Characterizing Stellar Flares in Ariel Targets: Activity Analysis and Transit Contamination

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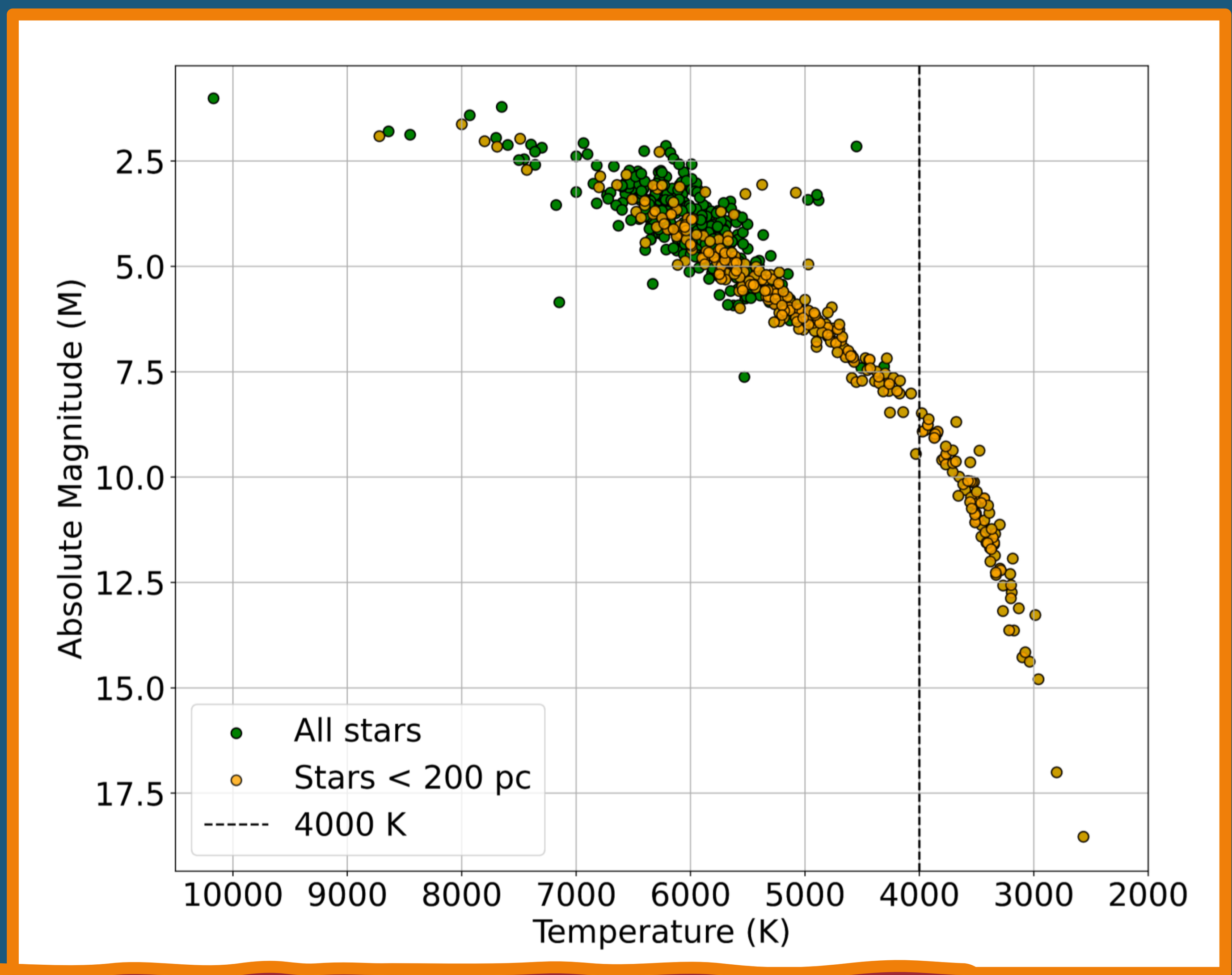
Goal

The objective of this work is to investigate stellar flaring activity in the confirmed exoplanet host stars of the Ariel Mission Consolidated Sample (MCS, July 2024 release, Edwards et al. 2022), with the aim of assessing flare probabilities during transit spectroscopy.

Method

Sample: 290 stars within 200 pc from the MCS with a TESS counterpart.



Flare identification and characterization

Bolometric luminosity computed using the tool VOSA (Virtual Observatory SED Analyzer) (Rodrigo et al. 2020).

Method based on Colombo et al. (2022) and G. Galletta et al. (2025):

- Identify and remove the contributions of long-term stellar variability on the lightcurve.
- Recognize impulsive events having properties typical of flares.
- Calculate amplitudes, time scales, and amounts of energy emitted.
- Calculate the slopes and the energy break of the cumulative curves.
- Calculation of GF.01 index:

$$GF.01 = \frac{0.1 - q}{m} / L_{bol}$$

Transit probability

The probability of observing at least one flare during a single transit visit is then given by

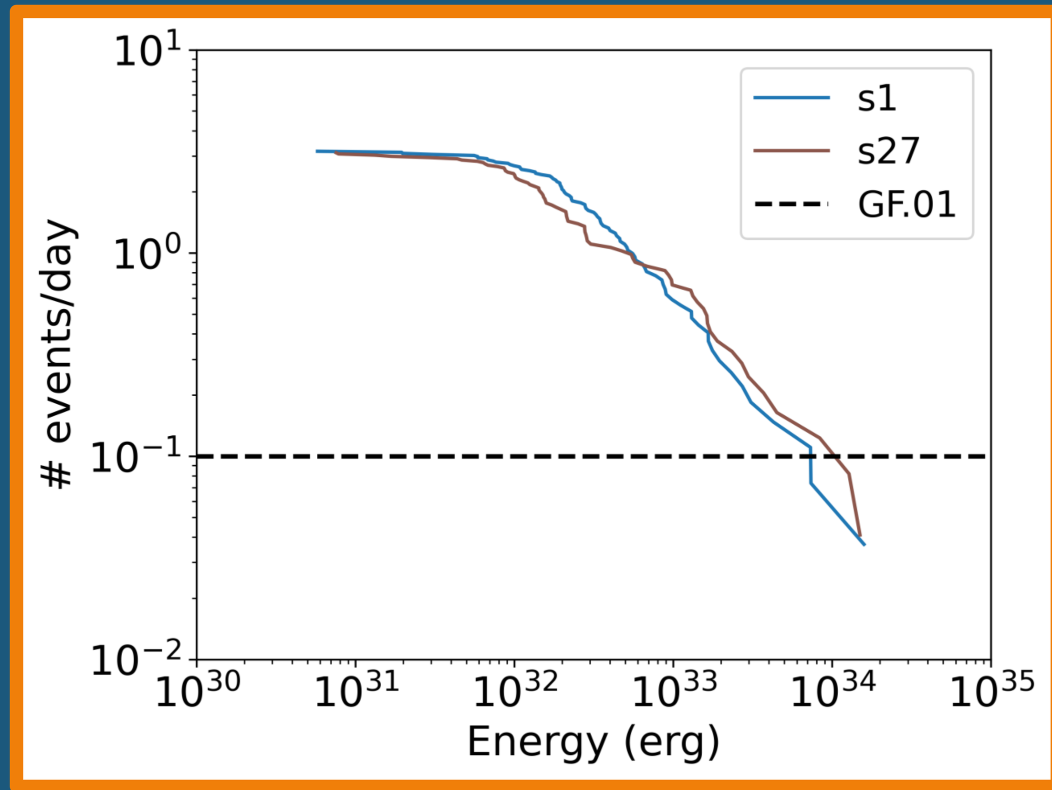
$$P_{flare} = (1 - e^{-\lambda}) \times 100$$

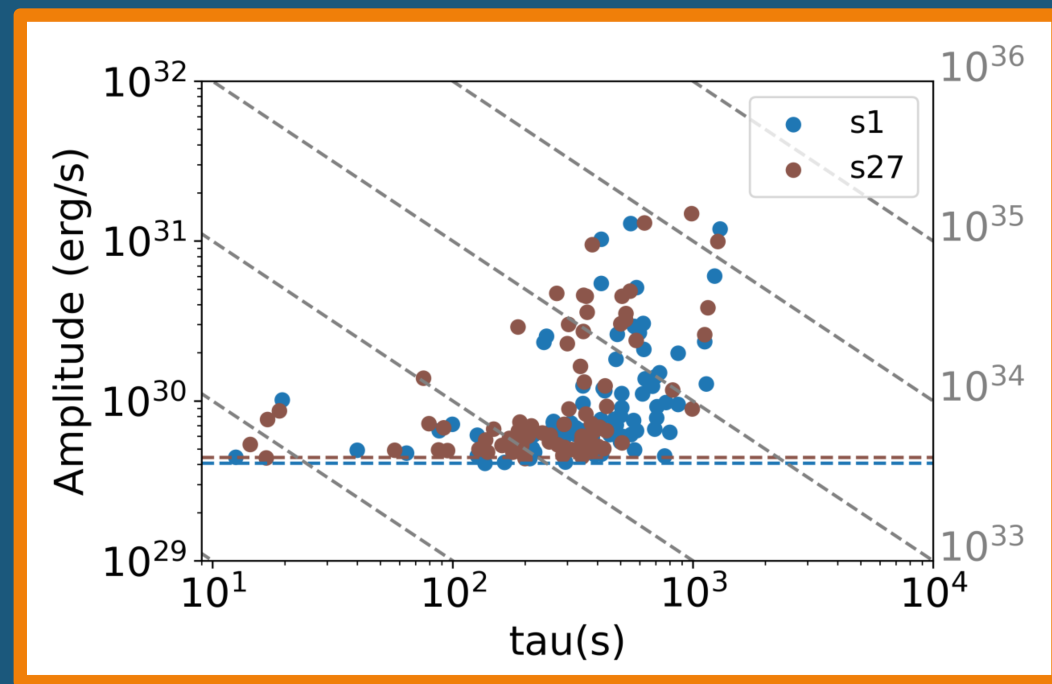
Where:

$$\lambda = rate \times t_{window}$$

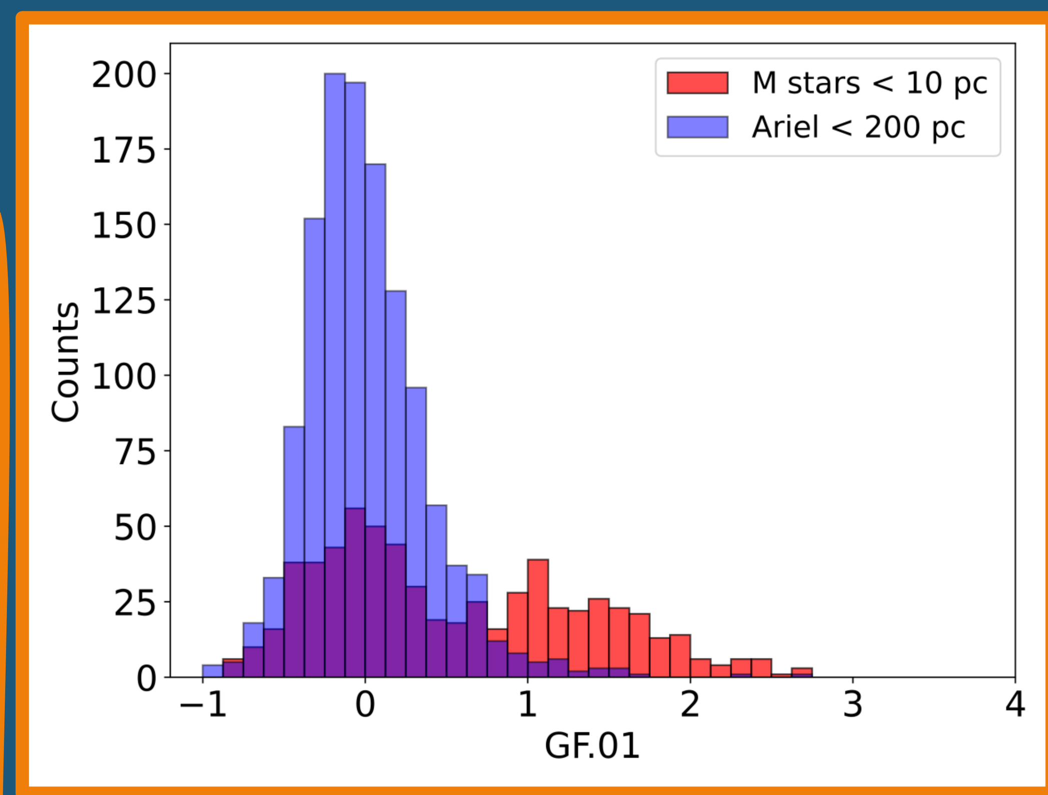
Results

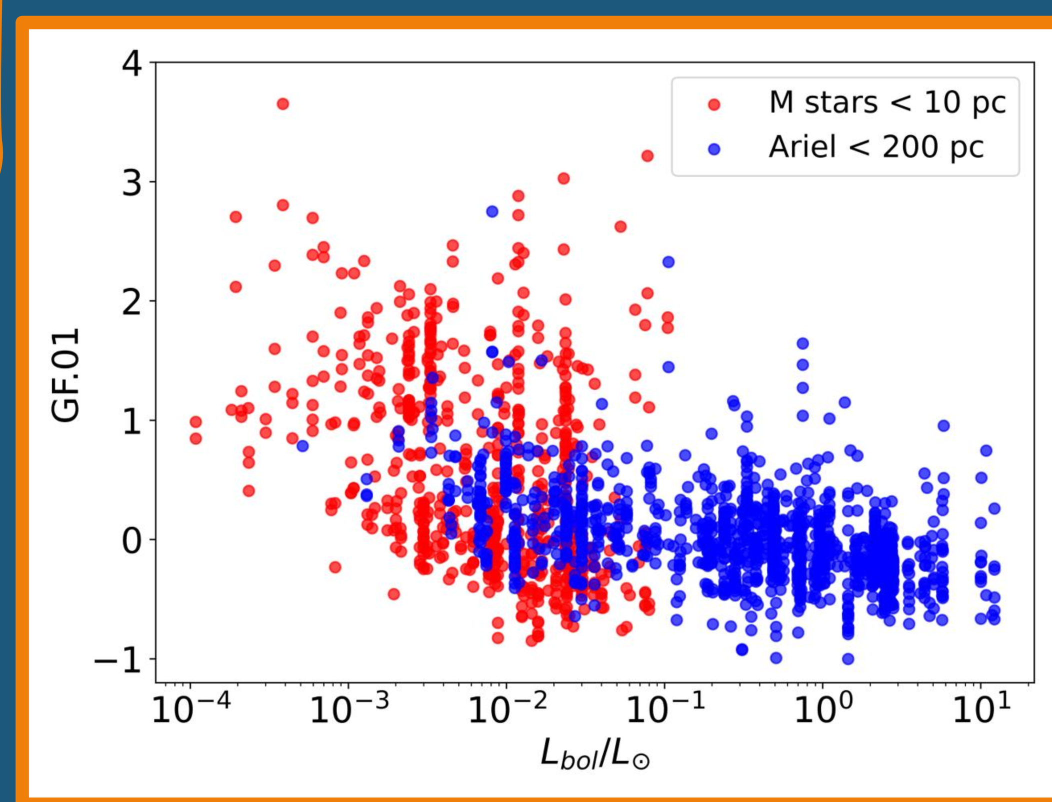
Cumulative distribution of number of flares per day as a function of flare energy for AU Mic. The dashed horizontal line marks the level used to estimate GF.01.





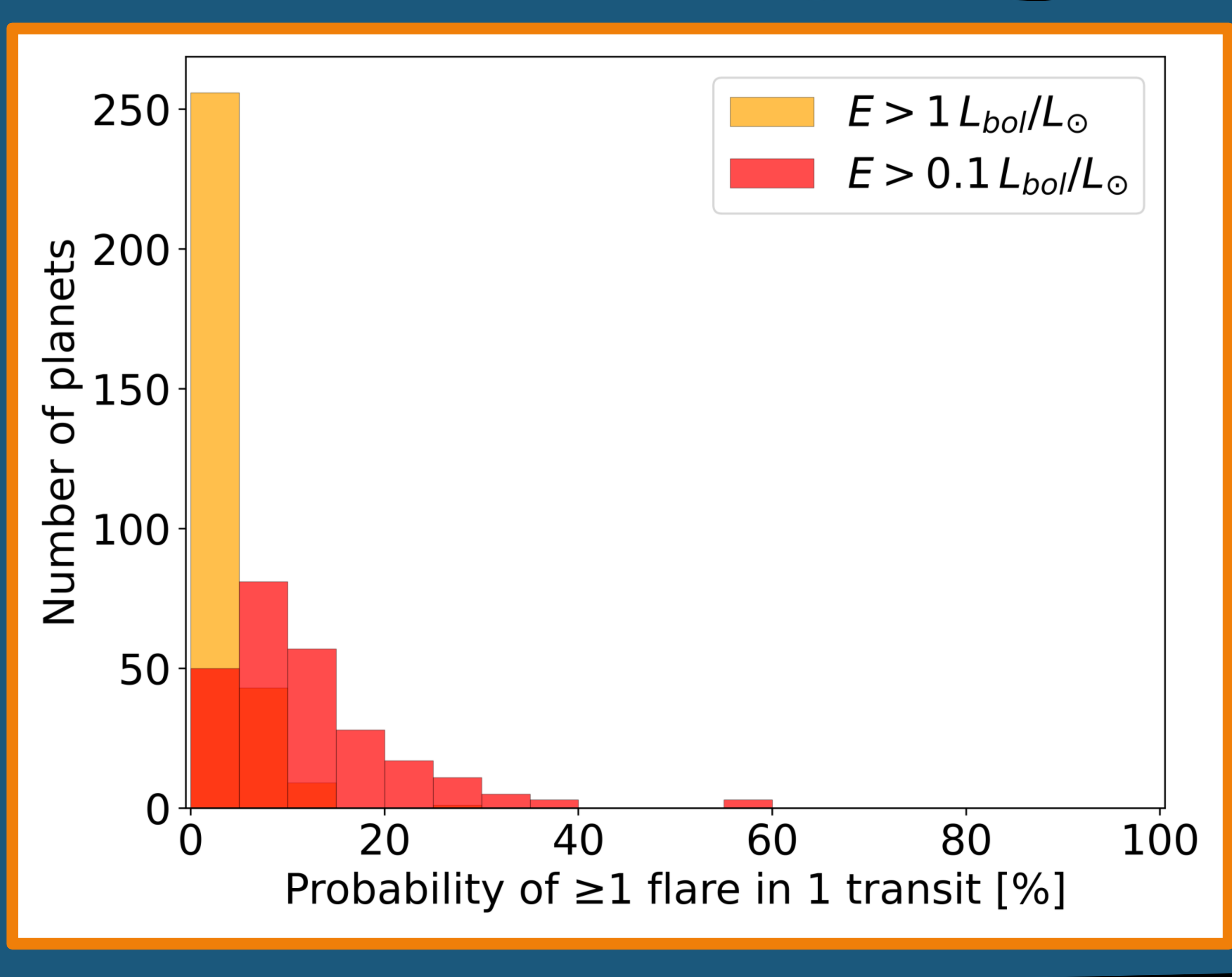
GF.01 distributions of the M stars sample (G. Galletta et al 2025) and MCS Ariel sample within 200 pc.





Conclusions

- We compute the probability of a flare occurring during a planetary transit.
- Most targets show moderate activity → near 0%
- AU Mic and HD 28109 reaches flare transit overlap probabilities of up to ~50%.
- TESS observations of AU Mic are consistent with this prediction, with four out of five transits affected by flares.



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