MAX PLANCK INSTITUTE FOR ASTROPHYSICS

HEACOSS 2026 · SRG / eROSITA · PLEIADES

Searching for X-ray flares from young stars in the Pleiades with SRG/eROSITA

Using the catalog of X-ray emitting stars in Pleiades from Khamitov et al., 2024

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16 June 2026

WHY OPEN-CLUSTER X-RAY FLARES

Flares trace the magnetic dynamo of stars

1 Late-type stars → convective envelopes

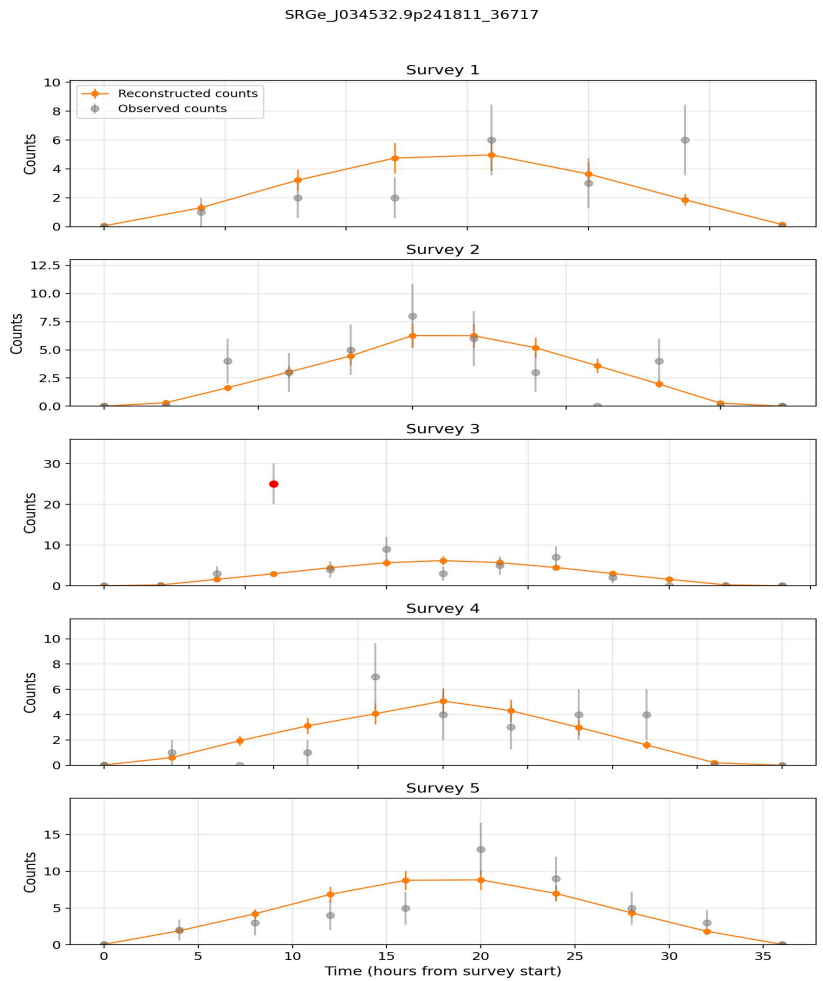
At ~125 Myr, some Pleiades stars rotate fast.
Rotation + a convective envelope drives a magnetic dynamo, heating coronae to millions of K.

2 Flares = reconnection

Magnetic reconnection releases energy impulsively: a sharp X-ray rise, a slow decay. The statistics of flares probe coronal physics directly.

THE DATA

eROSITA scans the sky in short, 6 months-apart visits



One source, five all-sky surveys (eRASS1–5)
~6 months apart

5 **all-sky passes**

~ Each source in Pleiades seen in ~10 visits every 4 hours, every ~6 months.

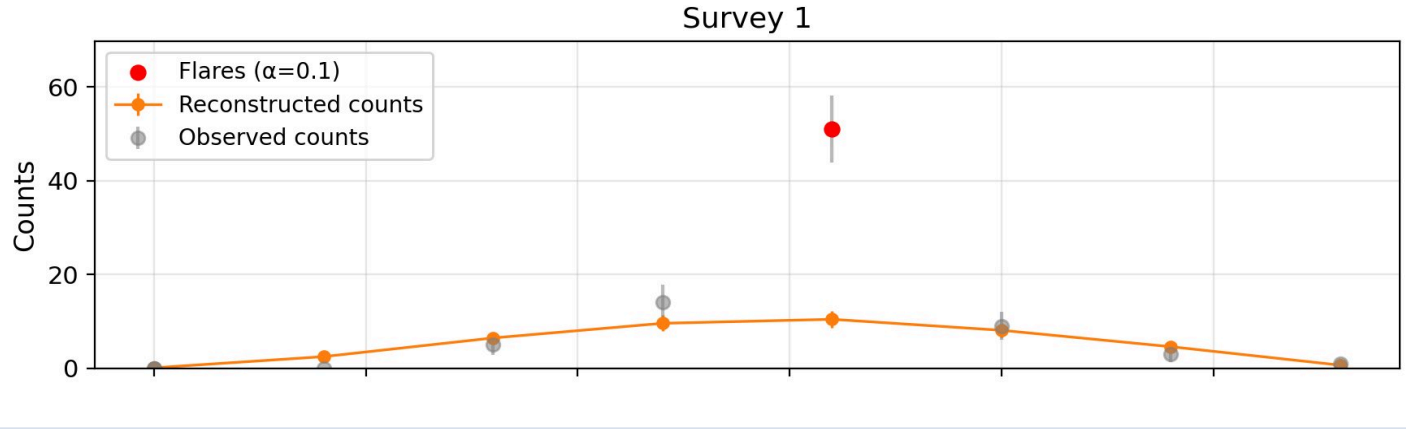
850 **X-ray sources, confirmed Pleiades members**

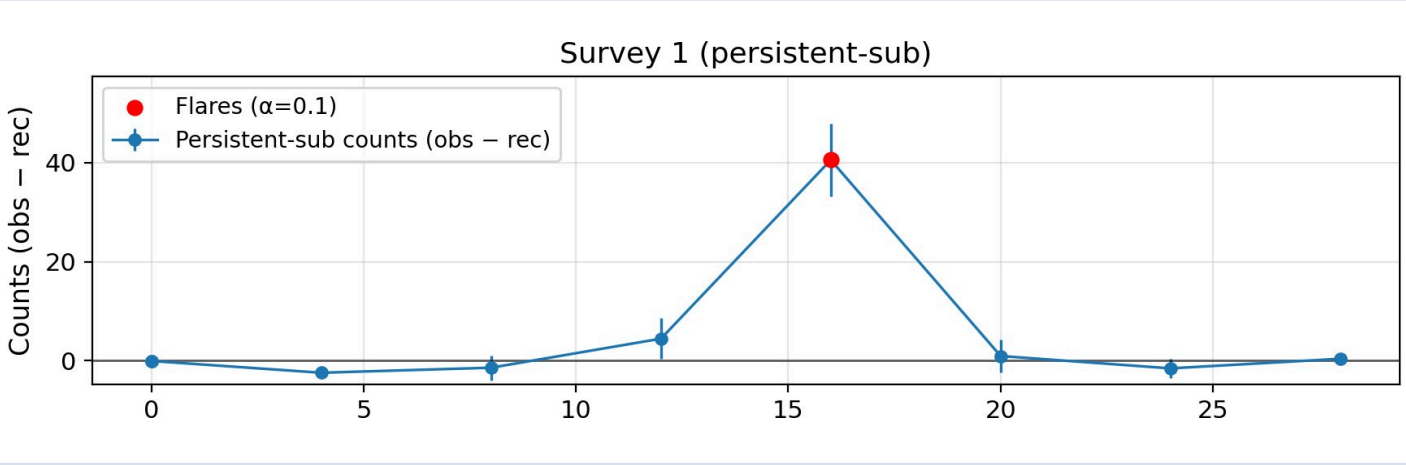
Using the catalog of X-ray emitting stars in Pleiades from Khamitov et al., 2024

0.3–2.3 keV **soft X-ray band**

THE METHOD

Model the quiescent baseline, then test every bin for excess





eROSITA source (SRGe J034404.4+255122),
Survey 1: raw counts (top), baseline-subtracted (bottom).

1 Reconstruct the baseline

Iteratively fit the quiescent rate per survey, clipping flare-like bins (orange curve).

2 Poisson significance

Per bin: p = P(≥ observed | Poisson at baseline). Flares are statistically significant positive excesses.

3 False-Positive control

Threshold p= α / N over all bins controls false positives across ~10^6 trials (red = flagged).

WHAT WE FOUND

Results

46 Flares
total detections (α = 0.1)

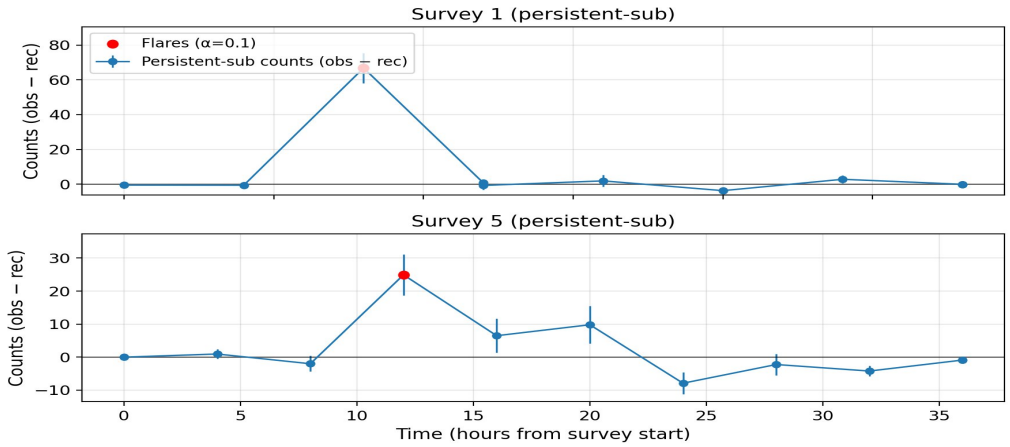
44 sources

2 sources with two flares

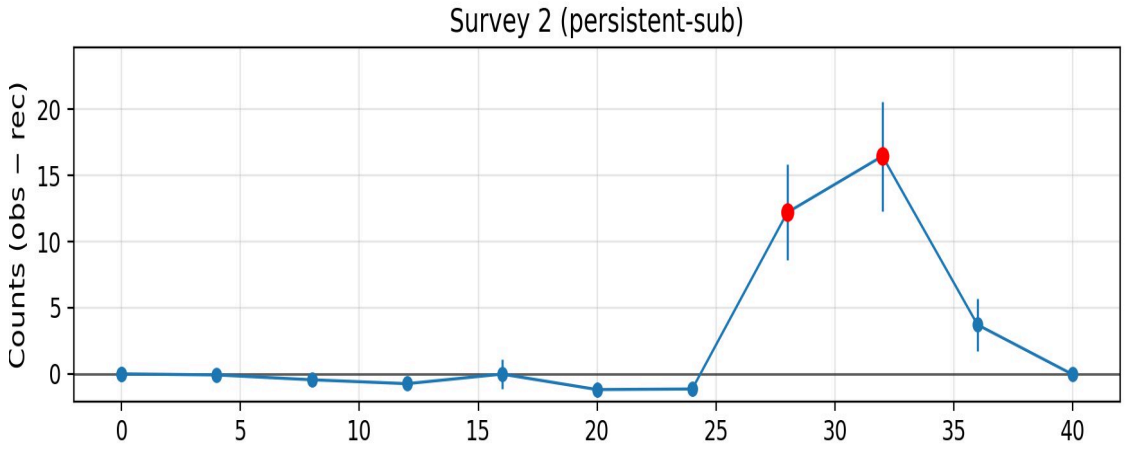
two flared in **different surveys** (months apart)

two sources with longer (>4 hours) flares

Different surveys — one source, Survey 1 & 5

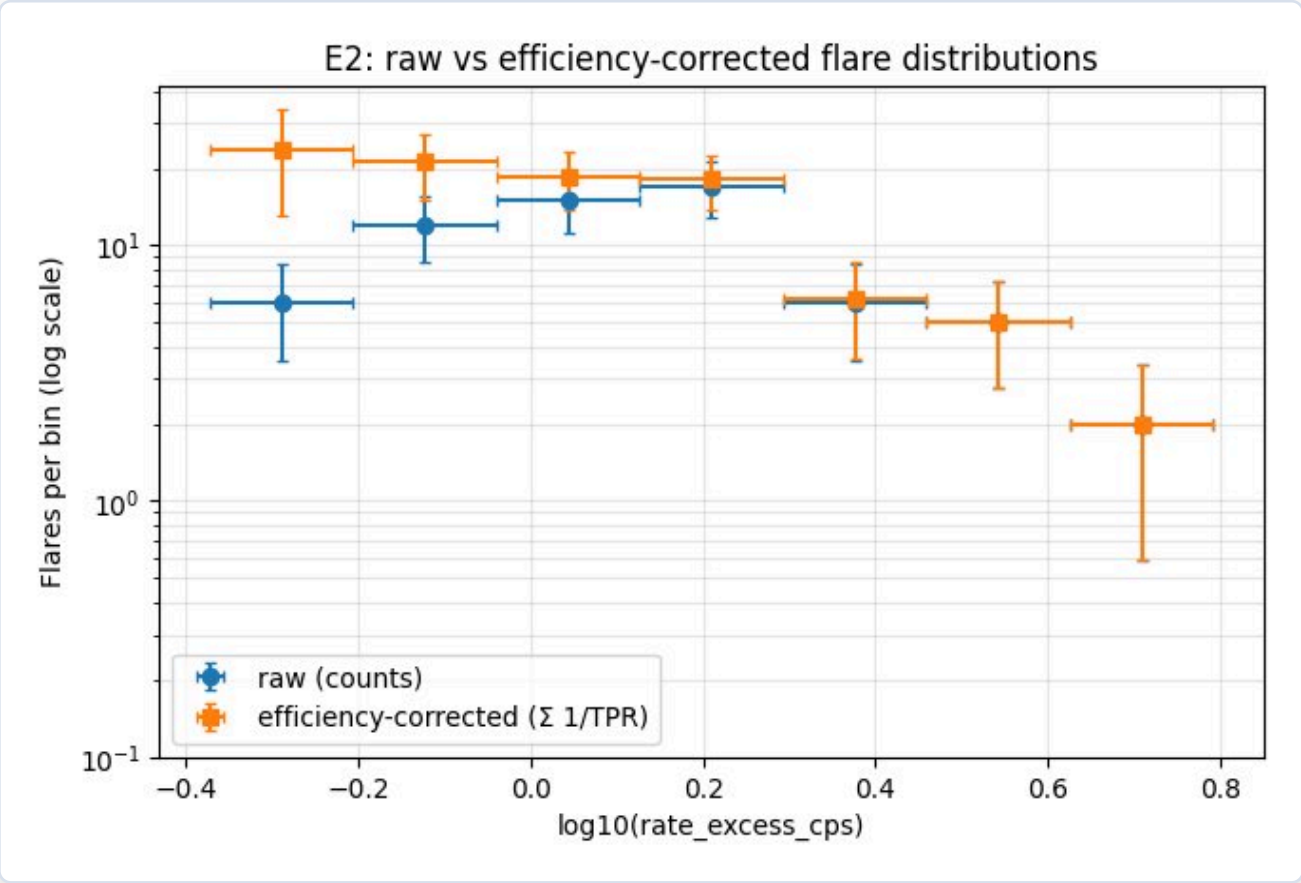


Consecutive bins — one source, Survey 2



VALIDATING THE PIPELINE & CORRECTING FOR WHAT WE MISS

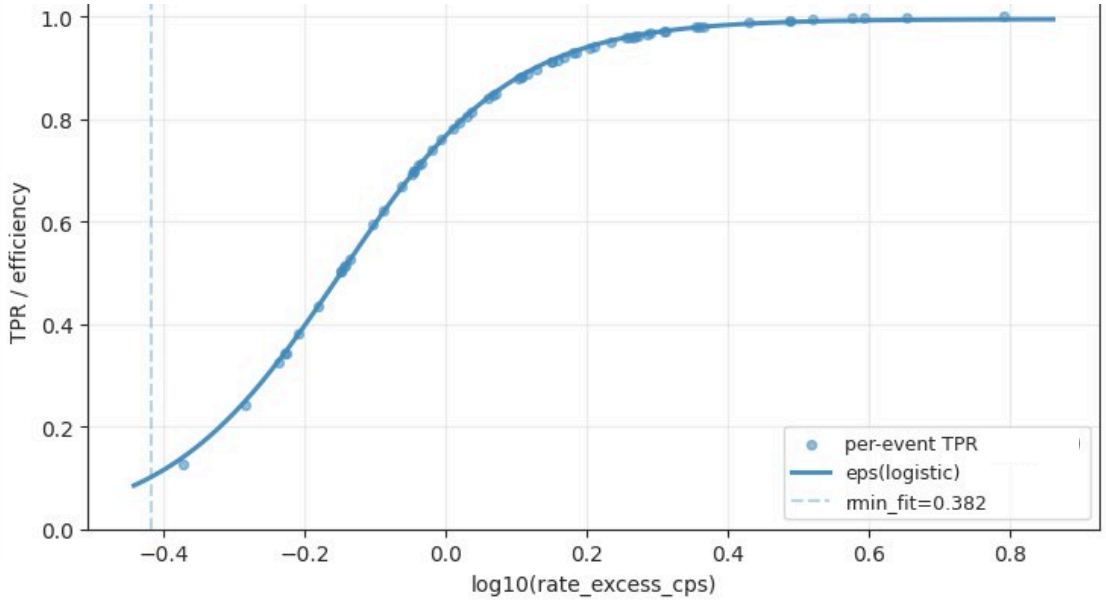
Flare Detection Efficiency and Flares' logN-logS



Inverse-efficiency weighting (Σ 1/ε) lifts the faint end the raw counts under-represent.

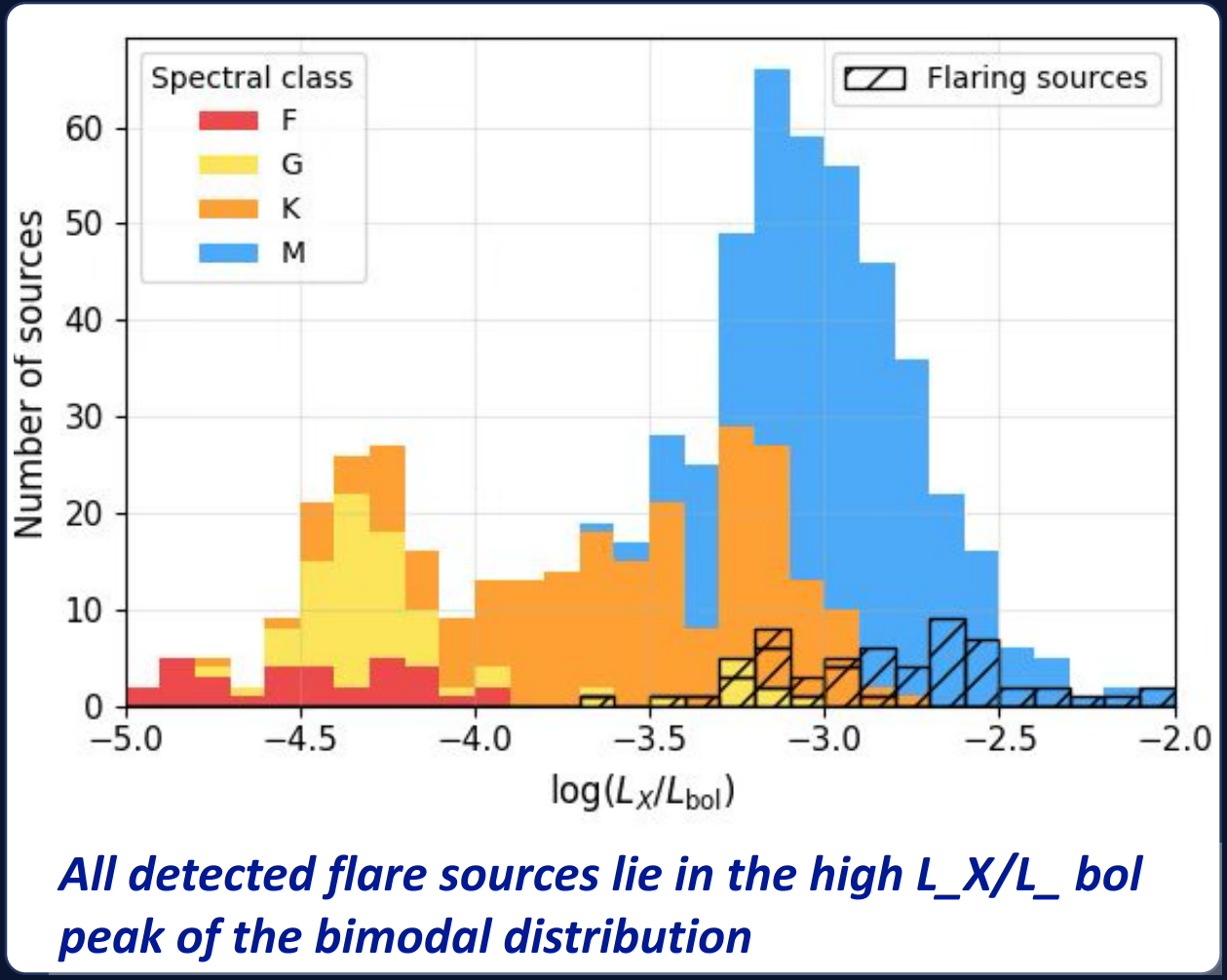
Injection test — efficiency.

Inject template flares of known excess rate into real light curves, re-run the pipeline → ε(baseline, amplitude).

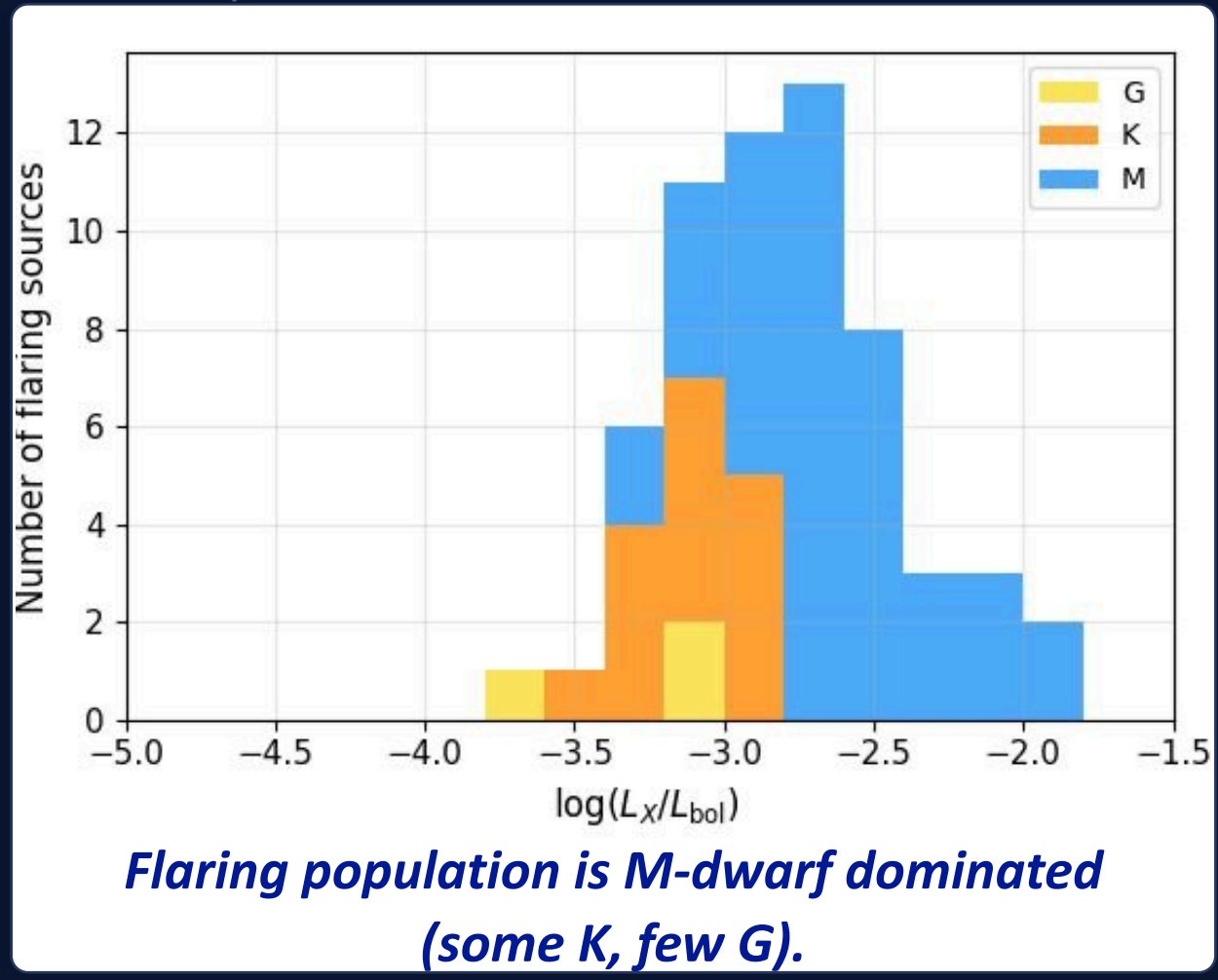


efficiency ε vs flare strength

The Flare Sources Spectral Type Distribution



All detected flare sources lie in the high L_X/L_ bol peak of the bimodal distribution



Flaring population is M-dwarf dominated (some K, few G).

Thank you!