Multiwavelength campaign on Mrk 509: Simultaneous LETGS and COS observations

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Abstract
We present here the results of a 180 ks Chandra-LETGS observation as part of a large multiwavelength campaign on Mrk 509. We study the warm absorber (WA) in Mrk 509 and use the data from a simultaneous HST-COS observation to assess whether the gas responsible for the X-ray and UV absorption are the same. In X-rays we find ions belonging to 3 distinct ionization phases in 3 different kinematic components (Δν = +70, -200, and -460 km/s). The UV spectrum shows 13 kinematic components, 3 of them can be associated to those in X-rays and thus can be co-located.

The source: Mrk 509
Mrk 509 is a nearby (z = 0.0344) Seyfert 1/QSO hybrid. Because of its proximity and brightness (L(1-1000 Ryd) = 3.2 x 10^{45} erg/s) is particularly suited for extensive multiwavelength campaigns.

Mrk 509 has a confirmed presence of an intrinsic ionized absorbing gas in X-rays (Yaqoob+03, Smith +07, Detmers+10) and also UV absorption lines (Crenshaw+95, Kriss+00, Kraemer+03).

The slow variability of Mrk 509 makes it also an ideal laboratory for reverberation mapping studies.

The X-rays: Chandra-LETGS
The LETGS spectrum of Mrk 509 shows the presence of a relatively shallow WA (N_H ∼ 5 x 10^{20} cm^{-2}) with 3 ionization phases (log ξ = 1.1, 2.3, and 3.2) in distinct kinematic regimes (Δν = +70, -200, and -460 km/s, respectively). Below we show a detail of the spectrum in the Oxygen region (left), and the Carbon region (center).

The right plot shows the stability curve for these components. Component 1 is not in pressure equilibrium with 2 and 3 and it is probably not part of the same long-lived structure. Indeed, upper limits for the location of these absorbers from the central source are R < 6 kpc, < 300 pc, and < 50 pc, respectively (Ebrero+11a).

The UV: HST-COS
The UV spectra showed a complex absorption system with 13 kinematic components ranging from Δν = -408 to +222 km/s (Kriss +11).

At least 3 of these components, one redshifted and two blueshifted with respect to the systemic velocity of the source, can be kinematically associated to the X-ray WA components and therefore are likely to be co-located.

The X-ray/UV connection
The ionic column densities of CIV and NV measured by COS are too low to produce substantial X-ray absorption. Lower limits on CVI and OVII (measured by FUSE and HST-STIS, resp.) would be consistent with our LETGS measurements (Ebrero+11a).

If the UV and X-ray absorbing gases are co-located, at least for some of the detected components, this would be consistent with a clumpy scenario where high-density low-ionization UV-absorbing clouds are embedded in a low-density high-ionization X-ray absorbing gas (to be further discussed in a forthcoming paper Ebrero+11b, in prep.)

References

For more details do not miss Jerry Kriss talk!