Towards Stellar Obliquities: Recovering Stellar Inclinations via High Precision Astrometric Monitoring

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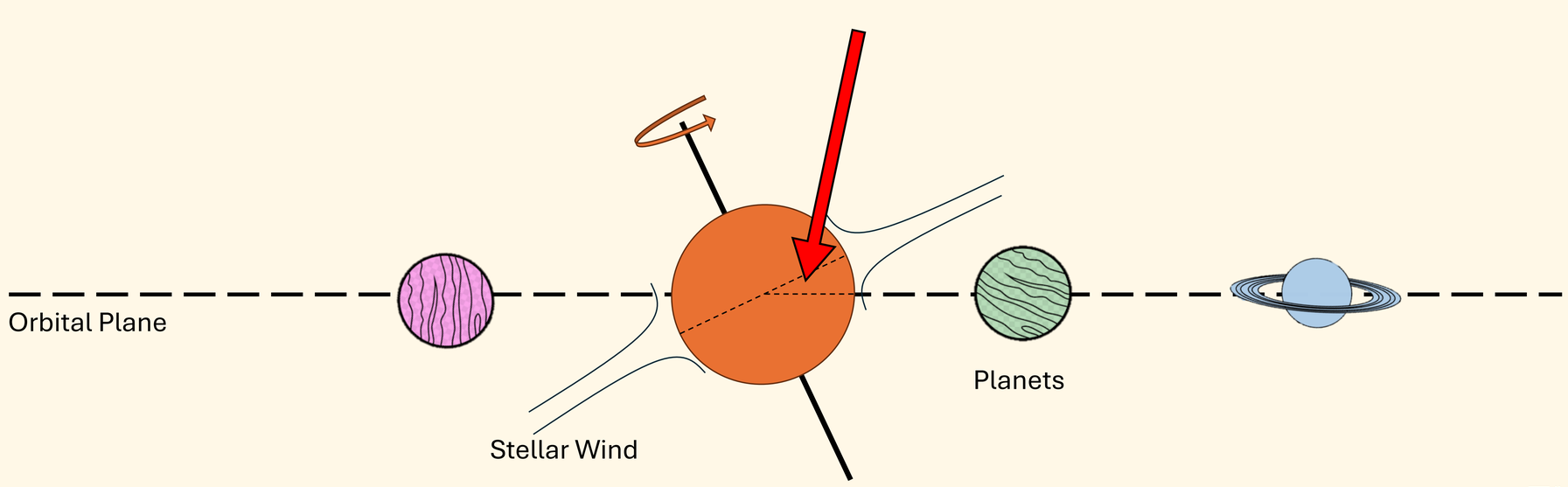


Figure 1

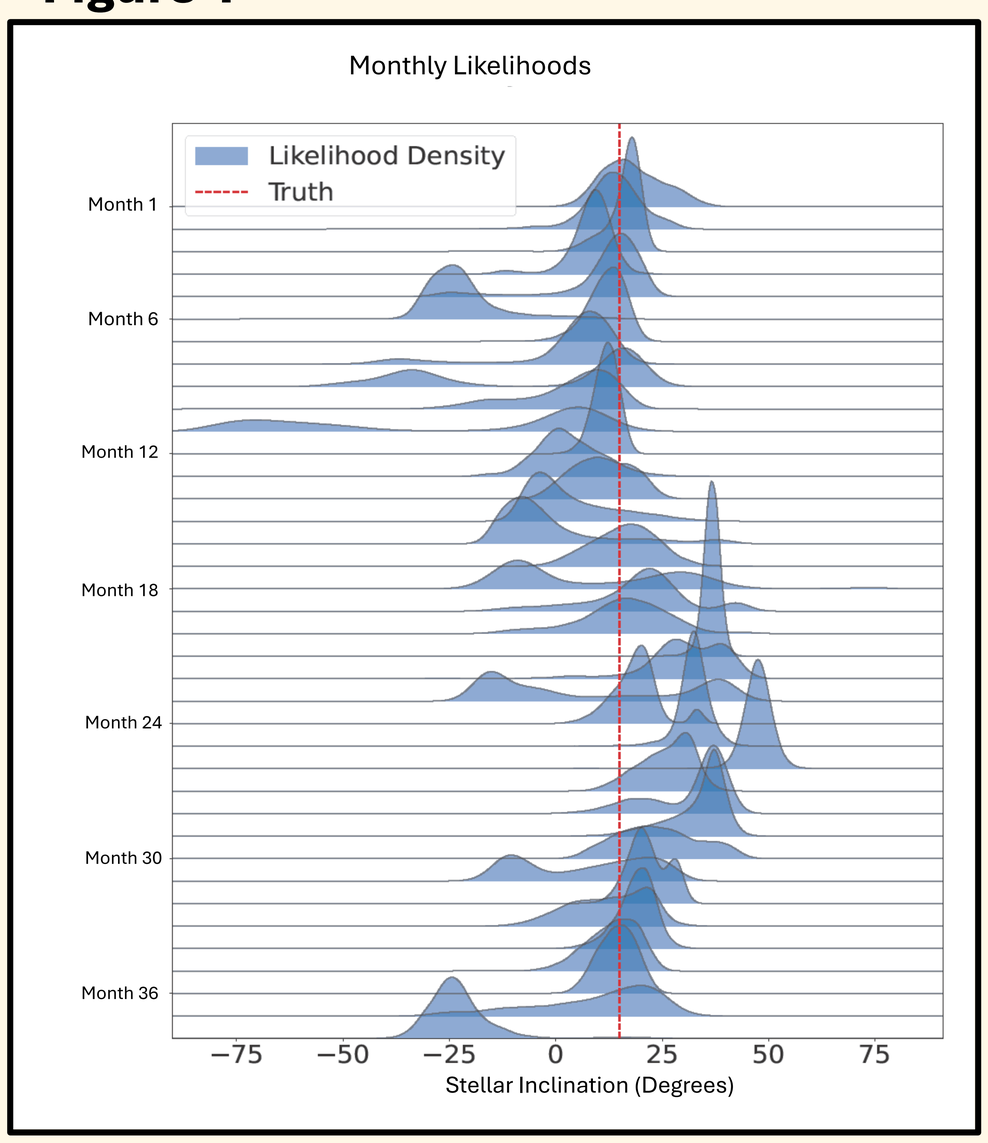


Figure 2

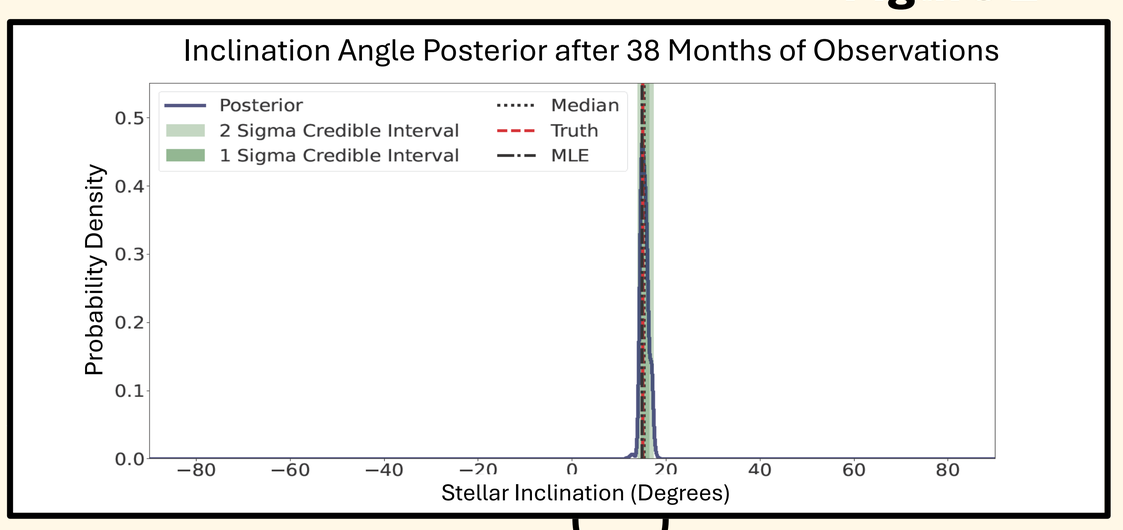
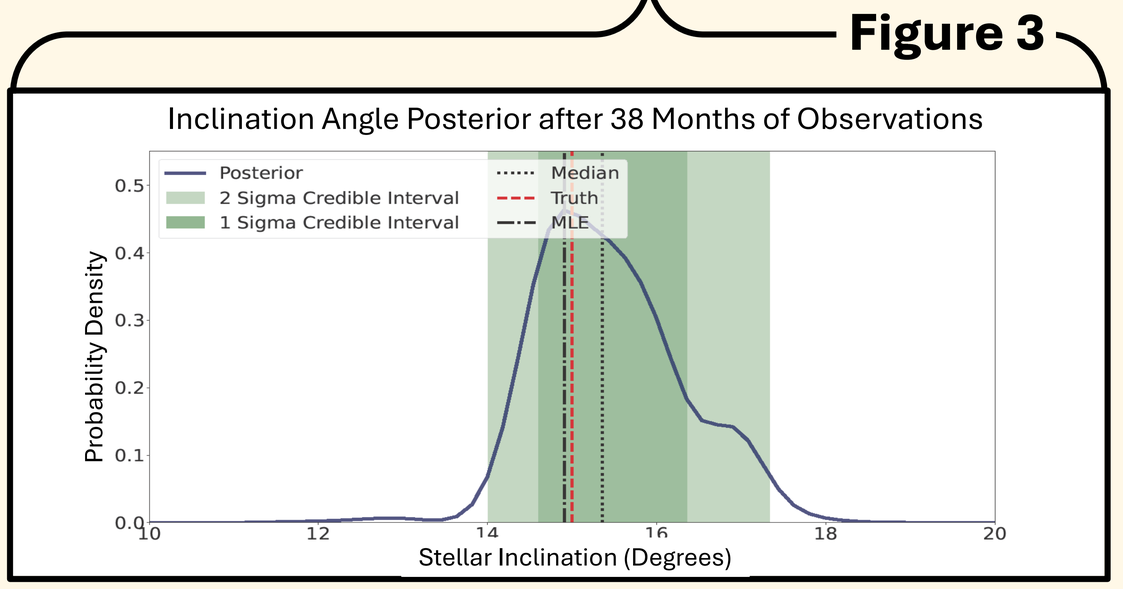


Figure 3



Why is stellar obliquity important?

The stellar obliquity is the angle between the stars' rotation plane, and the plane of rotation of the planets around it.

The bulk of **stellar wind** is emitted in a relatively thin disk from the star's equator. The obliquity determines what fraction of each planet's year is spent within the wind / heliospheric current sheet, which has major impacts on the **habitability** of the planets due to periodic changes in incident radiation and atmosphere loss rates. Additionally, The changing space-weather environment around exoplanets likely has a significant impact on atmospheric chemistry.

How is it possible to recover obliquities and inclinations?

The upcoming **TOLIMAN** space telescope is designed to find exoplanets around **Alpha Centauri (A&B)** using astrometry and has a precision of better than 1 micro-arcsecond. This level of precision means that astrometric deflections induced by **starspots** rotating across the face of the star are detectable.

Using Bayesian forward modelling, parameters such as the stellar inclination and the size and distribution of starspot groups can be recovered. Additionally, if exoplanets exist around Alpha Centauri, astrometry can give full orbital solutions, allowing for the stellar obliquity to be calculated.

We can infer inclination

Each month of observations provides a weak constraint on the stellar inclination posterior (Figure 1). Combining 3 years of observations (the expected TOLIMAN mission length) **gives a stellar inclination posterior to a precision of better than 1 (4) degree(s) at the 68% (95%) credible interval. (Figures 2 & 3).**

Future work

Current work with this model includes looking at recovering the size and distribution of starspot groups, investigating how different levels of stellar activity affect parameter recovery, if it is possible to recover active latitude bands, and seeing if differential rotation is detectable. These will all give insights into **stellar dynamos.**

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