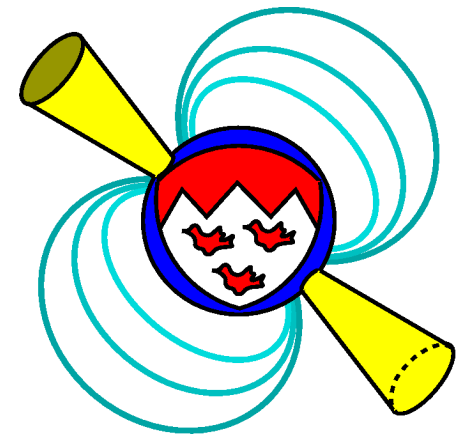


Repeated, Delayed Torque Instabilities in the Magnetar 1E 1048.1-5937 Following Outbursts

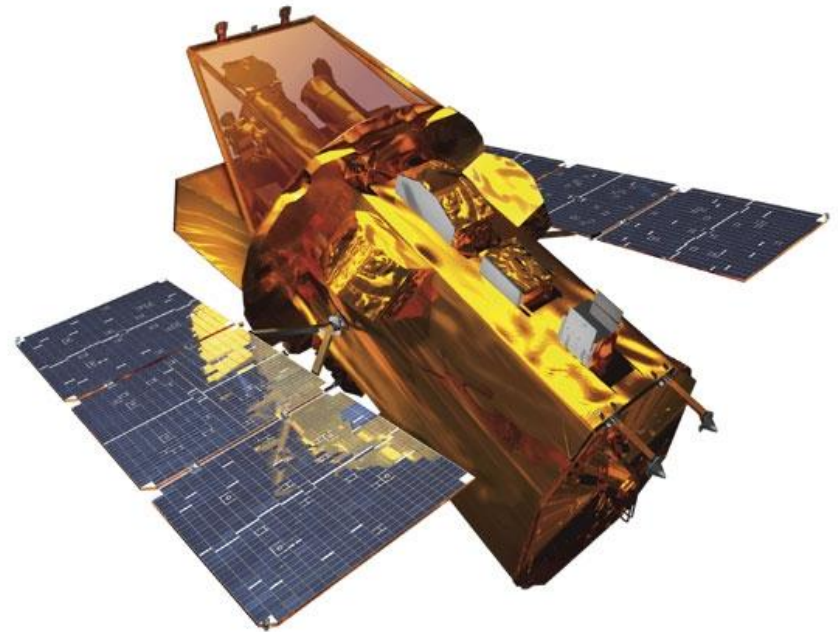
Robert Archibald
McGill University

Collaborators: V. M. Kaspi, C. -Y. Ng, P. Scholz,
A. P. Beardmore, N. Gehrels, & J. A. Kennea



Swift Monitoring Campaign

- Started observing 5 bright magnetars with Swift in July, 2011
- Continued from ~16 years of monitoring with RXTE (Dib & Kaspi 2014)

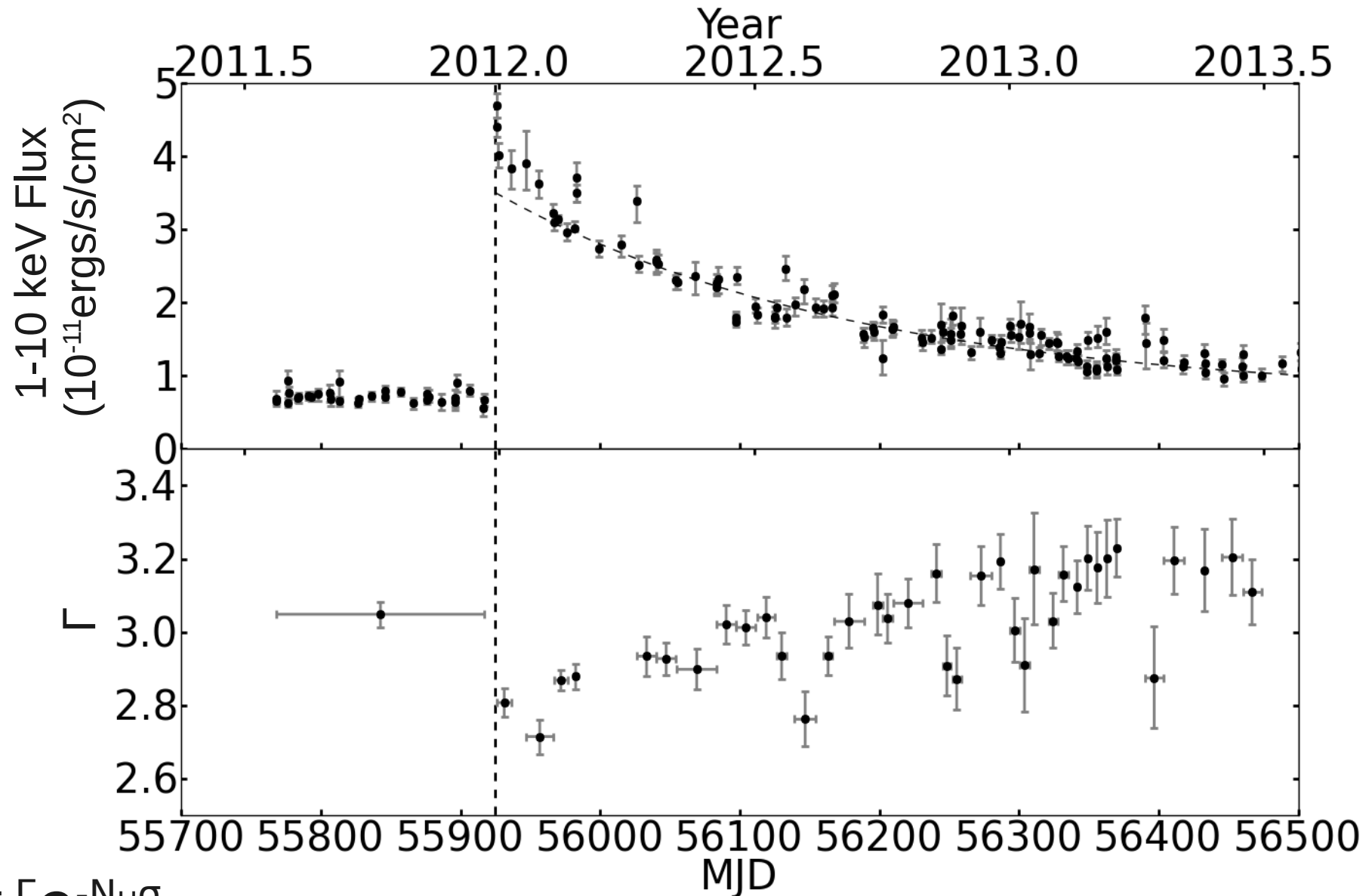


Swift Spacecraft

1E 1048.1-5937

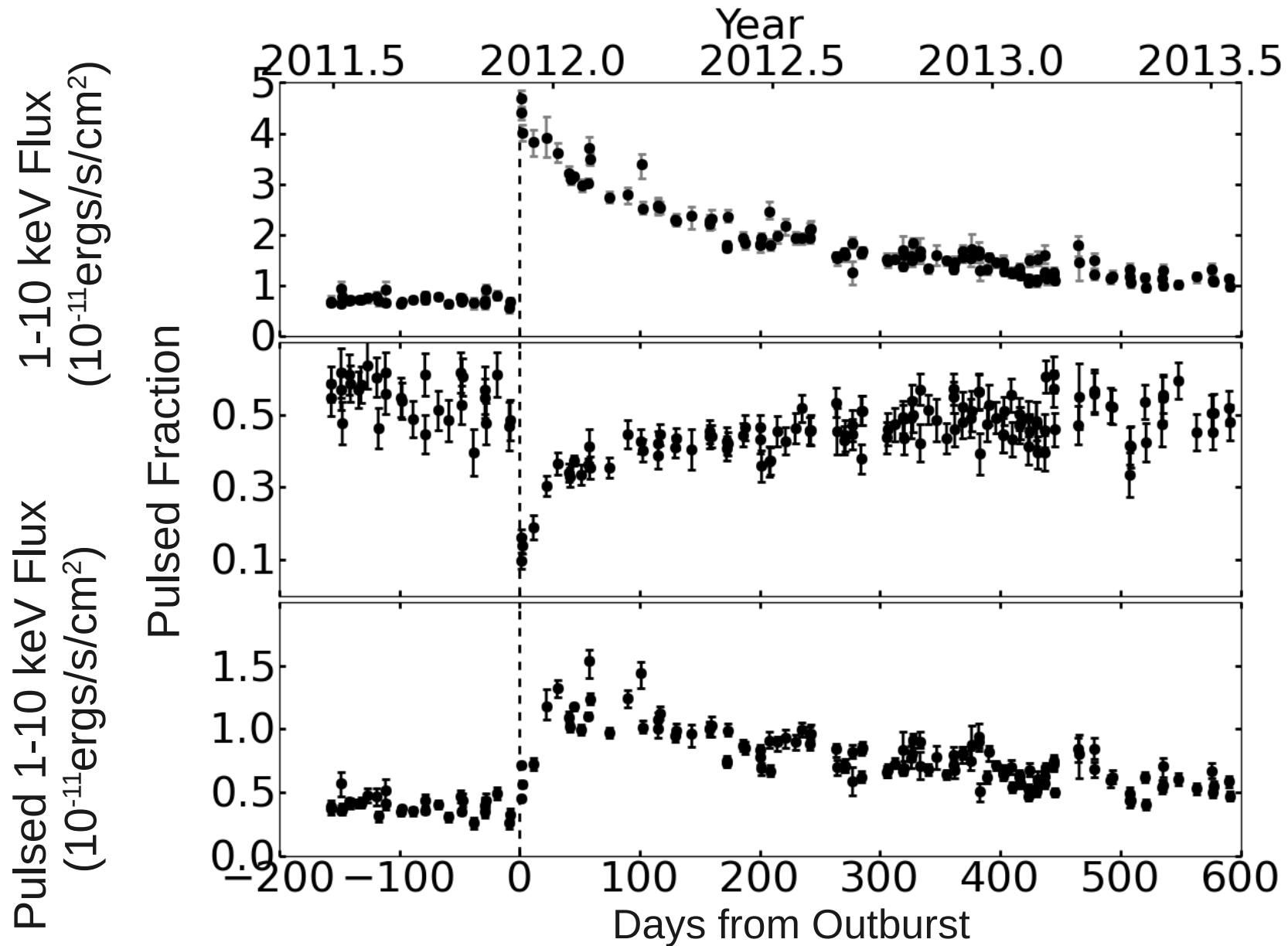
- ~6.46-s magnetar
- $\mathbf{B} = 3.9 \times 10^{14}$ G
- First detected Magnetar-like X-ray bursts from Anomalous X-ray pulsar (Gavriil, 2002)

2012 Outburst Flux and Spectra



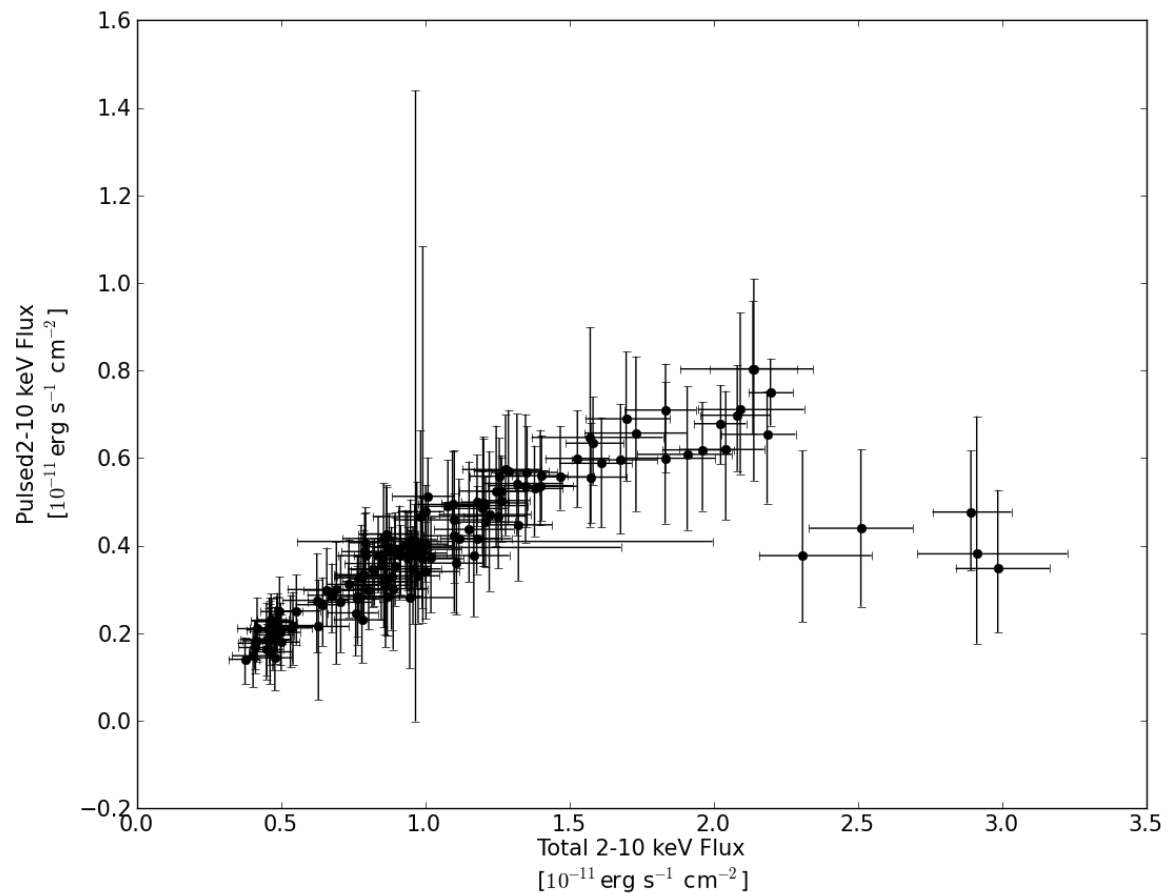
$$\text{Flux} \propto E^{-\Gamma} e^{-N_{\text{H}}\sigma}$$

2012 Outburst Pulsed Flux

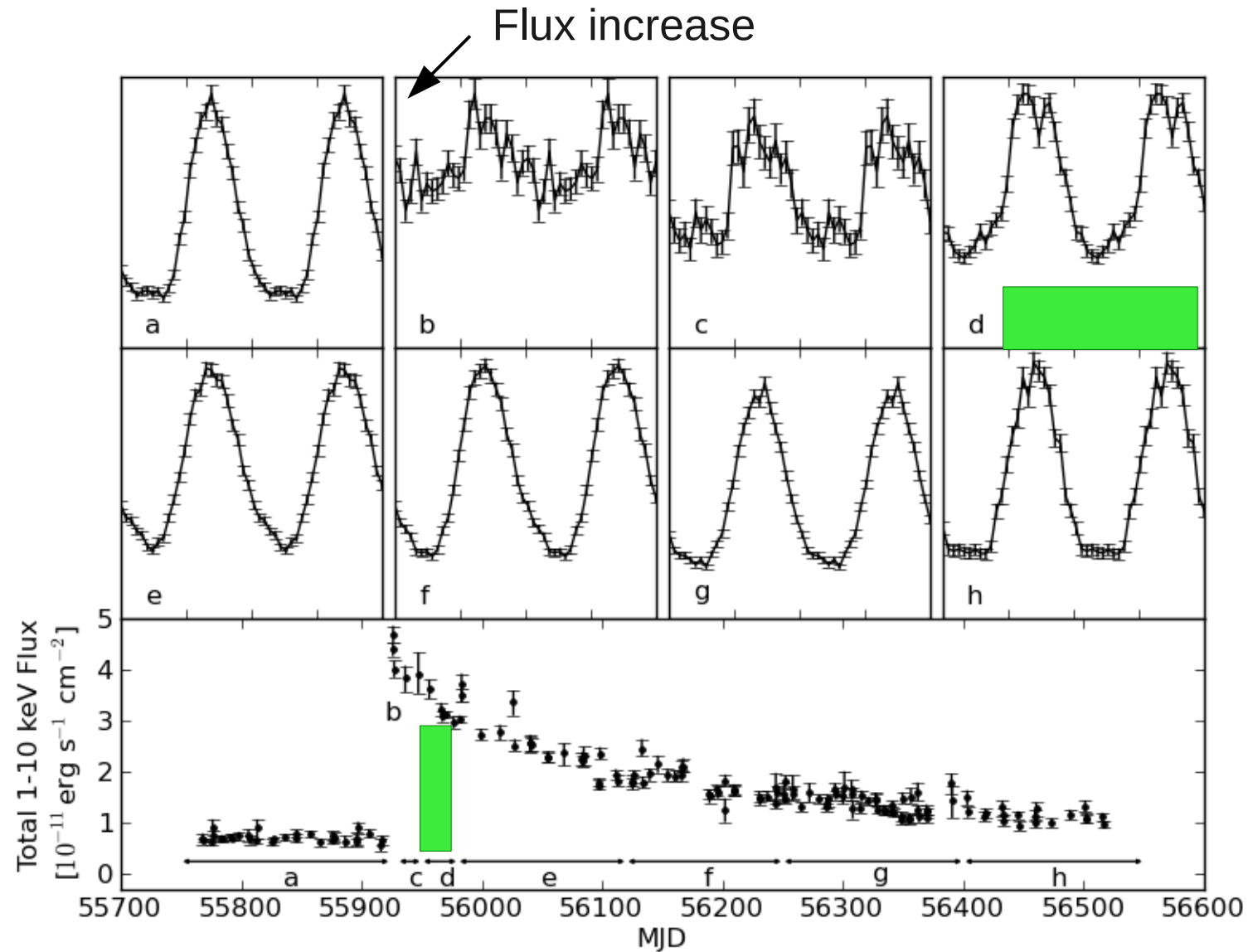


2012 Outburst Pulsed Flux

- Correlation noted by Tiengo et al. 2005 for another flux flare
- Fails at high flux



2012 Outburst Pulse Profiles



1E 1048.1-5937 Behaviour - 2012 Outburst

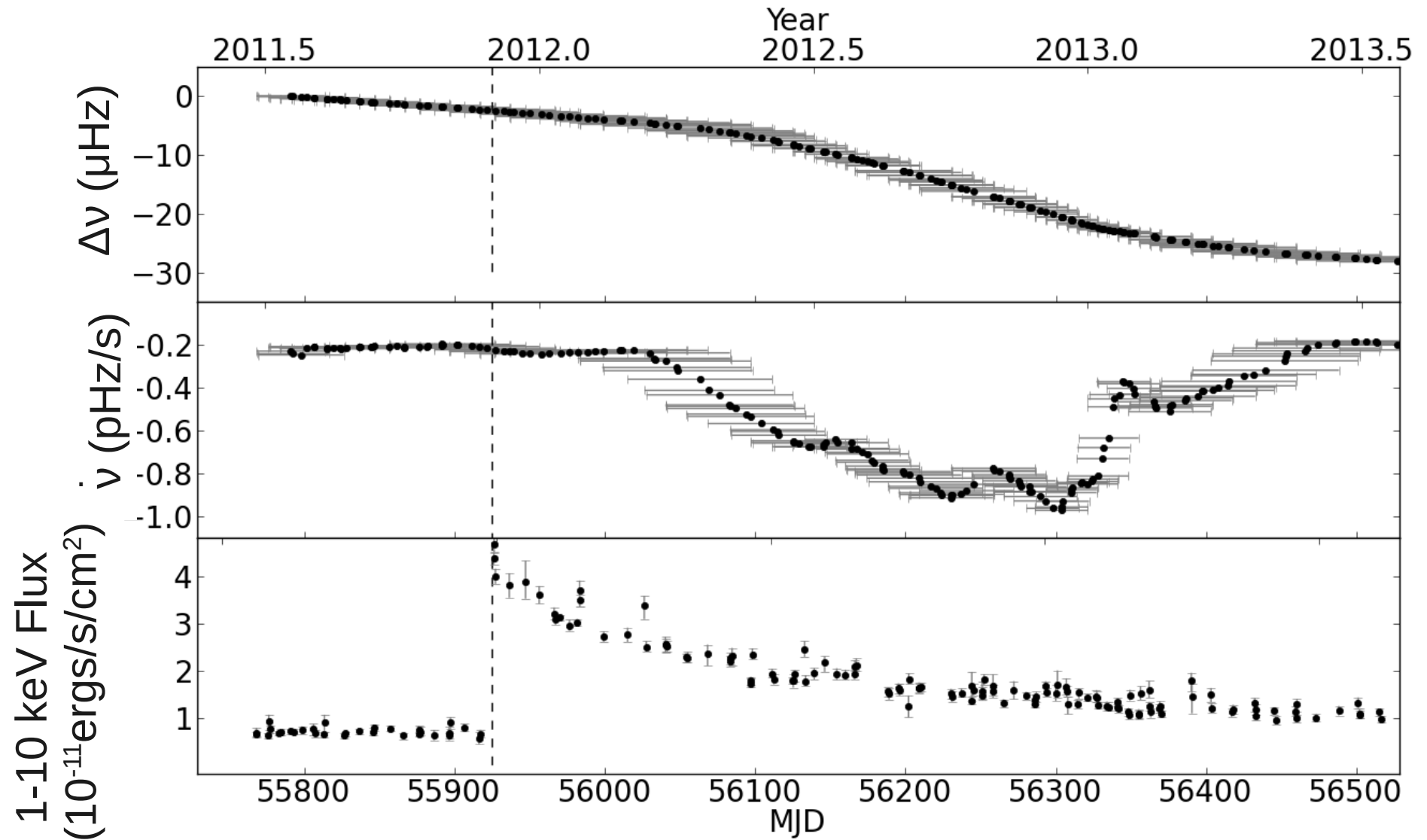
Typical

- Large Flux increase with long decay
- Strong Flux hardness correlation

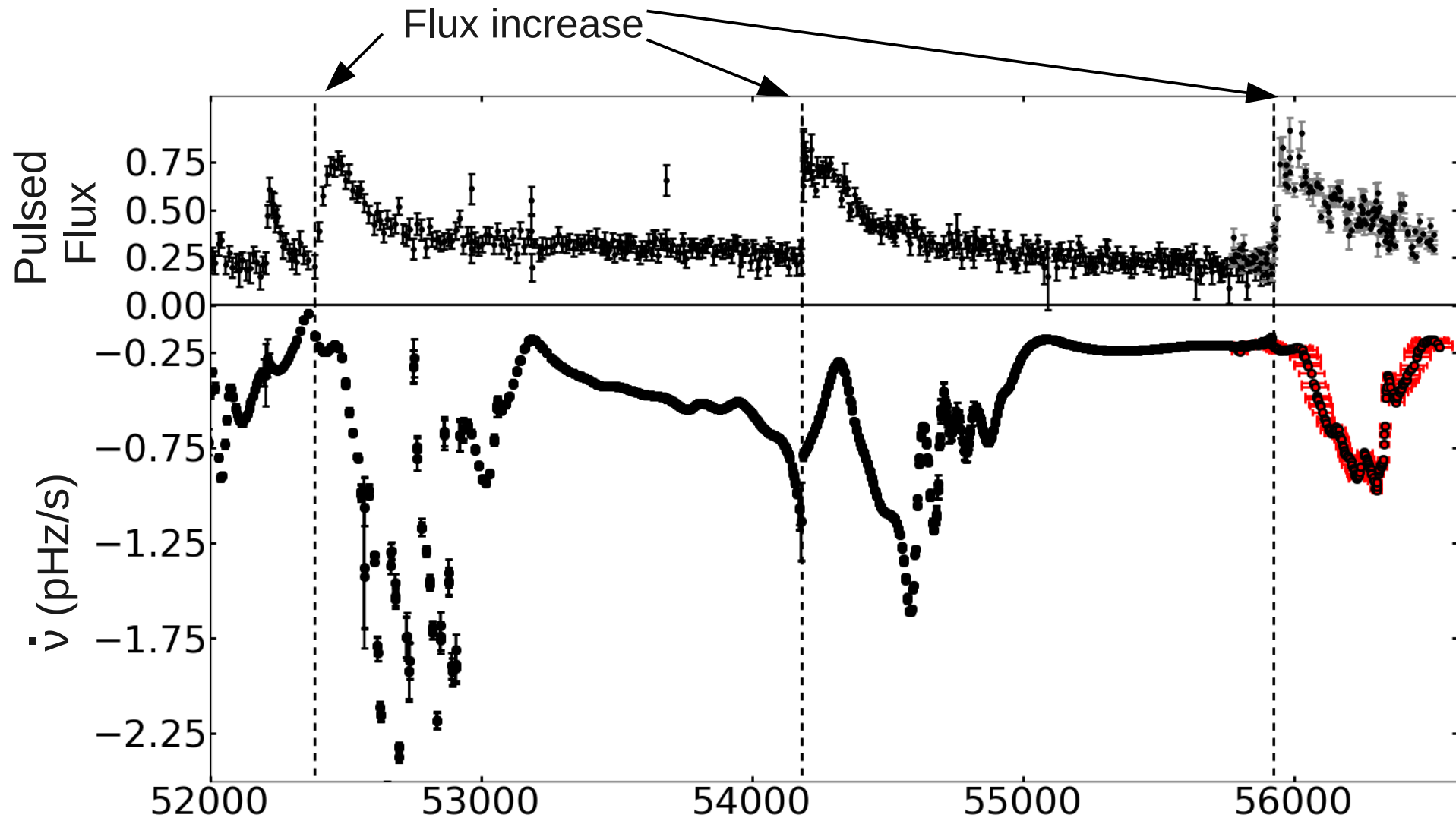
Unusual

- ~Month long delay between Flux flare and timing event
- No sudden timing change at flare epoch
- Pulsed Flux delay?

2012 Outburst Spin-down Rate

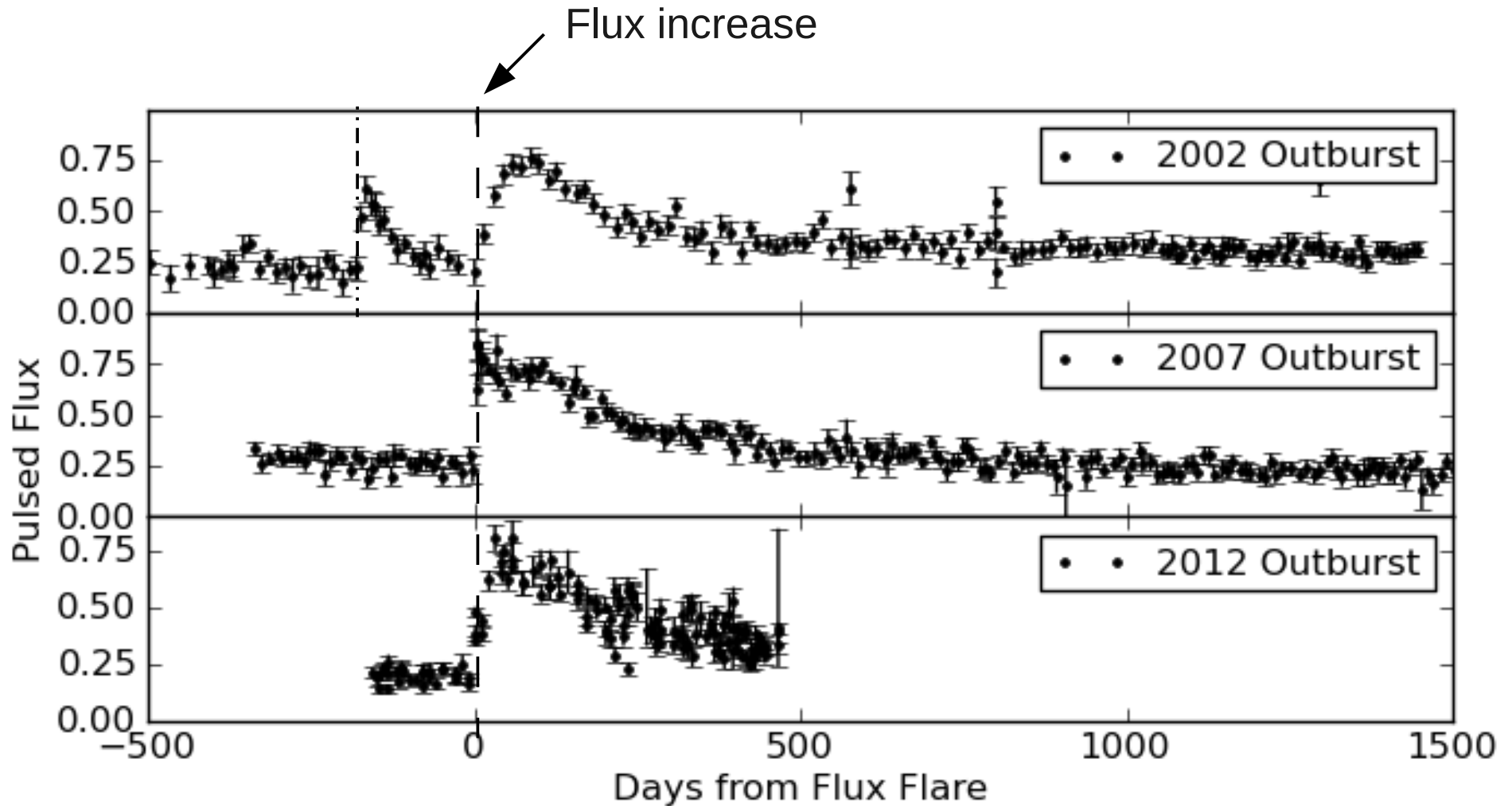


Repeated, Delayed Torque Variations Following Outbursts in 1E 1048.1-5937

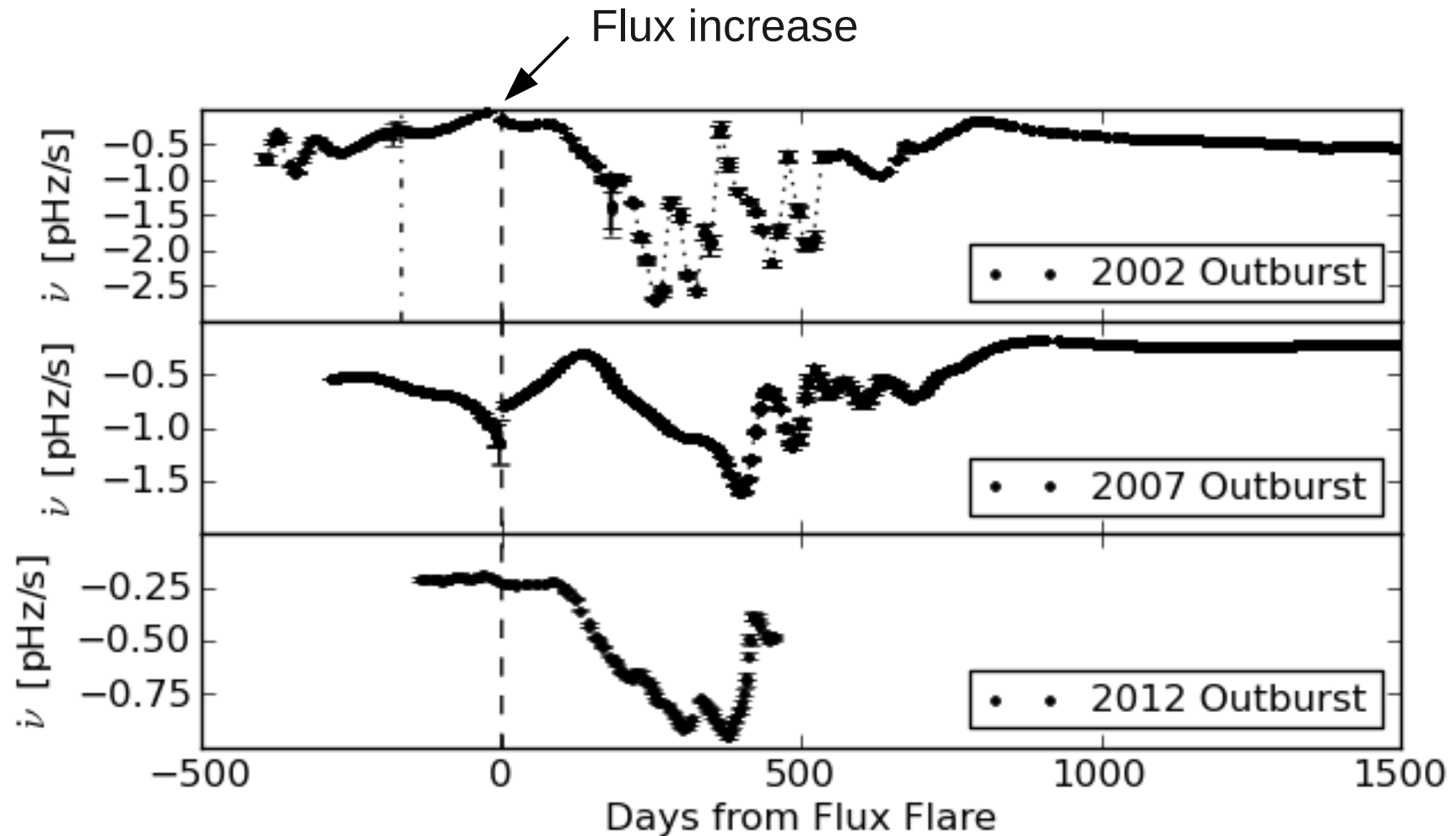


RXTE data from Dib & Kaspi, 2014

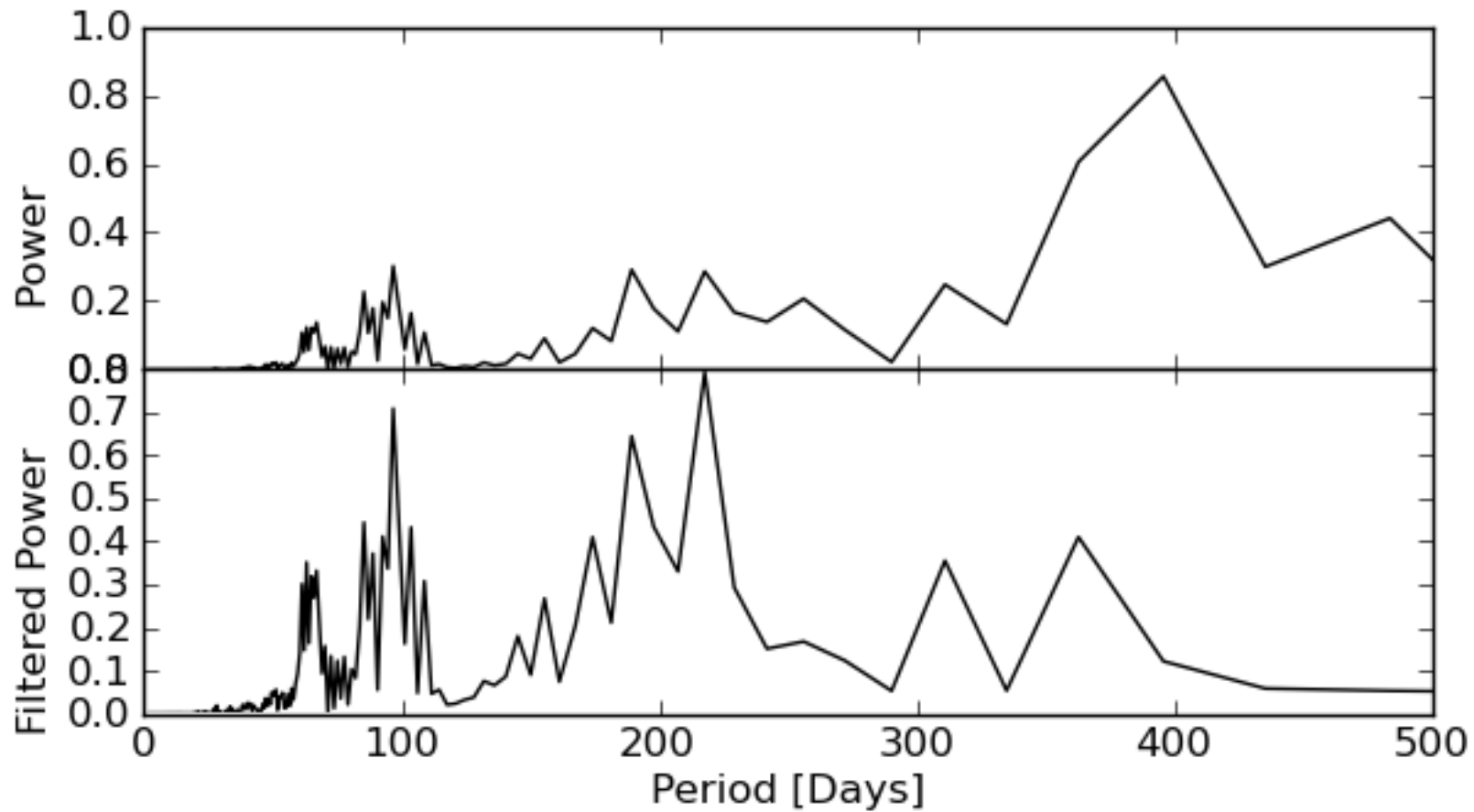
Similar Pulsed Flux Decays in 1E 1048.1-5937



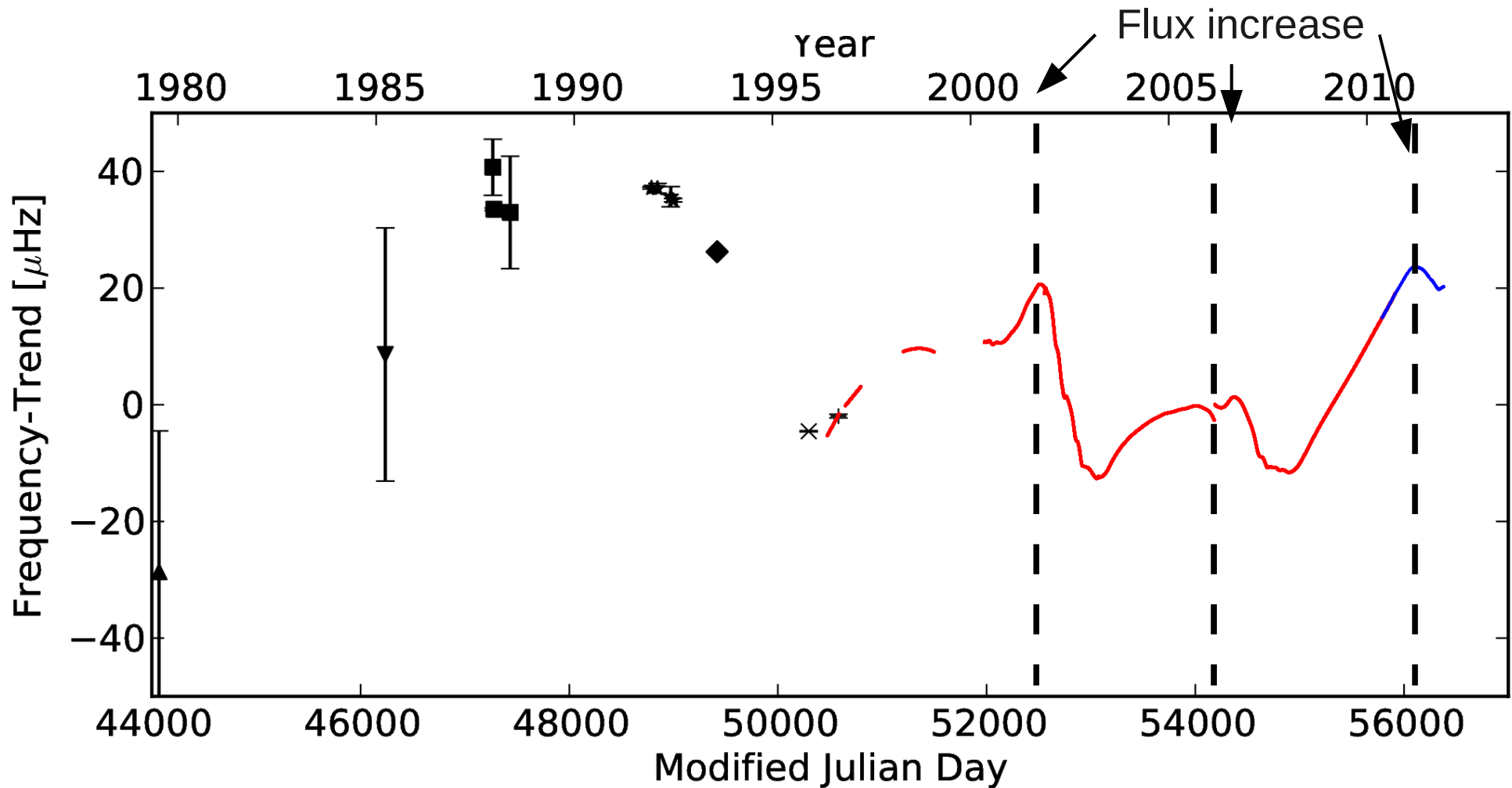
Repeated Torque Pattern Following Outbursts in 1E 1048.1-5937



Time-scale in Torque Variations



Long-term Timing of 1E 1048.1-5937



Summary

- 1E 1048.1-5937 has had 3 very similar outbursts
- ~100 day delay between flux increase and order of magnitude torque variations
- Pulsed flux evolution different from total flux evolution
- Expect Outburst in 2017 with smaller torque enhancements?