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Title	Yet another UFO in the X-ray spectrum of a high-z lensed QSO
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a standard Λ CDM cosmology with $H_0 = 70 \text{ km s}^{-1} \text{ Mpc}^{-1}$ and $\Omega_{\text{d}} = 0.73$. If we assume the magnification factor $\mu = 45$ between the estimated values of 30 and 60 (Trotter et al. 2000; Minezaki et al. 2009), we can infer an intrinsic X-ray luminosity $L_{2-10\text{keV}} \approx 3 \times 10^{44} \text{ erg s}^{-1}$ that corresponds to an intrinsic $L_{\text{bol}} \approx 1 \times 10^{46} \text{ erg s}^{-1}$ assuming the bolometric correction factor ($k_{\text{bol}} \approx 30$) by Lusso et al. (2012). Based on the $\text{H}\beta$ broadening, the SMBH mass has been estimated to be $M_{\bullet} \approx 1.8 \times 10^9 M_{\odot}$ (Peng et al. 2006) and this implies that the source is emitting at $\approx 5\%$ of its Eddington limit ($L_{\text{Edd}} \approx 2 \times 10^{47} \text{ erg s}^{-1}$).

The main result of our analysis is the first detection, to our knowledge, of an UFO in a radio-loud object at $z \geq 1.5$. The absorption feature is due to iron resonant absorption (essentially FeXXVI) in ionized and outflowing gas ($\text{Log}(\xi) \approx 3.9$, $N_{\text{H}} \approx 8 \times 10^{23} \text{ cm}^{-2}$) with a velocity of $v_{\text{out}} = (0.28 \pm 0.05)c$. It is worth noting here that the UFO characteristics of MG J0414+0534 are consistent with what observed in nearby radio-loud AGNs ($v_{\text{out}} \sim 0.04\text{--}0.43c$, $N_{\text{H}} \geq 10^{22} \text{ cm}^{-2}$, $\text{Log}(\xi) \sim 1.4\text{--}5.6$, Tombesi et al. 2014). Assuming standard “recipes” and considering the large uncertainties on parameters such as $M_{\bullet}$, μ and k_{bol} , we can try to infer a very rough and purely indicative estimate of the outflow mechanical output. Following Tombesi et al. (2012), we assume that the outflowing gas has been detected at a radius at which the observed velocity corresponds to the escape velocity, that is, $r = \frac{2GM_{\bullet}}{v_{\text{out}}^2}$. Using $M_{\bullet}$ and v_{out} reported above, we obtain that $r \approx 6.8 \times 10^{15} \text{ cm}$, that is, $r \approx 25r_{\text{g}}$. Following Crenshaw et al. (2003), we can estimate the mass-outflow rate as:

$$\dot{M}_{\text{out}} = 4\pi m_{\text{p}} \mu N_{\text{H}} v_{\text{out}} r C, \quad (1)$$

where m_{p} is the proton mass, μ the mean atomic mass per proton (1.4 for solar abundances), N_{H} the column of the ionized gas, v_{out} the line of sight outflow velocity, r the absorber’s radial location, and C the global covering factor ($C \approx 0.5$ here, i.e., similar at the median value obtained by Tombesi et al. 2010a). The obtained mass-outflow rate is of the order of $\approx 11 M_{\odot} \text{ yr}^{-1}$ that corresponds to $\dot{E}_{\text{kin}} \approx 2.5 \times 10^{46} \text{ erg s}^{-1}$, that is, $\approx 2.5 L_{\text{bol}}$, and to an outflow momentum rate of $\dot{p}_{\text{out}} \approx 6 \times 10^{36} \text{ g cm s}^{-2}$, that is approximately 17 times the radiation force $\dot{p}_{\text{rad}} = L_{\text{bol}}/c$. The $\dot{E}/L_{\text{bol}} \approx 2.5$ ratio is much larger than what is observed in the local Universe ($\dot{E}_{\text{kin}}/L_{\text{bol}} \approx 0.01$, Tombesi et al. 2013; Gofford et al. 2015) and well above the limit to switch-on/off feedback mechanisms by AGN-driven winds ($\dot{E}_{\text{kin}}/L_{\text{bol}} \geq 0.01$, Di Matteo et al. 2005; Hopkins & Elvis 2010) but it is consistent with what is observed in other distant quasars (see for example the case of the radio-quiet quasar HS 0810+2554 where $\dot{E}_{\text{kin}} \approx 9 L_{\text{bol}}$, Chartas et al. (2016). Moreover, together with the large ratio between the wind and radiation forces ($\dot{p}_{\text{out}}/\dot{p}_{\text{rad}} \approx 17$), this may indicate that the magnetic field is probably dominating in driving the outflow in accordance with the radio loudness of the source.

Finally, it is worth noting here that MG J0414+0534 is the seventh QSO at $z \geq 1.5$ in which UFOs have been detected. Excluding HS 1700+6416 (Lanzuisi et al. 2012) and PID352 (Vignali et al. 2015) which are non-lensed, the remaining objects, namely APM 08279+5255, PG1115+080, H1413+117, HS 0810+2554 (Hasinger et al. 2002; Chartas et al. 2003, 2007, 2009, 2016) and MG J0414+0534 are lensed. The flux enhancement due to the lensing does certainly help to collect good quality X-ray spectra and this may help in detecting such features. Alternatively, one can speculate that the flux enhancement makes it easier to probe weaker fluxes and, if the anti-correlation between the absorption line EW and the source flux observed in IRAS 13224–3809 (Parker et al. 2017) holds also at high- z ,

gravitational lensing helps in getting stronger features. However, the current absence of large enough samples of good-quality X-ray spectra of either lensed or non-lensed high- z QSO has hampered the study of these or other possible effects which must be accounted for if we want to understand how the feedback mechanism worked along cosmic time to shape the observed $M_{\bullet}$ – σ relation.

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