# **ORBITS FOR THE IMPATIENT**

a Bayesian Rejection-sampling Algorithm for Rapidly Fitting the Orbits of Long-period Exoplanets

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# **Direct Imaging Reveals Orbital Motion**

http://www.manyworlds.space/wp-content/uploads/2017/01/BVXrHQM-Imgur.gif

## **Orbit Fitting Lets Us Study Planets & Planet Formation**



 $\Omega$  (deg)

T₀

# Orbit Fitting Algorithms: the Industry Standard

# Markov Chain Monte Carlo (MCMC)

http://blog.revolutionanalytics.com/2013/09/an-animated-peek-into-the-workings-of-bayesian-statistics.html

\*\* awesome gif from blog.revolutionanalytics.com

# The Problem

MCMC algorithms take too long to converge when accessible astrometry covers a short fraction of the total orbit.



# The Solution

#### Orbits for the Impatient (OFTI)



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#### **OFTI** Advantage Over MCMC



# OFTI uses Independent Steps, while MCMC uses Correlated Chains



#### Science with OFTI: HD 95086 b



# Simulations with OFTI: WFIRST Discoveries



# Future Hacks and Science

- more orbits
- more simulations
- the eccentricity distribution of Brown Dwarfs
- add systematics parameters
- fit radial velocity & imaging combined datasets
- explore Nyquist sampling problems for smaller orbital periods (Eric already working on this)
- ...and much much more!

# What can OFTI do for you?

# References

# Overview:

• AJ, Blunt+ 2017

# Similar Techniques:

- ApJ, Ghez+ 2008
- ApJ, Konopacky+ 2016
- ApJ, Price-Wheelan+ 2017

# Science Papers:

- AJ, Nielsen+ 2017 (submitted)
- AJ, Ngo+ 2017
- AJ, Johnson-Groh+ 2017
- ApJ, Bryan+ 2016
- ApJL, Rameau+ 2016
- ApJL, De Rosa+ 2015





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