

News from the ISSI Team "Quasi-periodic Pulsations in Stellar Flares: a Tool for Studying the Solar-Stellar Connection"

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of the ISSI team

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Main aims

- Combine expertise in solar and stellar physics to fundamentally improve our understanding of flares.
- Perform a comprehensive study of flares observed by a variety of instruments.
- Use Hare-and-hound exercises to develop new robust analysis techniques.
- Use QPPs to determine how analogous the physical processes occurring in solar and stellar flares are
- Determine whether QPPs can be used to make inferences about the properties of the flare associated active regions.



Solar vs stellar flares

- **Energies of flares:** Stellar flares orders of magnitude greater than solar flares.
- **Observational differences:** White light vs other wavelengths, cadence, sensitivity, resolved vs unresolved.
- **Shape of flares:** Can the underlying flare shape ever be reliably removed, is there a 'standard' shape?

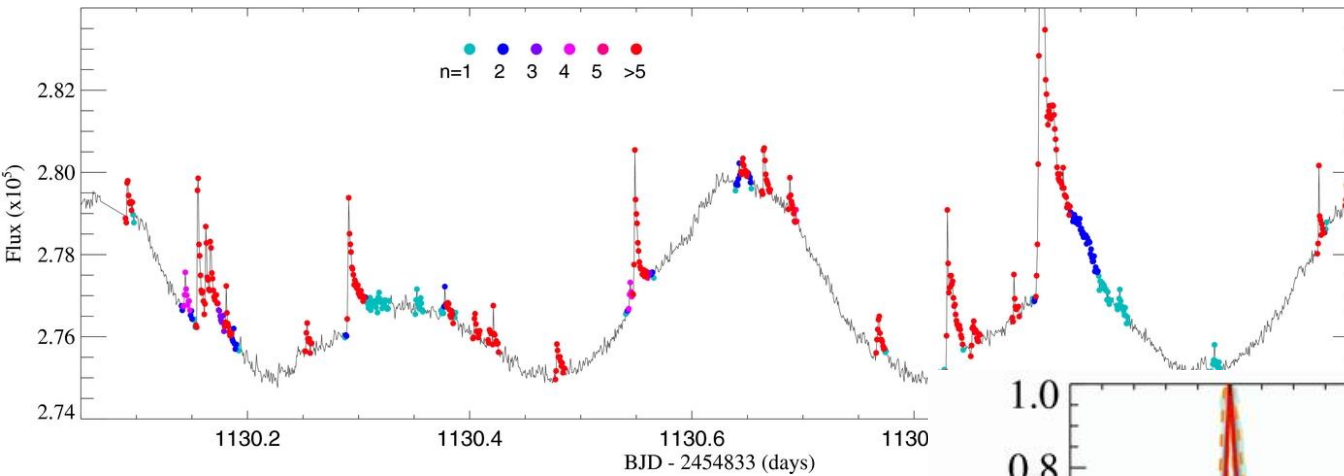


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- **Shape of flares:** Can the underlying flare shape ever be reliably removed, is there a 'standard' shape?
- **Are the same physical processes at work?**

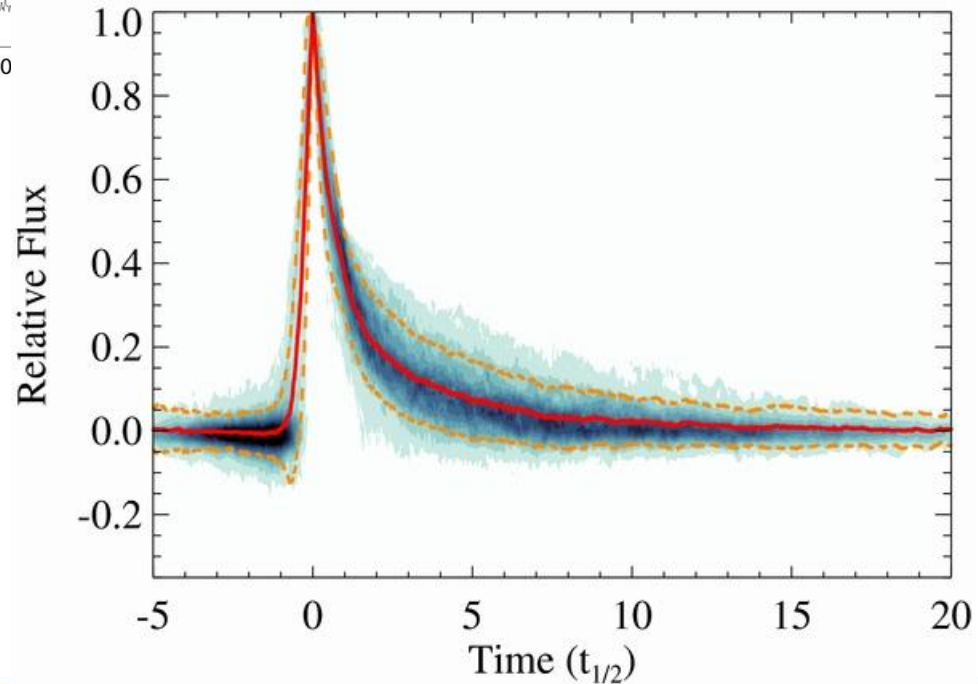


GJ1243: Davenport et al. (2014)



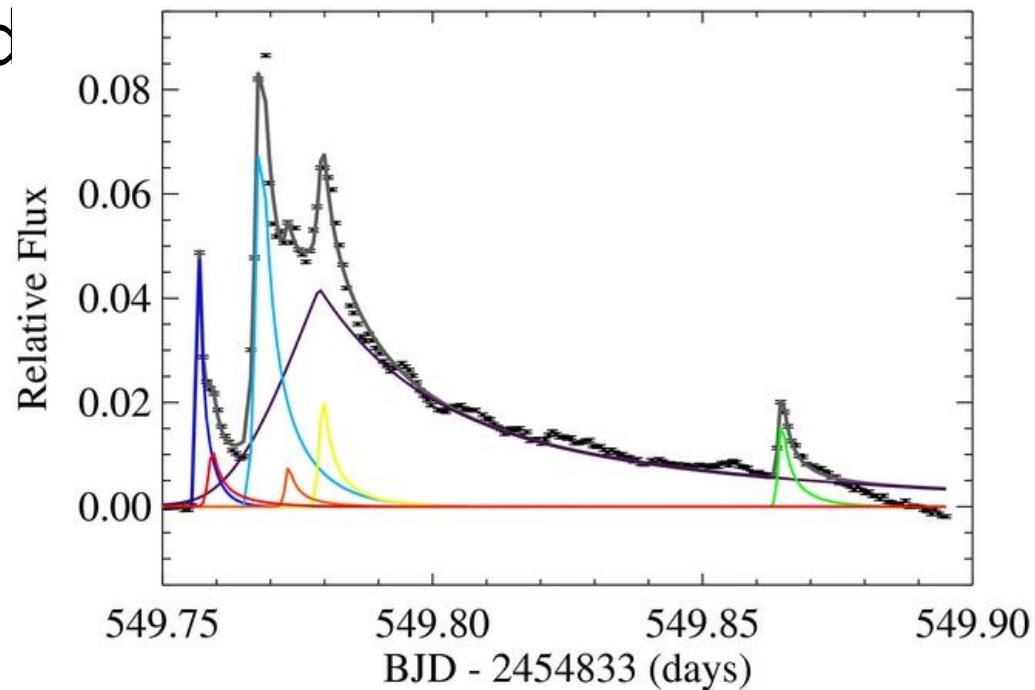
**Section of
Kepler
light curve**

Empirical Flare model
2 decay phases

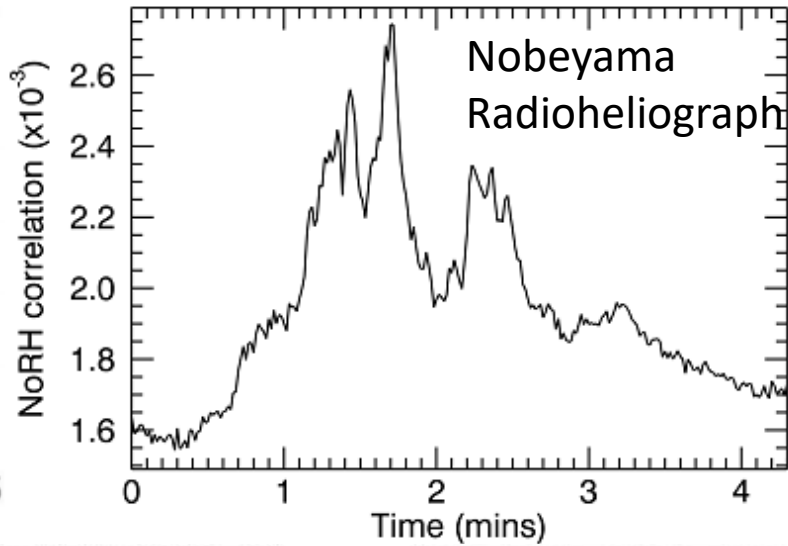
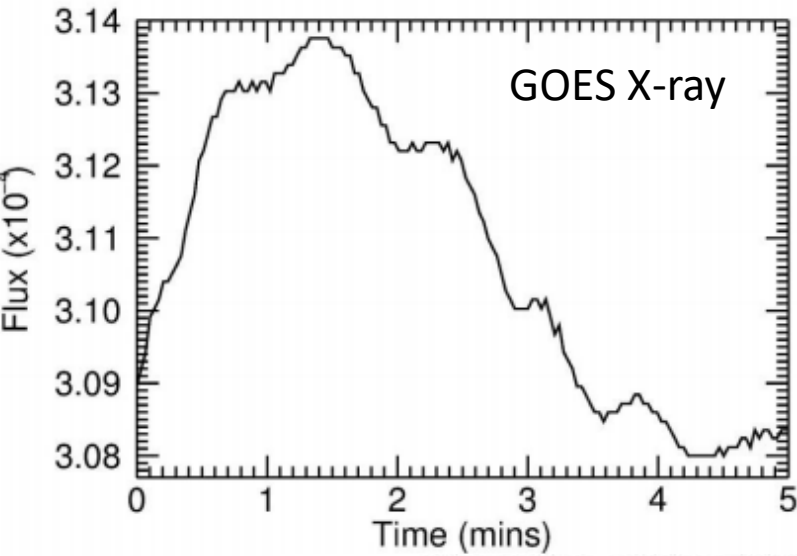


'QPPs' or just 'Complex'?

- Davenport et al. (2014) & Pugh et al., (2016) both looked at flares on GJ1243.
- Davenport identified a large fraction of flares as complex: 15.5%.
- Pugh identified QPP flares.

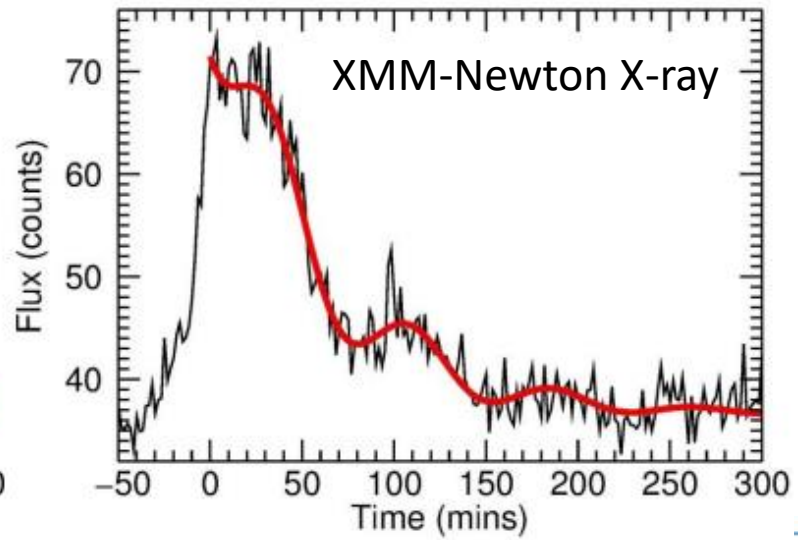
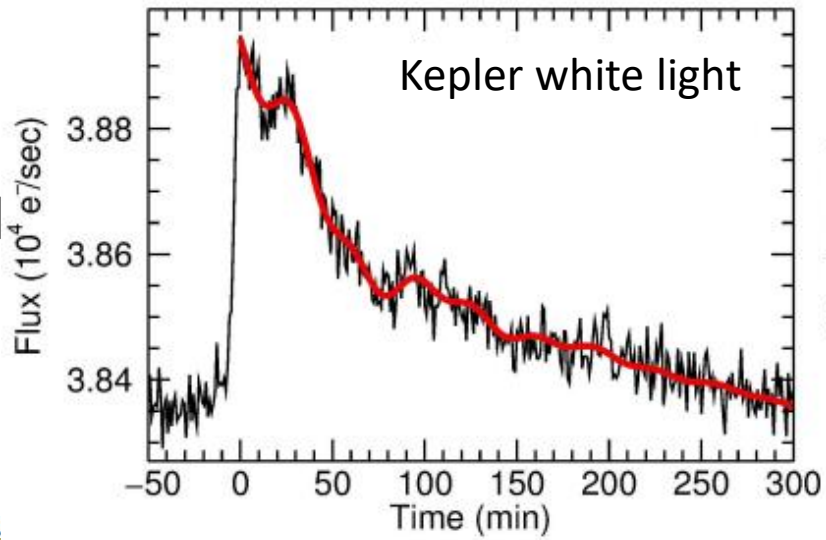


Comparison of solar & stellar QPP flares



**Pugh et al
2017**

**Pugh et al
2016**



Team website

- <http://www.issibern.ch/teams/quasistellflare/>

← → ↻ 🏠 ⓘ www.issibern.ch/teams/quasistellflare/index.php/sample-page/workshop-1-schedule/ ☆

Apps SAO/NASA ADS Cust: CFSA- Department of CSC User Services Try Warwick library pr Ca II K-Line Monitor Stellar Music Project NOAA/NESDIS/NGDC NSO/GONG: Data Ac

Workshop 1: Schedule

Our first meeting will take place between 27th Feb and 3rd March. The schedule is given below.

Monday

9:00 – Welcome, introductions, and aims

9:30 – Christoffer Karoff: [Evaluating the risk of a solar super flare](#)

10:00 – James Davenport: [Flares from Kepler: an Empirical Flare Template from GJ 1243](#)

10:30 – Coffee

11:00 – Discussion: Linking solar & stellar flares (led by Broomhall)

12:30 – Lunch

14:00 – Valery Nakariakov: Physical mechanisms for QPP in flares and their observational signatures

14:30 – Dmitrii Kolotkov: [Nonlinear oscillations of coalescing magnetic ropes](#)

15:00 – James McLaughlin: [Oscillatory Reconnection: wave-generating, periodic reconnection](#)

15:30 – coffee

16:00 – Discussion: Linking QPP theory and observations (led by Kolotkov)

17:30 – Finish

Objectives for workshop 1

- Build a database of stellar flares
 - Identify subset of QPP flares.
- Establish hare & hounds exercise.
- Establish subset of flares for combined analysis.
- Establish a recipe for detecting flares and QPPs.
- Work towards a statistical study of QPP flares.



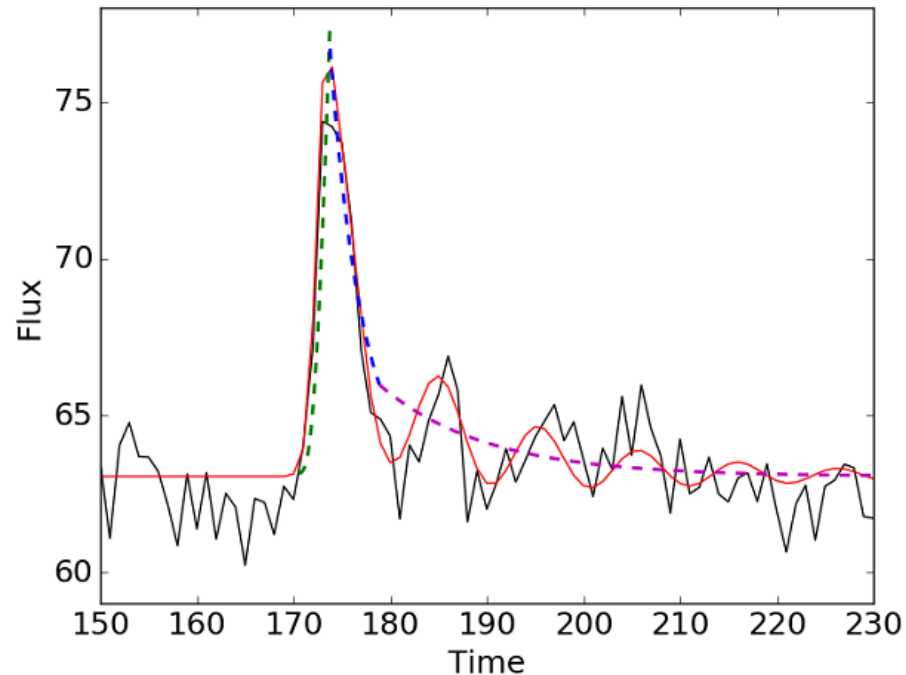
Hare and hound exercise

- The hare (Broomhall) creates artificial flares.
- The hounds (members of ISSI team) analyse the artificial flare light curves.
 - Fourier
 - Wavelet
 - EMD
 - Davenport's complex flare fitting routine (FBEYE)
 - Gaussian processing.



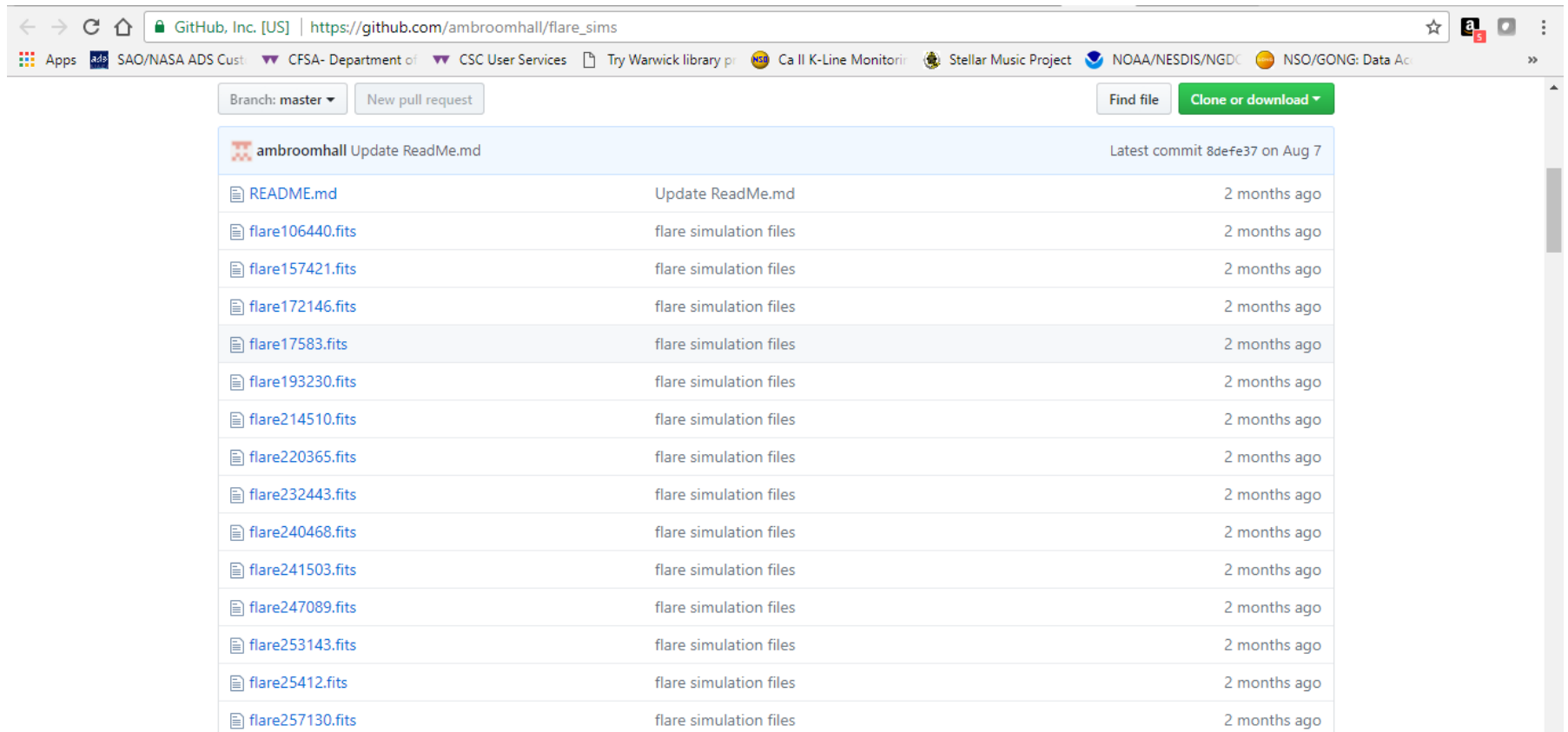
Artificial flares

- https://github.com/ambroomhall/flare_sims
- Different flare shapes.
- Different backgrounds
- Red & white noise
- Different numbers of QPPs (incl. 0).
- Different S/N



Please join the activity!

- https://github.com/ambroomhall/flare_sims



Branch: master | New pull request | Find file | Clone or download

ambroomhall Update ReadMe.md | Latest commit 8defe37 on Aug 7

File Name	Description	Time
README.md	Update ReadMe.md	2 months ago
flare106440.fits	flare simulation files	2 months ago
flare157421.fits	flare simulation files	2 months ago
flare172146.fits	flare simulation files	2 months ago
flare17583.fits	flare simulation files	2 months ago
flare193230.fits	flare simulation files	2 months ago
flare214510.fits	flare simulation files	2 months ago
flare220365.fits	flare simulation files	2 months ago
flare232443.fits	flare simulation files	2 months ago
flare240468.fits	flare simulation files	2 months ago
flare241503.fits	flare simulation files	2 months ago
flare247089.fits	flare simulation files	2 months ago
flare253143.fits	flare simulation files	2 months ago
flare25412.fits	flare simulation files	2 months ago
flare257130.fits	flare simulation files	2 months ago

Database: Solar – Val's page

- <https://www2.warwick.ac.uk/fac/sci/physics/research/cfsa/people/valery/research/qpp/>

Event Date	Time Start	Time End	Flare Class	Observed Periods	Bands Observed	Related Publications
16 October 2015	10:13 UT	10:24 UT	C3.1	~32-42 s	SXR, IRIS SiIV	Zhang et al. 2016
29 September 2015	05:05		M2.9	27.2 s 21.4 s	GOES 1-8 Å Fermi/GBM, 15-25 keV	Inglis et al. 2016
21 September 2015	01:57 UT	02:08 UT	C4.2	13 s in non-thermal emission 26 s in thermal emission	12-300 keV 4.9-34 GHz GOES SXR flux derivative AIA 304 Å	Kumar et al. 2017
11 June 2015	08:49		M1.0	10 s	GOES 1-8 Å Fermi/GBM, 15-25 keV	Inglis et al. 2016
06 May	11:45		M1.0	22.7 s	GOES 1-8 Å	Inglis et al. 2016



Database - Stellar

- To be placed on ISSI team website – to include links to data as well.

Star	Data Source	Period (mins)	Publication
II Peg	Stephanion Observatory (U-band)	3.67	Mathioudakis et al. (2003)
AT Mic	XMM-Newton	12.5	Mitra-Kraev et al. (2005)
YZ CMi	New Mexico State University 1 m Telescope (U band)	32	Anfinogentov et al. (2013)
Proxima Centauri	XMM-Newton	21.0, 11.45	Srivastava et al. (2013)
KIC9655129	Kepler	$78 \pm 12, 32 \pm 2$	Pugh et al. (2015)
KIC2852961	Kepler	68 ± 2	Pugh et al. (2016)
KIC2852961	Kepler	$93+27/-21$	Pugh et al. (2016)
KIC3128488	Kepler	$19+5/-4$	Pugh et al. (2016)
KIC3540728	Kepler	$43+13/-10$	Pugh et al. (2016)
KIC3540728	Kepler	36.7 ± 0.3	Pugh et al. (2016)
KIC4671547	Kepler	$4.6+0.9/-0.7$	Pugh et al. (2016)
KIC4758595	Kepler	$49+35/-20$	Pugh et al. (2016)

Data for stellar flares

- Team members currently using: XMM-Newton, Kepler, K2, GALEX.
- Future plans:
 - Application submitted to TESS GI program (led by Davenport).
 - Get radio observations – RATAN-600, Nobeyama 45m dish.
 - Try and get contemporaneous multi-wavelength observations of stellar flares.



Workshop 2: 26th Feb 2018

- Compare results for hare and hounds.
- Analyse a sub-set of real data & perform a statistical analysis of the QPP flares.
- Make comparisons between observed results in different wavelengths.
- Discuss the potential of theoretical works to produce the observed results for solar & stellar flares.
- Discuss future observing strategies.

