Physics of Planetary Systems — Exercises — Set 4

Problem 4.1 *(4 points)*

Analyse the light curve for the star TOI 715 ($\mathscr{M} = 0.23\mathscr{M}_\odot$). Overplot the phase-folded light curve with the model transit. Estimate the following quantities:

(a) transit duration,
(b) transit depth,
(c) orbital period of the planet candidate,
(d) orbital semi-major axis,
(e) stellar radius,
(f) transit probability,
(g) radius of the planet candidate,
(h) expected RV amplitude.

Hint: assume a circular orbit and an impact parameter $b = 0.2$. You can use this Python script for the data retrieval and analysis: `https://cloud.uni-jena.de/s/g2HNNqBaCGCXisc`.

Problem 4.2 *(3 points)*

Find *all* possible power-law stationary solutions for surface density Σ, temperature T, and viscosity ν of accretion disks. Which of them are physical and which are not?

Bonus problem 4.3 *(2 extra points)*

Estimate the sub-Keplerian rotation velocity v_ϕ ($< v_\mathrm{K}$) of a gas disk for stationary models where $T \propto r^{-\xi}$ and $\Sigma \propto r^{\xi-3/2}$.

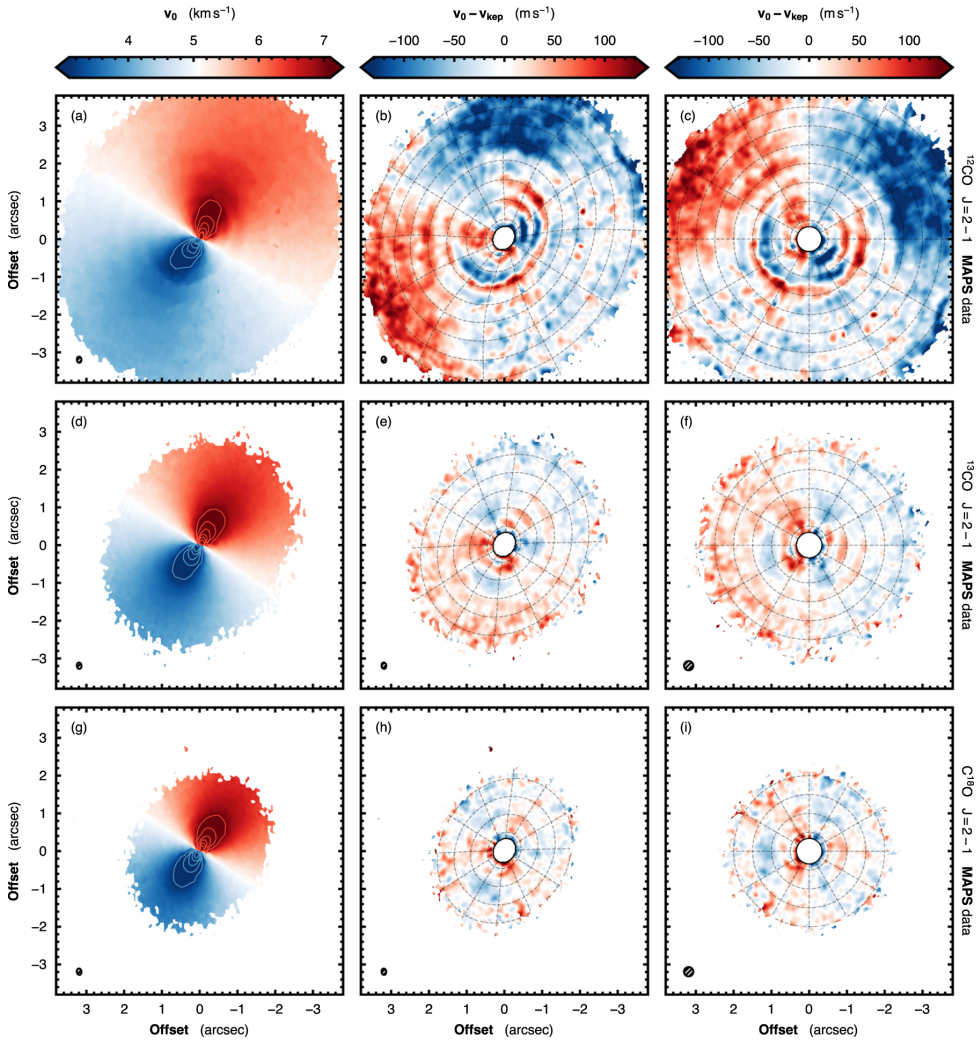

Figure 1: Velocity maps of different CO isotopologues around MWC 480: (left) pure velocities, (middle) differences to Keplerian velocities, (right) deprojected. (Credit: TEAGUE et al. 2021).

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