A flux state comparison of the transient X-ray pulsar SAX J2103.5+4545

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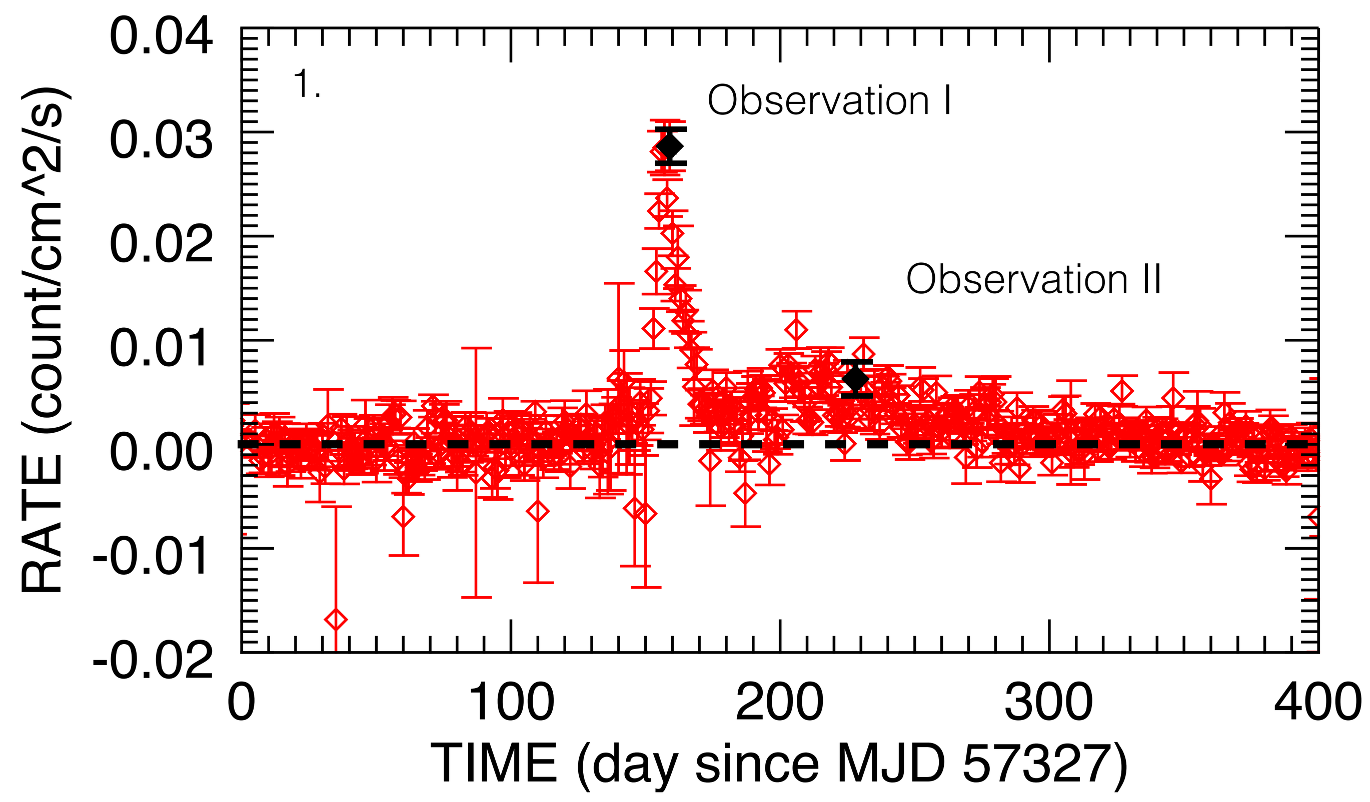
1. Observations

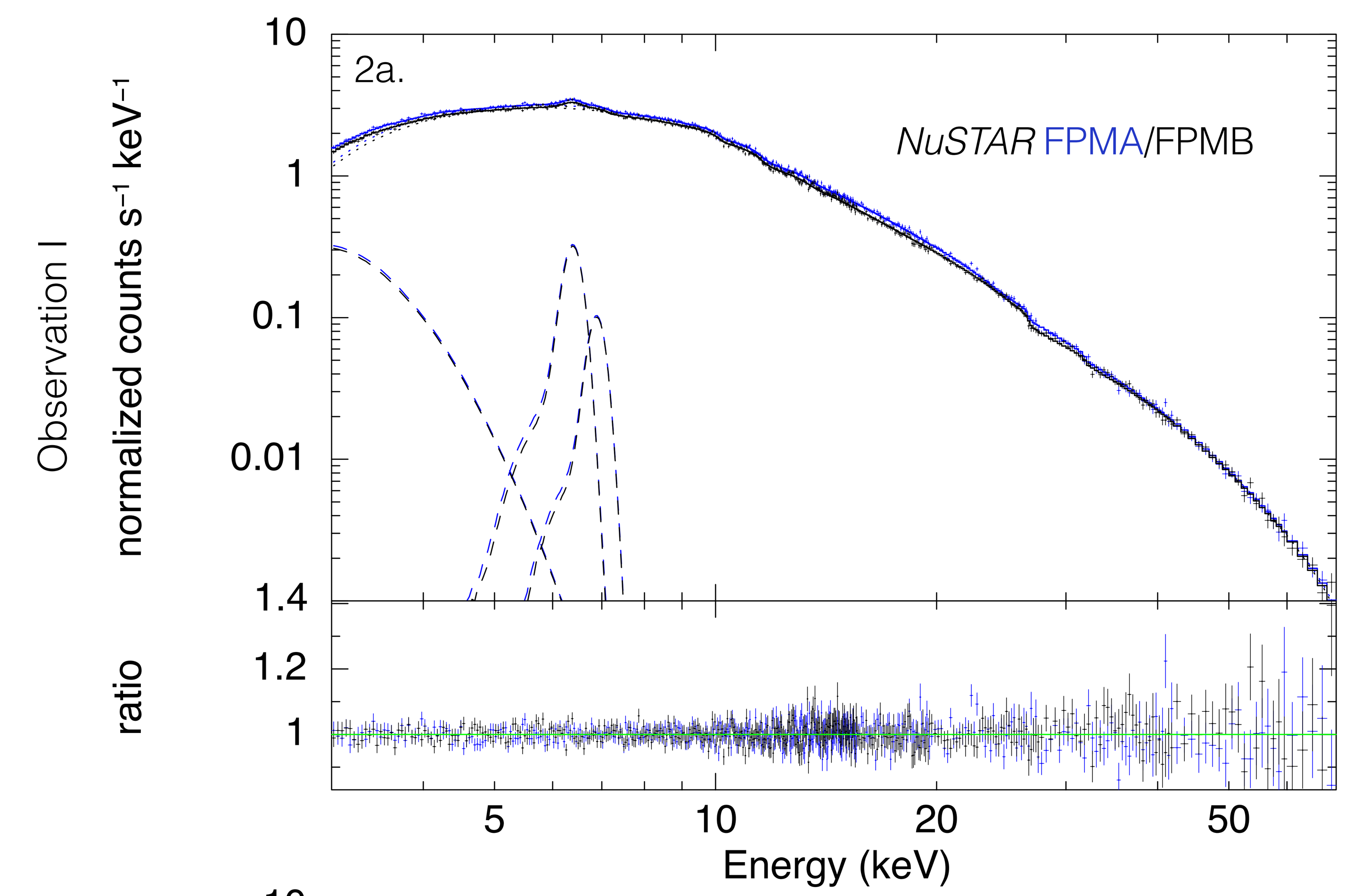
X-ray transients, detected only during active accretion, offer a unique opportunity to study individual accretion events. We observed the Be X-ray binary SAX J2103.5+4545 (hereafter J2103), with *NuSTAR* on 8 April and 16 June 2016 (Fig. 1). These ToOs captured the source during its bright precursor flare, at the brightest state since *NuSTAR*'s launch, and again later in outburst during periastron passage. **These observations provide insight into the hard X-ray spectrum of J2103 and allow us to search for cyclotron resonance scattering features (CRSFs)** (Brumback et al. 2017).

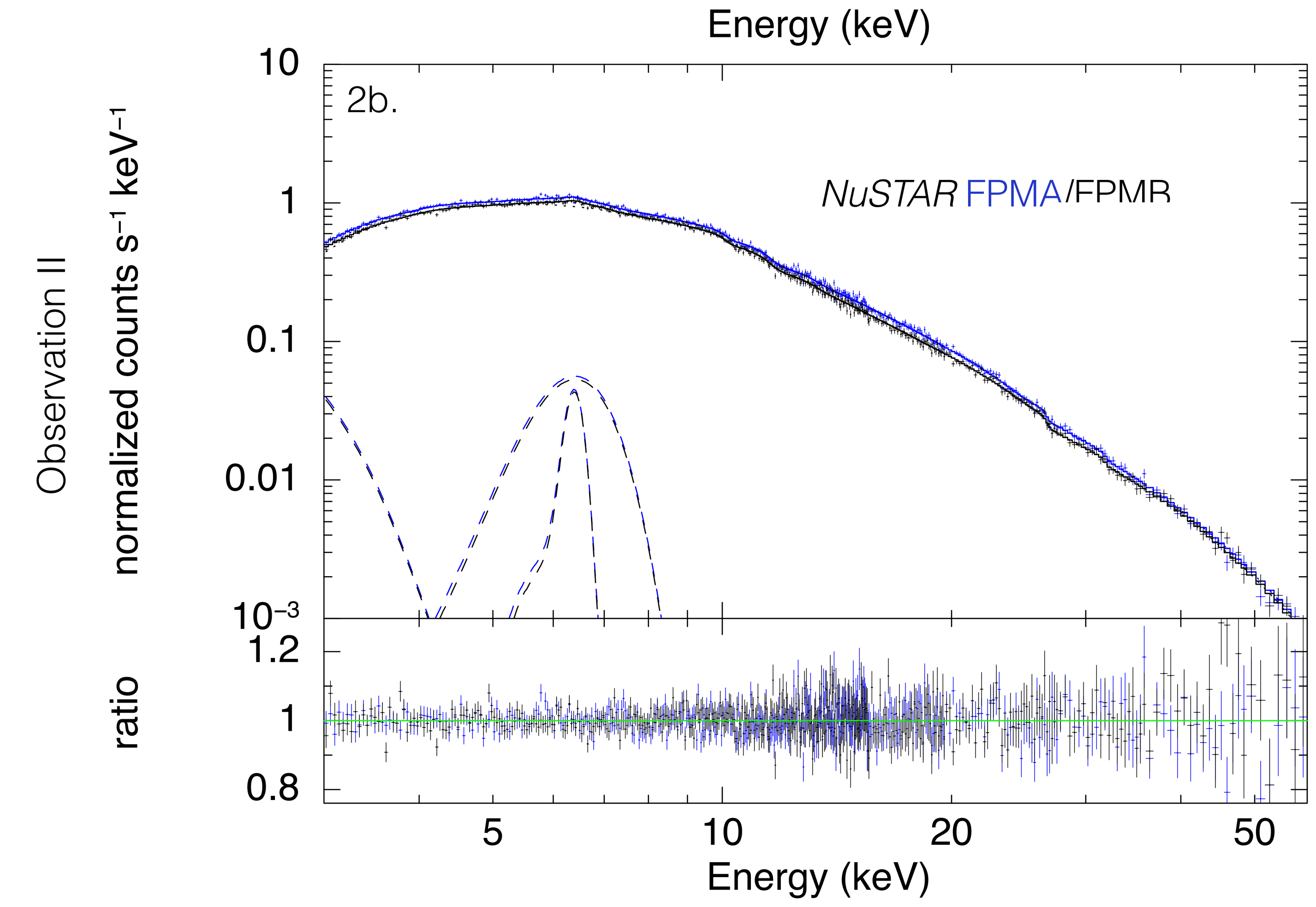


The Swift/BAT 10-20 keV light curve for J2103 showing its April 2016 outburst (red). The two black points mark the time of NuSTAR observations. The dashed black line marks a Swift/BAT rate of 0, to show the outburst flux above quiescence

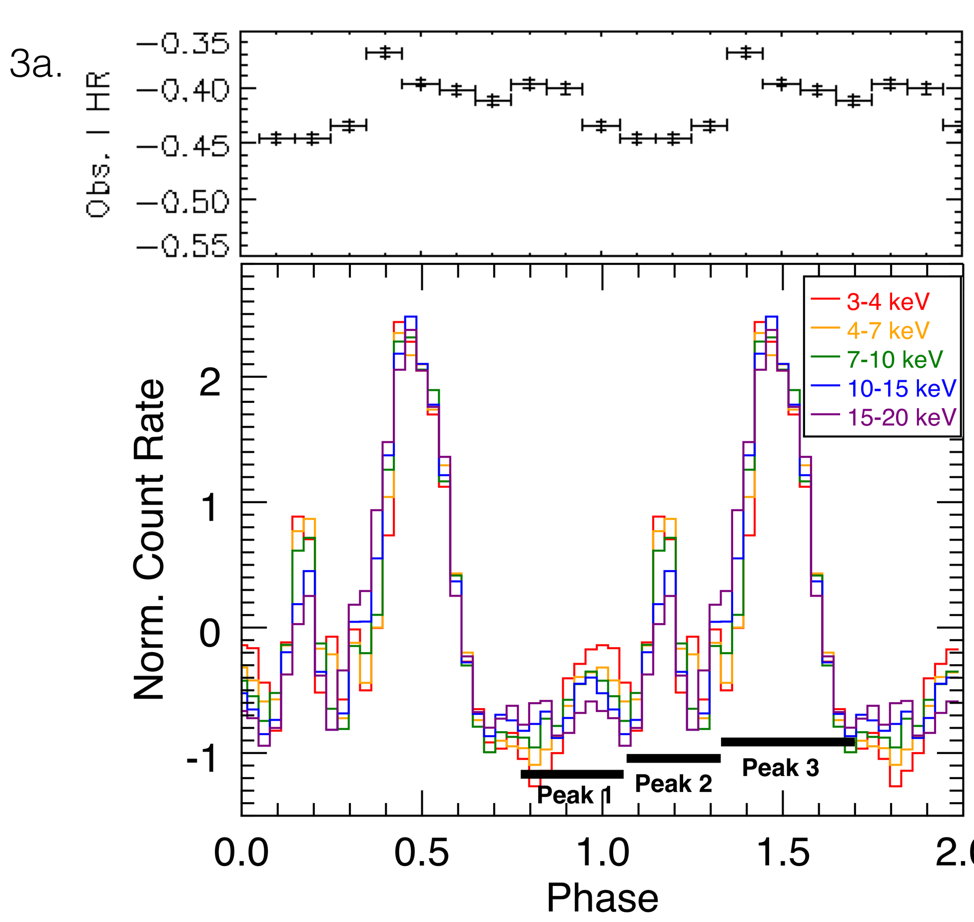
2. Phase-averaged spectra

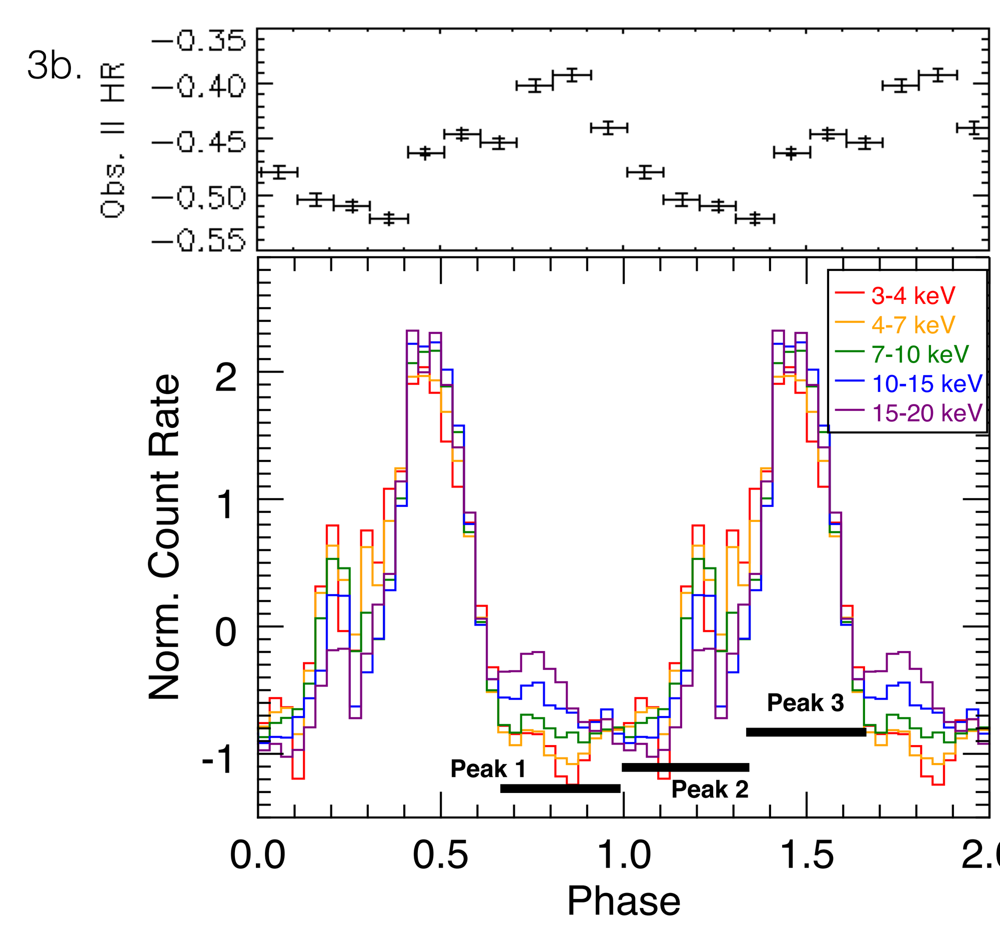
We fit the phase-averaged spectra with an NPEX model plus a thermal component. **We observe a highly ionized iron line in Obs I (Fig. 2a) for the first time in this source,** but not in Obs II (Fig 2b). Changes to the iron line structure could be tied to differences in accretion rate between Obs. I and Obs. II. Despite an almost order of magnitude change in flux, the spectral shape is broadly consistent across both observations.



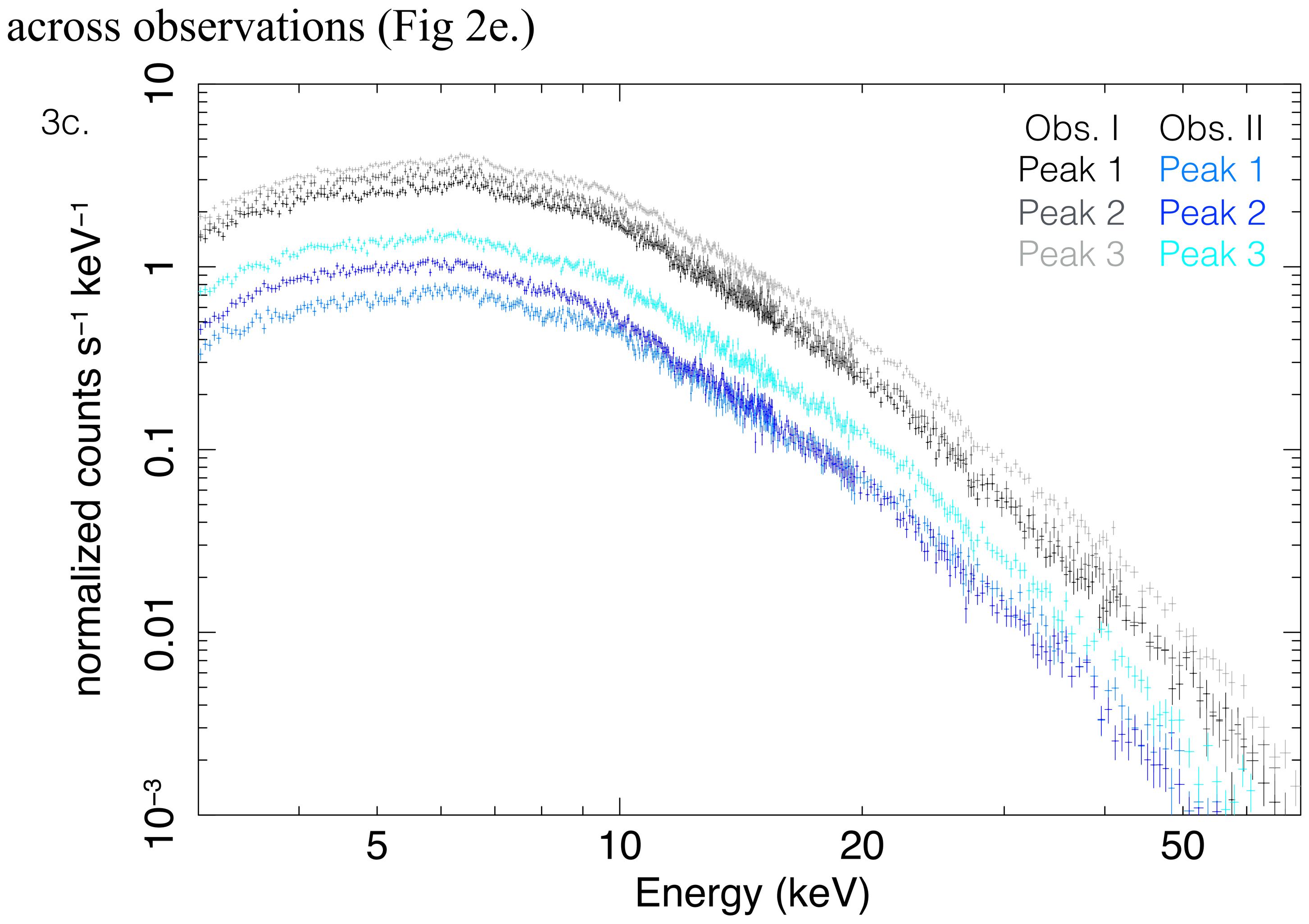


3. Timing analysis



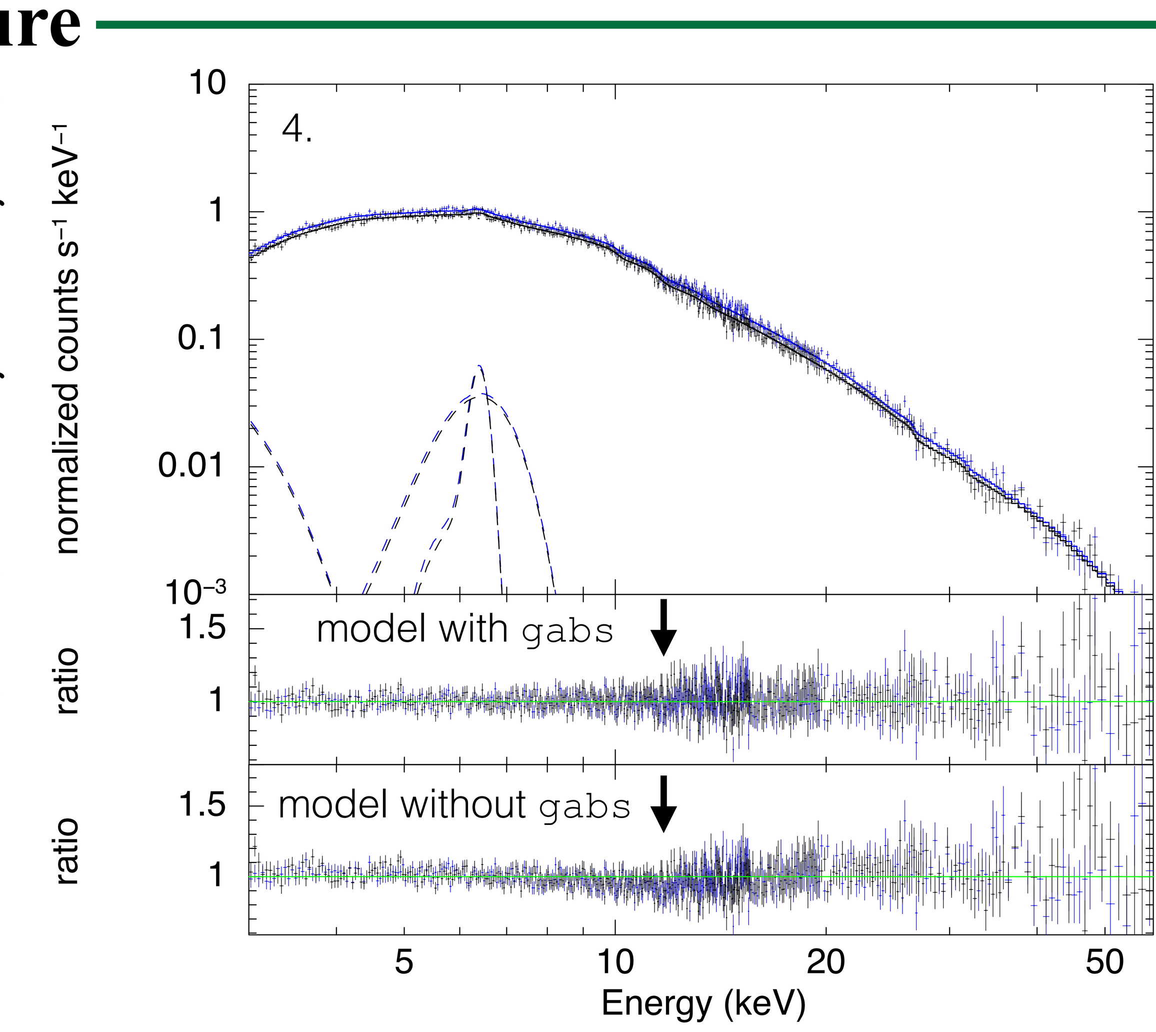


The pulse profiles for both observations show a three-peaked structure with some slight energy dependence (Figs 3a and 3b). Despite this, the shape of the continuum is approximately constant with pulse phase and across observations (Fig 2e.)



4. A possible absorption feature

While a clear CRSF is not obvious in either spectrum, an absorption feature at 14.5 keV is found in Obs. II with a delta chi squared of 6.4. We filtered the spectra from each observation into the three phase bins shown in Figs. 3a and 3b, corresponding to each peak of the pulse profile. We found strong phase dependence in the absorption feature between these bins, with Peak 2 being the most significant. In the Peak 2 phase bin of both Obs. I and Obs. II (Fig. 4), an absorption feature is detected at ~12 keV with 3 and 3.5 sigma confidence, respectively. **If this feature is related to cyclotron scattering, it implies J2103 has a magnetic field of ~ 1 x10^{12} G,** one of the lowest found for a cyclotron source.



References and Acknowledgements

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