The latest news from the

Radio-quiet Swift J1753.5-0127

Mari Kolehmainen (Oxford)
Rob Fender (Oxford)
Peter Jonker (SRON)
Jeroen Homan (MIT)
James Miller-Jones (Curtin)

UNIVERSITY OF Southampton

The X-ray Universe 2014
16th -19th June, Dublin, Ireland

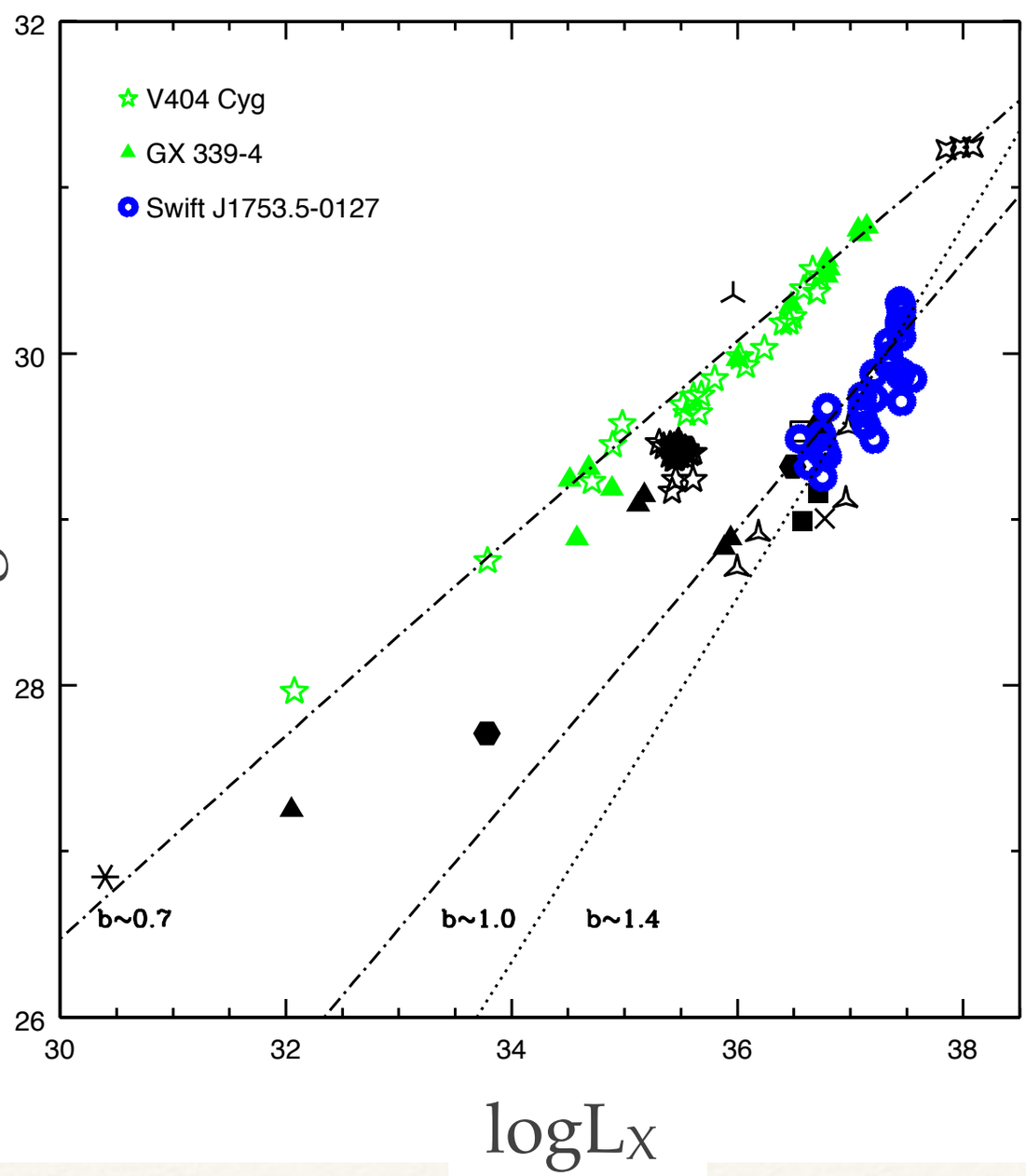
UNIVERSITY OF OXFORD

The radio/X-ray correlation

- ‘Universal’ property of LHS BHs

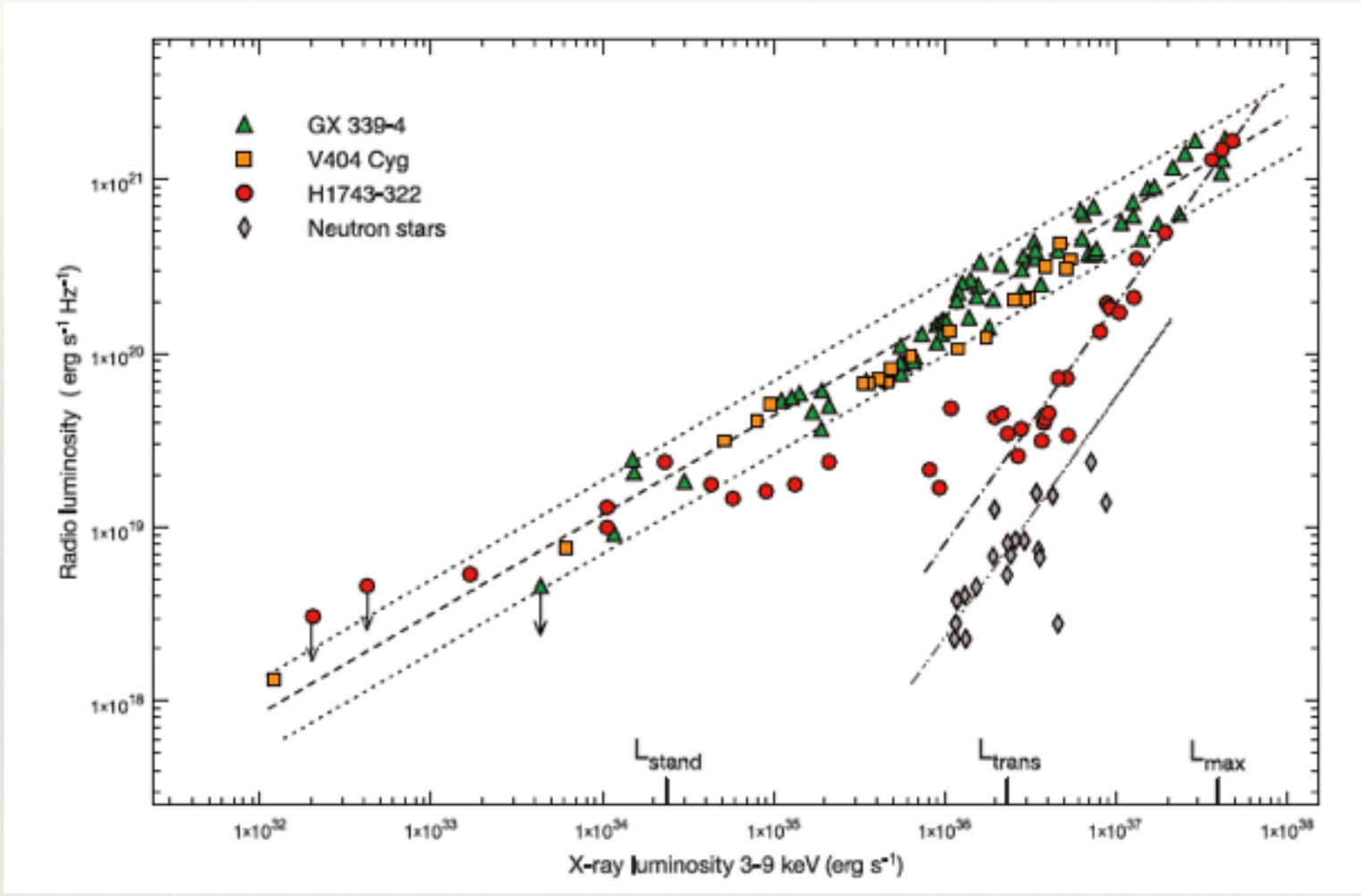
$$L_R \propto L_X^{\,b}$$

- Standard correlation $b \sim 0.6 \pm 0.1$
- Radio-quiet track steeper, b~1-1.4
- Previous observations of Swift J1753 from Soleri+2010



The radio/X-ray correlation

- Sources move up and down branches, flux ratio stays constant
- Few sources observed to jump from lower branch to the upper towards quiescence
  - H1743-322
  - GRO J1655-40
  - XTE J1752-522



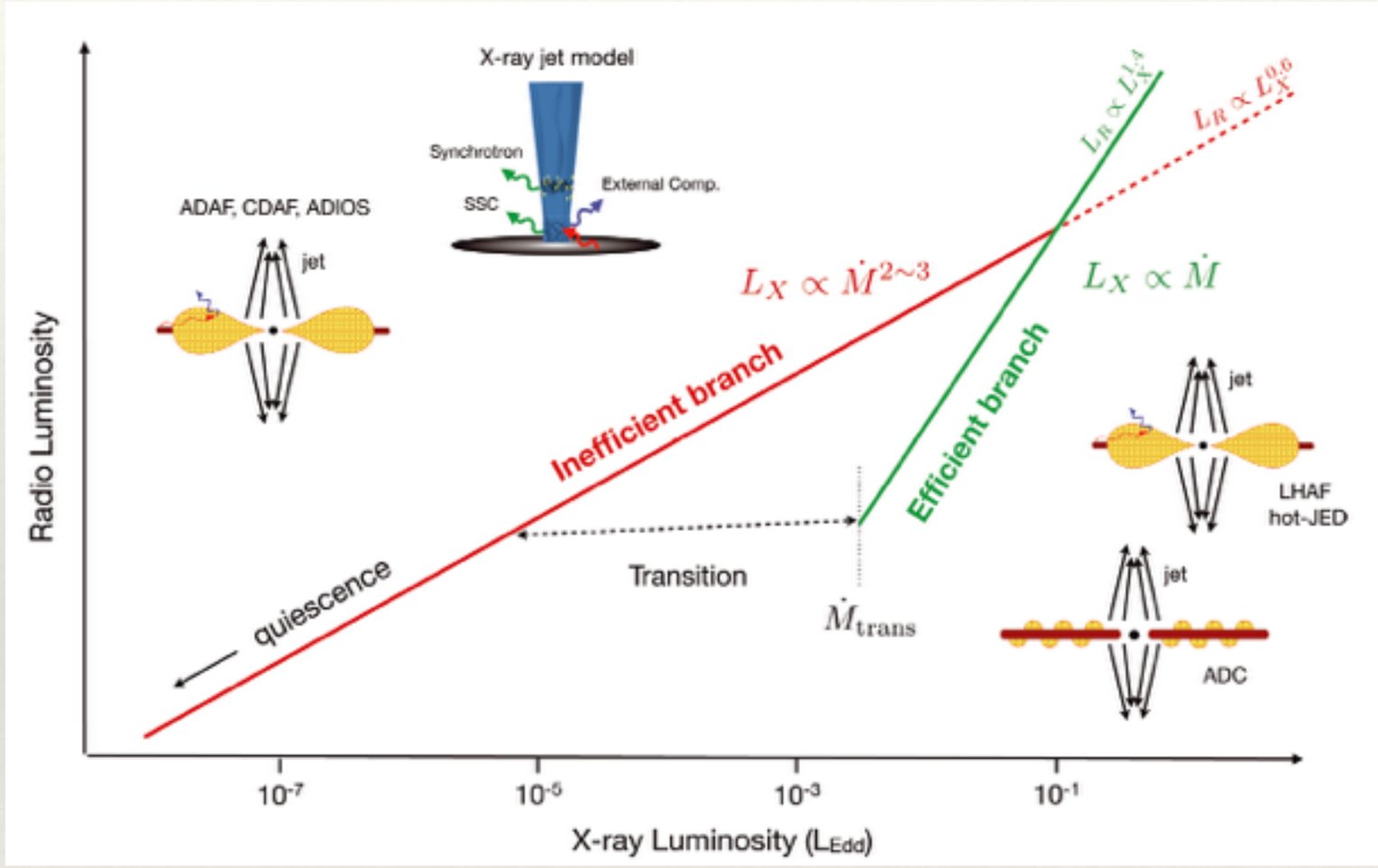
Coriat+2011

Radiatively efficient/inefficient flows?

- Suggested based on H1743-322, where $L_R \propto L_X^{1.4}$
- Empirically motivated
- Standard jet emission model assumes

  $P_{jet}=f\,P_{accr} \propto \dot{m}$,

  $L_{jet} \propto P_{jet}^{\zeta}$, $\zeta \sim 1.4$ on average for conical jets

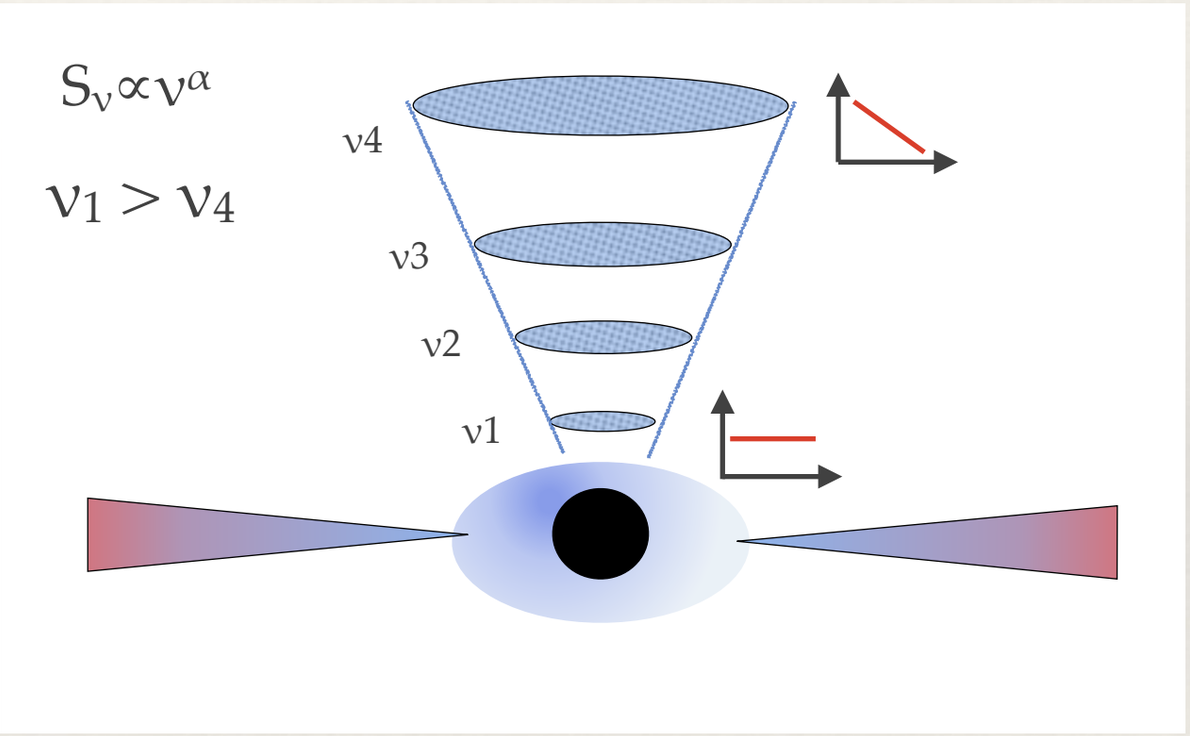


Coriat +2011

- For $L_R \propto L_X^{0.7\text{-}0.6}$, $L_x \propto \dot{m}^{2\text{-}3}$ ➡ radiatively inefficient flow (ADAF)
- For $L_R \propto L_X^{1.4}$, $L_x \propto \dot{m}$ ➡ radiatively efficient flow (LHAF, magnetic corona etc)

High frequency radio observations with AMI

- All previous observations low radio frequencies, high frequencies needed for core emission
- Arcminute Microkelvin Imager (*AMI*)
  - Large Array between 12 - 17.9 GHz, centred at 15.38 GHz
- Radio monitoring programme ongoing since the start of 2013
  - 1 observation/week on average



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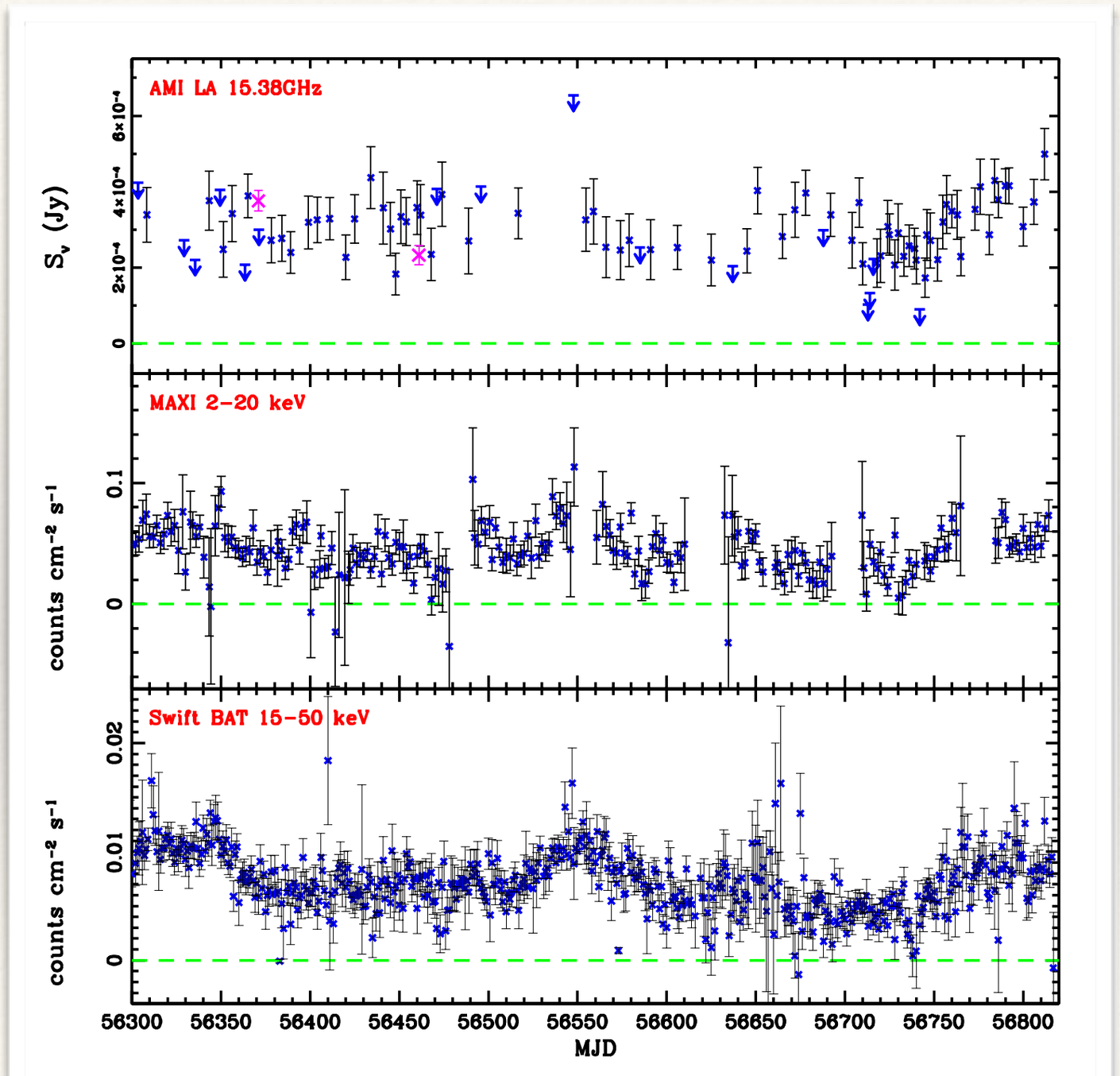
AMI Large Array, image courtesy of the Cavendish Laboratory, University of Cambridge

Swift J1753.5-0127

- X-ray flux from MAXI
  - counts to flux conversion factor
  - persistent low flux state



Kolehmainen+2014c

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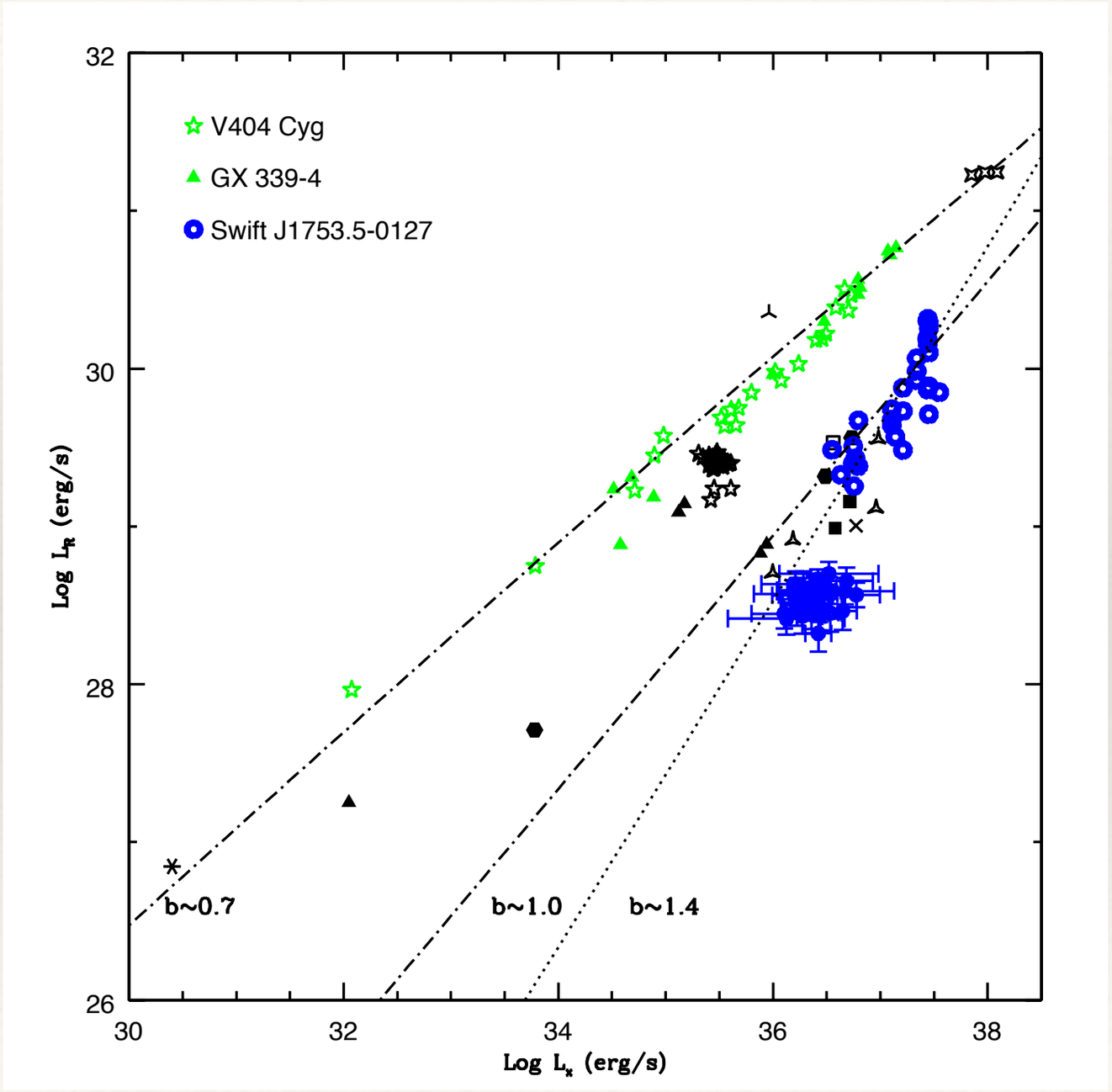
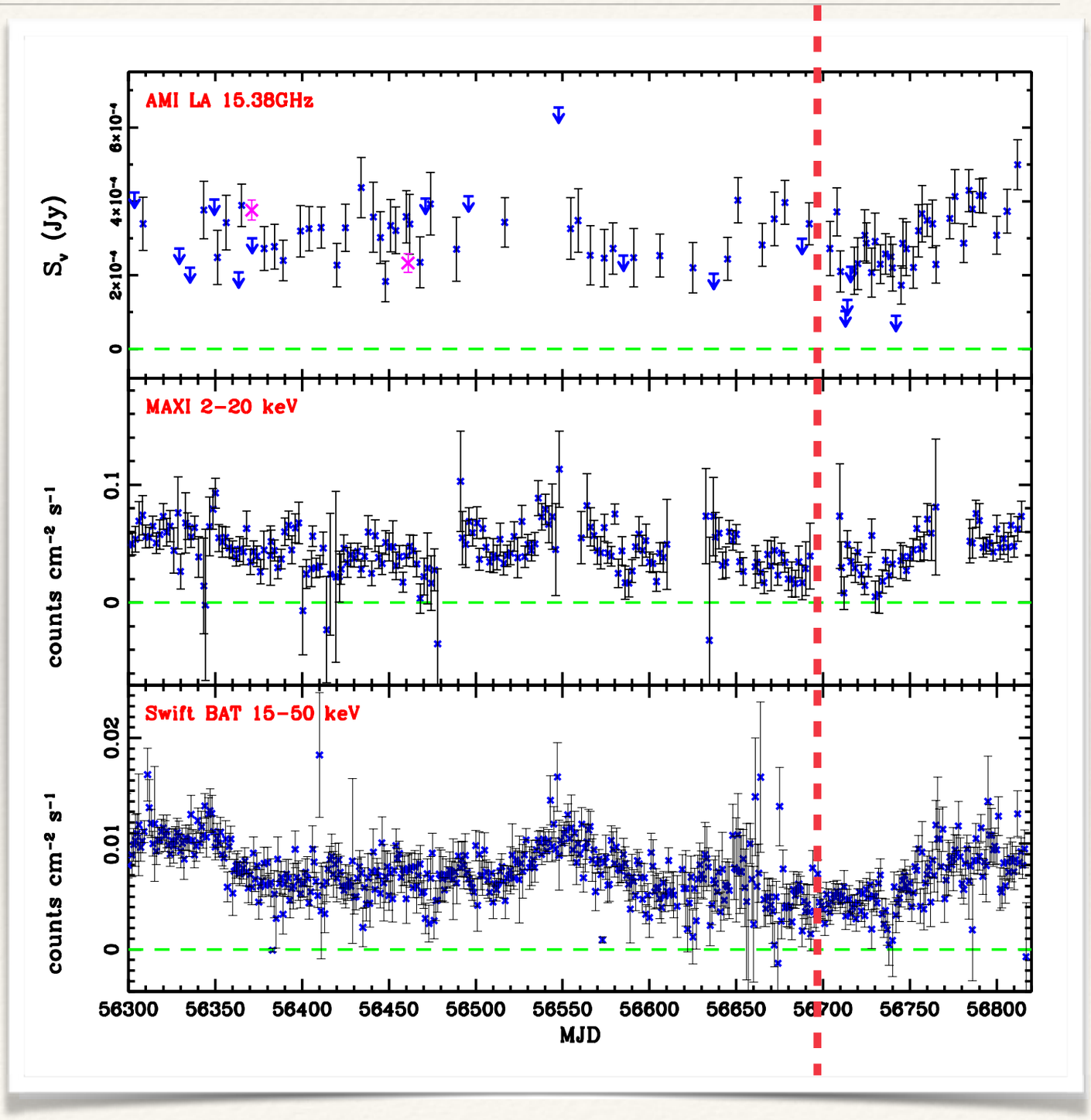


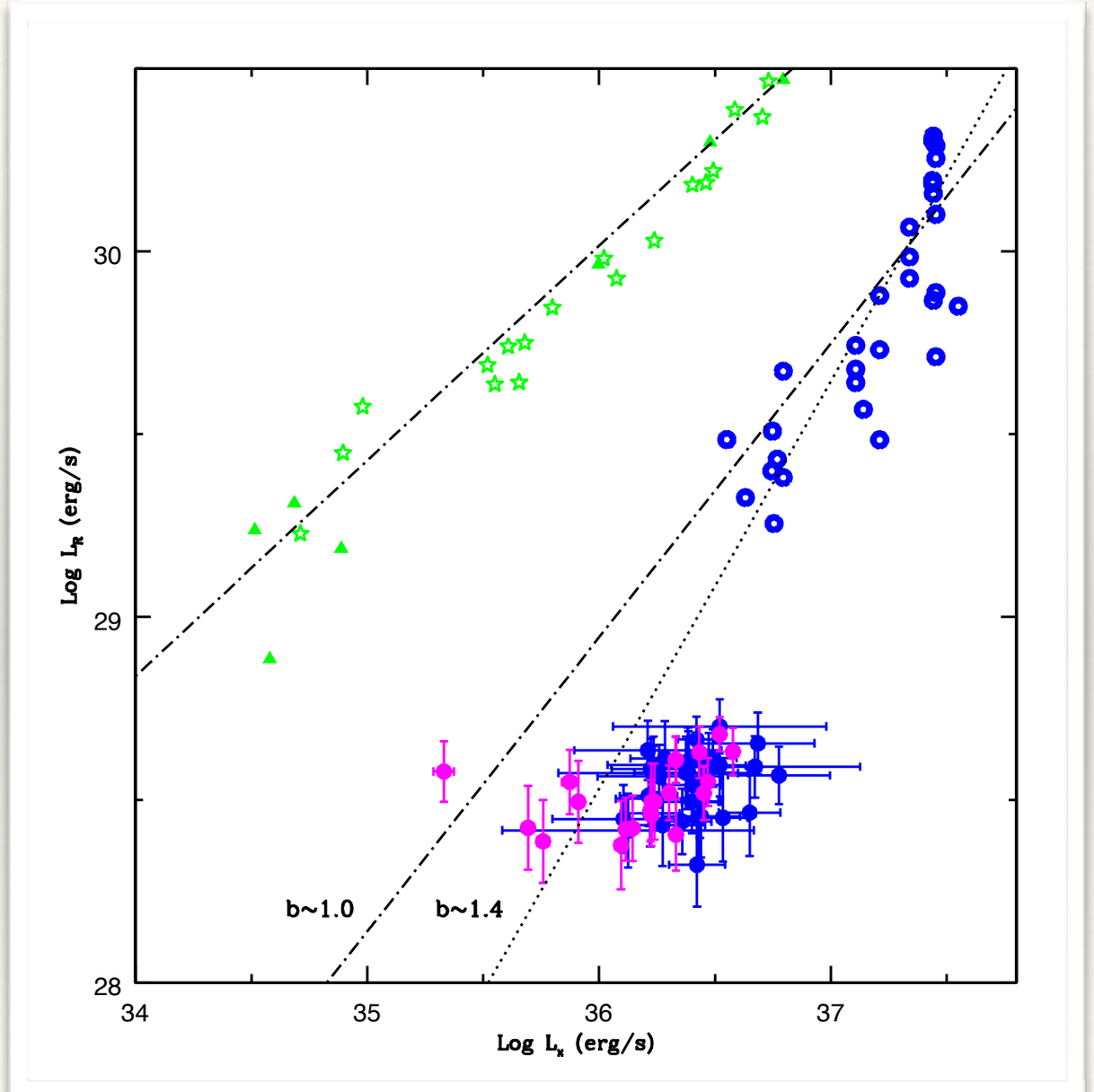
Swift J1753.5-0127

- X-ray flux from MAXI
  - counts to flux conversion factor
  - persistent low flux state
- Swift ToO campaign trickered, pointed XRT observations



Radio-quiet Swift J1753.5-0127

- Very little variation during 2013, until X-ray flux dropped below MAXI sensitivity
- Decreasing X-ray flux, constant radio flux
- High hopes for source moving towards standard correlation



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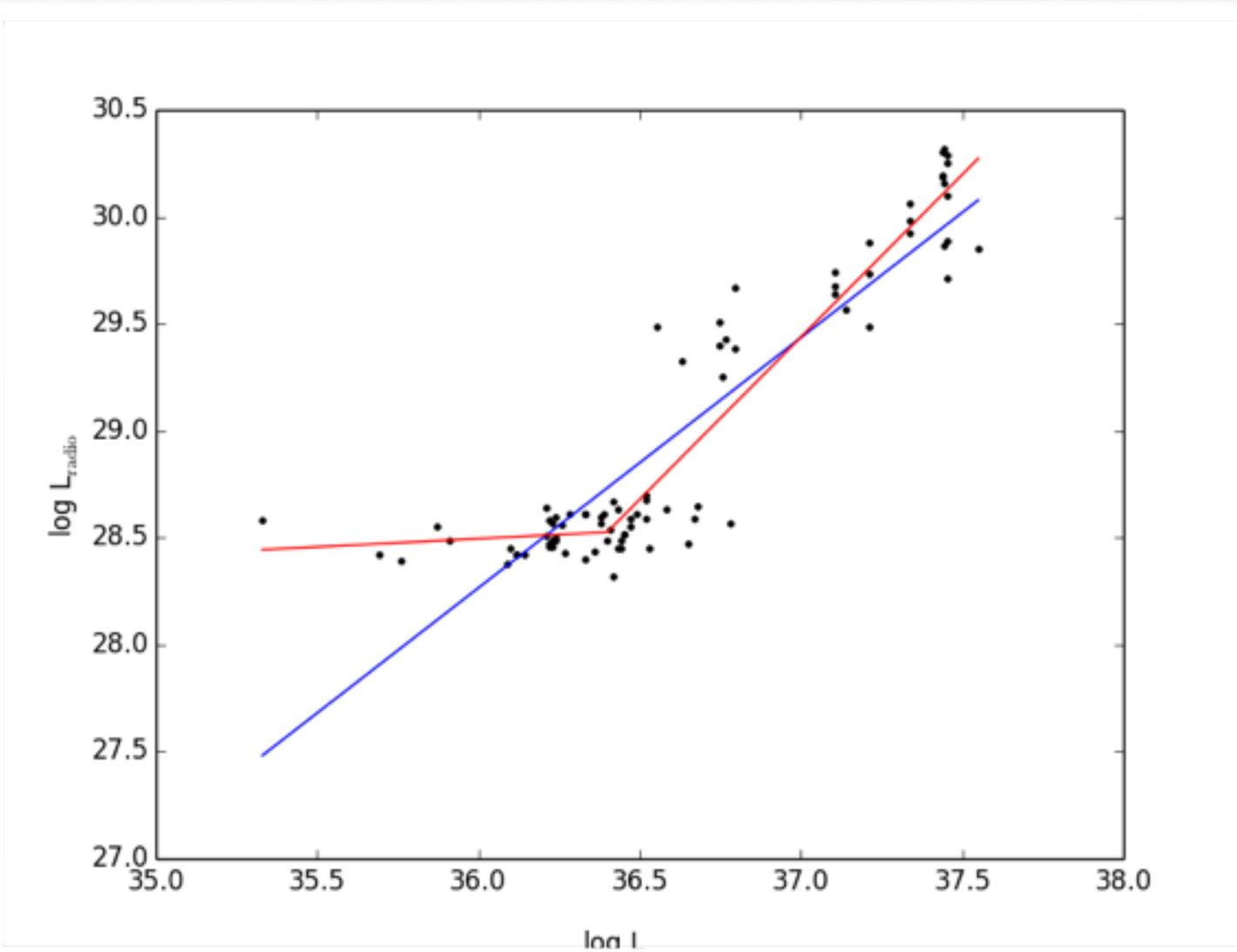
Swift J1753 on the 'transition track'

- Data best fit by broken power law
  - indices 1.5±0.1 and 0.1±0.1
  - turnover at $\log L_X \sim 36.4$ ($L_X \sim 10^{-3} L_{Edd}$)
- Single power law index 1.2±0.1
- F-test prefers broken power law, but neither is a good fit

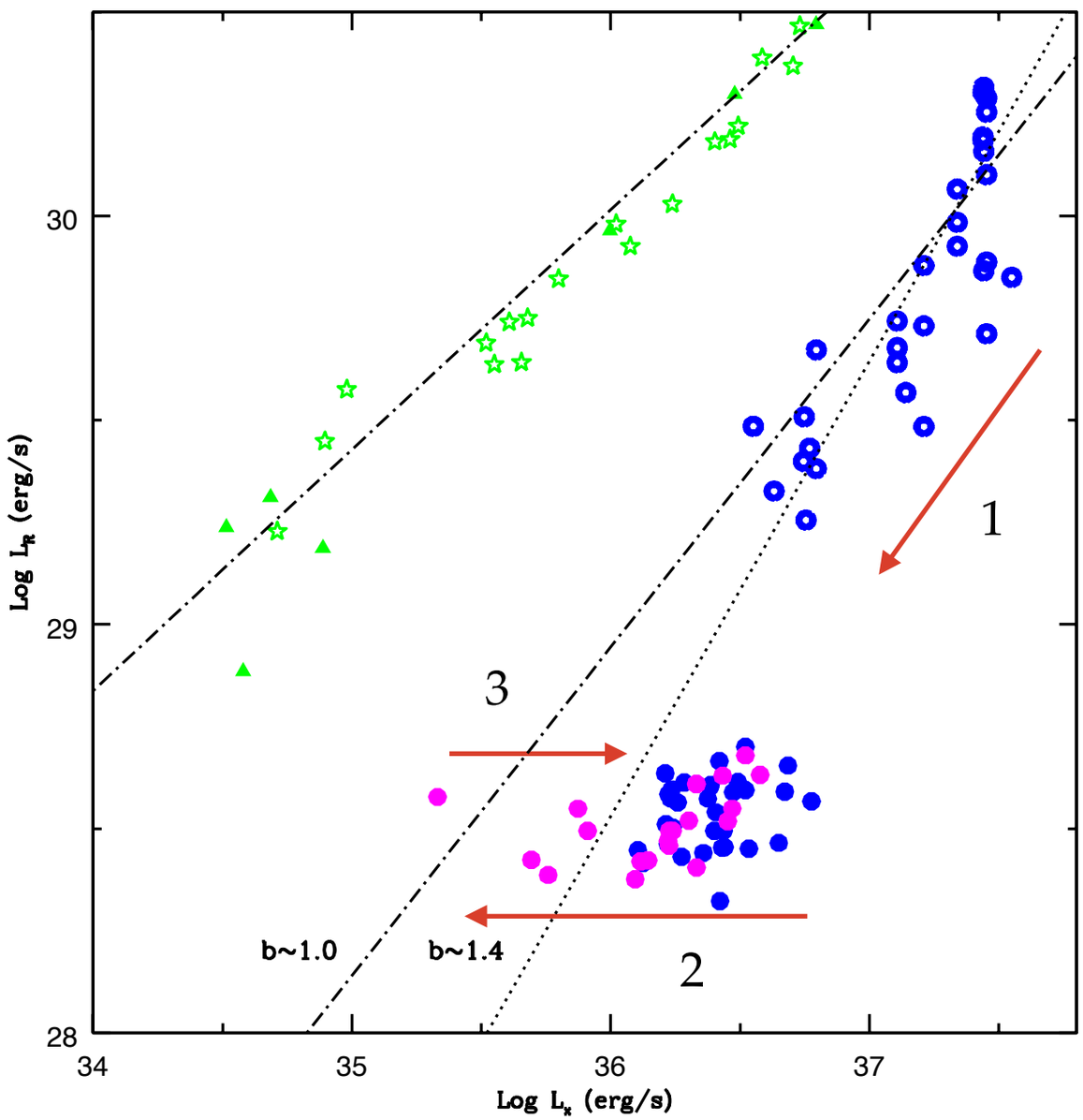


Swift J1753 on the 'transition track'

- Behaviour very similar to H1743-322
- Radio-quiet branch

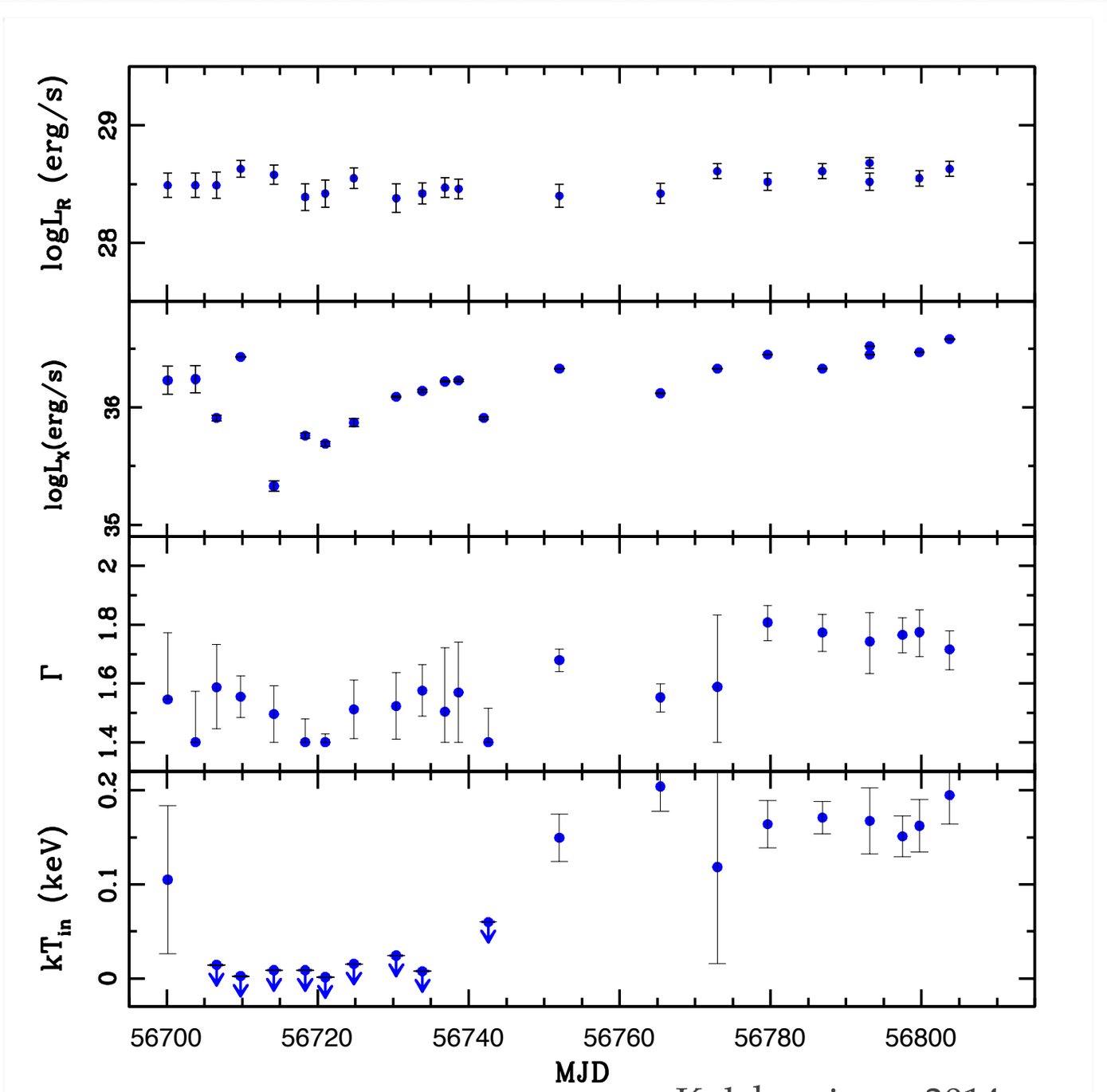
  $F_R \propto F_X^{1.5\pm0.1}$
- 'Transition branch'

  $F_R \propto F_X^{0.1\pm0.1}$
- Break at $L_{trans} \sim 2\times10^{-3} L_{Edd}$



X-ray properties

- Roughly an order of magnitude change in L_X, no change in L_R
- Small changes in X-ray spectrum
  - spectral index varies slightly during the faintest state
  - disc temperature unconstrained



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Swift J1753 on the 'transition track'

- Several scenarios for the dual track behaviour

1. radiatively efficient → radiatively inefficient
   - no obvious parameter(s) to explain the change (such as hysteresis, spin etc)
   - no obvious change in spectrum
2. radiatively inefficient → efficient
   - change in outflow rather than accretion
   - P_{jet} not fixed fraction of P_{accr}, but $f \propto \dot{m}$, then $L_R \propto L_X^{2\zeta/q}$
3. radiatively efficient → efficient

- if η=constant, accretion rate changes but jet power stays the same

Conclusions

- More careful broadband/multi-wavelength analysis needed to better understand the radio/X-ray properties of the sources on the radio-quiet branch
- Signs of dual track behaviour in Swift J1753.5-0127 during an extensive radio monitoring campaign
  - An order of magnitude change in Lx, no change in L_R, and very little change in the X-ray spectrum during the transition
  - Next step is to figure out why!