Breaking the rules at z=0.45: the rebel case of RBS 1055

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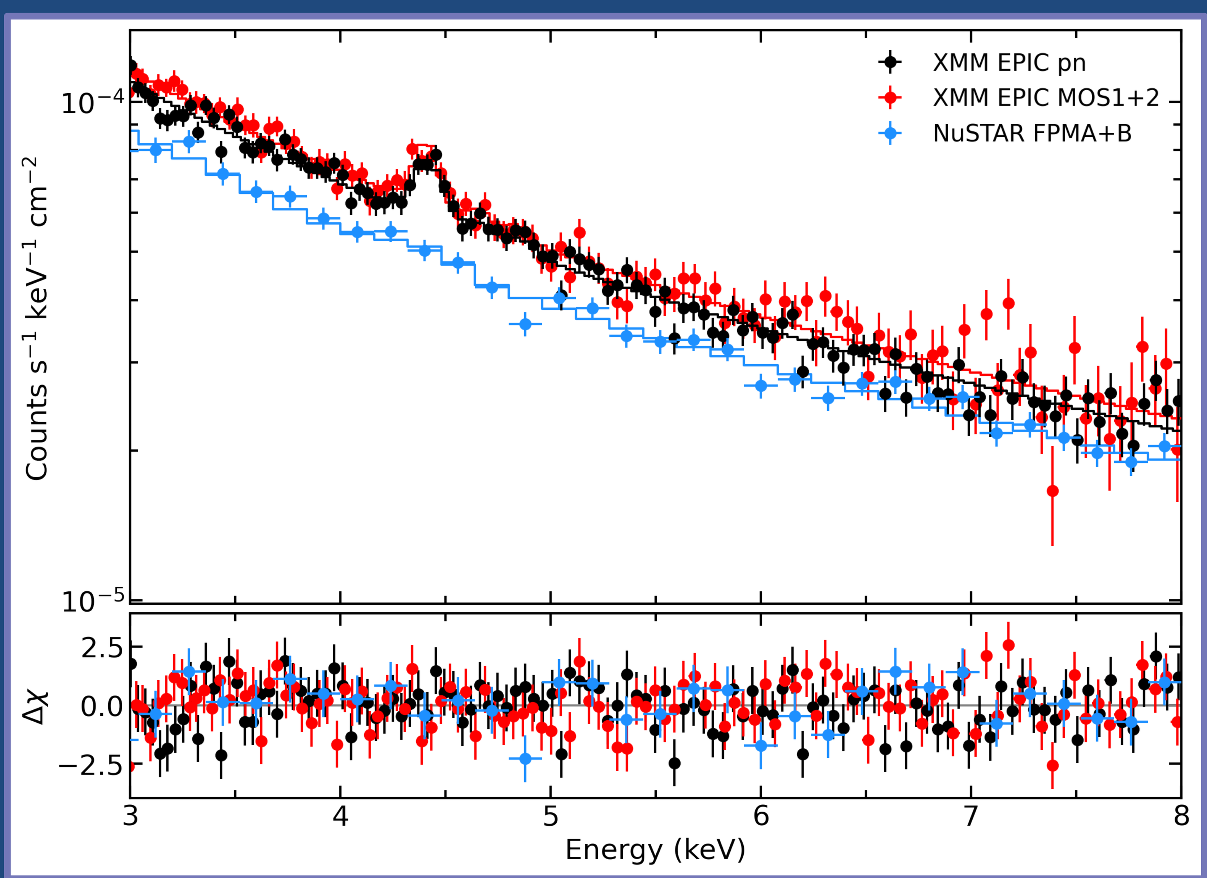
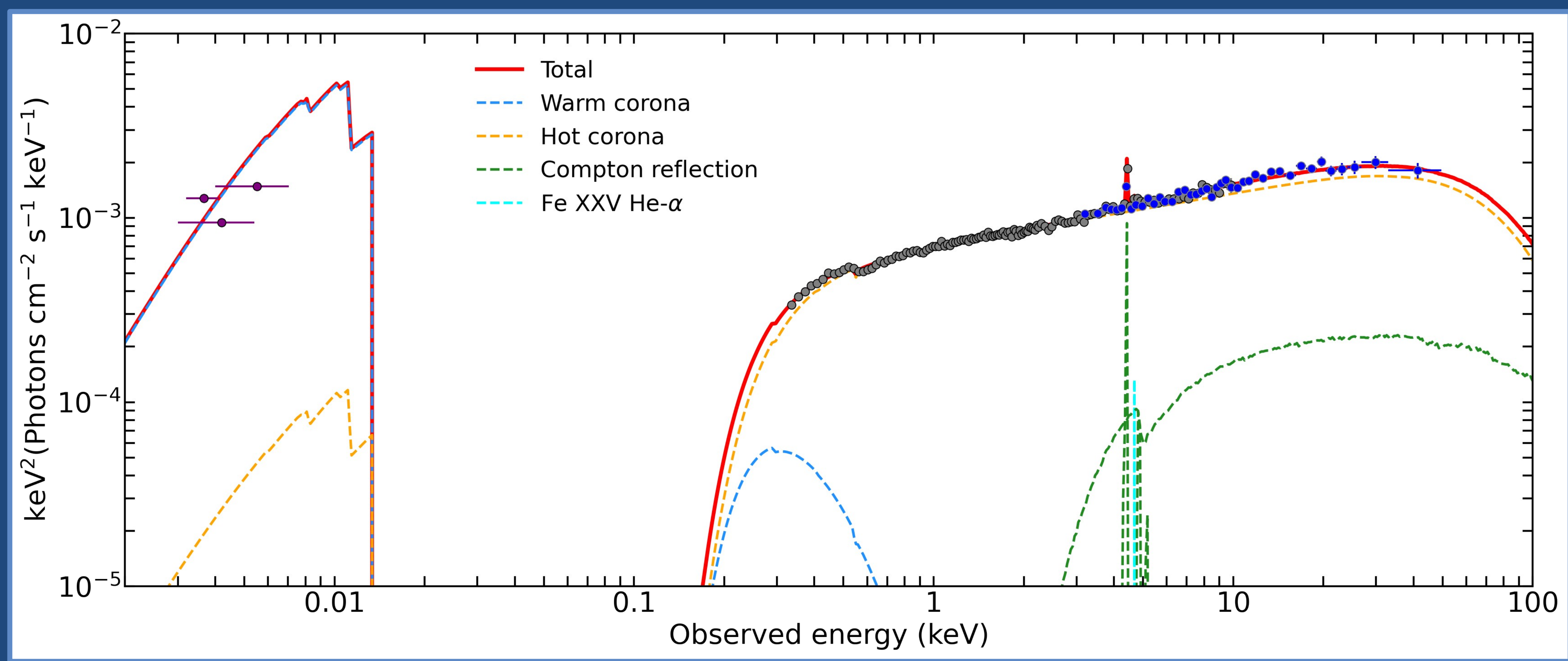
Very luminous quasars are unique sources for studying the circumnuclear environment around supermassive black holes. The current paradigm for Active Galactic Nuclei (AGN) postulates the presence of several components that contribute to the overall spectral shape in the X-rays. The hot (kTe =50-100 keV) and warm (kTe =0.1-1 keV) coronae are responsible for the hard and soft power law continua while the circumnuclear toroidal reflector accounts for the Iron Kα emission line and the associated Compton hump. However, all these spectral features are simultaneously observed only in a handful of sources above z=0.1.

We show results from a long NuSTAR observation (250 ks long) of the bright quasar RBS 1055 at z=0.45, performed on March 2021 and from archival XMM-Newton pointings (185 ks long) taken on July 2014. An optical spectrum of the source taken with the Double Spectrograph at the Palomar Observatory, quasi-simultaneous to the NuSTAR one, is also analyzed.

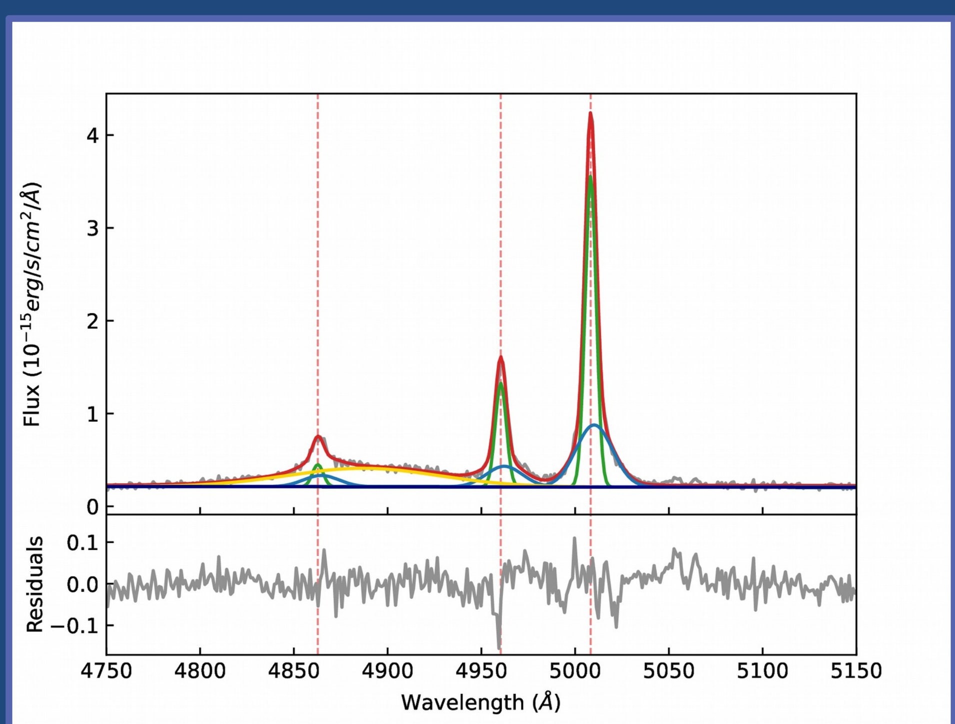


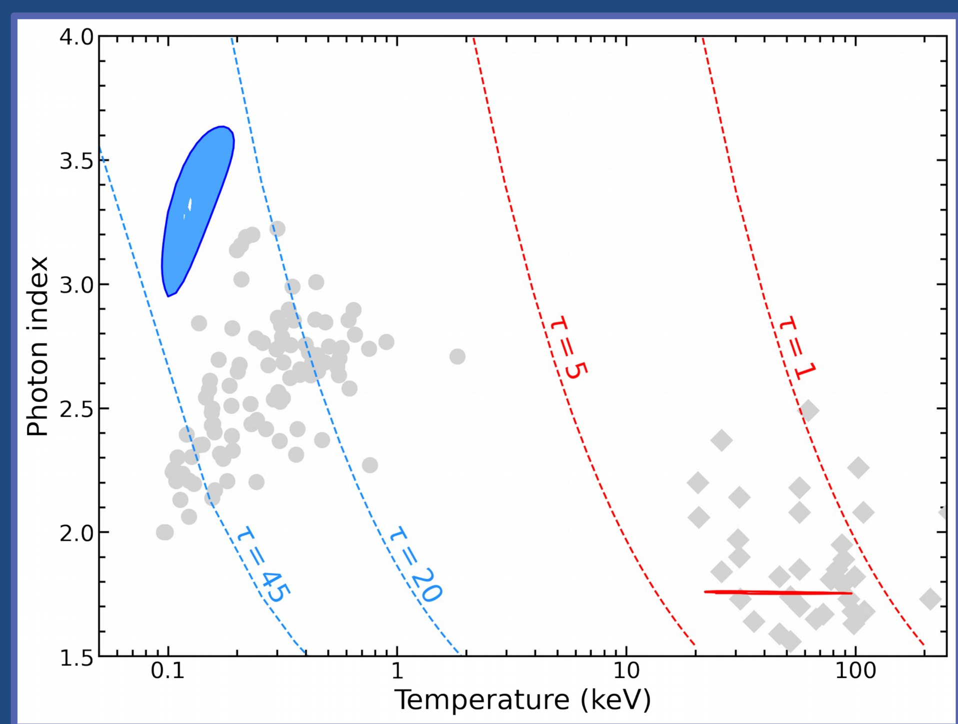
XMM-Newton and NuSTAR spectra are shown with the corresponding best fitting models.



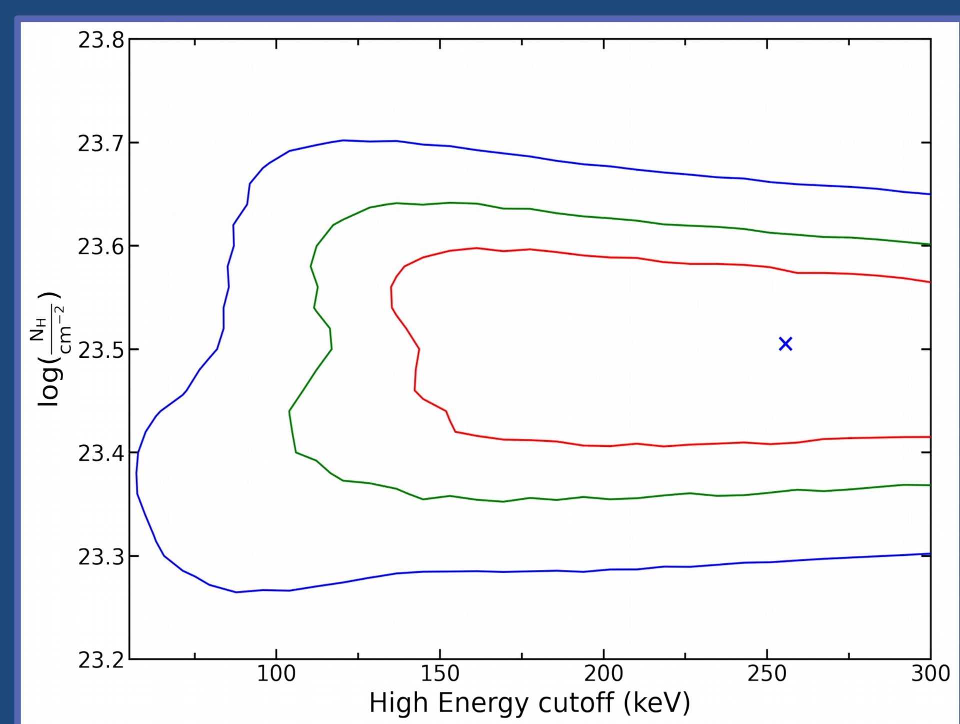
The total best fitting model is shown as a red solid line and UV/X-ray data are overimposed. The four spectral components are labeled and showed as dashed lines. XMM-Newton OM data are plotted in purple, pn data in grey and NuSTAR grouped FPMA/B data in blue.

Hβ-[OIII] region. The red curve represents the best-fit model. Gold Gaussian components represent the emission originating from the BLR and the magenta curve refers to the iron emission. Green Gaussian components reproduce the NLR emission and blue ones trace the outflowing gas in the NLR.





Contour plots obtained with two nthcomp components for the warm and hot coronae are shown in blue and red, respectively. Shaded regions indicate 68% confidence levels. Dashed red and blue lines indicate different Thomson optical depths obtained with the formula (A1) in Zdziarski et al. (1996). Grey circles and diamonds are data points reported in Petrucci et al. (2018) for their sample composed of 22 sources.



Contour plots between the column density of the reflector N_H and the high energy cutoff E_c obtained with Borus model. Red, green and blue solid lines indicate 68%, 90% and 99% confidence levels.

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Our main results can be summarized as follows:

- we confirmed the presence of an intense Fe Kα emission line at E=6.41 ±0.02 keV, with an EW=55±6 eV. This measurement is ~3σ above the predicted value from the observed EW-L(2−10 keV) relation (Bianchi et al. 2007) and it is one of the few above L(2−10 keV) = 10^{45} erg/s. If a toroidal reflector is considered (Borus model), an equatorial column density $N_H=3\times10^{23}$ cm^{-2} is retrieved;
- the nuclear continuum is well modeled with a cutoff power law with Γ=1.70±0.03, Ec>110 keV and a soft excess. The two-coronae model (Petrucci et al. 2013, 2018) well reproduces the broad band spectrum of RBS 1055, with temperatures kT=0.12±0.05 keV, kT=30^{+90}_{-10} keV and Thomson optical depths τ=30±10 and τ=$3.0^{+1.0}_{-1.9}$ for the warm and hot corona, respectively;
- the source also confirmed to be extremely bright in the X-rays, with an inferred α_{ox} = 1.06. This value is at the lower end of the observed α_{ox} distributions (Martocchia et al. 2017, Vagnetti et al. 2013, Gianolli et al., in prep.);
- the optical spectrum revealed a likely peculiar configuration of our line of sight with respect to the nucleus, and the presence of a broad [O III] component, tracing outflows in the NLR, with a velocity shift v =1500±100 km s^{-1}, leading to a $\dot{M}_{out}$ = 19.6 ± 1.1 M yr^{-1} and $\dot{E}_{kin}/L_{Bol}$~0.26%.