Joint X-ray observations of Cygnus X-1 at orbital phase zero

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We present first results of simultaneous observations of the high mass X-ray binary Cygnus X-1 for 50 ks with XMM-Newton, Chandra-HETGS, RXTE, Suzaku, INTEGRAL, and Swift in 2008 April. The observations are performed close to phase 0 of the 5.6 d orbit when pronounced dips in the X-ray emission from the black hole are known to occur. The dips are due to highly variable absorption in the focused wind from the O-star companion to the black hole. Compared to previous high resolution spectroscopy studies of the dip and non-dip emission with Chandra, the addition of XMM-EPIC-pn and Suzaku-XIS data allows for a better determination of the continuum through the broad iron line region, while RXTE and INTEGRAL constrain the >10keV continuum.

Several absorption dips with complex substructure severely reduce the count rate in the soft X-ray band (Suzaku-PIN). Some of the dips are also apparent above 4 keV (RXTE-PCA), and few appear even in the 20–40 keV band (INTEGRAL-IBIS). In order to guide the eye when comparing the different instruments, selected dip-structures are shown in color. Hard X-rays above 12 keV (INTEGRAL-IBIS, Suzaku-PIN) are influenced by scattering in the wind around orbital phase 0.

The neutral absorption edges (e.g., O-K, Fe-L, Ne-K) are probably from lower ionized Si and related to the dips. (All spectra shown on this poster are averaged over dip and non-dip phases.) The absorption lines are formed in the focused wind of the supergiant companion star, which is photoionized by the X-ray source. The analysis of redshifts and equivalent widths (via the curve of growth), which constrains the accretion flow, is still ongoing.

The spectrum measured by XMM-Newton’s EPIC-pn camera provides a high enough signal-to-noise ratio at a resolution that allows for the investigation of the relativistically broadened iron Kα line. Within the joint observation, the continuum can be determined more easily.

The high resolution Chandra-HETGS and XMM-RGS spectra reveal plenty absorption lines of mostly highly ionized (He- and He-like) ions. The absorption lines between 6 and 7 Å are probably from lower ionized Si and related to the dips. (All spectra shown on this poster are averaged over dip and non-dip phases.) The absorption lines are formed in the focused wind of the supergiant companion star, which is photoionized by the X-ray source. The analysis of redshifts and equivalent widths (via the curve of growth), which constrains the accretion flow, is still ongoing.