AGN-enhanced outflows of low-ionization gas in star-forming galaxies at 1.7<z<4.6

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[Aim & sample] Fast and energetic winds are invoked by galaxy formation models as essential processes in the evolution of galaxies. These outflows can be powered either by star-formation and/or AGN activity, but the relative dominance of the two mechanisms is still under debate. We use spectroscopic stacking analysis to study the properties of the low-ionization phase of the outflow in a sample selected from a compilation of deep optical spectroscopic surveys, mostly zCOSMOS-Deep and VUDS, comprising 1330 star-forming galaxies (SFGs), 79 X-ray individually detected ($10^{42}<L_X<10^{45}$erg s^{-1}) Type 2 AGN at $1.7<z<4.6$, and 20 AGN not individually detected AGN showing narrow emission lines in their spectra and whose mean X-ray properties are consistent with the presence of a Type 2 AGN.

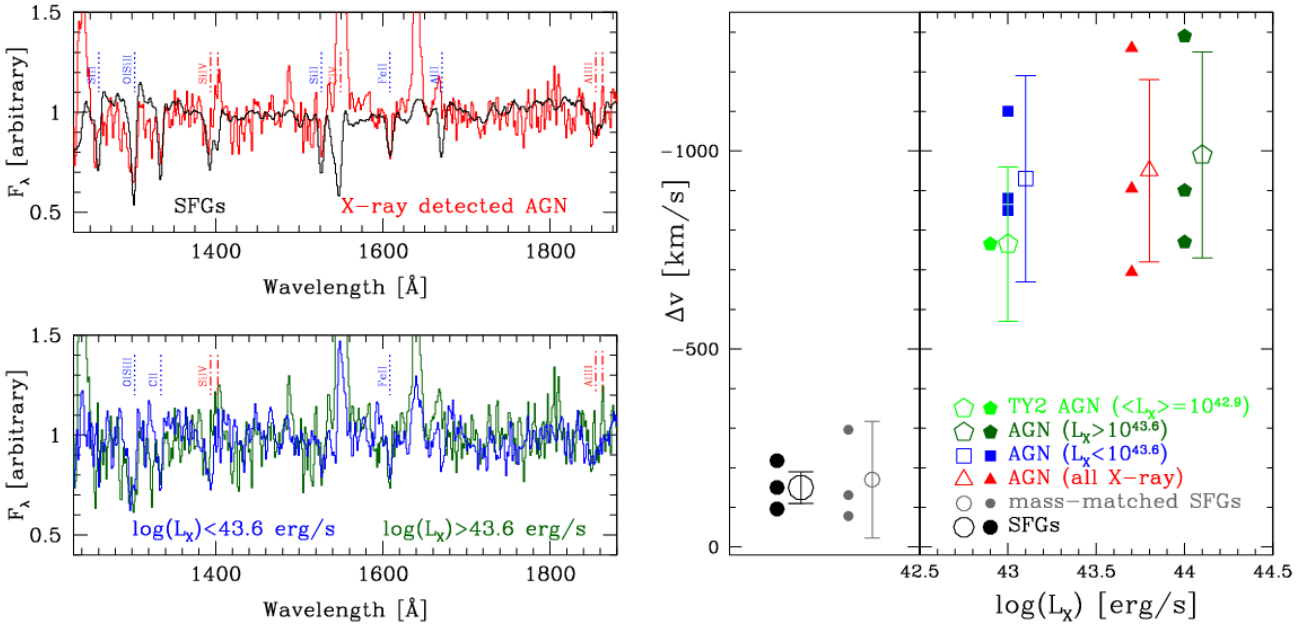

Figure 1: *Left, top* - continuum normalized stacked spectra of the total SFGs sample (black) and the individually detected X-ray AGN sample (red). Most prominent ISM lines show a larger blueshift in the AGN composite spectrum with respect to both the SFGs sample. *Left, bottom* - stacked spectra of individually detected X-ray AGN with $L_X>10^{43.6}$ erg s^{-1} (green); individually detected X-ray AGN with $L_X<10^{43.6}$ erg s^{-1} (blue). Most prominent ISM lines show similar blueshifts in both composite spectra. All spectra are at rest with respect to their systemic redshift. Vertical lines mark ISM low- (blue) and high-ionization absorption lines (red). *Right* - Measured velocity offsets of ISM lines in the six stacked spectra analysed in the paper as a function of X-ray luminosity: control sample of SFGs (black), mass-matched sample of SFGs (grey), total sample of individually X-ray detected AGN (red), X-ray AGN with $L_X<10^{43.6}$ erg s^{-1} (blue), X-ray AGN with $L_X>10^{43.6}$ erg s^{-1} (dark green), TY2 AGN not individually detected in X-ray (light green). Filled symbols indicate measurements of individual lines tracing outflowing gas. Empty symbols indicate the mean value for each sub-sample. Error bars represent mean errors for each sub-sample.

[Results] We measure mean velocity offsets of ~ -150 km s^{-1} in the SFGs while in the AGN sample the velocity is much higher (~ -950 km s^{-1}), suggesting that the AGN is boosting the outflow up to velocities that could not be reached only with the star-formation contribution. The sample of X-ray AGN has on average a lower SFR than non-AGN SFGs of similar mass: this, combined with the enhanced outflow velocity in AGN hosts, is consistent with AGN feedback in action.
We further divide our sample of AGN into two X-ray luminosity bins: we measure the same velocity offsets in both stacked spectra, at odds with results reported for the highly ionized phase in local AGN, suggesting that the two phases of the outflow may be mixed only up to relatively low velocities, while the highest velocities can be reached only by the highly ionized phase.