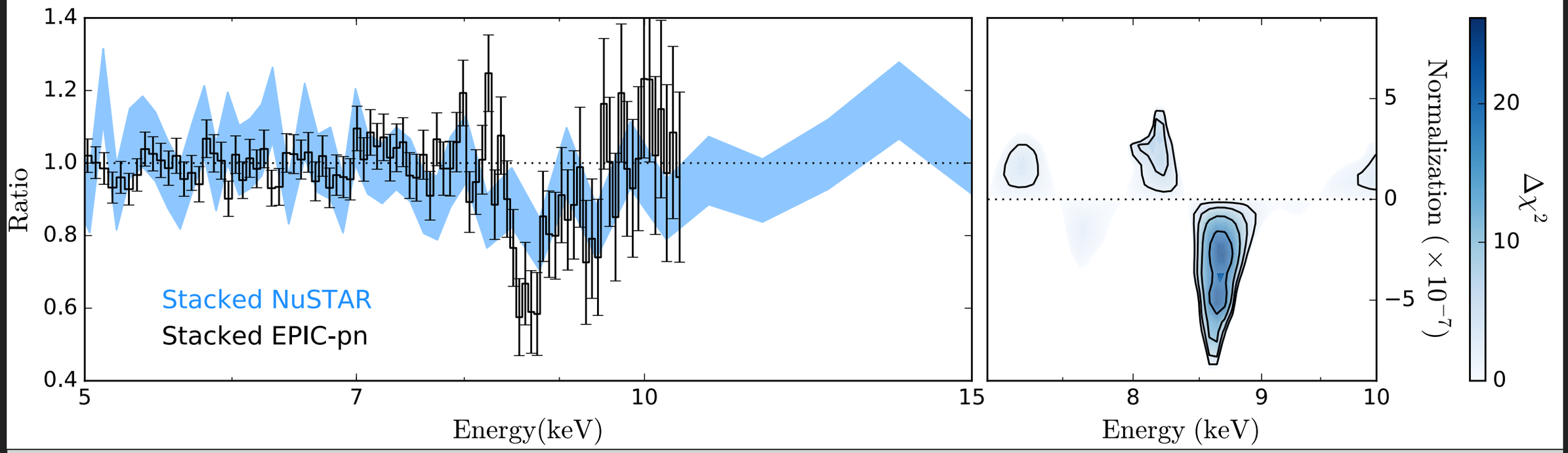


MICHAEL PARKER

C. PINTO, A. FABIAN, A. LOHFINK, D. BUISSON, W. ALSTON, J. JIANG, IRAS COLLABORATION

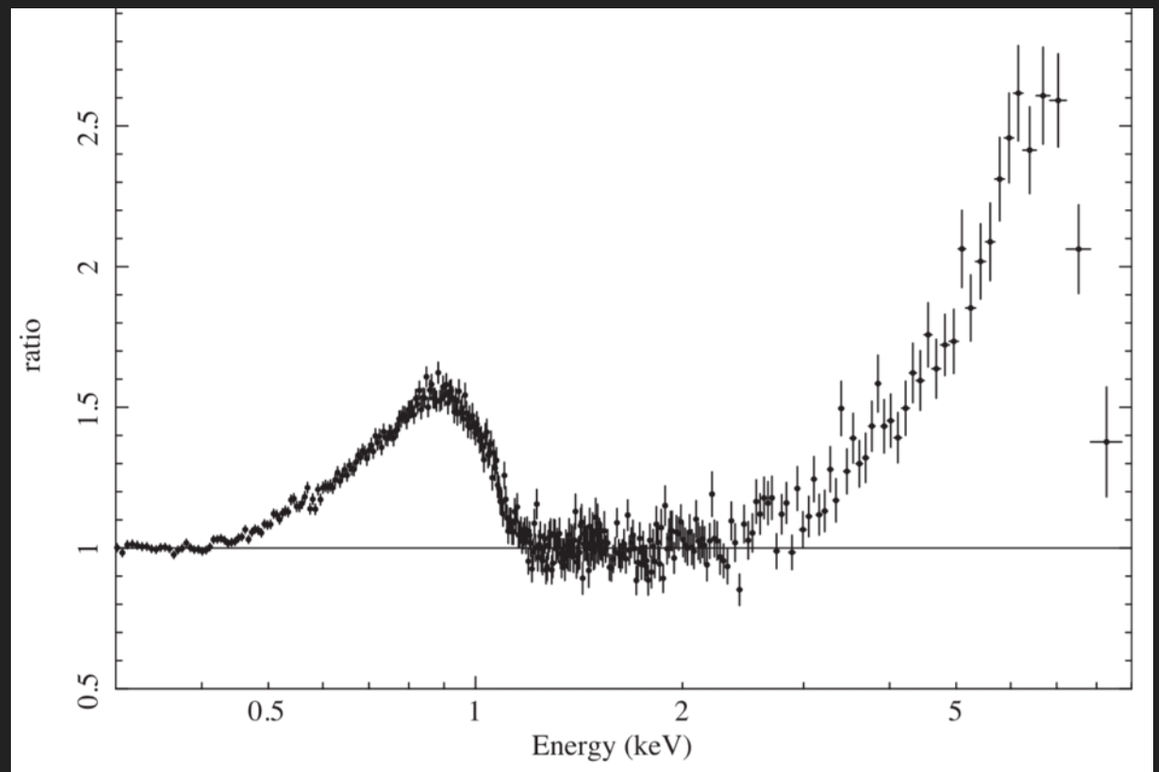
RAPIDLY VARIABLE RELATIVISTIC ABSORPTION

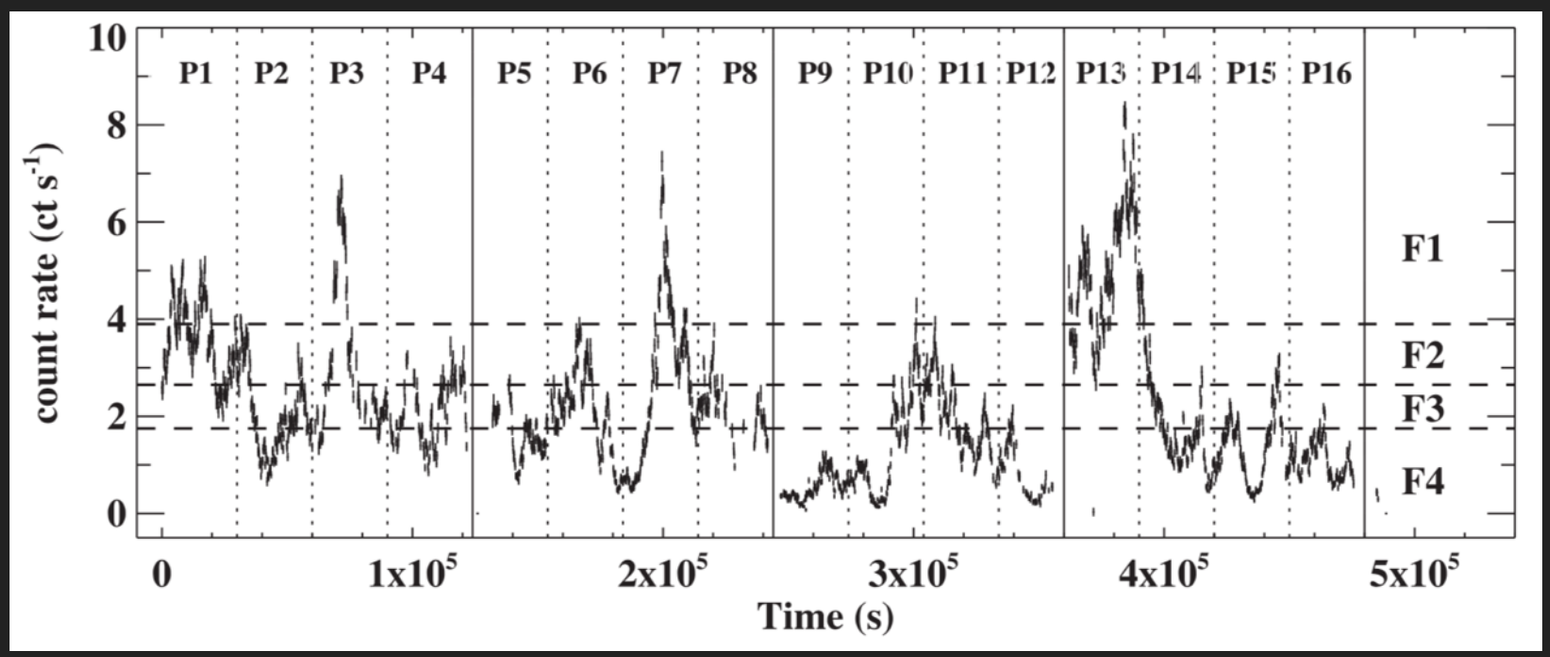
European Research Council
Established by the European Commission

IRAS 13224–3809

- The most X-ray variable AGN in the XMM-Newton archive
- Narrow-line Seyfert 1 galaxy
- Shows strong relativistic iron emission lines (Fe K & Fe L)

Fabian et al. 2013

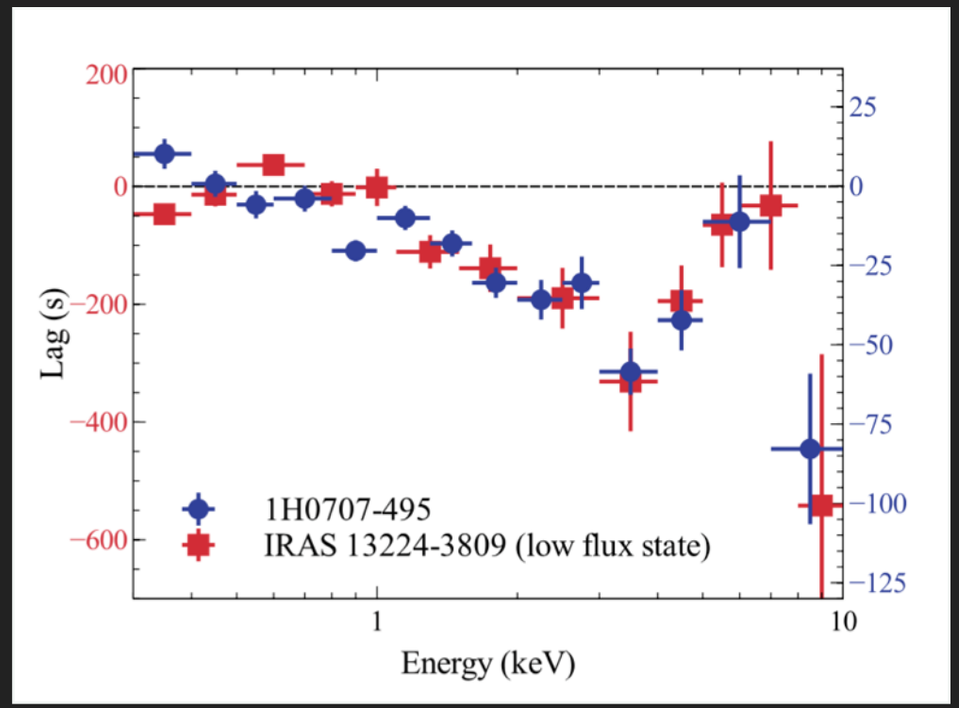


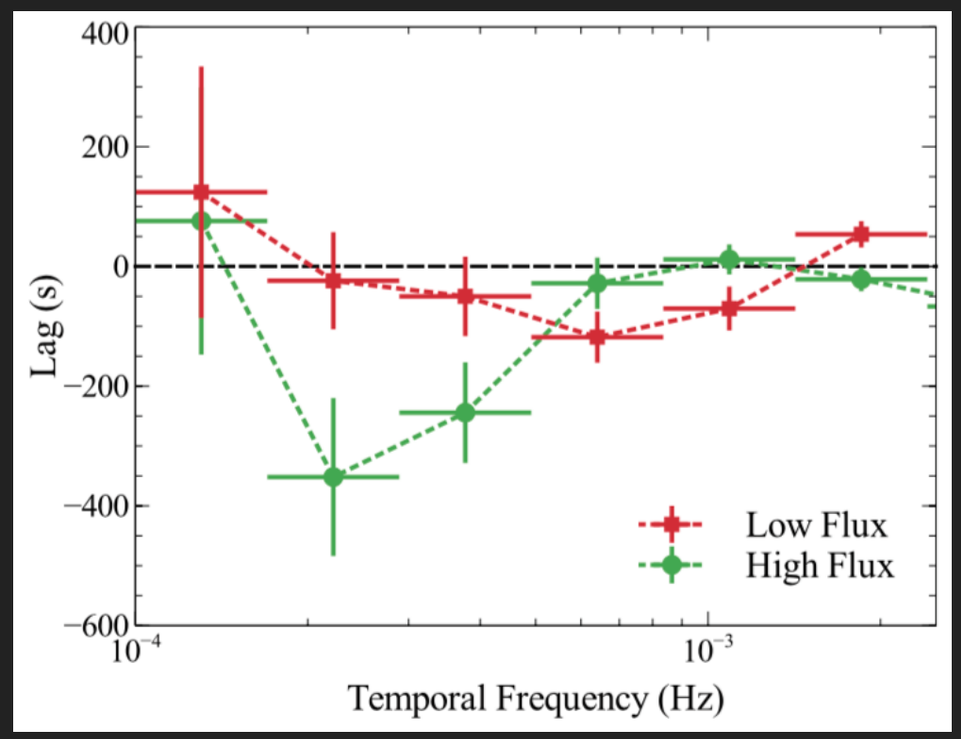


Chiang et al. 2015

IRAS 13224-3809

- Shows strong X-ray reverberation - the delay between primary and reflected emission
- Reverberation seems to be flux-dependent - geometric effect?

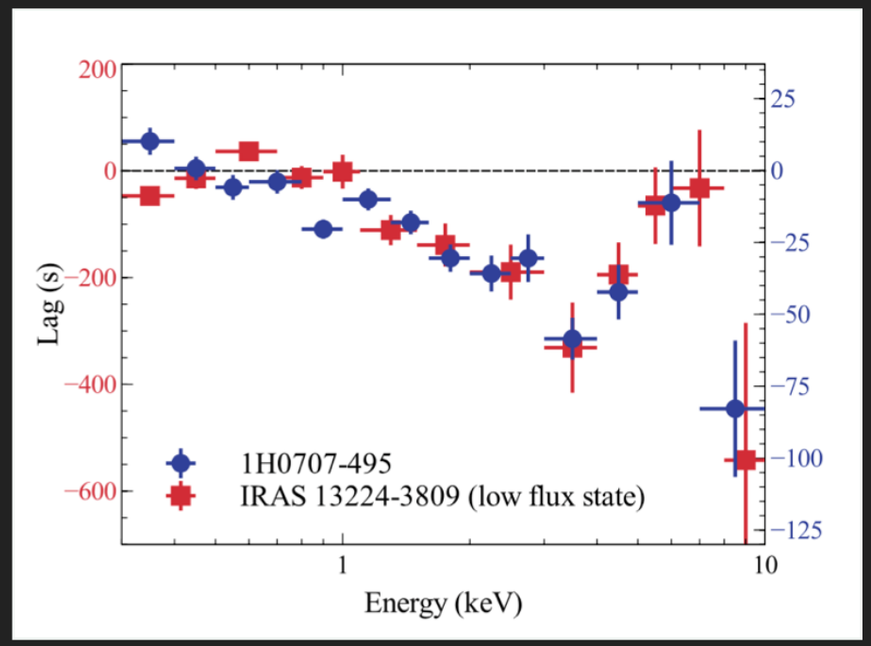




Kara et al. 2013

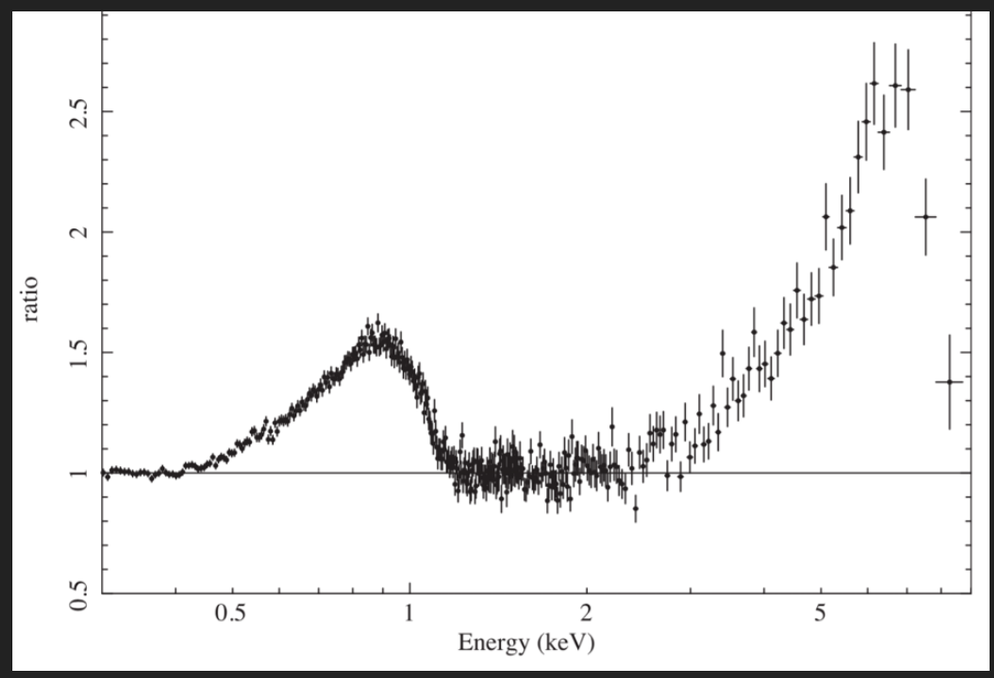
2016 OBSERVING CAMPAIGN

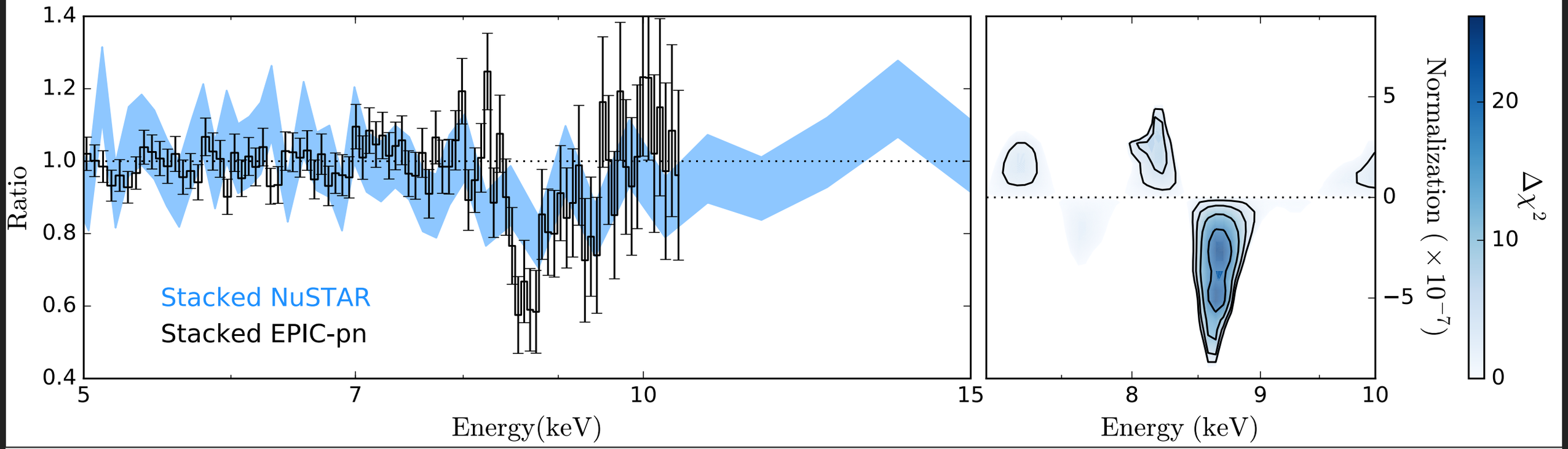
- 1.5 Ms (~17 days) with XMM-Newton and 500 ks with NuSTAR
- Intended to study X-ray reverberation - map the inner disk to unprecedented precision
- Not intended to find ultra-fast outflows!



Kara et al. 2013

Fabian et al. 2013



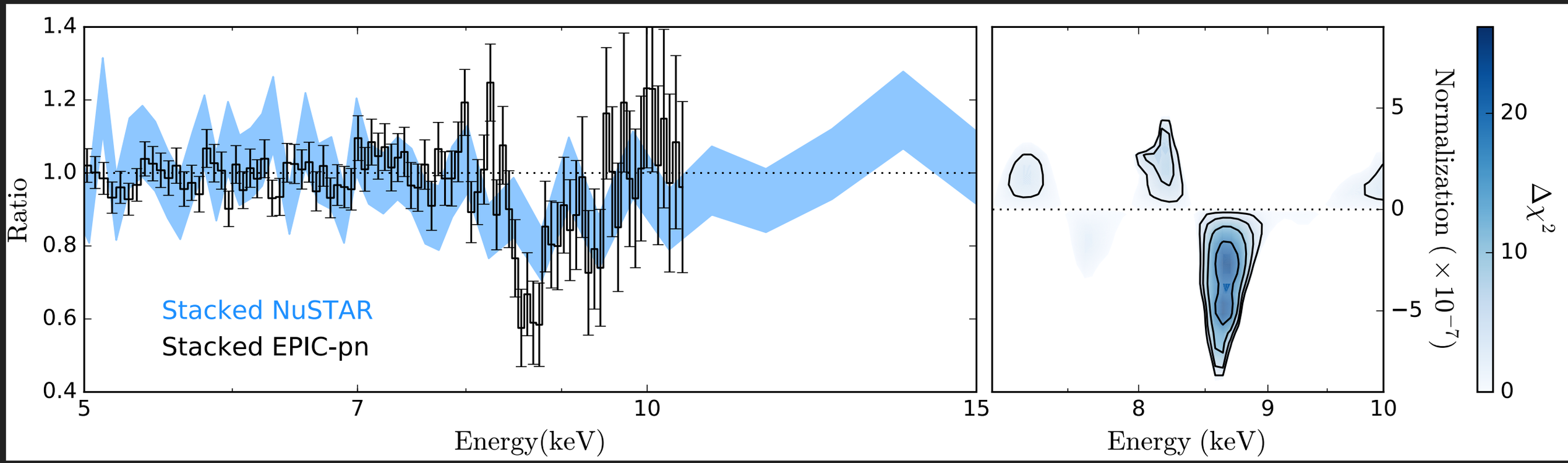


THE 0.24C OUTFLOW IN IRAS 13224−3809

Parker et al. 2017a, Nature 543, 83

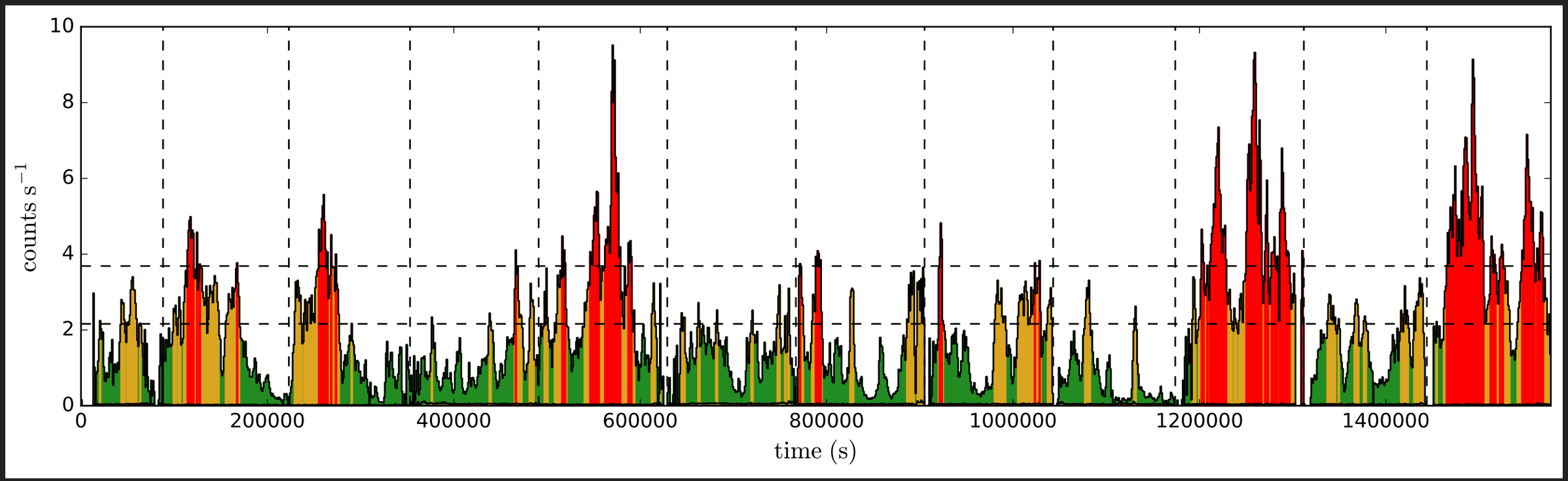
Parker et al. 2017b, MNRAS 469, 1553

RAPIDLY VARIABLE RELATIVISTIC ABSORPTION



- Strong absorption feature in the stacked EPIC-pn spectrum
- Consistent with the NuSTAR data
- Significant at ~4σ, after fitting the reflection
- Velocity is 0.24c, depending on ionization

RAPIDLY VARIABLE RELATIVISTIC ABSORPTION

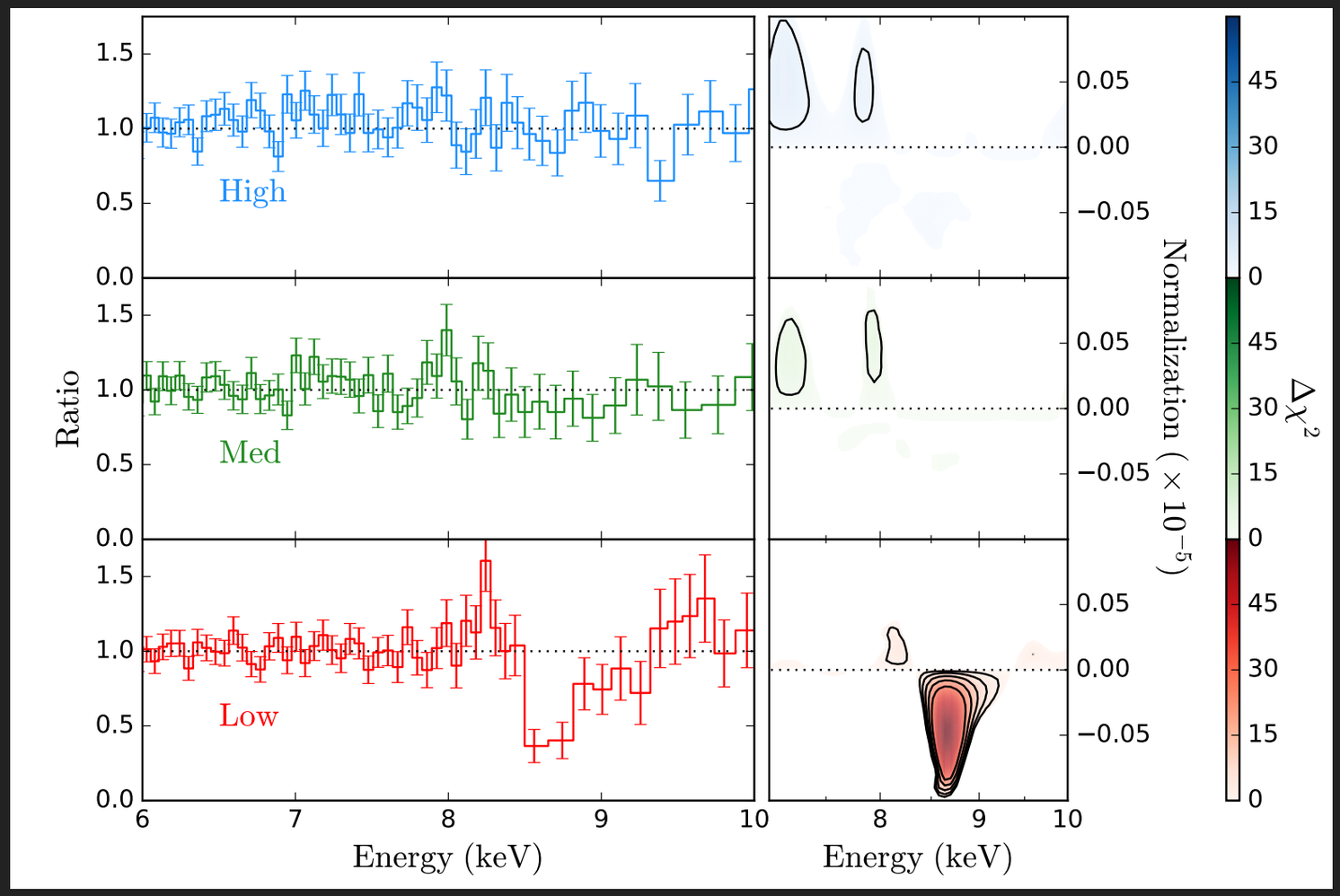


FLUX-RESOLVED SPECTROSCOPY

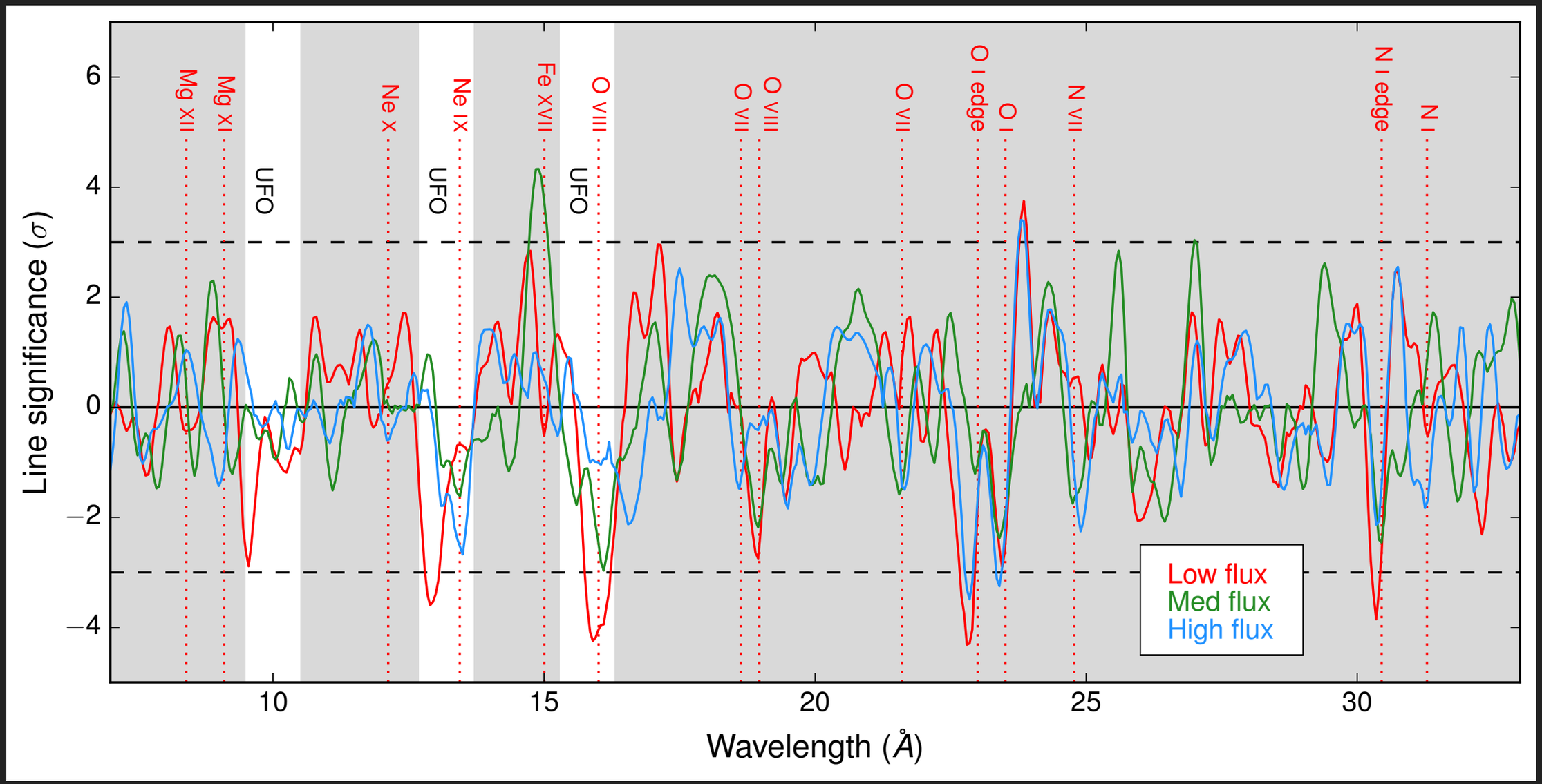
- Split the lightcurve into 3 different flux bands
- Extract spectra for each band

FLUX-RESOLVED SPECTROSCOPY

- Strong variability of the line strength with flux!
- Present at ~7σ in the low state, not required at higher flux
- First time this has been observed within observations



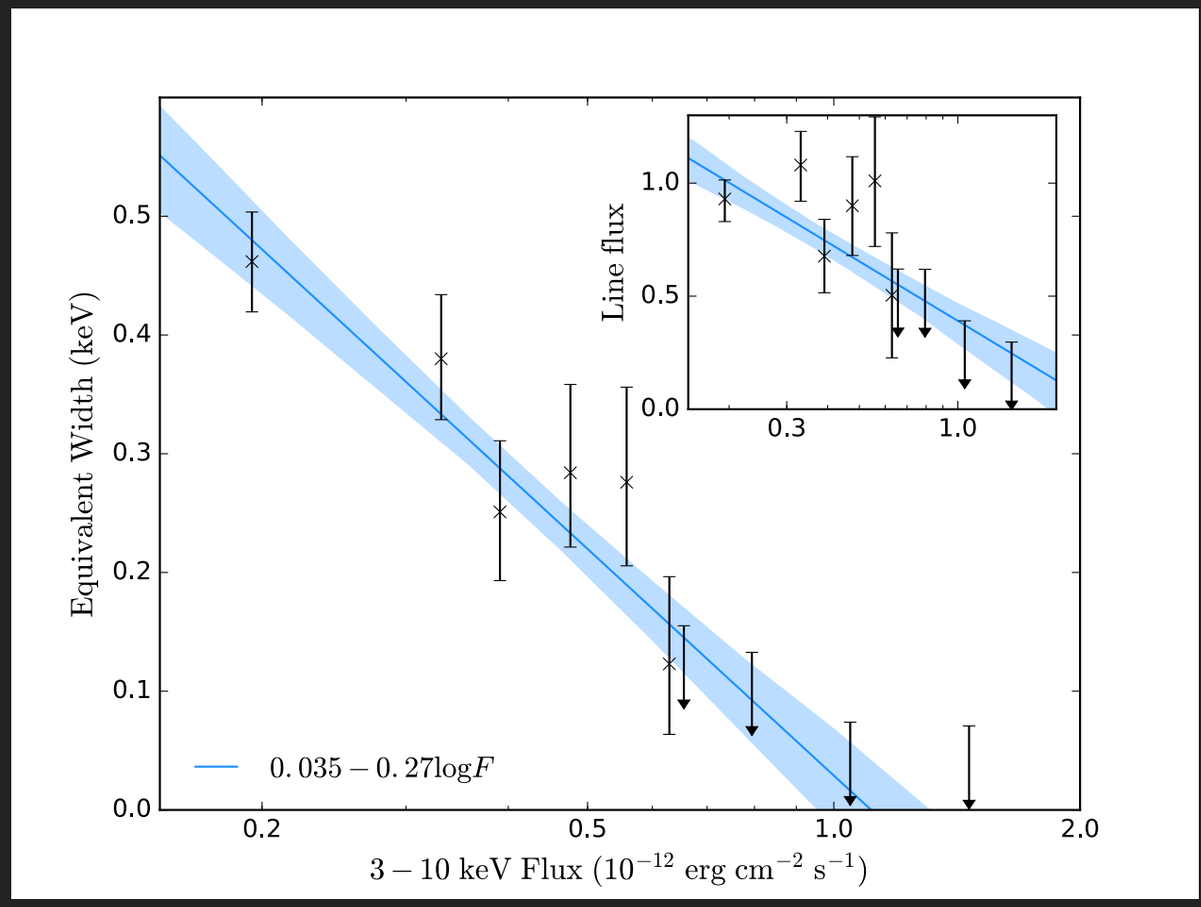
FLUX-RESOLVED SPECTROSCOPY



- Same flux dependence in grating spectrum
- Exactly where predicted by UFO model

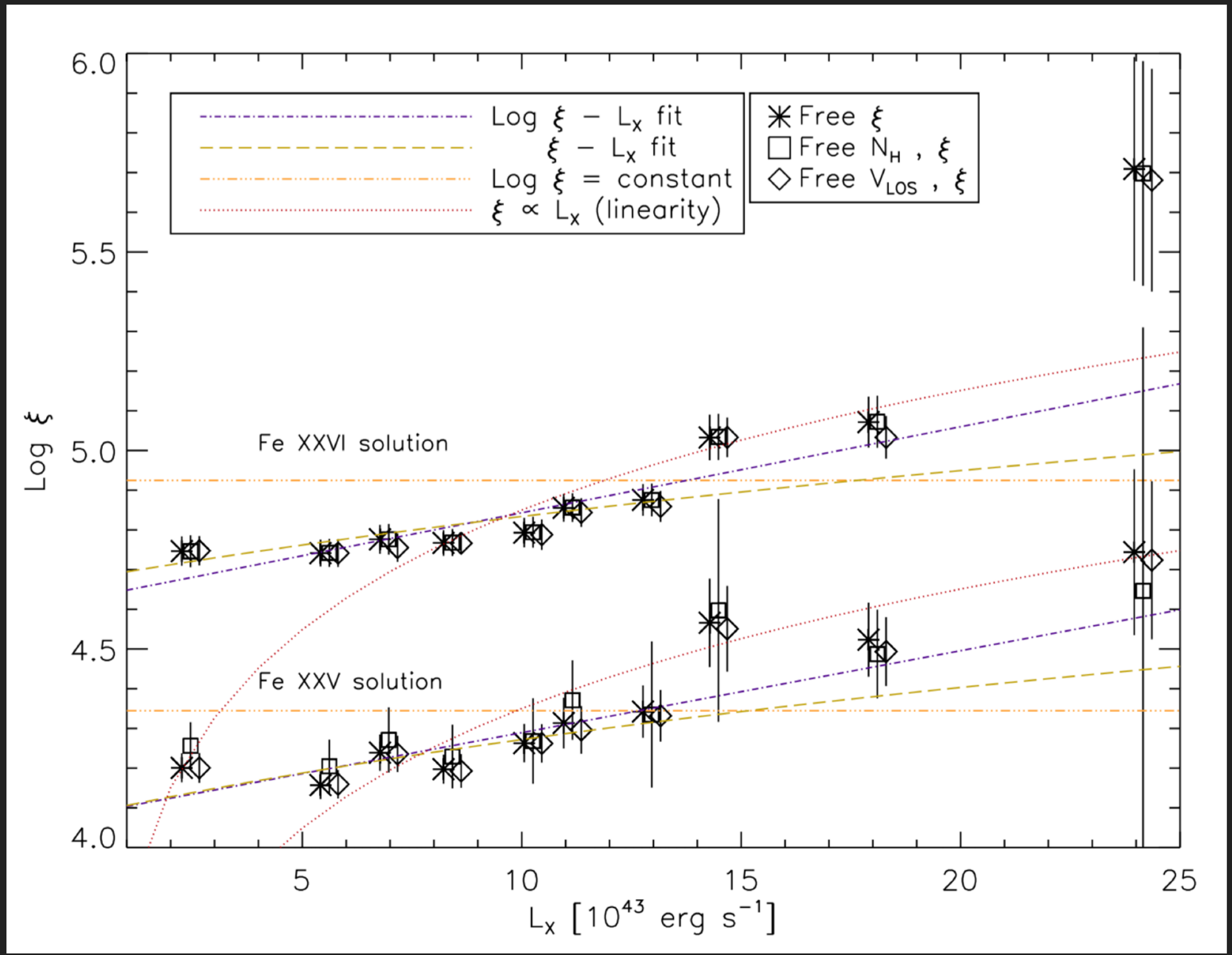
FLUX-RESOLVED SPECTROSCOPY

- Splitting the data into 10 flux-resolved spectra shows a strong correlation between the equivalent width and flux.
- The line is clearly responding to the source flux, on timescales of <5ks
- Consistent with absorption lines being fully ionized by the X-rays



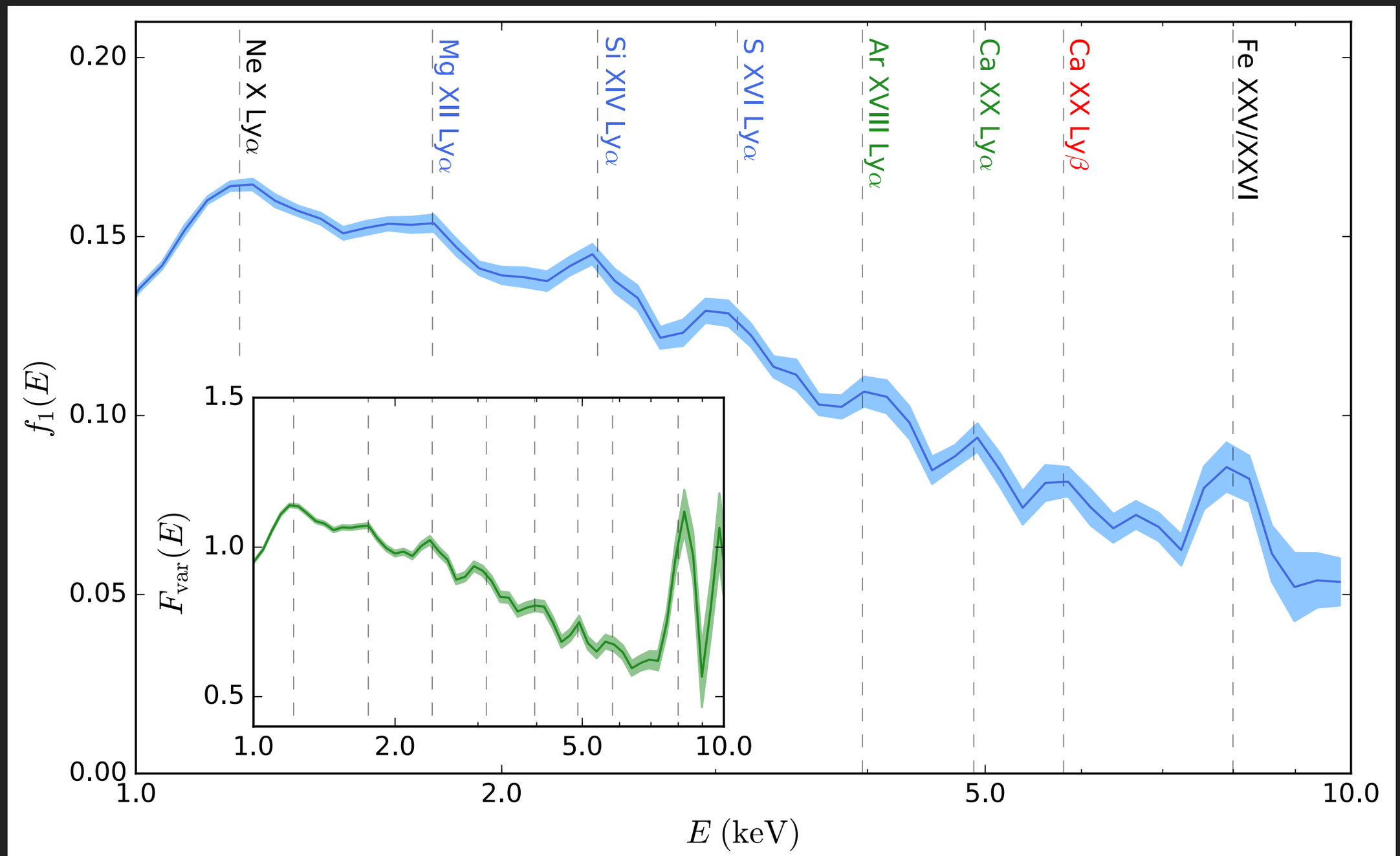
FLUX-RESOLVED SPECTROSCOPY

Pinto et al., in prep.

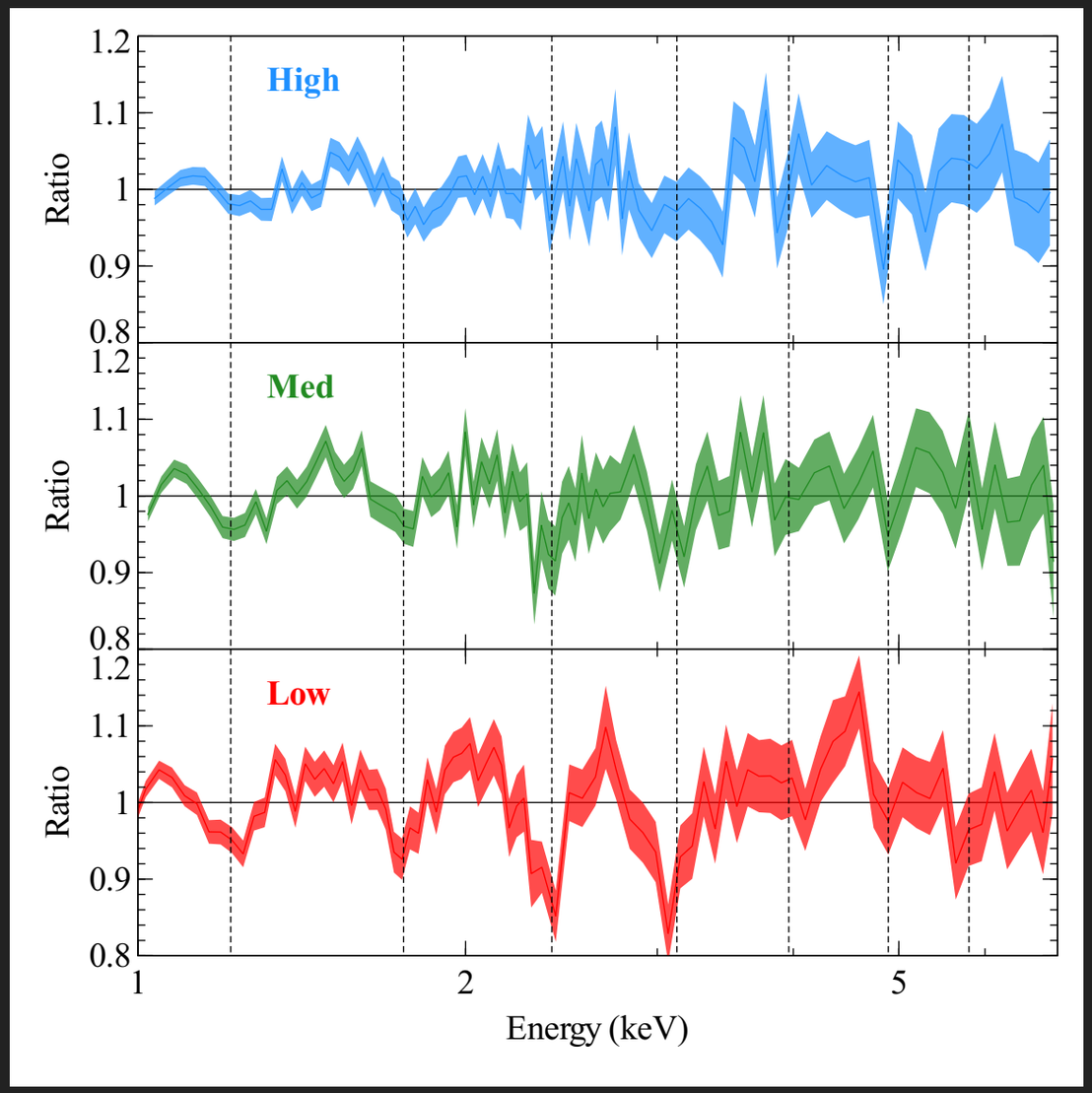


VARIABILITY SPECTRA

Parker et al. 2017b, MNRAS 469, 1553

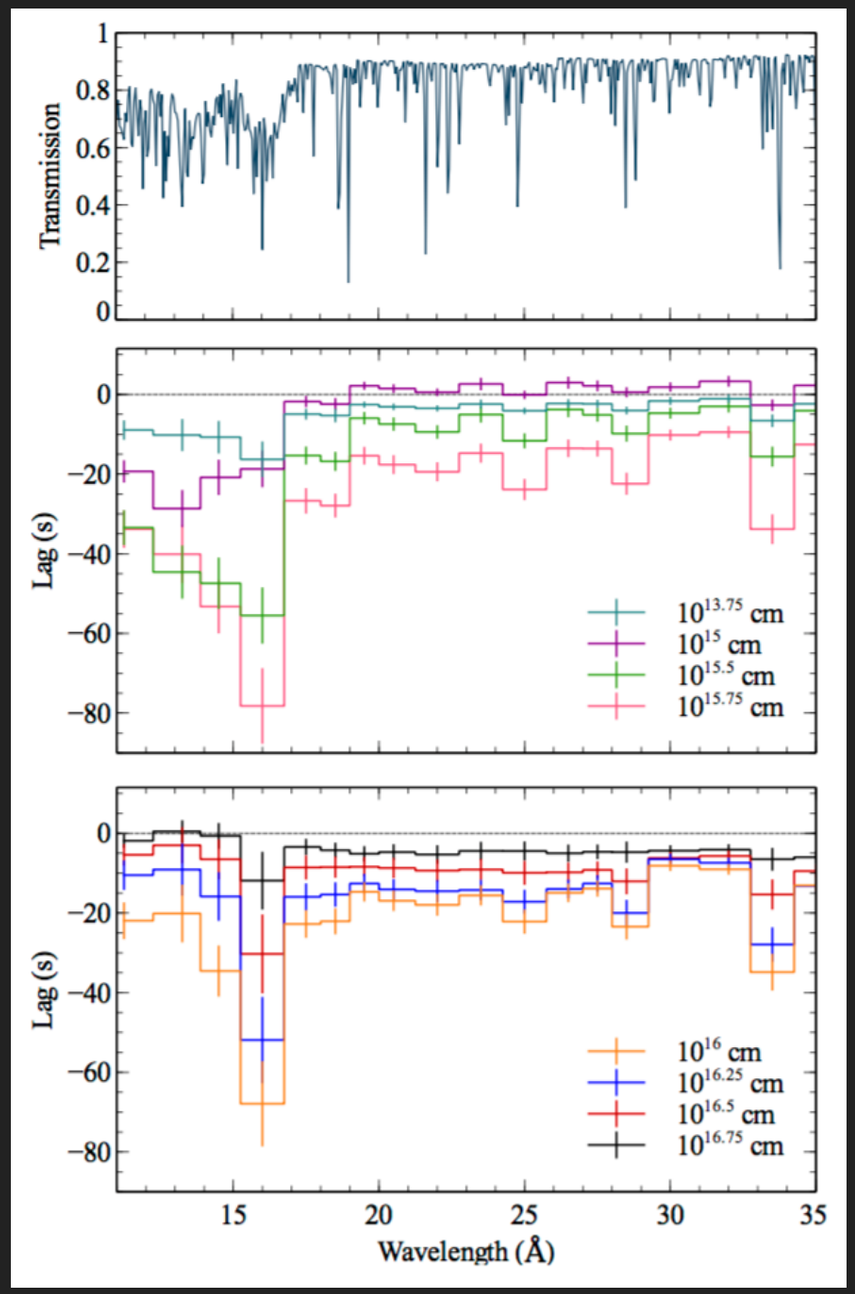


INTERMEDIATE LINES

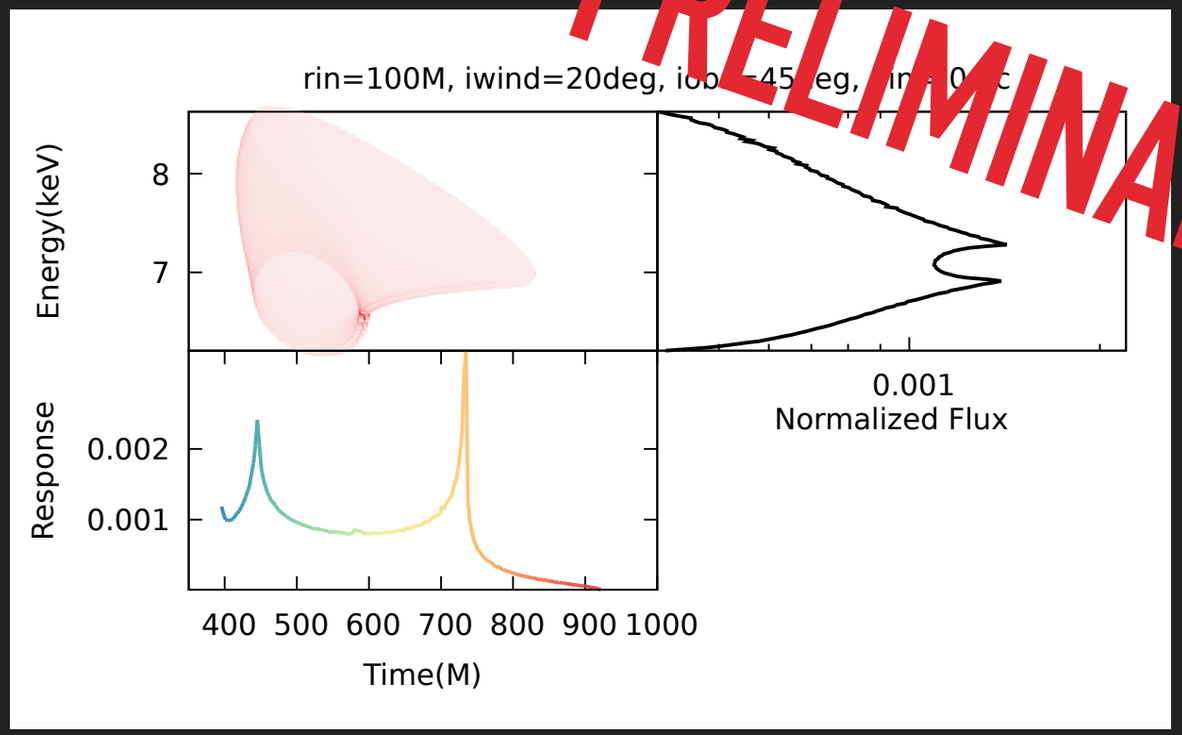


- Intermediate energy lines also present in raw data
- Again, strongly flux dependent
- See also Jiachen Jiang's poster!

THE FUTURE: REVERBERATION MAPPING THE OUTFLOW



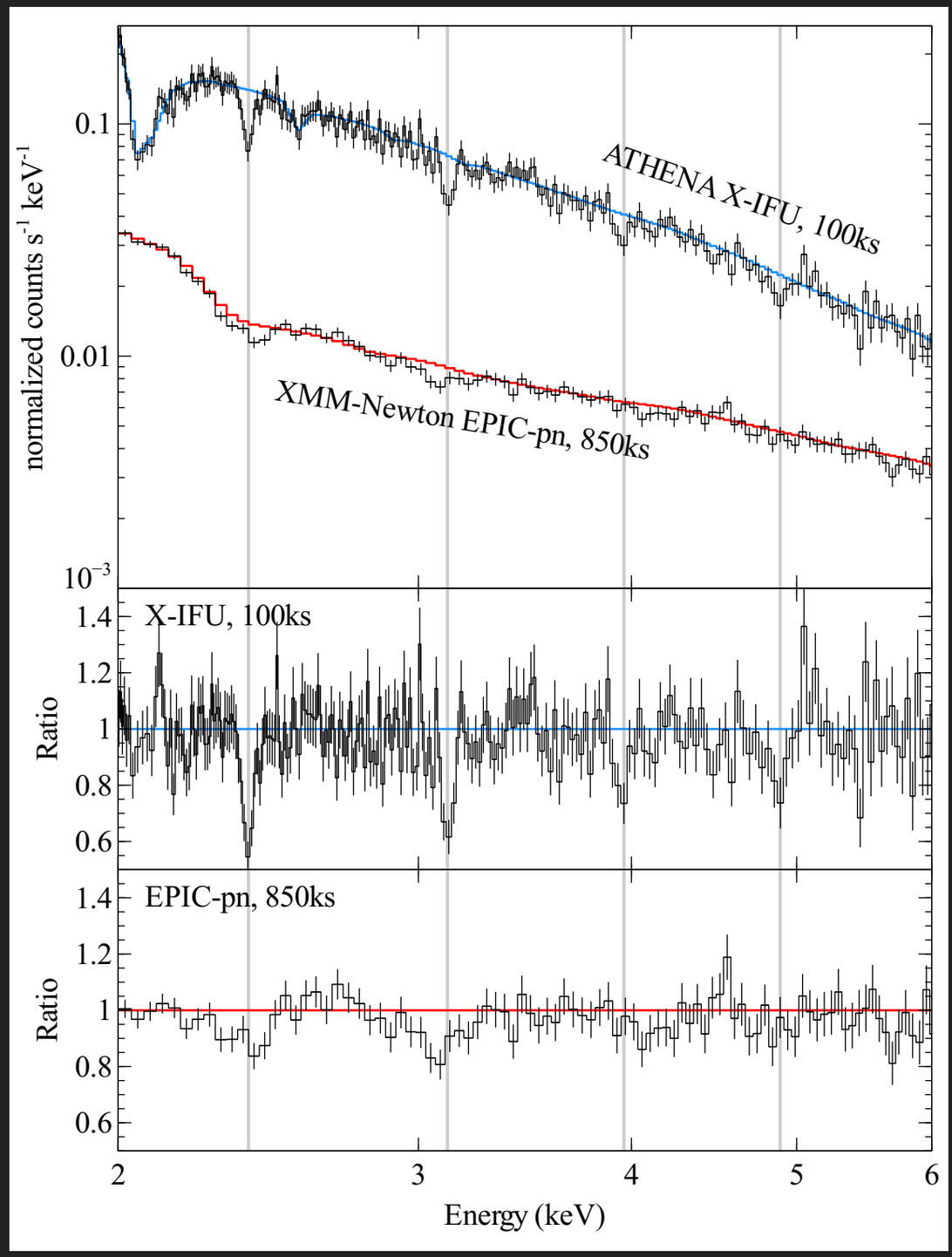
Silva, C. V. et al., 2016



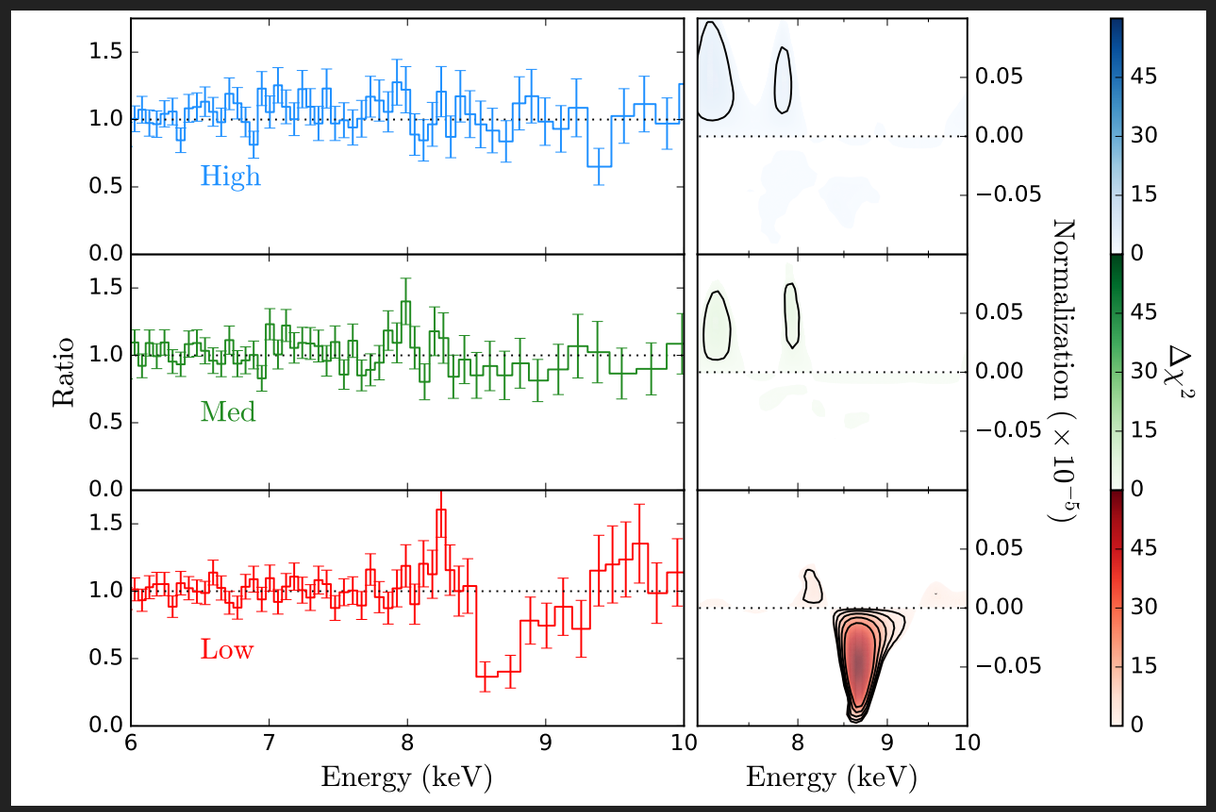
Jiang, J. et al., in prep.

THE FUTURE: ATHENA

- Improvement for intermediate energy lines much greater than for Fe
- ATHENA will be revolutionary for low-M, rapidly variable winds



CONCLUSIONS



- Ultra-fast outflow detected at 8.6 keV in the most X-ray variable AGN
- Absorption lines are present at 0.24c found from O, Ne, Mg, Si, S, Ar, Ca, and Fe
- These lines are strongly flux dependent, and appear in variability spectra
- Should now be possible to reverberation map the UFO