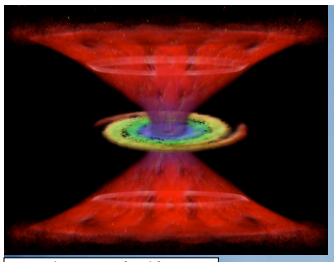

Artist's conception of wind from an accretion disk around a black hole.
Image courtesy of Harvard CfA

Suzaku Observations of H1743-322: Implications for Disk Winds

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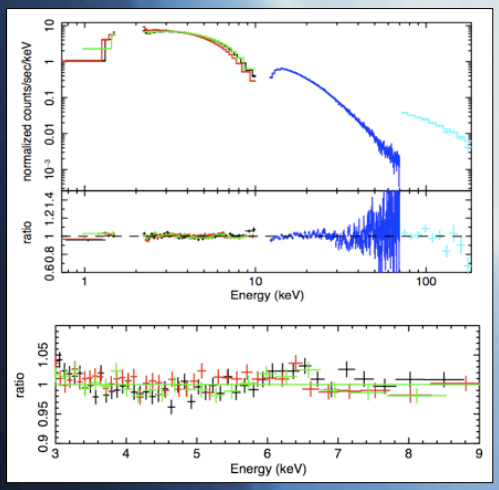
Instrument	Parameter	Theoretical Value (Å)	Flux (10^{-5} photons cm^{-2} s^{-1})	Equivalent Width (mÅ)
Suzaku (LHS)	Fe XXV	1.850	6.4	<1.2
	Fe XXVI	1.780	3.9	<0.72
Chandra (HSS)	Fe XXV	1.850	43	4.3
	Fe XXVI	1.780	54	6.4
Chandra (VHS)	Fe XXV	1.850	<50	<1.2
	Fe XXVI	1.780	<30	<0.9

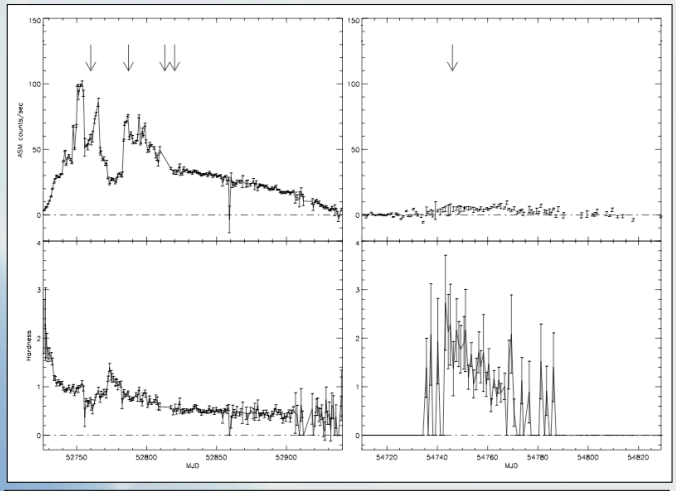
Abstract: Disk winds can be key to understanding disk physics and inflow-outflow connections in accreting black holes. Using *Suzaku* we observed the black hole candidate H1743-322 in the low/hard state on 2008 October 7 for 72 ksec. The spectra rule-out Fe XXV and Fe XXVI absorption lines, and thus rule-out an ionized disk wind like that was previously detected in a disk-dominated high/soft state with Chandra. Our results suggest that the wind is quenched, rather than merely too highly ionized to be detected. This adds to a growing picture that winds and jets are anti-correlated and state-dependent. We will report and discuss our *Suzaku* results in the context of inflow-outflow connections in accreting systems.

Previously, *Chandra* observations of H1743-322 found evidence of an ionized disk wind in the high/soft state (HSS), in the form of Fe XXV and XXVI absorption lines (Homan et al. 2005, Miller et al. 2006). These lines were absent when *Chandra* observed H1743-322 in the very high state (VHS). The *Suzaku* limits for the equivalent width in the low/hard state (LHS) are commensurate with those from *Chandra* in the very high state, but well below the equivalent widths seen in the high/soft state.



Top panel: *Suzaku* spectrum of H1743-322 fitted with an absorbed broken power-law model: $\Gamma_1 = 1.56$, $\Gamma_2 = 2.2$, $E_{break} = 36$ keV. The black, red and green curves represent the data from the XIS detectors. The blue and cyan curves represent the data from the PIN and GSO detectors, respectively.

Bottom panel: Data/model ratio from 3-9 keV for the broken power-law model. Above 2.0 keV, there is no evidence of iron absorption lines. But, there is an apparent emission line around 6.4 keV.



Left panel: *RXTE/ASM* one-day averaged light curve with errors (1.5-12 keV) and one-day averaged (5-12 keV)/(3-5 keV) hardness ratio, for the bright phase of the 2003 outburst of H1743-322 (Miller et al. 2006). The source progresses through the very high or steep power-law state followed by the high/soft state. The arrows at the top of the plot denote the days on which H1743-322 was observed with *Chandra*.

Right panel: *RXTE/ASM* one-day averaged light curve with errors (1.5-12 keV) and one-day averaged (5-12)/(3-5 keV) hardness ratio, for the October 2008 outburst of H1743-322. The source rise is typical of the low/hard state. The arrow at the top of the plot denotes the date on which we observed H1743-322 with *Suzaku*.

Discussion/Results:

- The continuum spectrum can be described by a broken power-law.
- Fe XXV and Fe XXVI absorption lines that were absent in the very high state (VHS) are also absent in the low/hard state (LHS). It is uncertain whether the wind was quenched in the VHS, or if the ionization parameter in the wind had increased and hindered its detection. However, the ionizing flux in the LHS is a factor of 2.5 lower than in the VHS. This demonstrates that disk winds are indeed state dependent: strongest in the disk-dominated HSS, and weak or absent in other states.
- An analysis of H1743-322 indicates the possible presence of the Fe K emission line.
  - For a centrally illuminated neutral and ionized disk, equivalent widths for the Fe K emission line tend to range between 100 eV-150 eV and 100 eV-500 eV, respectively (George & Fabian 1991, Ballantyne et al. 2002).
  - Our fits (using a Gaussian + broken power-law model) for low ionization iron (Fe I - Fe XVI) from the *Suzaku* data resulted in an equivalent equivalent width of 7.5 mÅ (24.9 eV). This low equivalent width can possibly be due to a high inclination of the source ($\theta > 80$ degrees).

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