Superflares in G, K and M Type Dwarfs

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Introduction
Light curve data from stars, captured by the Kepler satellite, provide insights into stellar flares. Superflares of energies above 10\textsuperscript{44} erg are observed. We perform a statistical analysis and search for environments under which flares occur more frequently and with higher energies. Magnetic activity is confirmed to be key for flare generation.

Superflare Sample
Kepler observations of light curves from G, K and M type dwarfs in quarters 0 to 6 are used.
Total amount of stars: 117661
Superflaring stars: 795
Superflare events: 6830

Analysis
• Rate of superflare occurrence for individual stars: \( \nu \propto \frac{\text{Dynamo number}}{\text{Effective temperature}} \)
• Normalized rate: \( \nu/\nu_{\text{eff}} \)
• Convective turnover time \( \tau_c \)
• Inverse Rossby number: \( R_o = \frac{\tau_c}{P_{\text{rot}}} \)
→ non-dimensionalized rotation rate

To find any correlation between physical parameters of the stars and the superflare rate, we need to consider averages in intervals of e.g. the effective temperature \( T_{\text{eff}} \) or the inverse Rossby number. The averaged superflare occurrence rate in such intervals we denote as \( \nu_{\text{eff}} \).

Temperature

![Temperature Graph]

Rotation Rate

![Rotation Rate Graph]

Flare Energy

![Flare Energy Graph]

Spot Coverage

![Spot Coverage Graph]

References

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Conclusions
• Superflare rates decrease with effective temperature.
• Rates increase with rotation rate up to a saturation point.
• Average flare energy increases with rotation rate.
• Rotation rate enhances magnetic activity.
• Fast rotators show higher spot coverage.
• Magnetic fields are essential for flares.