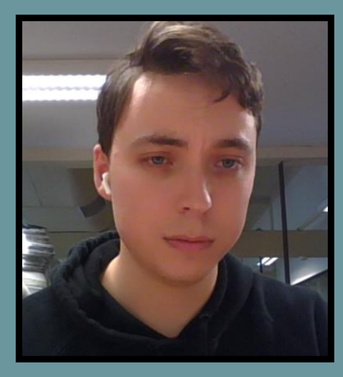
Recovering Stellar Inclination with High Precision Astrometry

By Conaire Deagan

That's me

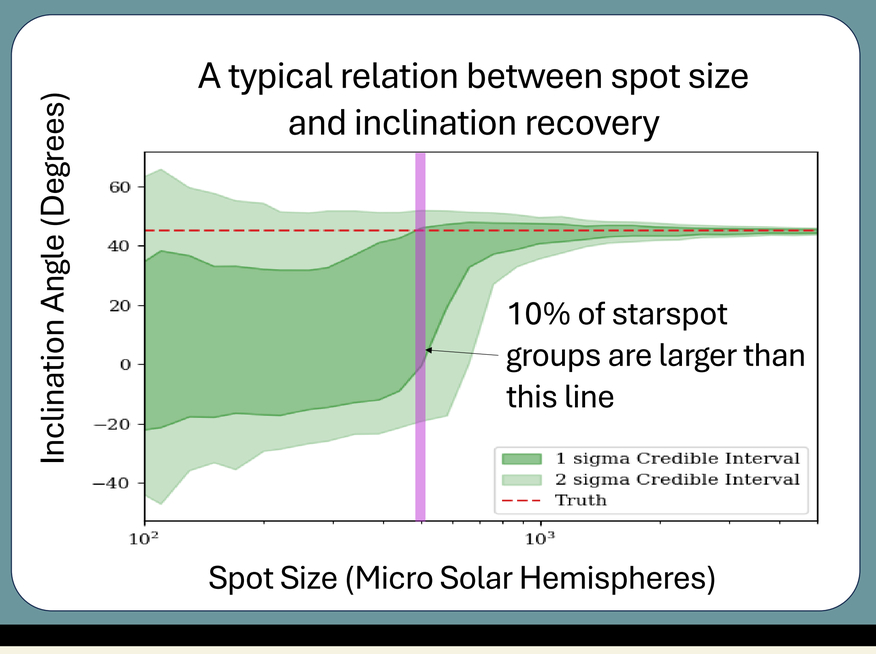


I: We can learn about stellar surfaces by monitoring astrometric signals induced by starspots

The astrometric position of nearby stars has stellar activity induced jitter, on the order of **sub-micro arcseconds**. This jitter is primarily due to starspots. New technologies, such as the **TOLIMAN** space telescope, in combination with compute intensive simulations can measure this jitter and infer properties of the star itself.

One important property is the **stellar inclination angle** – the angle between the stars rotational plane and the orbital plane of surrounding planets. This is important because this plane is where the **heliospheric current sheet** is located, and hence where the bulk of energetic particles are emitted. This will therefore determine the intensity and periodicity of **planetary bombardment** of energetic particles, which has severe impacts on habitability.

Below is a demonstration of how a single rotation with a starspot present can constrain this stellar inclination angle.



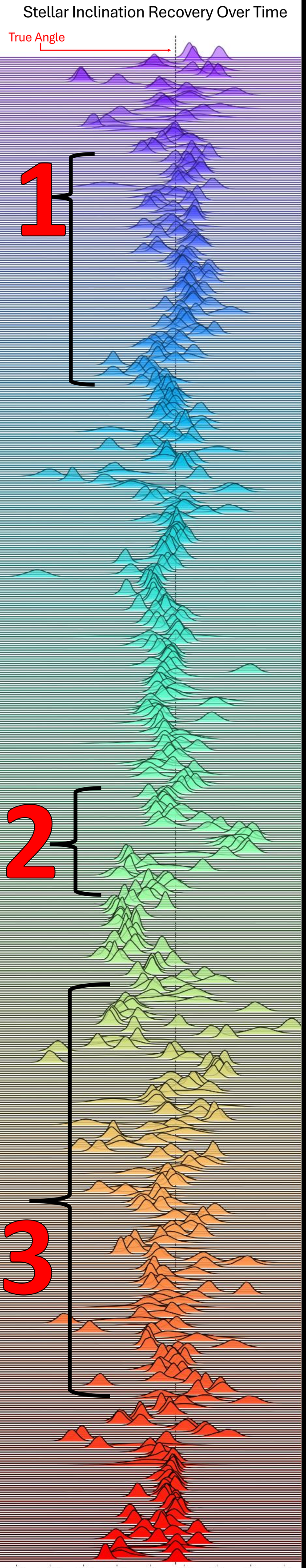
II: Short Term stellar activity affects recoveries

The diagram on the left shows the likelihood distribution of the stellar inclination angle. Each density is the likelihood for each subsequent rotation. The accuracy of recovery depends on the complexity of the starspot distribution, and the complexity of the model.

1 Most of the time, the starspot distribution on the stellar surface is simple, and recovery is consistently good.

2 Occasionally, complex starspot distributions (or small signals) can inhibit recovery for insufficiently complex models. These periods are often short lived, and usually less than mission lifetimes. More complex models improve recovery but get exponentially more computationally expensive.

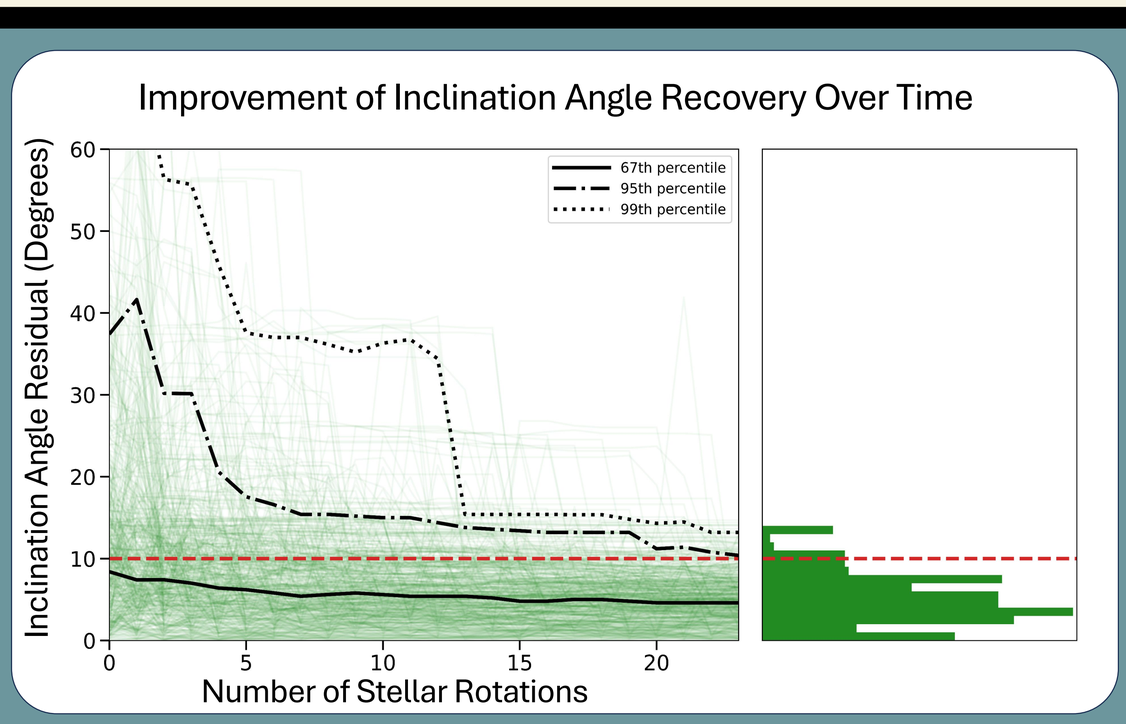
3 During periods of less stellar activity, where starspots are smaller and less frequent, the ability to recover the signal is impeded and the likelihood range is extended (i.e. more uncertainty on results).



III: Longer observations means better recovery

Combining the likelihood of subsequent observations improves recovery of stellar inclination angle. This depends heavily on starspot size and frequency distributions. **If you would like to know more, ask me!** The starspot distribution used in these simulations are reasonable.

For a reasonable observation period, **>95% of the time, the angle can be recovered to within than 10 degrees.** >67% of the time, it is within than 5 degrees



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