Spectral/timing evolution of black-hole binaries

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Main points

- Evolution through states
- State transitions are sharp
- Jet ejection is clearly connected
- Neutron-star binaries do the same
- High (> 20 keV) energy is crucial
Evolution through states

- Hard and soft states are not everything
- Four distinct states can be identified
- Time variability is important
- Transitions mark states
Transitions are sharp

- Grey region: low variability, high-frequency oscillations
- QPO line: variability changes, a new QPO appears
- Transition can take a few seconds

X-ray Astronomy 2009

Belloni (2009)
Jet ejection is clearly connected

- **Hard, variable:** steady jet
- **Soft, quiet:** no jet
- **Transition:** jet line
- $\sim$ **QPO line**

Neutron stars do the same

- *Similar cycle and evolution*
- *Radio ejections during transitions*

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**Aql X-1**

Belloni (2009)

Tudose et al. (2009)
AGN do (almost) the same

- Most AGN are on the variable branch
- A couple are in HIMS
- Variability confirms..
- .. only those
High (> 20 keV) is crucial

- Timing changes
- Spectrum does not change much
- Change driven by hard component
- What happens at higher energies?
High (> 20 keV) is crucial

- High-E cutoff (temperature)
- Clear variation
- From thermal to non-thermal?

see poster by S. Motta
The Jet Paradigm: from Microquasars to Quasars

- Springer Lecture Notes for Physics
- 10 chapters
- Publication: November 2009
- X-ray Binaries to Active Galactic Nuclei
- Papers on arXiv next week
COSPAR 2010 event

- Bremen, July 2010

X-ray Astronomy 2009

Bologna - 2009 September 7-11