Eccentricity Distribution of Short-Period Exoplanets

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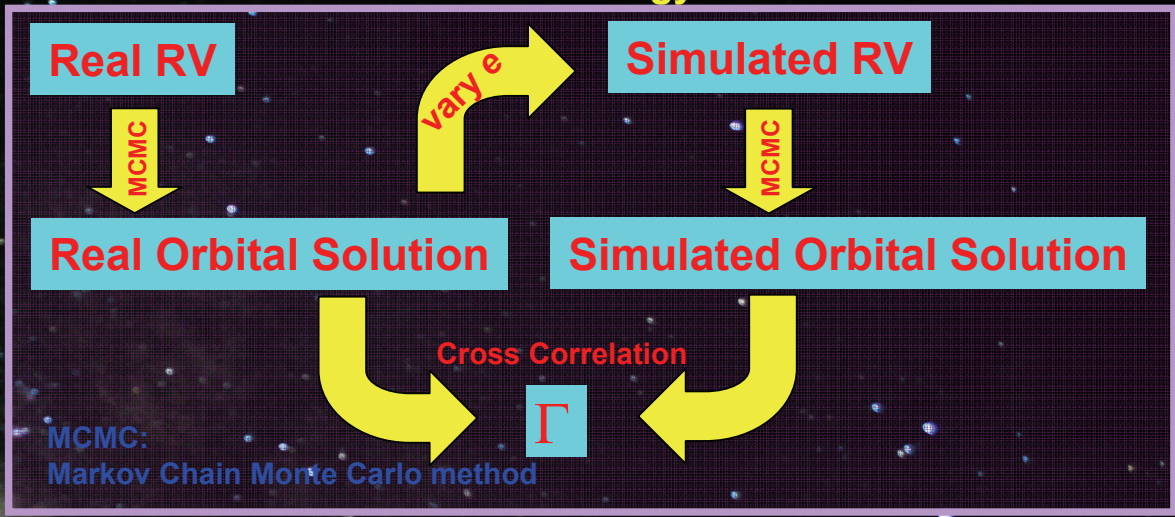
Introduction

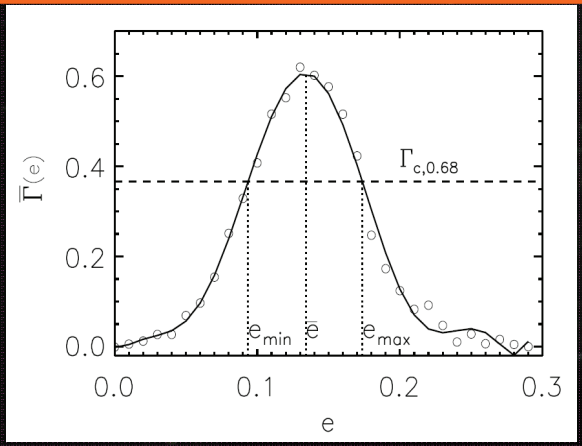
We apply standard MCMC analysis for 50 short-period, single-planet systems discovered with radial velocity technique. We develop a new method for accessing orbital eccentricity, namely Γ analysis, which combines frequentist bootstrap approach with Bayesian analysis of each simulated data set. We use a Bayesian population analysis to show that a mixture of analytical distributions is a good approximation of the underlying eccentricity distribution. For short-period planets, we find the most probable values of parameters in the analytical functions given the observed eccentricities. These analytical functions can be used in theoretical investigations or as priors for the eccentricity distribution when analyzing short-period planets. As the measurement precision improves and sample size increases, the method can be applied to more complex parametrizations for the underlying distribution of eccentricity for extrasolar planetary systems.

Methodology



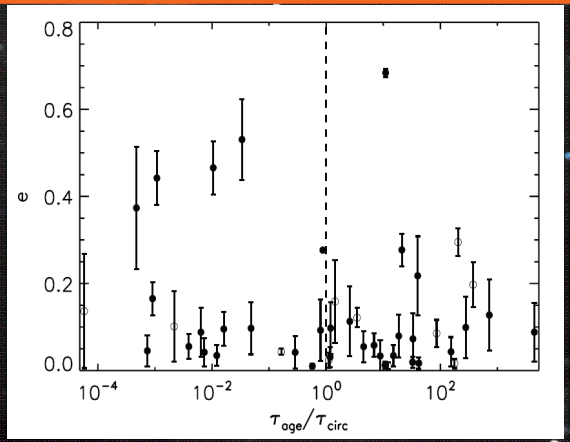
Result

a)



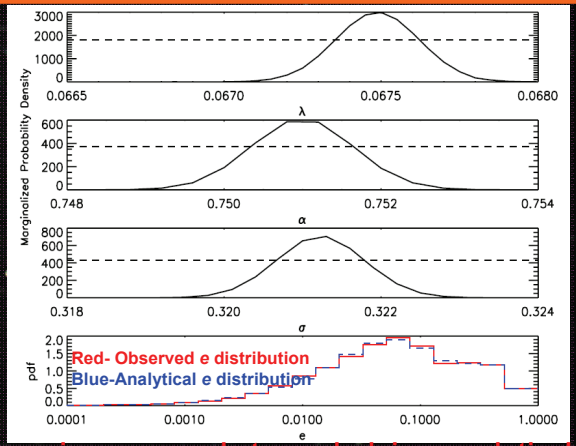
Example of HD 68988 b

b)



Indication of Tidal Effect:
e - τ_{age} / τ_{circ} distribution

c)



Bayesian approach to underlying analytical e distribution for short-period exoplanet systems:

$$f(e|\alpha,\beta,\sigma)=\alpha\cdot f_{Exponential}(e|\beta)+(1-\alpha)\cdot f_{Rayleigh}(e|\sigma)$$