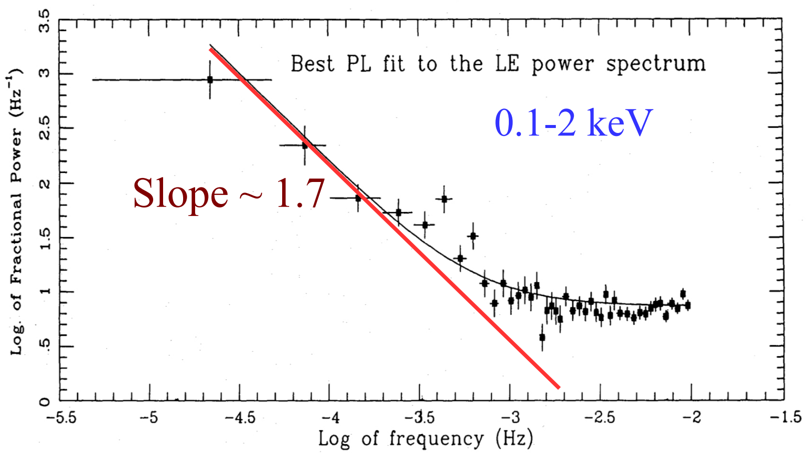
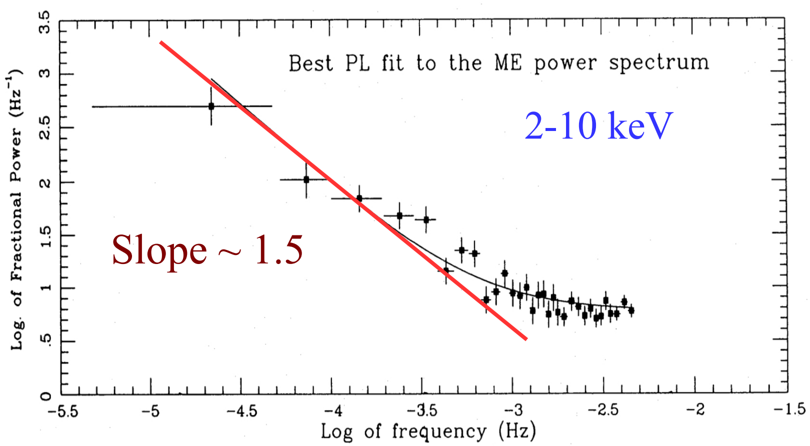
X-ray power-spectrum (PSD) studies in the past have focused mainly in the ~0.5-2 keV (“soft”) and ~2-10 keV (“hard” band). It has been established long time ago that the PSD slope is flatter in the hard band.





NGC 4051; Papadakis & Lawrence, 1994, MNRAS

This implies the amplitude of short term variations is larger at high energies and excludes models where the observed variations are due to variable soft photons and a hot, static, Comptonizing corona.

I present the results from a systematic study of the PDS features in many more energy bands. The main objective of the project is to investigate:

How do the PSD break frequency, ν_{br}, the high frequency slope, α_{hf}, and the PSD norm, A_{PSD}, vary with energy?

Main results are:

i) PSD slope flattens with increasing energy,

ii) ν_{br}, A_{PSD} do not depend on energy,

and can constrain current (and future) theoretical models/ideas which try to explain X-ray variability in accreting compact objects.

Data analysis and Results

1) I chose objects which are X-ray bright, highly variable, and have been observed extensively by XMM (i.e. with a net exposure time larger than 0.5 Msec).

2) I produced light curves in 5 energy bands (namely: 0.3-0.5, 0.5-0.9, 0.9-1.5, 1.5-4 & 4-10 keV).

3) I estimated PSDs between 10^{-4} & 10^{-2} Hz, and fitted them with the model: $P(\nu)=\frac{A_{PSD}}{\nu\left[1+\left(\frac{\nu}{\nu_{bf}}\right)^{(\alpha_{hf}-1)}\right]}$

4) I fitted the PSDs twice: **i)** $\boldsymbol{\alpha_{hf}}$**-tied,** $\boldsymbol{\nu_{bf}}$ **variable & ii)** $\boldsymbol{\nu_{bf}}$**-tied,** $\boldsymbol{\alpha_{hf}}$ **variable**.

Model (ii), gives a much better fit to the data.

Main results:

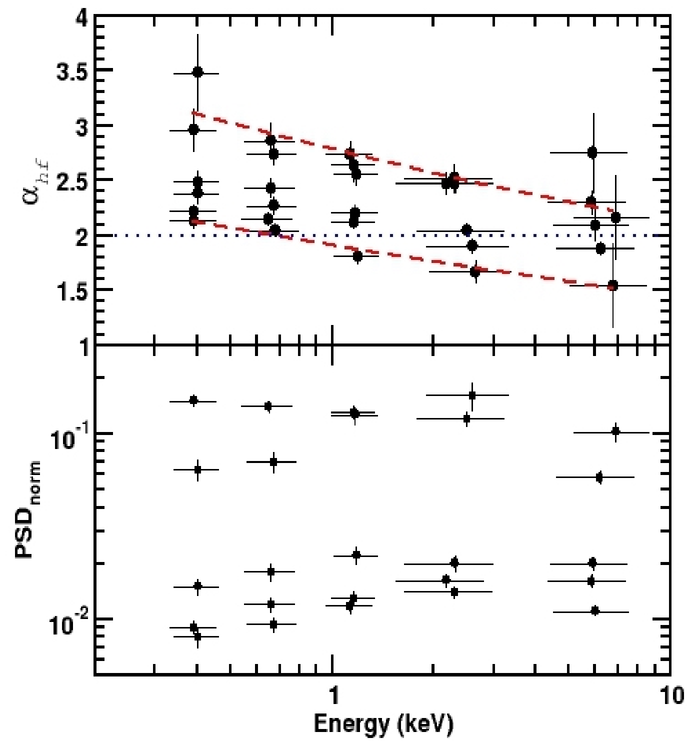
i) ν_{bf} and A_{PSD} do not depend on energy,

ii) α_{hf} flattens with increasing energy as: $\alpha_{hf} \propto E^{-0.}$

iii) At any given energy:

the PSD slope and normalization

are *not* the same for all objects.



Discussion

A) The results are *not* consistent with "propagating fluctuations (within the corona)" models (e.g. Churazov et al 2001, MNRAS; Arevalo & Uttley 2006, MNRAS).

According to these models: ν_{bf} should be positively correlated with energy and the PSD slope should be the same, at all energies, for all objects, contrary to what is observed.

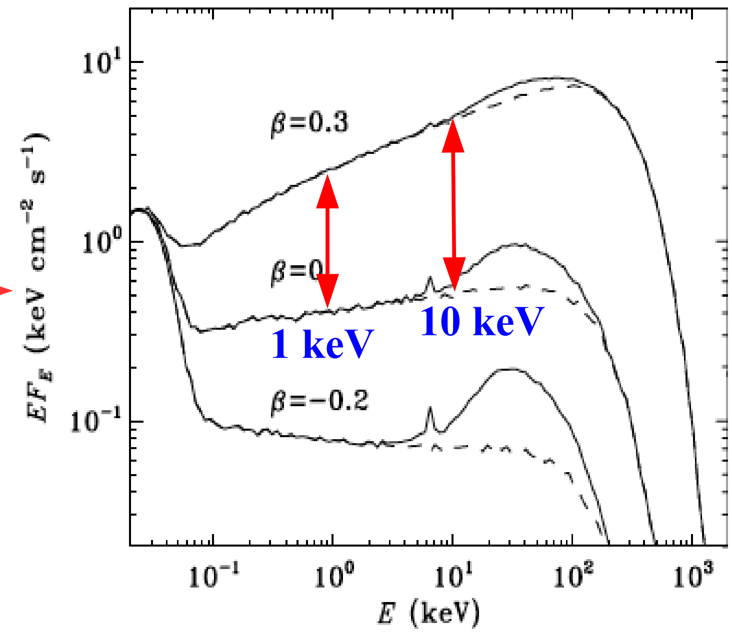
B) The flattening of the PSD slope with energy implies that the corona is not static. The observed X-ray variability must be due to variations of the corona properties.

For example, within models of magnetic flares due to reconnection of magnetic field lines above the disc:

i) the dissipation time scale is the major time scale and does not depend on E, consistent with the results (if responsible for ν_{br}).

ii) if corona is outflowing & accelerating, high energy light curves should be "steeper", hence the flattening of α_{hf} with increasing E (a distribution of terminal velocities may explain the different α_{hf}).

iii) if the flares are not random, but appear in "correlated trains of events in an avalanche fashion" (Merloni & Fabian, 2001, MNRAS) and proceed from soft to hard, an rms-flux relation may be established and time-lags could be explained.



(Malzac, Beloborodov & Poutanen, 2001, MNRAS)