The NGTS Clusters Survey

Understanding the early evolution of stellar and planetary systems

Edward Gillen[1,2]* S. Hodgkin[2] G. Smith[2] J. Jackman[3] T. Moulton[4] J. Briegal[2] & the NGTS Consortium

[1] QMUL [2] Cambridge [3] Warwick [4] Harvard

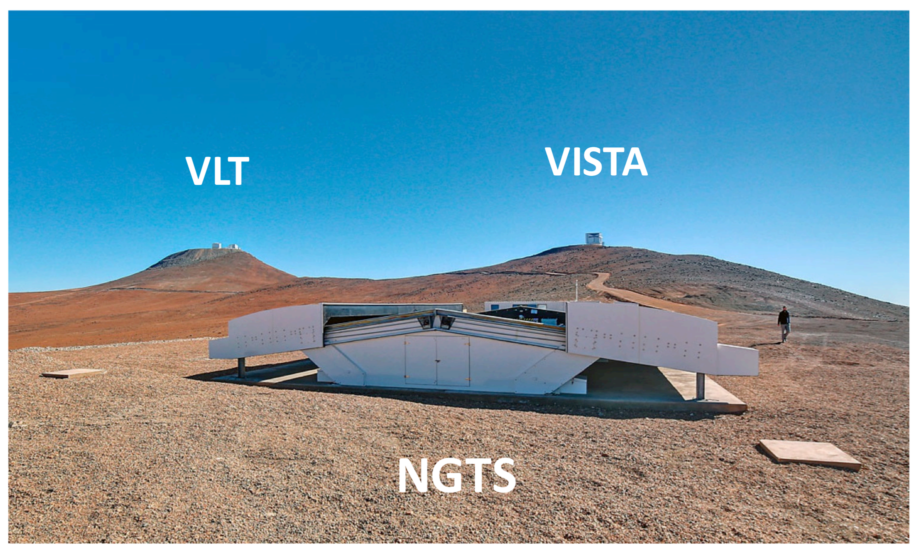
* e.gillen@qmul.ac.uk, Winton Fellow

1. Survey goals and current status

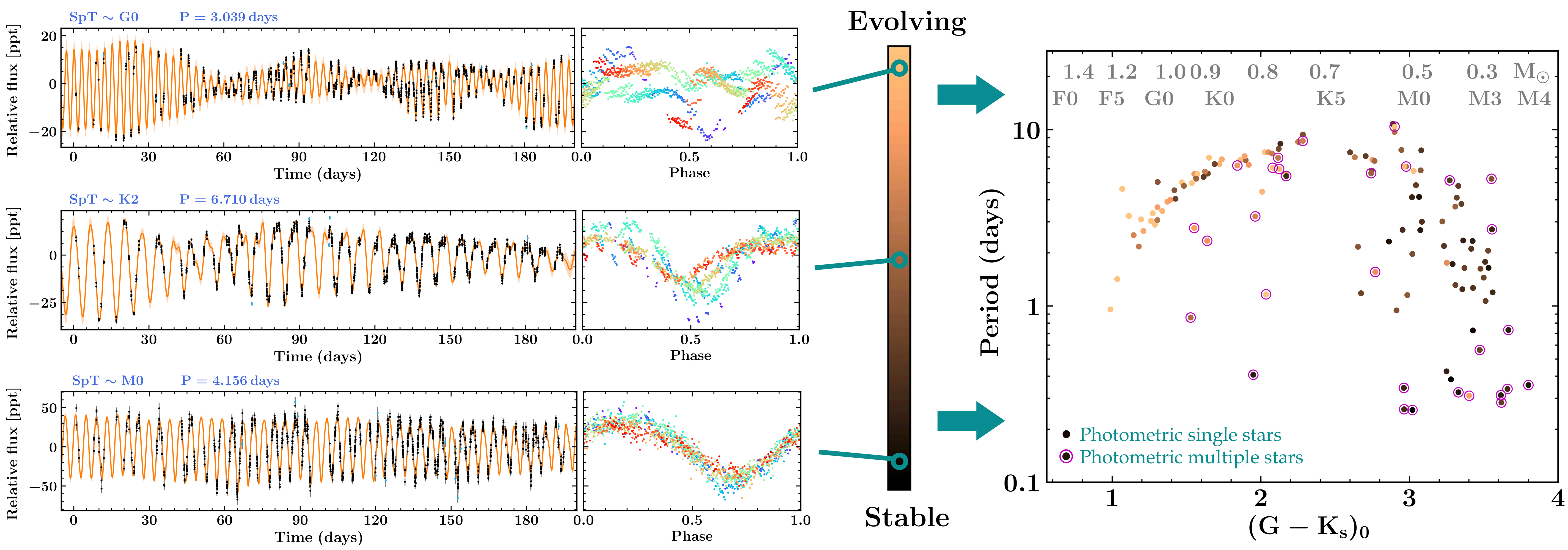
The Next Generation Transit Survey (NGTS) is a state-of-the-art wide-field photometric facility comprised of 12 independent robotic telescopes based at ESO's Paranal Observatory. NGTS is conducting a systematic survey of nearby young open clusters with ages between 1 Myr - 3 Gyr, which are each being monitored at 12-second cadence every clear night over 200-250 day periods to:

- Characterise the evolution of stellar rotation, active region lifetimes, flares, and the star-disk interaction
- Detect and characterise transiting planets and eclipsing binaries.

10 open clusters have been observed to date, with early results providing new insights into the early evolution of stellar rotation, flare frequency and the star-disk interaction, as well as precise constraints on stellar evolution theory from new, well-characterised eclipsing binary systems.



2. Evolution of stellar rotation: New insights from 200 days of monitoring Blanco 1

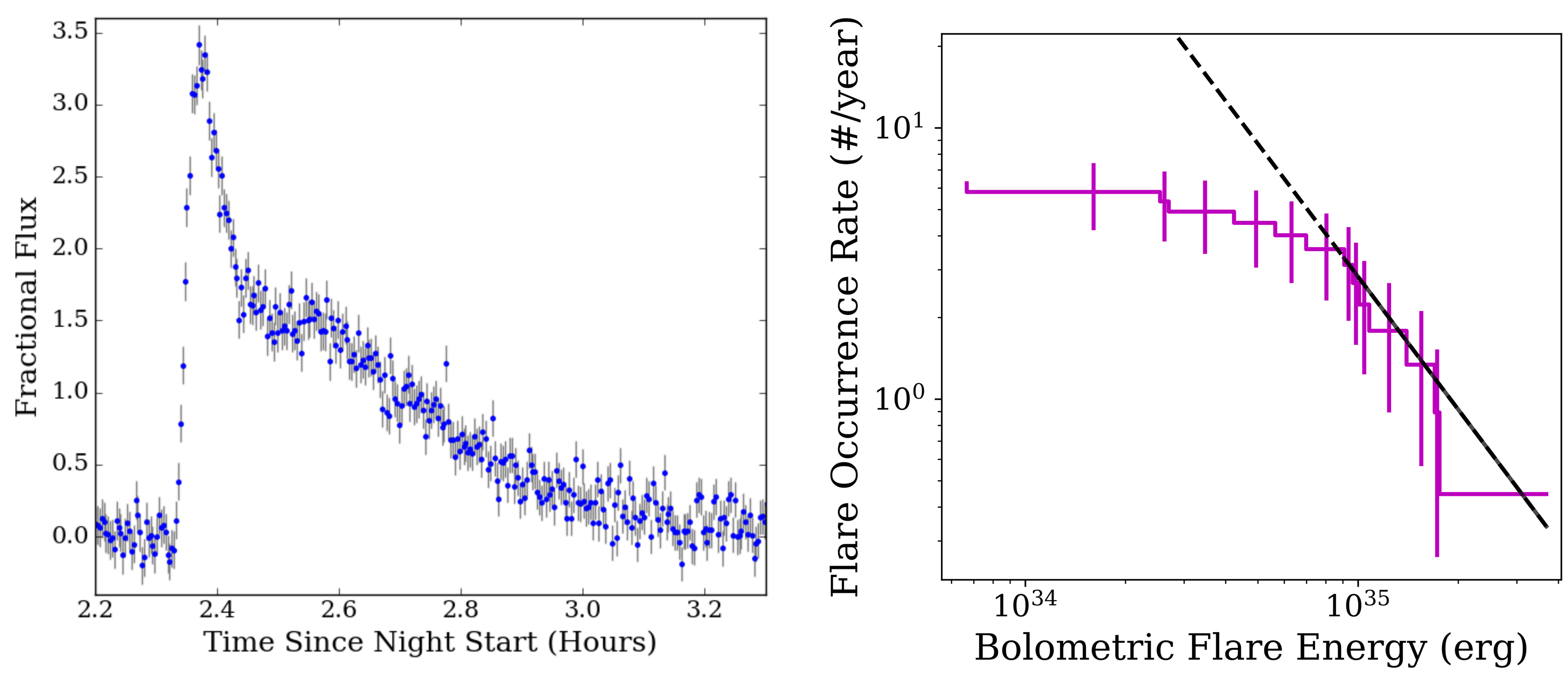


Young stars in Blanco 1 (~115 Myr) display rotational modulation patterns with different levels of evolution. *Left hand figures*: NGTS light curves (black) with our GP rotation model (orange). *Middle left*: phase-folded light curves, coloured indigo-to-red for beginning-to-end of the observations. We computed a simple metric for the level of evolution in each light curve based on their self-similarity over the ~200 day NGTS baseline (*middle right colourbar*) and show the rotation period distribution in Blanco 1 (*right hand figure*) coloured by the level of evolution in each light curve. Two key points are evident:

1. The light curves of F, G and early K stars evolve most, whereas M stars appear to evolve least.
2. ~F5-K5 single stars follow a well-defined rotation sequence from ~2 to 10 days, whereas stars in photometric multiple systems (circled) typically rotate faster. This may suggest that a moderate-to-high mass ratio companion inhibits angular momentum loss mechanisms during the early pre-main sequence, and this signature has not been erased at ~115 Myr.

Interested? Check out the paper, **NCS I:** **Gillen et al. 2020 (MNRAS 492 1008)**

3. Evolution of flare activity: White-light flares from the youngest stars in Orion



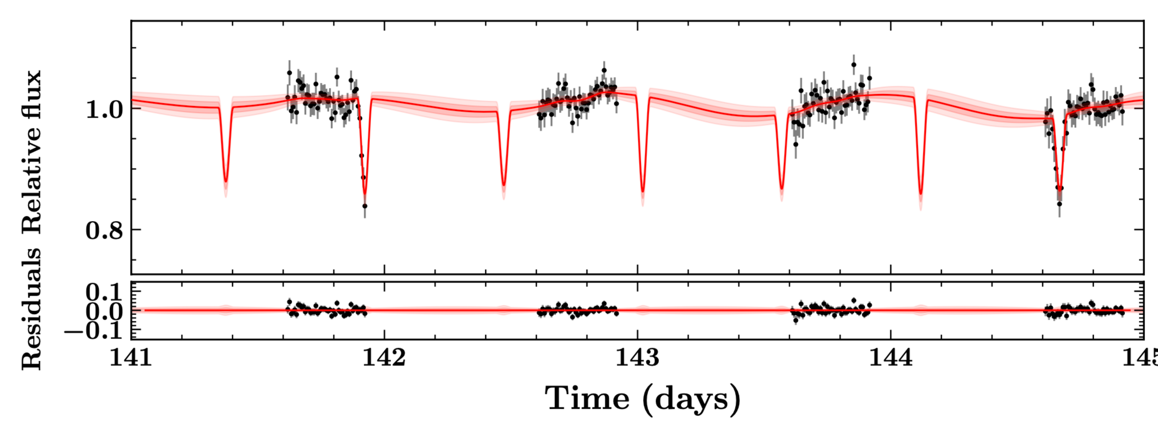
We observed high energy white-light flares from pre-main sequence (PMS) stars associated with the Orion complex. These comprise some of the most energetic white-light flares observed to date (up to 5.2×10^{35} erg; *see left panel for an example flare*).

From our power law fit to the cumulative flare frequency distribution (*right panel*), we estimate that the average ~M0-M3 star in the Orion complex flares with an energy above 10^{35} erg once every 130 days. This is almost 1000 times the rate measured for older M dwarfs using *K2* observations, highlighting how active these PMS sources are.

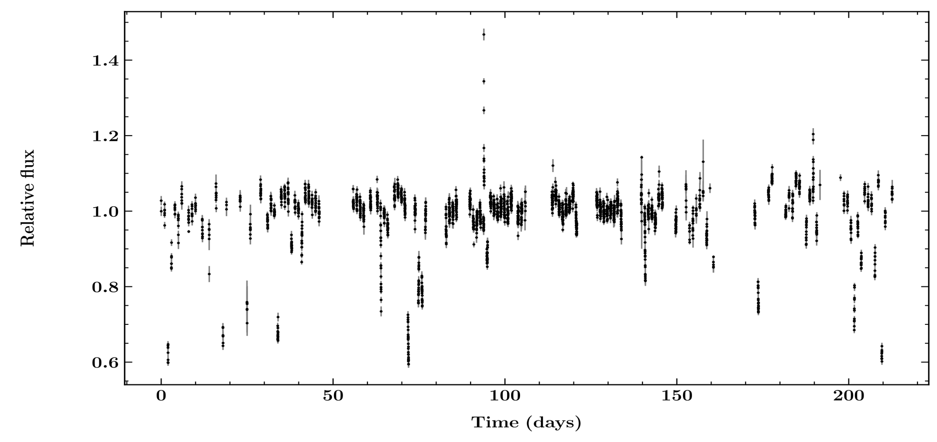
Interested? Check out the paper, **NCS II:** **Jackman et al. 2020 (MNRAS 497 809)**.

4. Want to see more NCS results?

NCS III: A low-mass EB in Blanco 1 spanning the fully convective boundary.
Check out Gareth Smith's poster!



NCS IV: The search for Dipper stars in the Orion A Molecular Cloud Complex from NGTS survey data.
Check out Tyler Moulton's poster!



Interested in "Extracting stellar variability from 1 million NGTS light curves"? Check out Josh Briegal's poster!