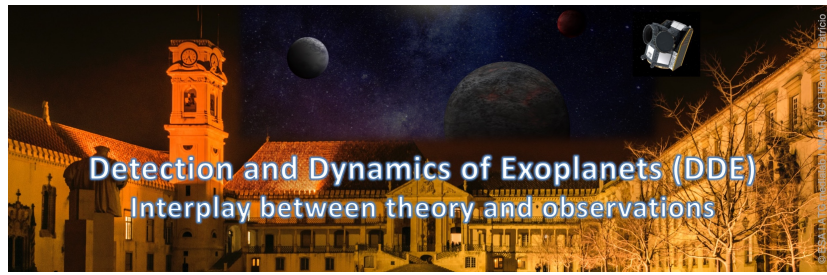


Detection and Dynamics of Exoplanets (DDE): Interplay between theory and observations



Contribution ID: 24

Type: **not specified**

From Tides to Currents: Unraveling the Mechanism That Powers WASP-107b's Internal Heat Flux

Thursday, July 10, 2025 2:45 PM (15 minutes)

The sub-Jovian exoplanet WASP-107b ranks among the best-characterized low-density worlds, featuring a Jupiter-like radius and a mass that lies firmly in the sub-Saturn range. Recently obtained JWST spectra reveal significant methane depletion in the atmosphere, indicating that WASP-107b's envelope has both a high metallicity and an elevated internal heat flux. Together with a detected non-zero orbital eccentricity, these data have been interpreted as evidence of tidal heating. However, explaining the observed luminosity with tidal dissipation requires an unusually low tidal quality factor of $Q \sim 100$. Moreover, we find that secular excitation by the RV-detected outer companion WASP-107c, generally cannot sustain WASP-107b's eccentricity in steady state against tidal circularization. As an alternative explanation, we propose that Ohmic dissipation—generated by interactions between zonal flows and the planetary magnetic field in a partially ionized atmosphere—more naturally maintains the observed thermal state. Under conservative assumptions for the field strength, atmospheric circulation, and ionization chemistry, we show that Ohmic heating readily accounts for WASP-107b's inflated radius and anomalously large internal entropy. In light of this result, tidal mechanisms need not contribute significantly to WASP-107b's present-day energy budget, reconciling the tension between the system's age and measured eccentricity with a tidal quality factor $Q > 10,000$.

Presenter: BATYGIN, Konstantin (Caltech)

Session Classification: Star-planet interactions and exoplanets' characterization