**The β Pictoris System**

- β Pictoris b (~10 M⊕) is likely inducing a warp in the debris disk
- Planet’s orbit gives insight on disk dynamics, dynamical history, and possible unseen planets
- Possibly the first directly-imaged exoplanet to also transit
- Gemini Planet Imager (GPI) astrometric monitoring program (PI: Graham) to constrain orbit of β Pic b so far has two years of data

**Problem: PSF Subtraction Distorts Planet’s PSF**

- Traditionally, distortion of the planet PSF is a nuisance term that needs to be calibrated by repeating the analysis with fake planet injections

**KLIP-FM Computes the Distorted PSF**

- The existence of the planet PSF in the reference PSFs will cause the planet to appear in the model and subtract itself
- Effect can be calculated analytically with KLIP-FM developed by Pueyo[3] (see poster 138.01)
- pyKLIP: Open-source implementation of KLIP and KLIP-FM

**Technique Validation through Orbit Fitting**

- We measure the position of β Pic b in seven GPI datasets, combine with previous astrometric data, and fit an orbit (following the analysis in Millar-Blanchaer et al.[5])
- Orbit should follow Keplerian motion, so residuals will reveal any potential systematic errors and validate our calculated uncertainties

**Astrometry using Forward Models, MCMC, and Gaussian Processes**

- Self-subtraction effects actually give us information on the location of the planet, so we can use our forward models to derive better astrometry
- Markov-Chain Monte Carlo (MCMC) gives the posterior of possible positions of the planet
- Gaussian processes necessary to model the correlated nature of the noise and for accurate estimation of the statistical errors

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**References:**