Evidence of rocky planet engulfment in the wide binary system HIP 71726-37

The Star-Planet Connection - ESO Workshop

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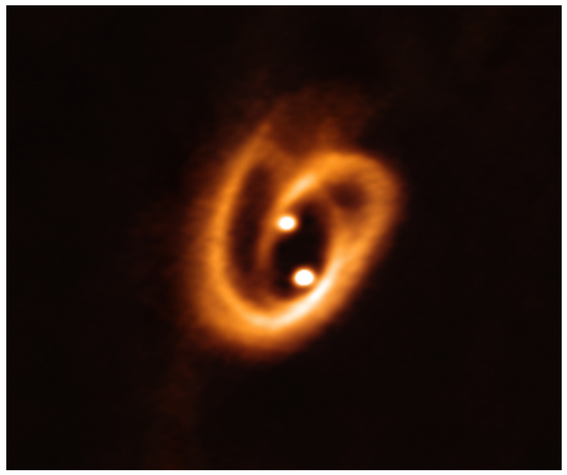
Binary Systems



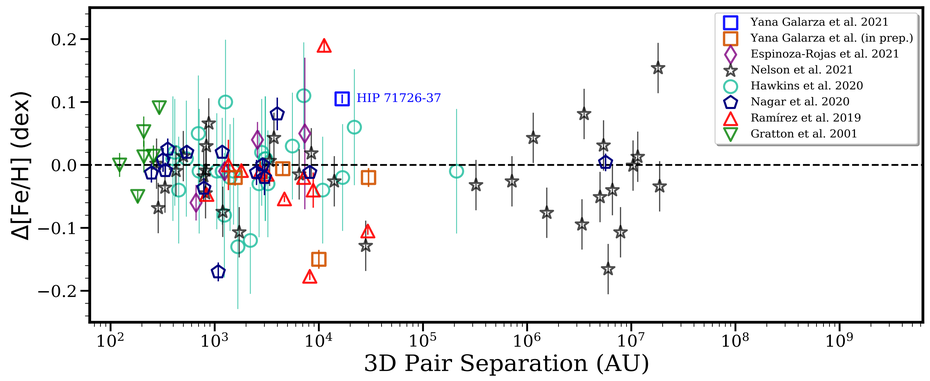
Credit: ALMA (ESO/NAOJ/NRAO)

Assumptions:

(1) Binary systems stars are formed at aproximately the same time (**coeval**) and from the same pre-stellar gas (**conatal**).

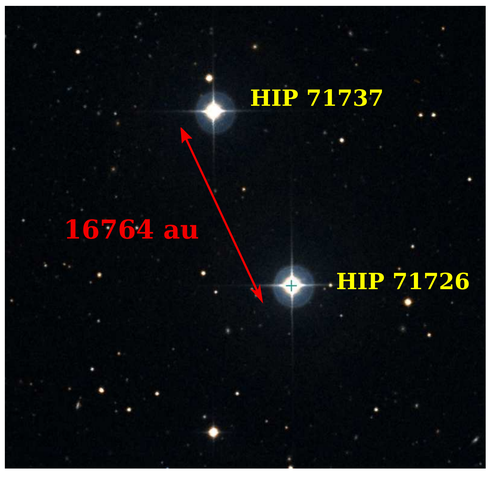
(2) If the assumption (1) is true, then the components of a binary system should be **chemically homogeneous**.

$$\Delta[\mathrm{Fe/H}] = [\mathrm{Fe/H}]_{\mathrm{A}} - [\mathrm{Fe/H}]_{\mathrm{B}} \sim 0.0 \text{ dex}$$



Most of the binary systems analyzed with high-resolution instruments (R > 60 000) are consistent to the level of 0.1 dex. However, whithin this level, some pairs have a large difference in Li abundance between the components, which may indicates a planet engulfment event.

The wide binary system HIP 71726/HIP 71737



Credit: Simbad

Observation and analysis

- Spectra (S/R = 350) obtained with the Robert G. Tull Coudé Spectrograph (R = 60 000) at the McDonald Observatory.
- Stellar parameters and chemical abundances determined through the differential technique.
- Ages and masses estimated using isochrones of stellar evolution.

Fundamental parameters

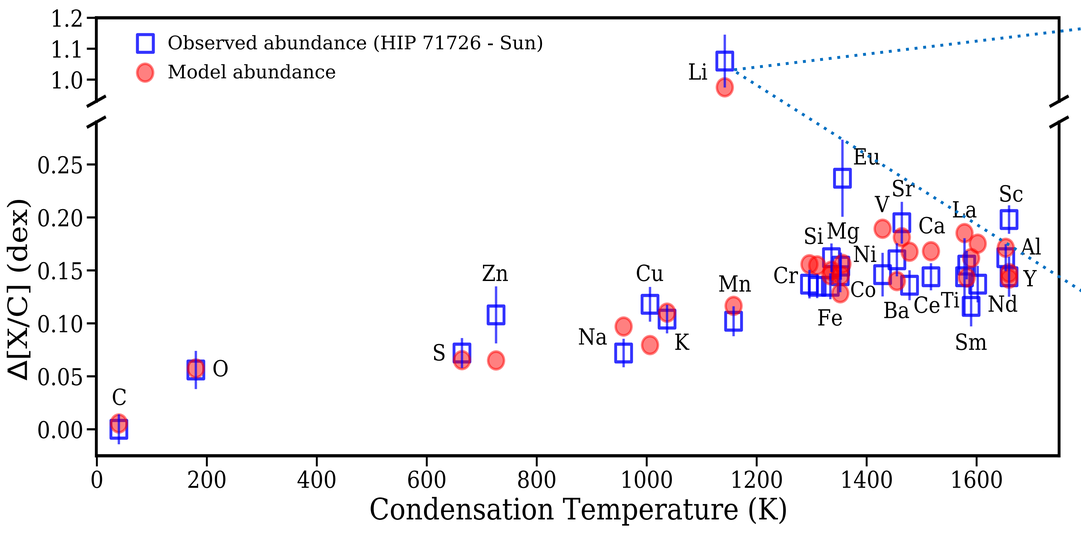
ID	Teff (K)	[Fe/H] (dex)	Log *g* (dex)	Age (Gyr)	Mass ($M_\odot$)
HIP 71726	5957 +/- 9	0.16 +/- 0.01	4.26 +/- 0.02	4.2 +/- 0.3	1.18 +/- 0.01
HIP 71737	5934 +/- 9	0.05 +/- 0.01	4.35 +/- 0.03	5.1 +/- 0.3	1.09 +/- 0.01
Difference	23	0.11	0.09	0.9	0.09

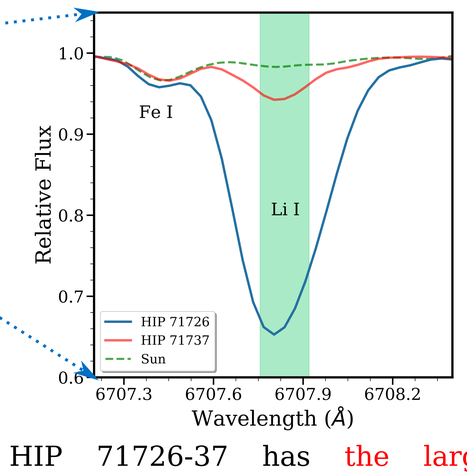
The components of HIP 71726-37 are chemically inhomogeneus at the level of ~0.1 dex.

The difference in age could indicate that the pair is not coeval. However, it is coeval when we adopt the median or the lowest [Fe/H] as the 'real' metallicity of the system in the age determinations.

Therefore, the system HIP 71726-37 is truly coeval and conatal!

Planet engulfment





HIP 71726-37 has the largest difference of Li (~1.0 dex) detected in twin-star binary systems!

Conclusions

- HIP 71726 is rich not only in refractory elements, but also in lithium abundance.
- A planetary engulfment of ~10 Earth masses reproduces well the abundance pattern of HIP 71726 and its high lithium abundance.
- Our results has important implications for studies of the evolution of planetary systems and chemical tagging.

More details in:
Yana Galarza et al. 2021, arXiv:2109.00679