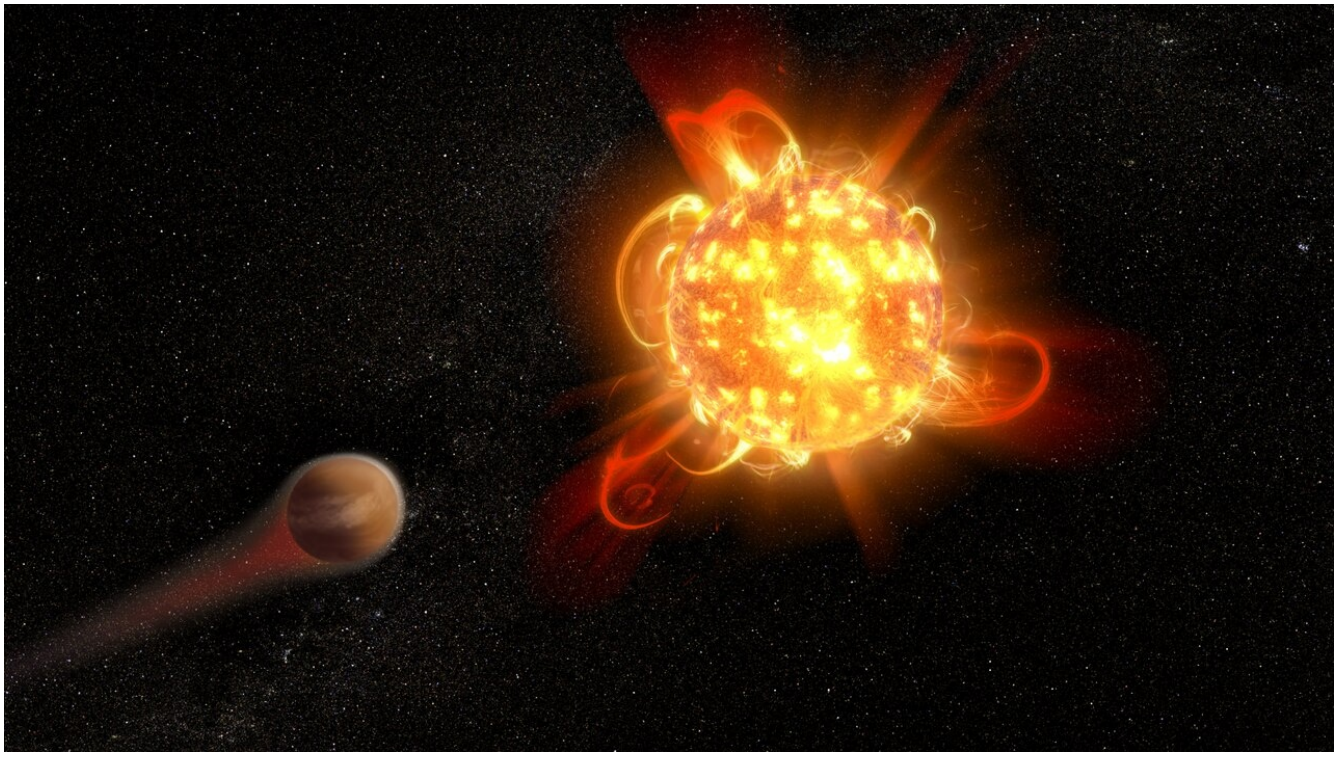
Red dwarf stars are low-mass, relatively cool stellar objects that frequently exhibit unexpected **flares**, manifested as **transient brightenings**. These can span a wide range of magnitudes, and the detection of even the least energetic events is crucial for advancing our understanding of the physical processes governing these stars. This knowledge is specially relevant because these stars are usually hosting **rocky exoplanets**, and flaring activity can partially **drive** the **habitability** of those planets.

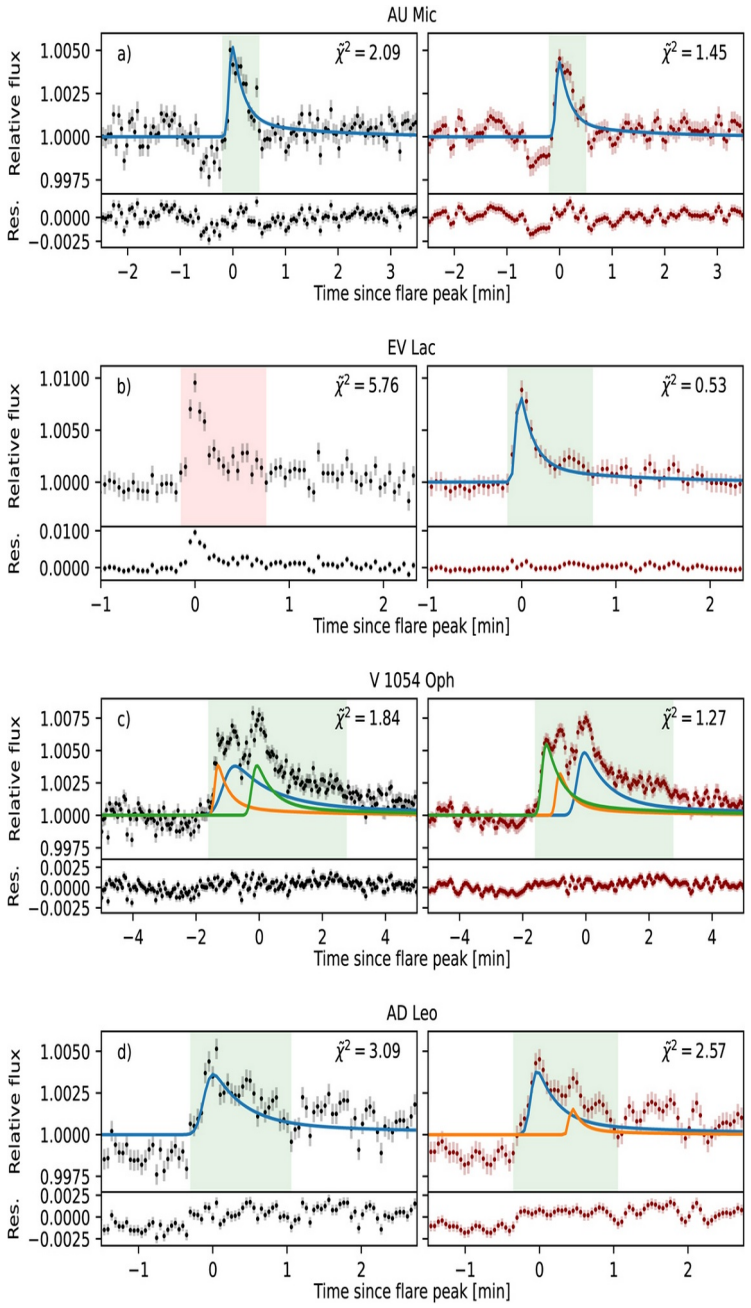
Contemporary astronomical survey telescopes, both ground-based and space-based, enable nearly continuous monitoring of a vast population of dwarf stars. Given the immense data volume produced by such surveys, the implementation of automated data processing techniques is indispensable, with the automatic detection of stellar flares representing a key analytical challenge.

In the present project, the detection of flares will not rely on conventional Convolutional Neural Network (CNN) architectures. Instead, it will employ **Spiking Neural Networks** (SNNs) from the **NeuroAI** field, which constitute a class of biologically plausible neural models originating in the field of **Computational Neuroscience** that reproduces the **biological learning** neuronal processes **present in the brain**. These networks emulate the temporal dynamics of biological neurons through discrete spike-based signaling and incorporate learning mechanisms (such as e-prop) that surpass the capabilities of state-of-the-art backpropagation based architectures, and are considered the **next-generation AI**. Owing to their intrinsic capacity to model dynamic systems, SNNs are particularly well-suited for the analysis and processing of temporal data, specially those with a limited amount of training data or low SNR.

This MSc thesis proposal is conducted in collaboration with a member of the Institute of Sciences of Cosmos at the University of Barcelona (ICCUB).



Artistic representation of a red dwarf star showing several flares, and an exoplanet around the star.



Example of some light curves of flaring stars obtained by space based telescopes (TESS and CHEOPS). Credits: [Poyatos, J. et al. (2025)].