MODELING THE MORPHOLOGY OF WHITE-LIGHT FLARES

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MAIN TAKEAWAYS

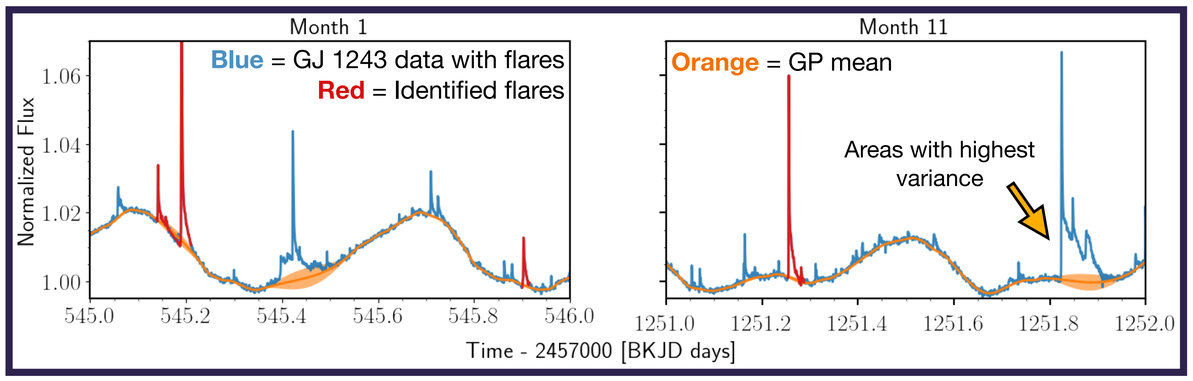
- **We present an updated analytic and continuous flare template to describe the morphology of white-light flares on active stars. Open source flare template coming soon (Tovar Mendoza et al. *in prep*)**
- **Our flare template can be used to model photometric flare data at different time cadences and from various telescopes (e.g *Kepler, TESS)*.**
- **We compare *TESS* 20-sec, 2-min, and 10-min flare data and find finer stellar flare structure is revealed in the shorter cadence data.**

WHITE-LIGHT FLARES: GJ 1243

- We revisit the benchmark dM4e flare star GJ 1243 (Hawley et al. 2014) and use 11 months of *Kepler* Data Release 25, 1-minute data for our analysis.
- We vetted the Davenport et al. (2014) flare sample and used 404 classical (single-peak) flare events to construct the new flare template.

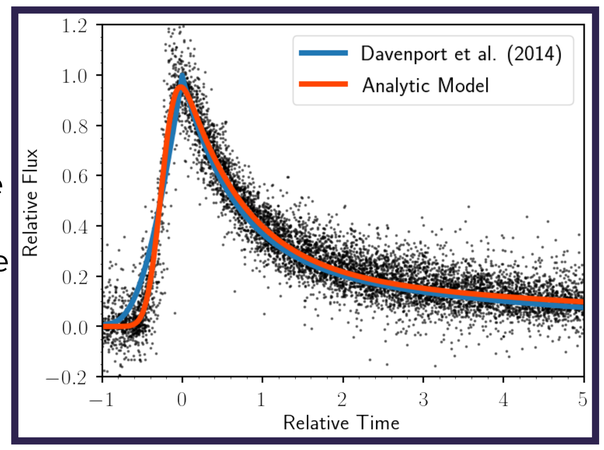
MODELING STARSPOT VARIATIONS

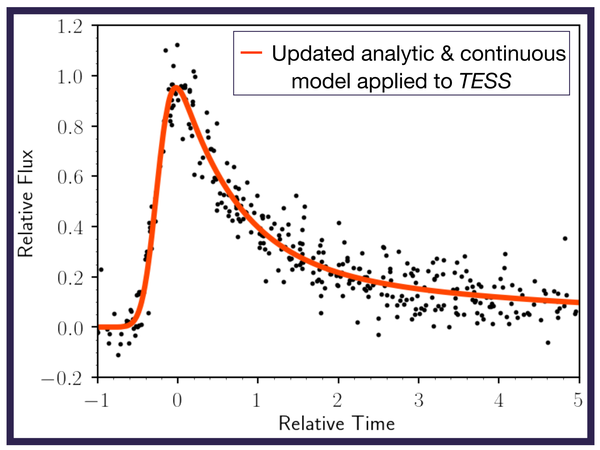
- Gaussian Processes (GPs) have been used to model stochastic variability in light curves. Here we use a simple harmonic oscillator kernel (Foreman-Mackey 2018) to robustly model the starspots on GJ 1243.
- We mask out the underlying flares in the light curve to prevent the GP from being skewed by frequent flaring events. We expect the GP to have the highest variance in areas where flares occur.



FLARE TEMPLATE

- Previous studies have shown flares have a time dependent profile and have derived an empirical template (Davenport et al. 2014).
- However, the model is based on a piece-wise function that creates a discontinuity at the flare peak & systematically under samples the peaks of flares.
- By using a vetted flare sample + GP starspot detrending + new parameterization (Jackman et al. 2018) the updated template addresses the limitations of the previous model.





- We use GJ 1243 data from *TESS* sectors 14 & 15 to identify 25 classical flares.
- Each flare is scaled to a relative amplitude, peak and timescale.
- Our flare template can be used across different data sets and to model flares at different time cadences.
- New model uses a convolution of a gaussian and double exponential to model the heating and two-phase cooling portions of flare events.

FLARES AT VARIOUS CADENCES

- We apply our model to *TESS* data and fit a flare on the M3.5 star at various cadences.
- We note the 20-sec data provides more resolution, revealing more flare structure. Meanwhile, long cadence data provides less resolution and can obscure our ability to differentiate between classical and complex flares.