Project 1 - Radial Velocities

Part 3.

The goal of this exercise is to work with a contemporary RV-dataset and correctly identify as many planetary RV-signatures as possible. You saw last week that without a good initial guess for the planetary period, it is difficult find planets in RV-data. In research, a first search for possible RV-signatures is often done by looking at the Fourier transform of the data and identifying the temporal frequencies with most power. A challenge here is that RV-datapoints are usually non-equally spaced, which makes the application of most Fourier transform algorithms impossible. For this exercise, we want to utilize the Lomb-Scargle periodogram.

1. Plot the RV-data supplied in `mystery_system_rv.csv`. Can you guess why the dataset presents such significant jumps in the data? Think about a way to correct the data for these jumps. Can you already identify a periodic signal by eye?

2. Inform yourself about the Lomb-Scargle periodogram and compute it for the given dataset. You will quickly realize that the provided dataset is of a multiplanetary system. Try to identify a few candidate detections and note down guesses for their periods and RV semi-amplitudes. *Hint: Smoothing the* Lomb-Scargle periodogram *can help to identify candidates.*

Part 4.

We now want to confirm the candidate detections from Part 3 of the exercise. For this, we will utilize the state-of-the-art RV-fitting tool `RadVel`[1]. As this tool is used frequently in research, we supply you with a few pre-defined functions to ease the interaction with `RadVel`[2]. This exercise is meant to be an exploratory process to arrive at the following two goals:

1. Try to identify as many exoplanet signatures as you can. For each potential planet, note down your estimates for the minimum mass $m \sin(i)$[3], the period P and the eccentricity e. Are you more confident in some detections than others?

2. **(Bonus)** Can you determine the host-system by the properties of your planet candidates.[4]

Note *To receive feedback on your project work please upload it as a PDF-file to the moodle-course. In case you have any questions, please contact Komal Bali (kobali@phys.ethz.ch), Janina Hansen (jahansen@ethz.ch), and Sean Jordan (jordans@ethz.ch).*

[1] `https://radvel.readthedocs.io`
[2] In case you are interested, please feel free to look into the original code
[3] Host star mass $m_s = 0.97\,\mathrm{M}_\odot$, gravitational constant $G = 6.67 \cdot 10^{-11}\ \mathrm{m}^3/\mathrm{kg}/\mathrm{s}^2$
[4] Use `https://exoplanetarchive.ipac.caltech.edu` or `https://exoplanet.eu/home/`.