Stellar superflares in NGTS

James Jackman
P. Wheatley, C. Pugh

J.Jackman@warwick.ac.uk
Stellar flares

- Explosive phenomena caused by reconnection events in the magnetic field of a star
- Typically at least 100 times greater in energy than the Carrington solar event, but can go up to 10,000 times

Image credit: NASA's Goddard Space Flight Center/S. Wiessinger
Effects on habitability

- Stellar flares could have a big impact on the habitability of exoplanets
- In particular on “habitable zone” Earth sized planets around M Dwarfs - e.g. TRAPPIST-1
- Superflares can cause...
Effects on habitability

- Ozone Depletion
- Increased UV irradiation
- Atmospheric Removal
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Image credit: NASA’s Scientific Visualization Studio and the MAVEN Science Team
Stellar flares

- Need to understand how often they occur, range of energies, amplitudes, durations…
- Especially for G-M spectral types
- Single events difficult/ impossible to predict

Image credit: NASA's Goddard Space Flight Center/S. Wiessinger
Kepler and K2 Results

- Studies of G star superflares
- Stellar flare morphology
- Long baseline photometry - occurrence rates for spectral types and single stars

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BUT

- Vast majority of observations at 30 minute cadence - miss short events!
- Set target list
- Real-time follow up not possible
Superflares in NGTS

- Spectral types G8V to M5V

Flare brightness ≥ 5.5 stellar brightness!
Flare Statistics – Energy

- Push redder than previous *Kepler* data
- Upper envelope of flare energies
Flare Statistics – Fractional Amplitude

- Increase in brightness against stellar colour
- Sudden increases in flux could act to move the “habitable zone” outwards for short periods of time

1.0 = Flux increase due to flare equal to quiescent flux of star

Redder, cooler stars

Graph showing scatter plot with x-axis labelled as g-i (mag) and y-axis labelled as Max Fractional Flare Amplitude.
Single Stars

HD43162C

- Active M3.5 dwarf
HD43162C – Flaring Activity

- Flaring rate - how many flares above a certain energy we’d expect per day
- Result could be put into studies of flaring activity on planetary atmospheres

![Cumulative Flare Frequency vs Flare Energy Graph](image)
Conclusions

- Studies of stellar flares need to be done to fully understand occurrence rates and energies
- NGTS is well suited for both surveys and single star studies
- First year of NGTS data will soon be made public, available on the ESO archive
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