

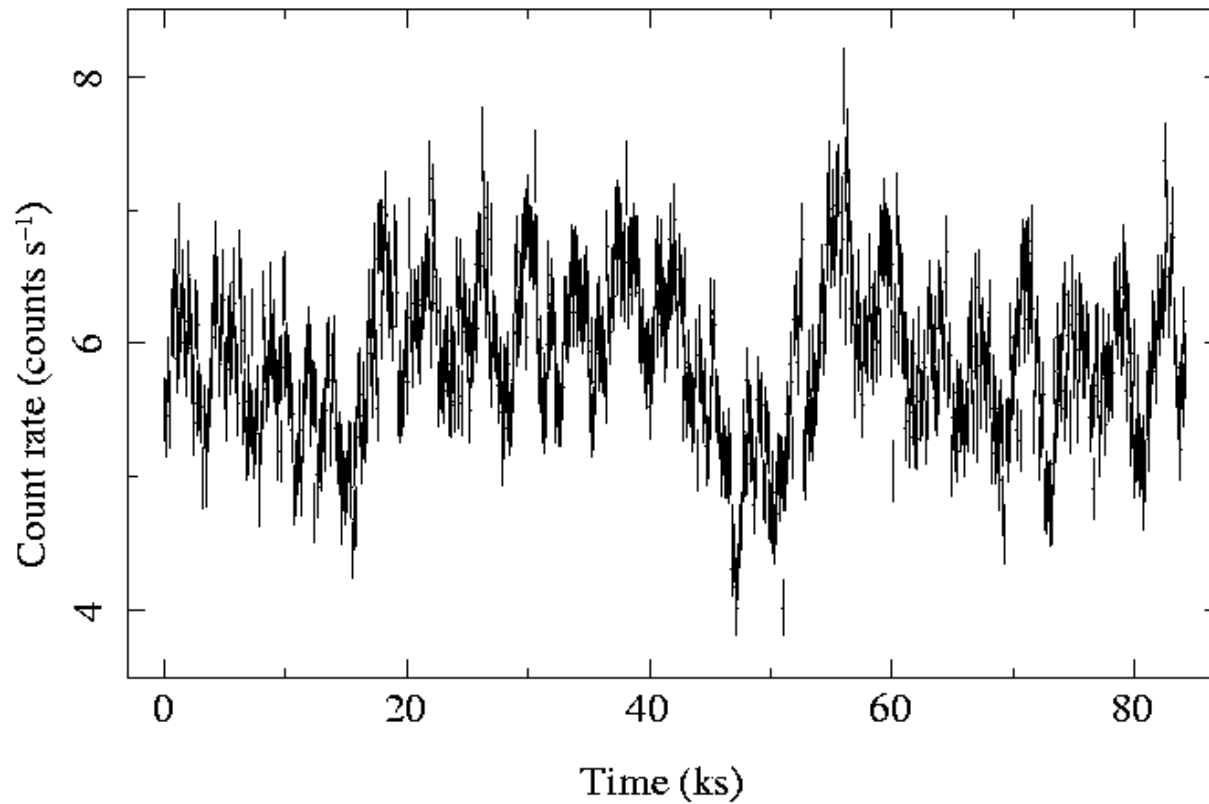
*The XRB analogy to the first
AGN QPO*

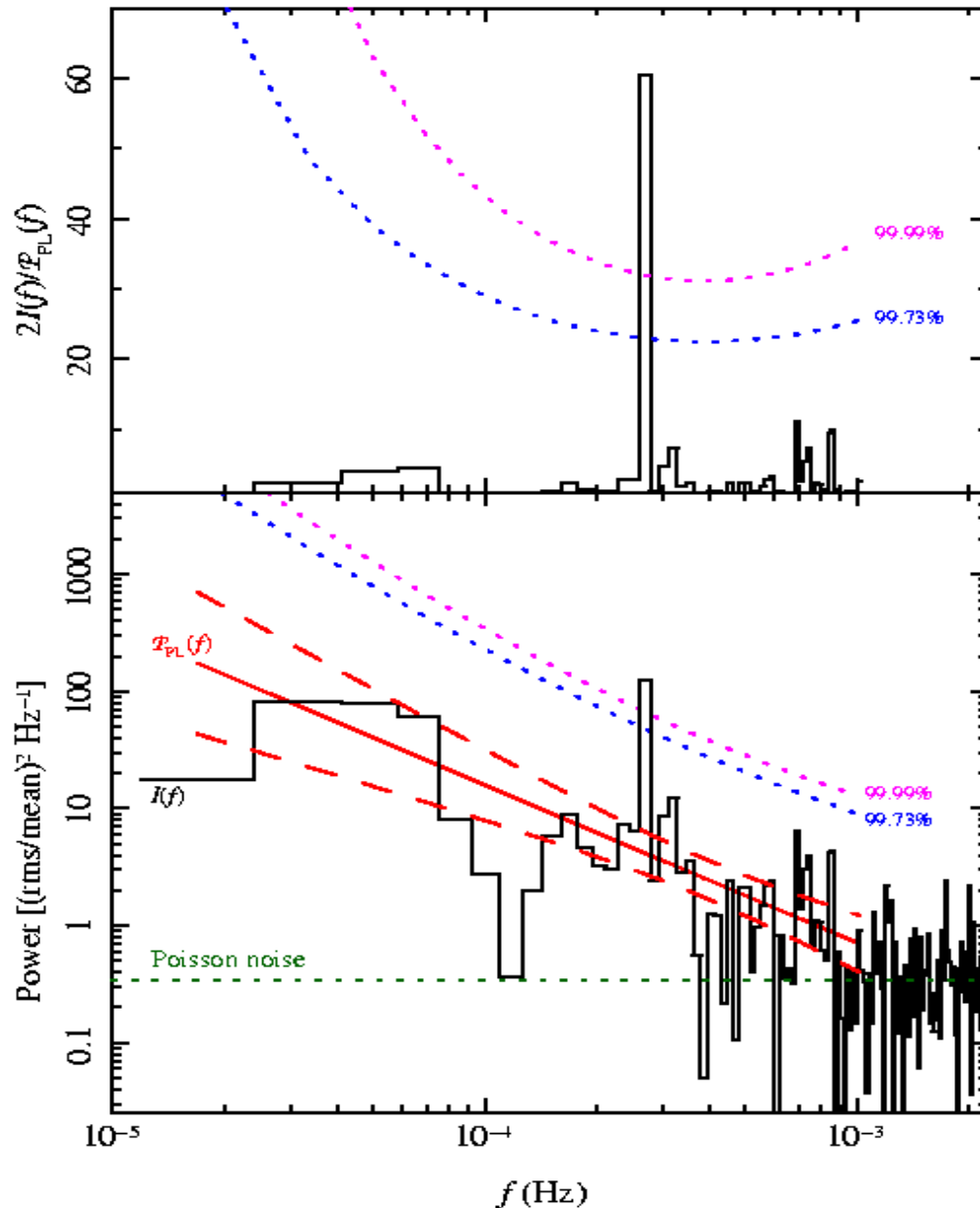
Matthew Middleton
Chris Done
Marek Gierliński



The first AGN QPO - RE J1034+396

Gierliński et al. 2008

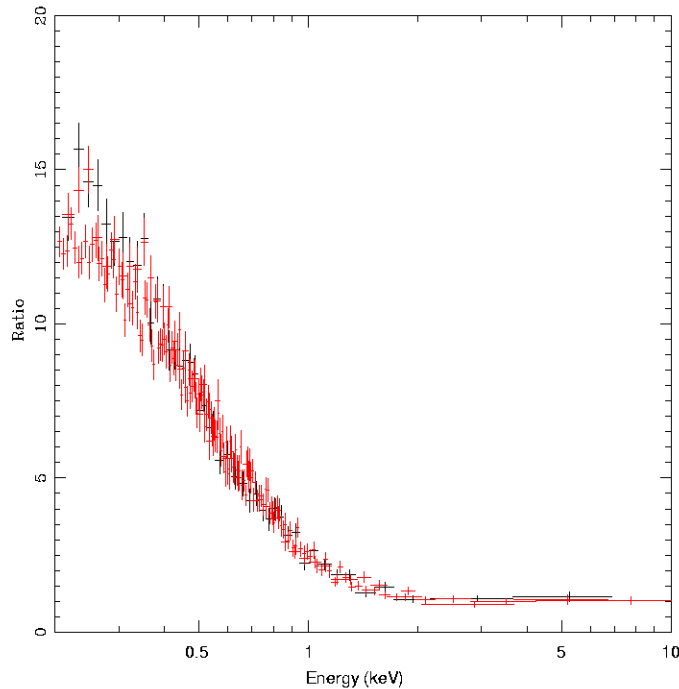




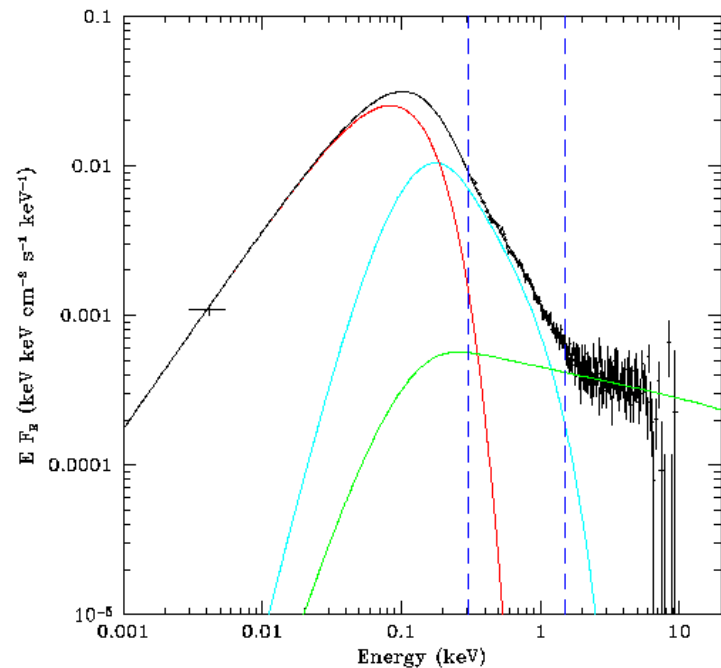
*>5 σ detection
(Gierliński et al.
2008)*

*Correctly modelling
the red-noise
(Vaughan et al.
2006)*

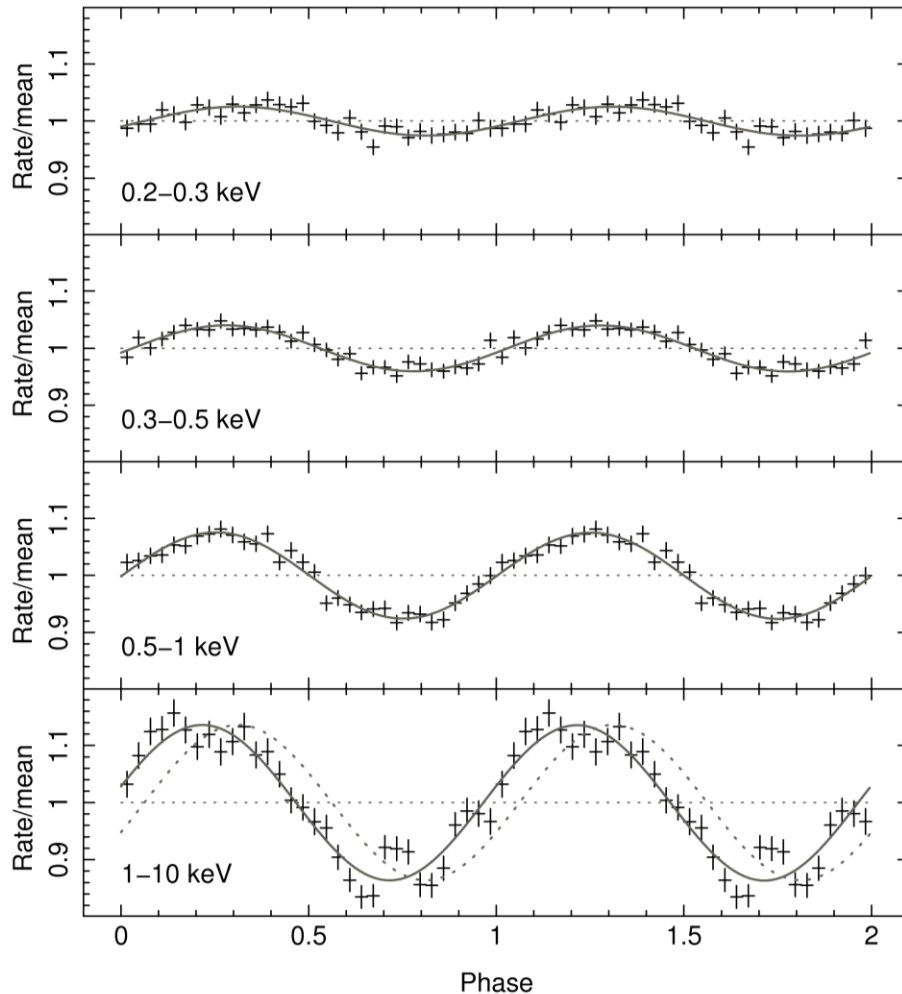
RE J1034+396 – a unique source



Large Soft Excess



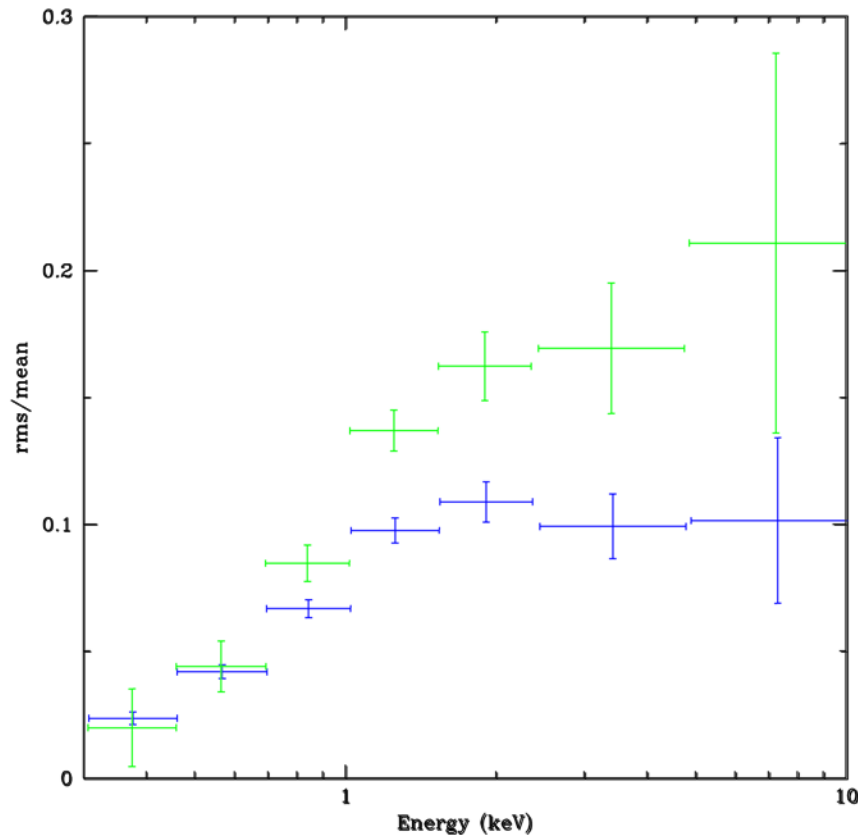
'hot-disc' SED



*QPO fractional
variability increases
with energy.*

Finding the origin: RMS spectra

Middleton et al. 2009

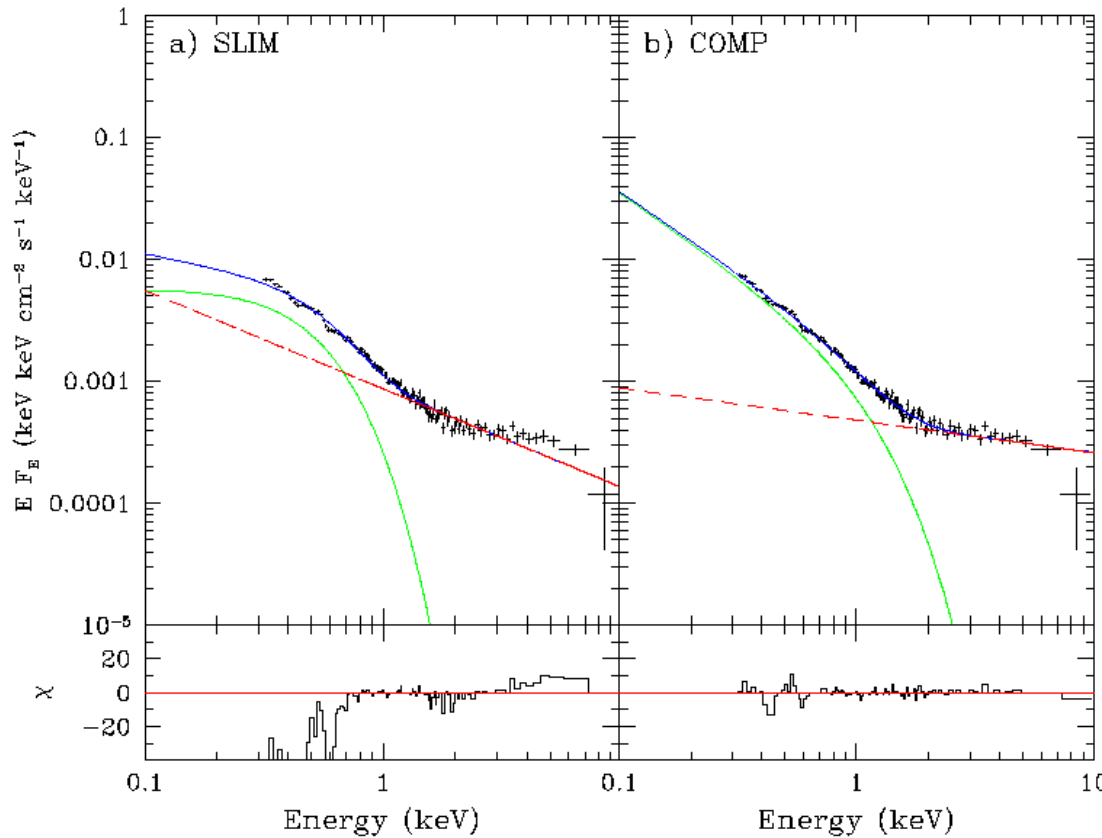


Use Δt to create rms spectra of different frequency bands

Green: rapid variability (inc QPO 135-5000 μ Hz)

Blue: QPO (270 μ Hz)

Finding the origin: Spectral fitting



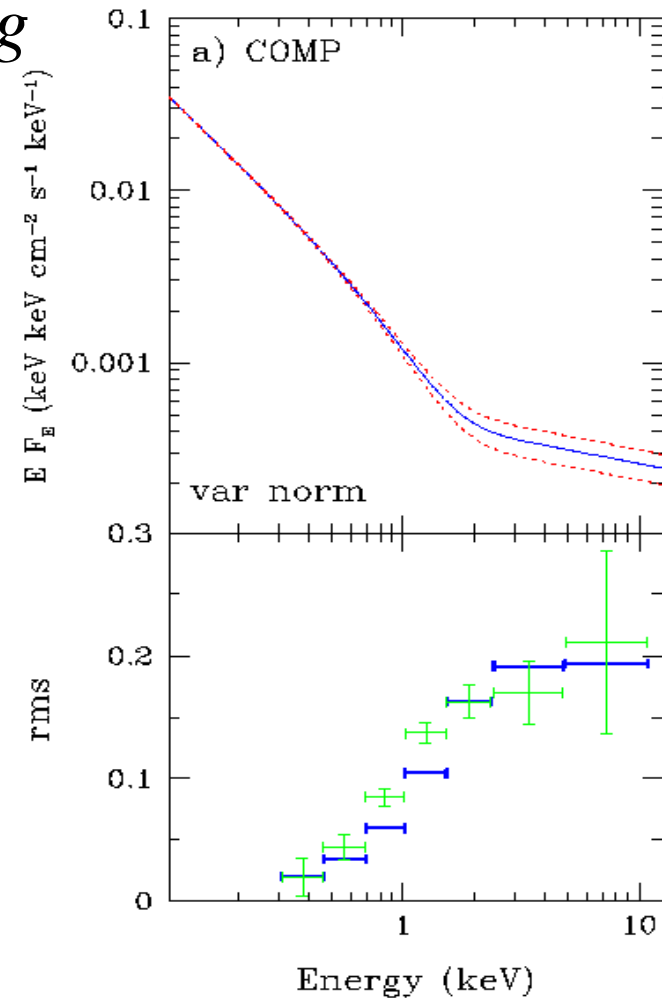
*Must fit both the
variability and
energy spectrum!*

Middleton et al. 2009

Finding the origin: Spectral fitting

*By varying spectral
components in
model gives test
rms spectrum*

*Match to rapid
variability to get
QPO origin*



Middleton et al. 2009

What the models tell us...

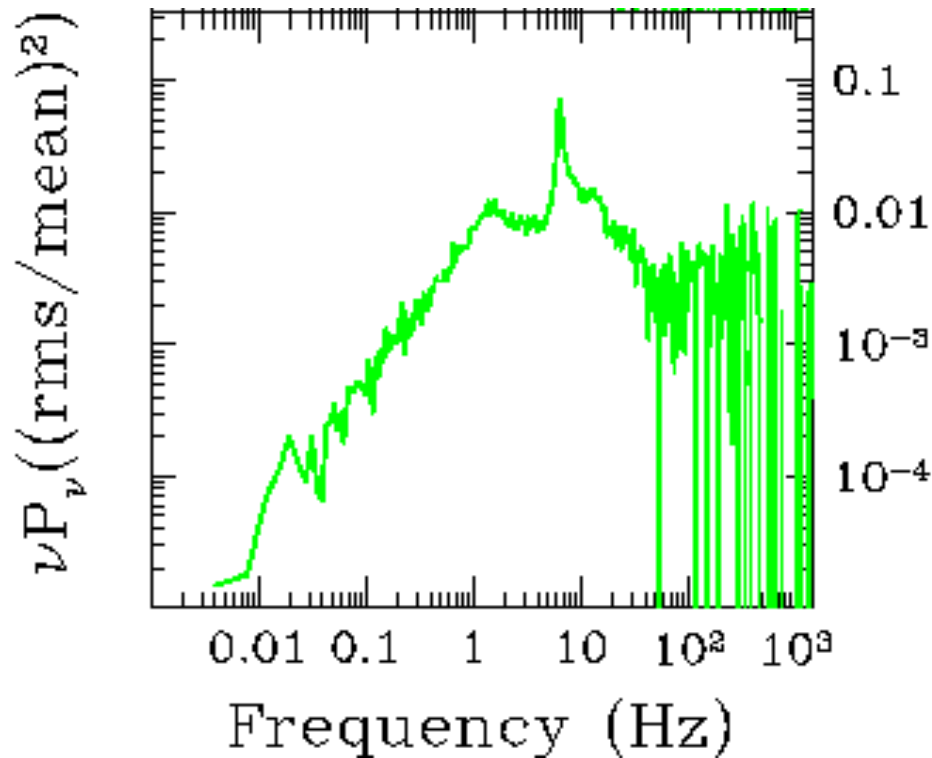
*i) Spectrum well fit by low-temperature
Comptonisation*

*ii) Also provides soft excess but not a
generic origin!*

*iii) Changing model parameters reproduces
rms shape*

X-ray binary LFQPOs

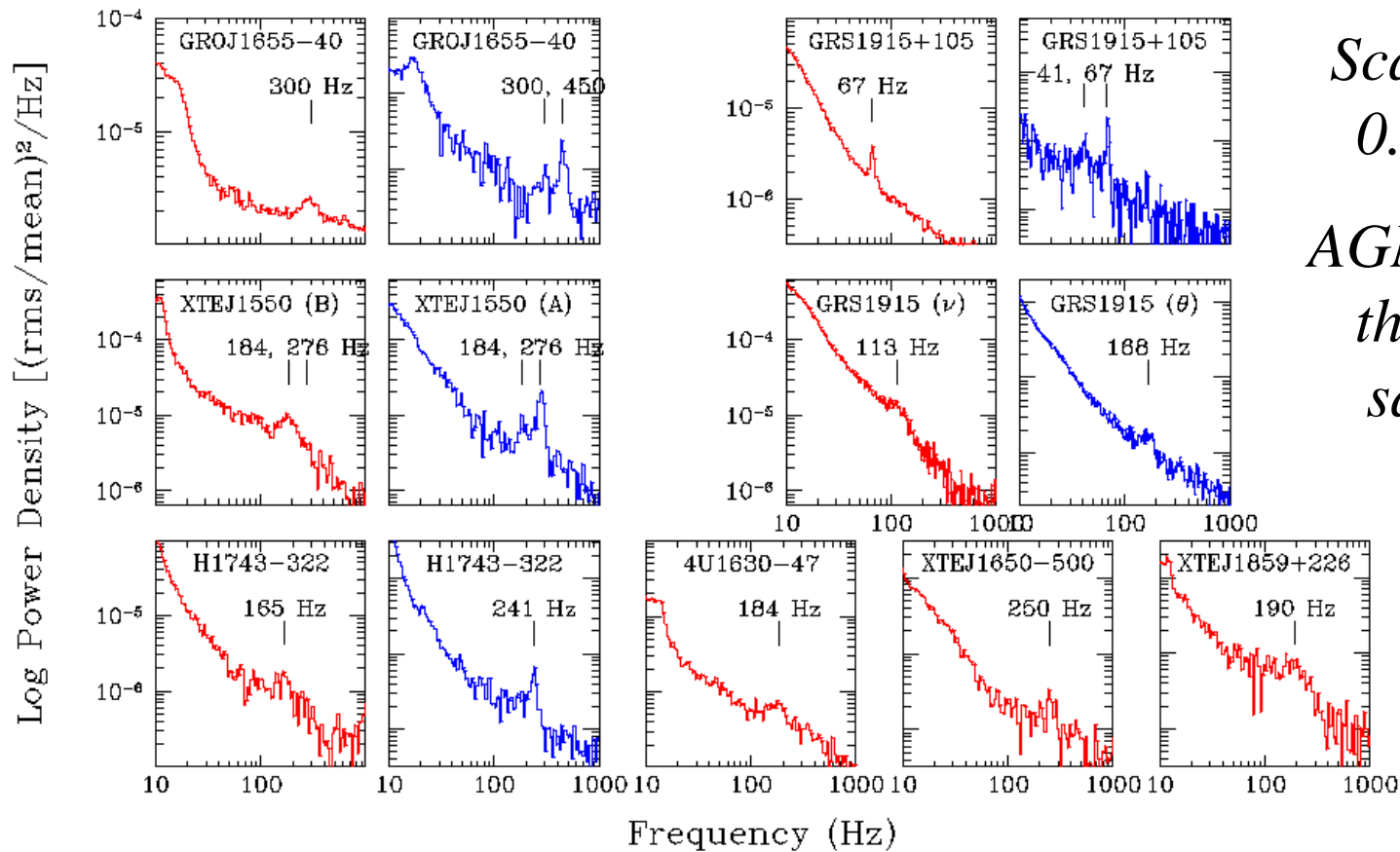
Remillard & McClintock 2006



*Mass scaling
with frequency
> 10L_{Edd}*

*XRBS show
LFQPO sub-Edd
so not the
LFQPO!*

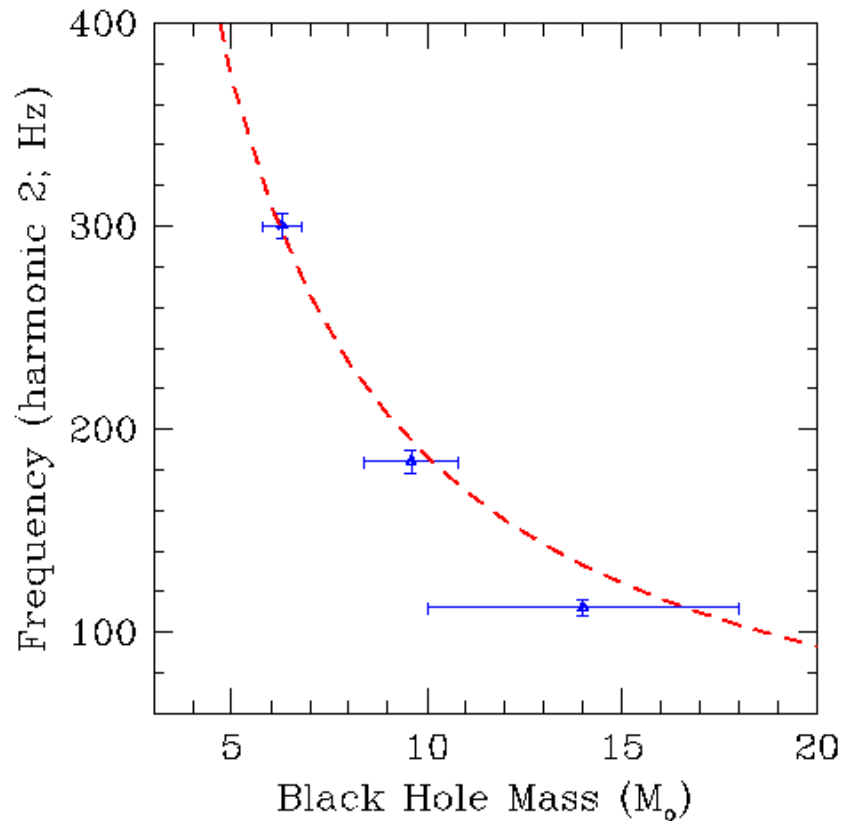
X-ray binary HFQPOs



*Scaling gives
 $0.3-0.5L_{Edd}$
 AGN seen with
 this but not
 same SED*

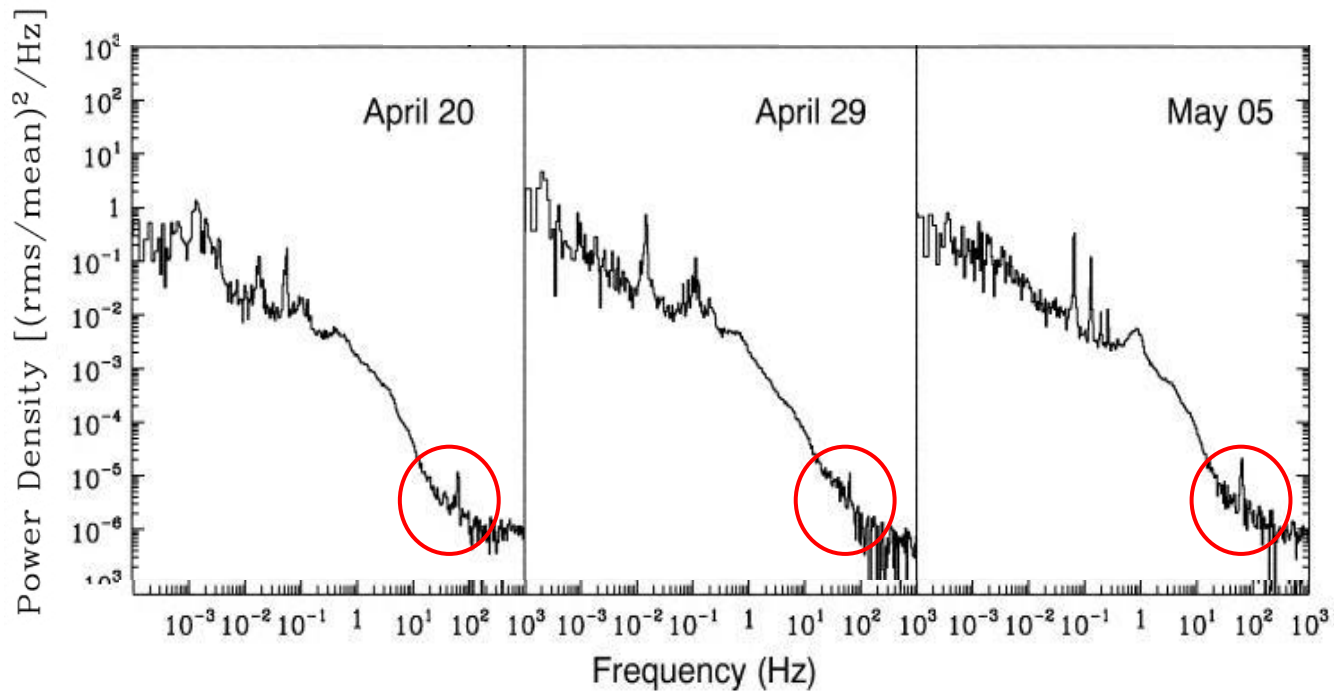
'Unique QPOs' of GRS 1915+105

Remillard & McClintock 2006



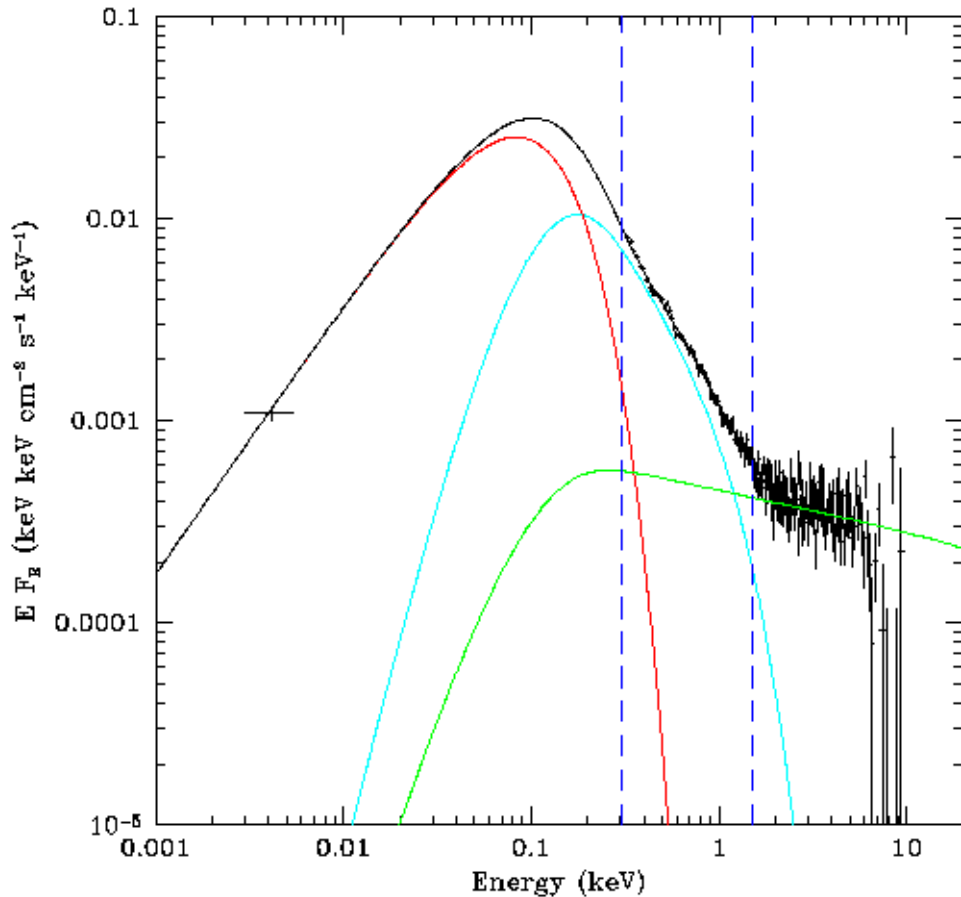
67Hz and 41 Hz QPOs do not obey this prediction!

'Unique QPOs' of GRS 1915+105



Morgan, Remillard & Greiner 1997

SED comparison



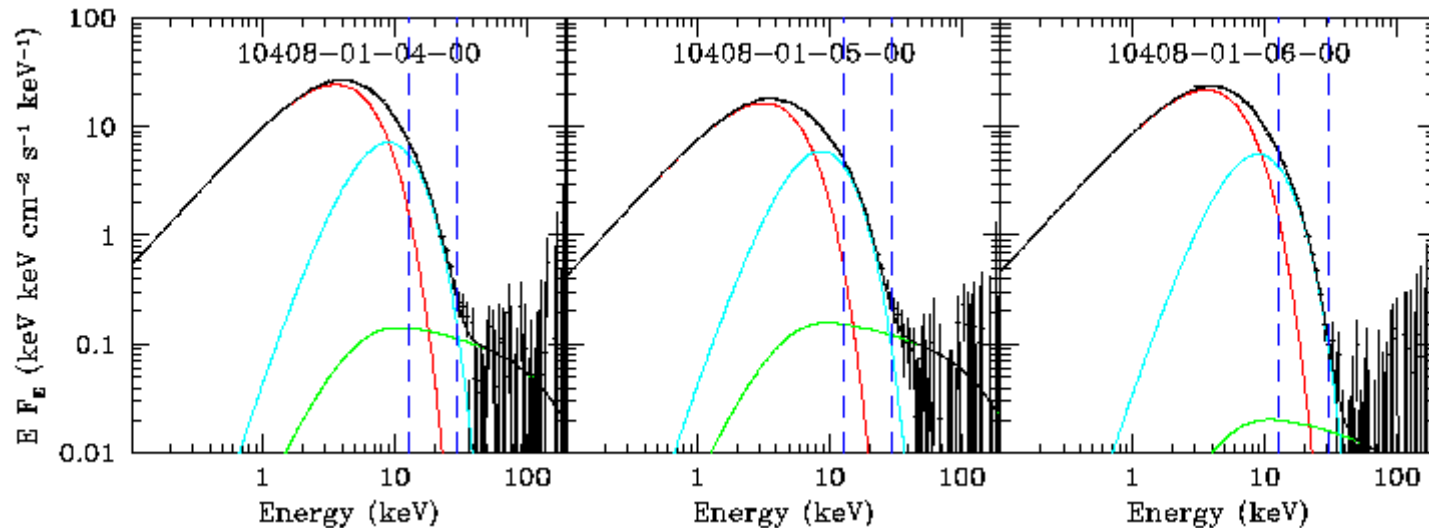
XRB and AGN should show the same spectral state when showing the analogous QPO

OM data gives optical/X-ray SED for REJ1034+396

Middleton & Done 2009

SED comparison

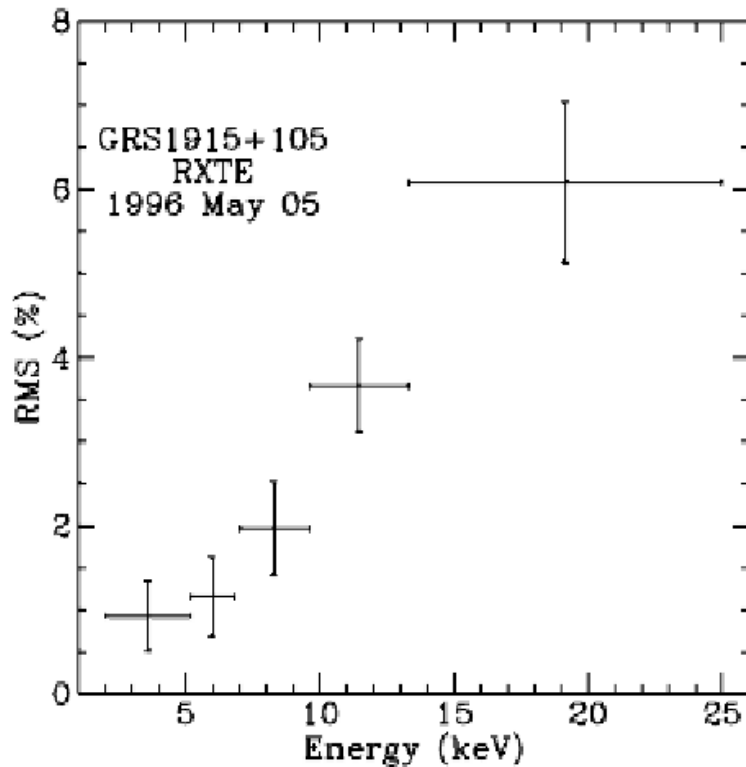
Middleton & Done 2009



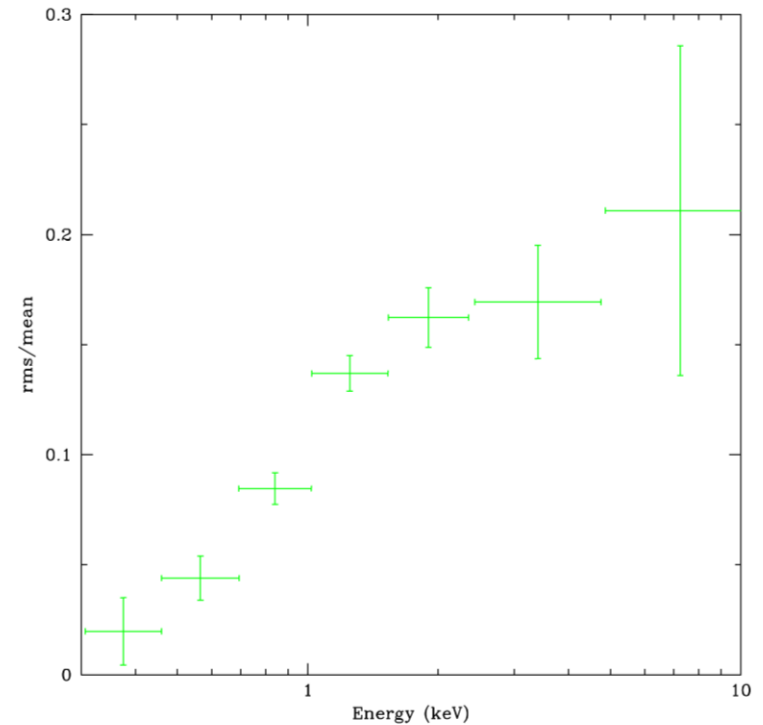
*Observations with the most significant 67Hz QPOs
(+HEXTE)*

Looks same as REJ1034+396!

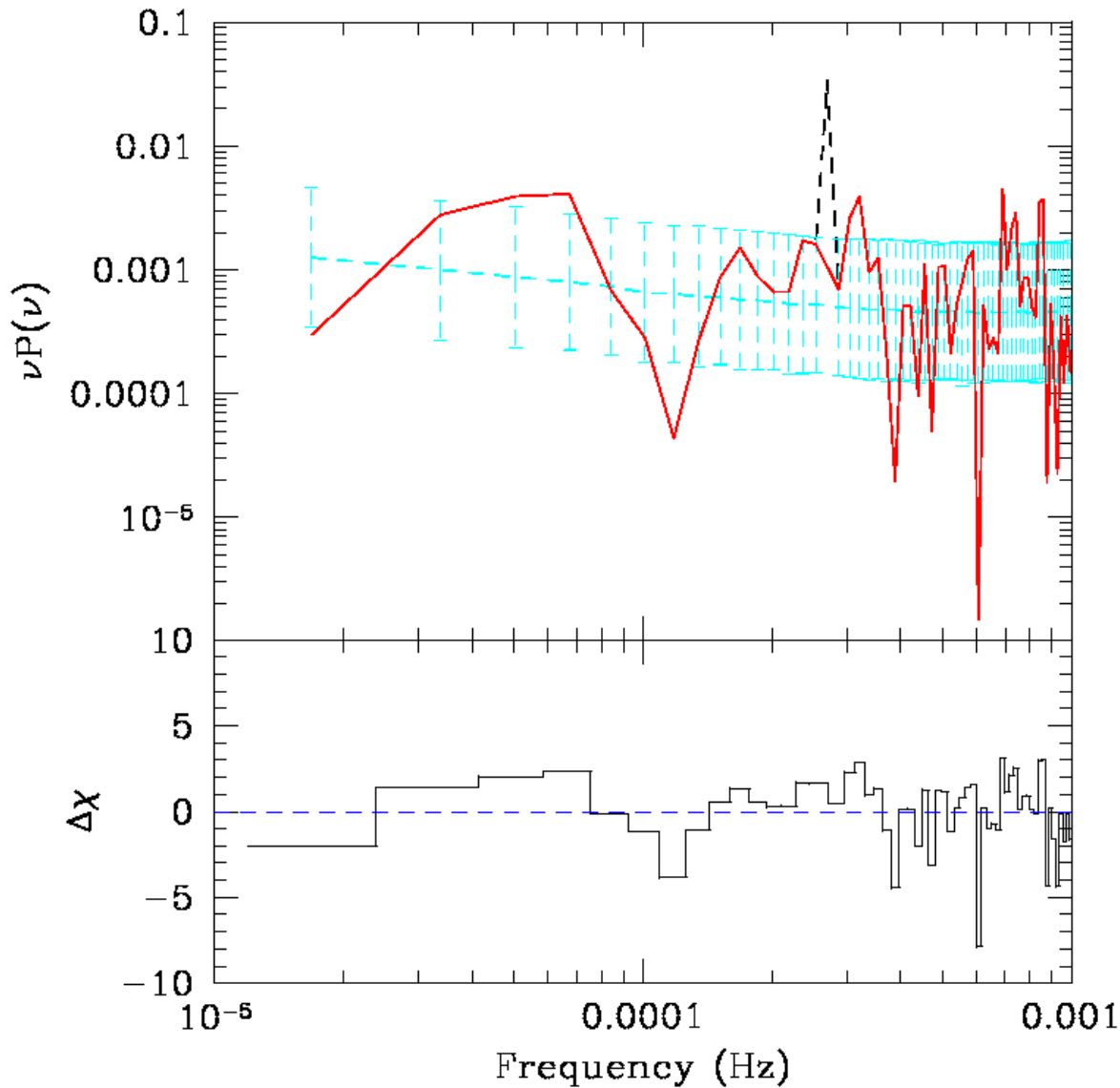
RMS comparison



Morgan & Remillard 1997



Middleton et al. 2009



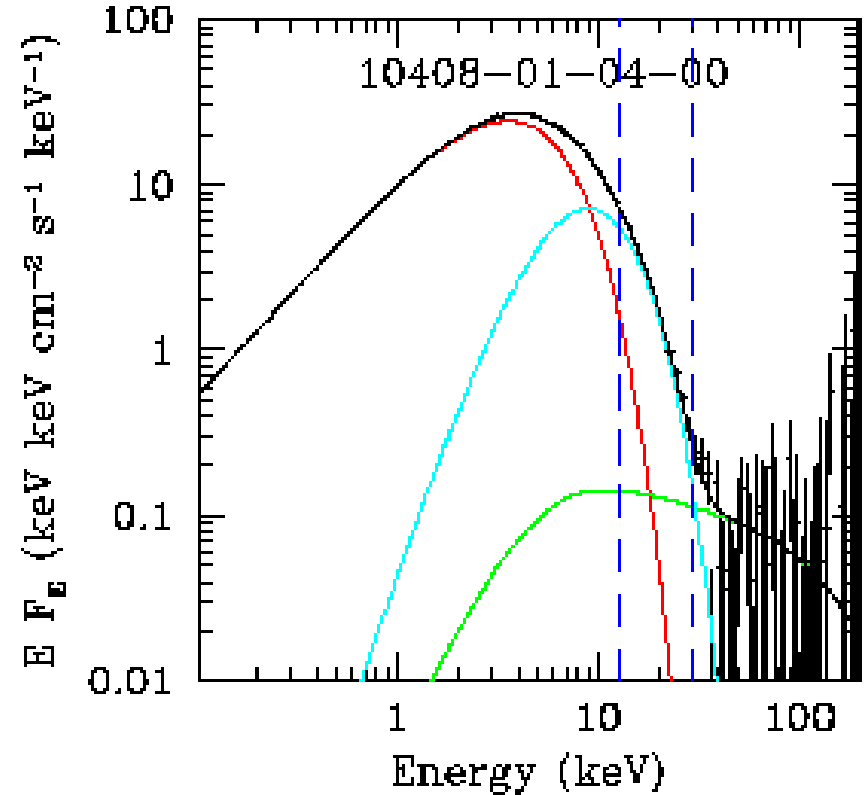
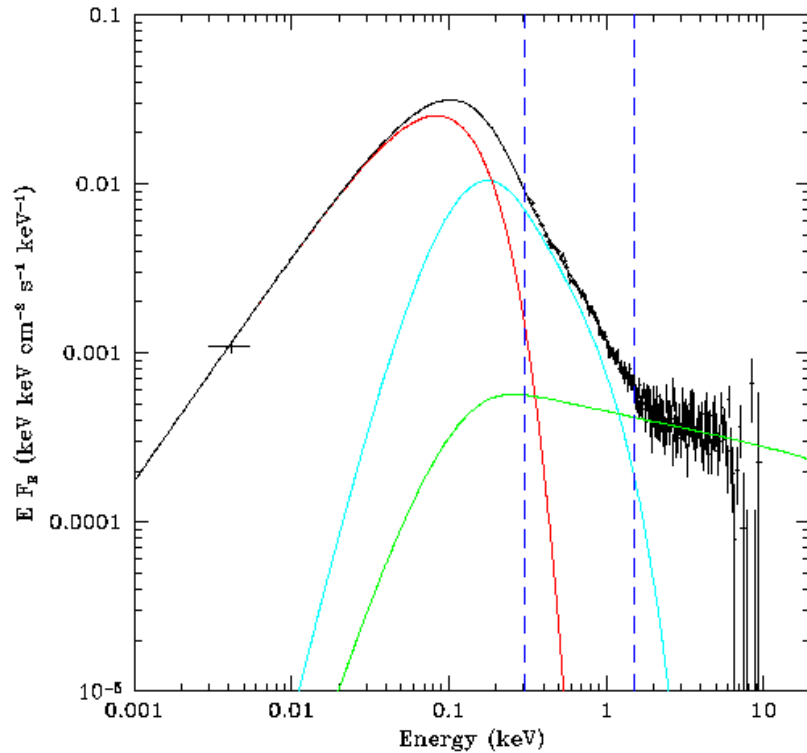
Middleton & Done 2009

*Slope under the
XRB HFQPOs is ν^{-1}*

*Simulations show
that the slope under
REJ1034+396 is
 $\sim \nu^{-1.3}$*

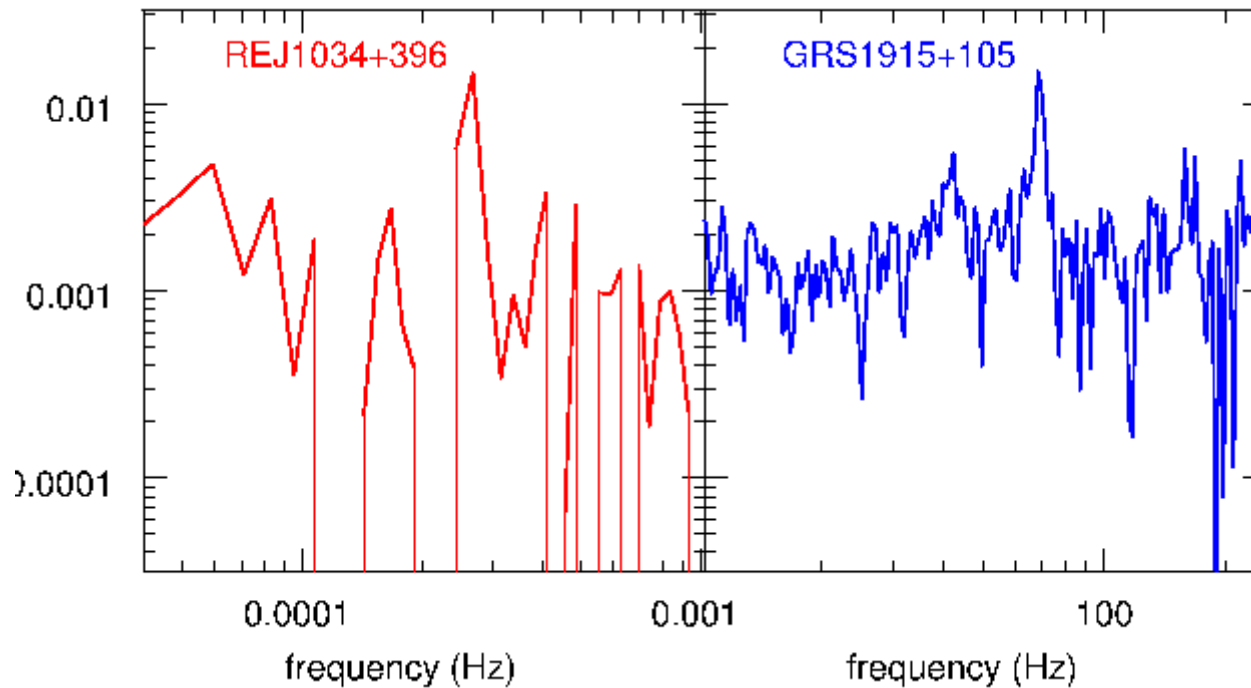
*Normalisation
different!*

Bandpass effects



Middleton & Done 2009

PDS comparison - BP corrected



Middleton & Done 2009

Conclusions

- 1. RMS and energy spectra point towards low-temperature Comptonisation as source of soft excess (in this source) and diluting component.*
- 2. Many XRB QPOs are seen, cannot be standard LF or HFQPO from mass scaling.*
- 3. 67Hz QPO of GRS 1915+105 provides a ‘good’ mass accretion rate and is seen in same state but power spectrum normalisations differ.*
- 4. Correcting bandpass makes normalisations agree!*