Variable Tidal Dissipation From Exoplanet Observations

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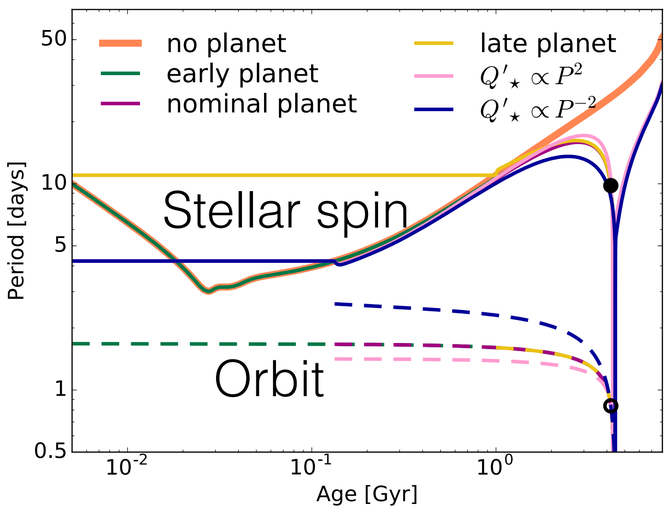
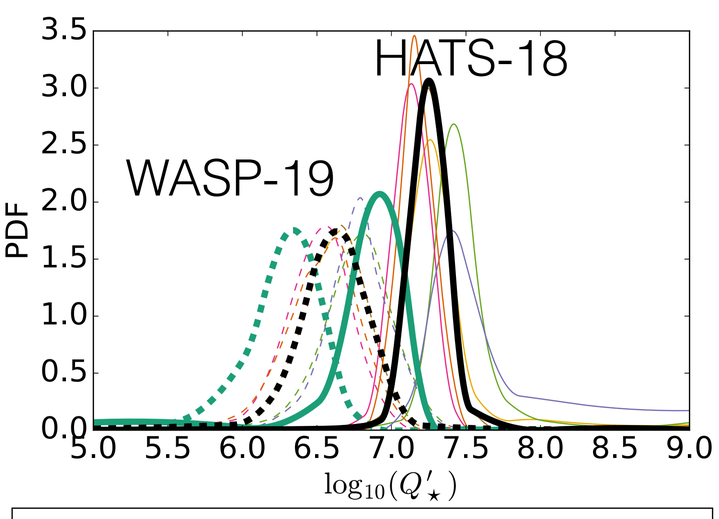
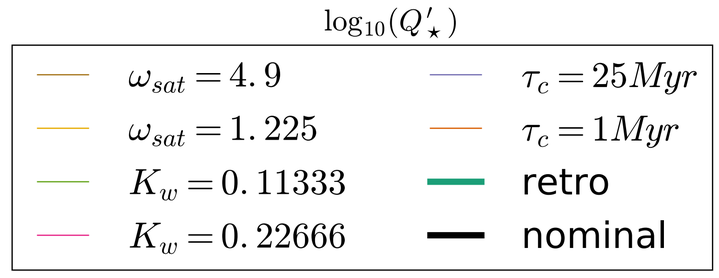
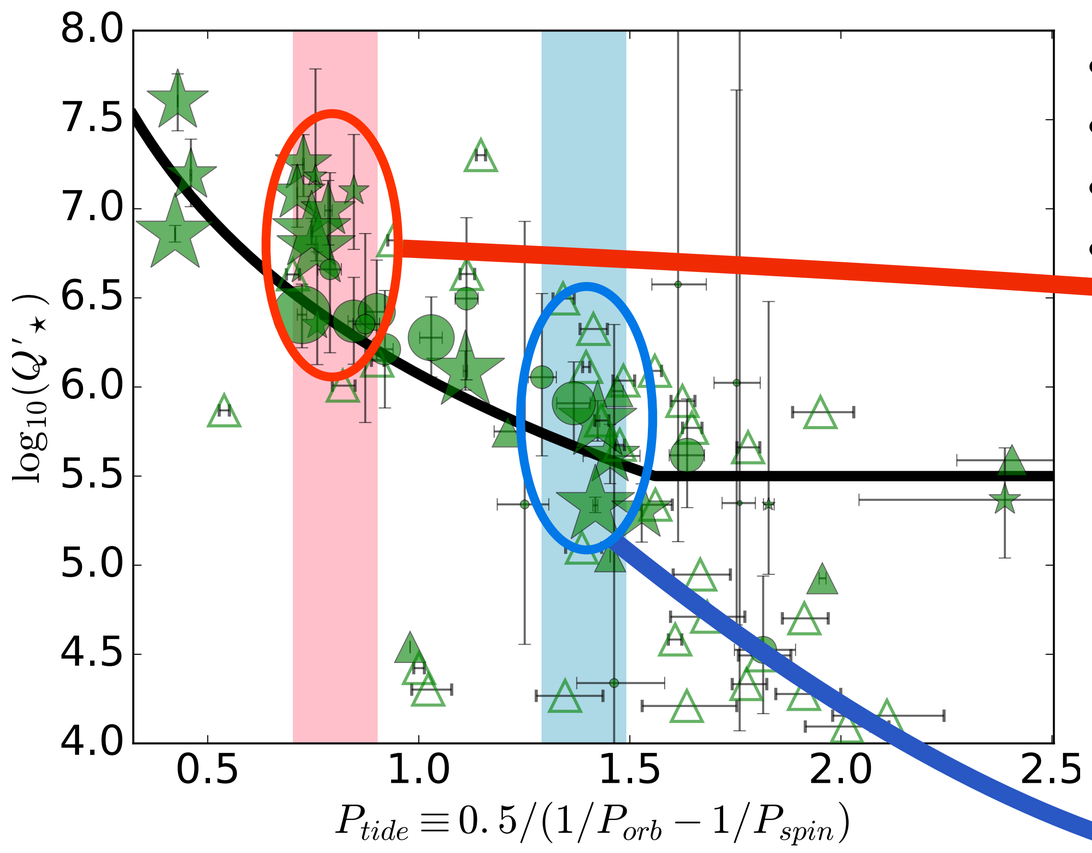
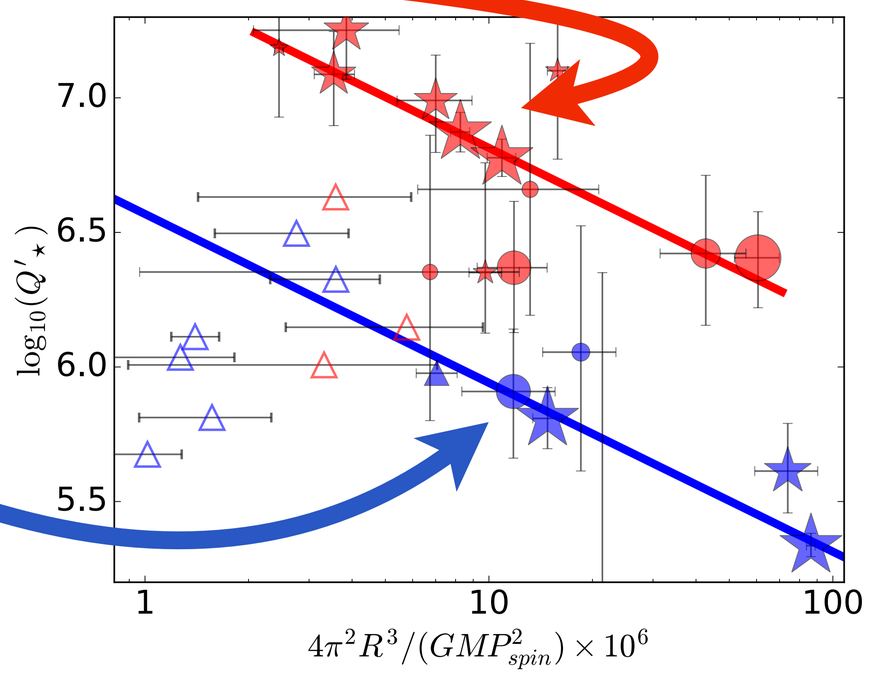






- Many exoplanet hosts spin faster than single stars of the same age.
- Initial differences in spin get wiped out by magnetic wind spin-down.
- Tidal coupling with planetary orbit naturally provides angular momentum.
- Amount of spin-up probes present-day tidal dissipation in the star.
- Very weak sensitivity to:
  - Planet formation mechanism and initial conditions.
  - Spin-down model parameters.
  - Possibly different dissipation in the past





- Repeat for all systems with P_{orb} < 3 days
- Systems with similar tidal frequencies give similar $Q'_\star$
- Strong frequency dependence
- Even suggested dependence on stellar spin

- At short tidal periods match constraints from exoplanet inspiral.
- At long periods match constraints from binary star and exoplanet circularization.
- In misaligned systems, many tidal frequencies are active simultaneously
  - Obliquity dissipates due to term with $P_{tide} = P_{spin} / 2$
  - Orbit decays due to term with $P_{tide} = P_{orb} / 2$
- The frequency dependence above explains observed obliquities with no free parameters

Fraction of initial orientations that end up aligned