

Complex X-Ray Spectral Variability in Mini-BAL QSOs

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Abstract. Multiple *XMM-Newton* observations of the mini-BAL QSOs PG 1351+640 and PG 1126–041 revealed dramatic and complex spectral variability on different timescales, providing clues about the physical mechanism responsible for outflows in quasars.

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Quasar outflows provide a feedback mechanism between supermassive black holes and their environments. We performed temporally resolved X-ray spectral analysis on two mini-BAL QSOs, PG 1351+640 ($z \sim 0.09$) and PG 1126–041 ($z \sim 0.06$); these sources host ultraviolet absorbing gas outflowing at $v \sim 3500 \text{ km s}^{-1}$ and $v \sim 5000 \text{ km s}^{-1}$, respectively. The investigation of their X-ray properties provides insights into the physical mechanism responsible for launching and accelerating such outflows.

The main results of multiple *XMM-Newton* observations are the following:

- *High column densities* ($\sim 10^{23} \text{ cm}^{-2}$) of X-ray absorbing gas are detected. Different phases of gas are detected in each source, with ionization parameters spanning the range $\sim 10\text{--}100 \text{ erg cm s}^{-1}$. This gas is only partially covering the continuum source.

- *Strong X-ray spectral variability on different timescales (years, months, and hours) is detected.* This variability can be well reproduced by variations of physical parameters (column density, covering factor) of the ionized absorbers.

- *The optical-to-X-ray spectral index is found to be significantly variable.* The α_{OX} parameter, measured simultaneously for each epoch thanks to the Optical Monitor aboard *XMM-Newton*, is variable. What drives the changes in α_{OX} is the strong X-ray variability.

- *The detection of a high velocity X-ray outflow* ($v \sim 15000 \text{ km s}^{-1}$) in PG 1126–041 is made possible thanks to a very high signal-to-noise-ratio observation.

Overall, these observational results are in qualitative agreement with radiatively driven accretion disk wind models. Further insights into the physics of quasar outflows would be provided by checking whether such models can also *quantitatively* reproduce the observed complexities.

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