the most successful radial velocity instrument: ESO's 3.6-m telescope on Mt La Silla, Chile. (Credit: ESO)

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