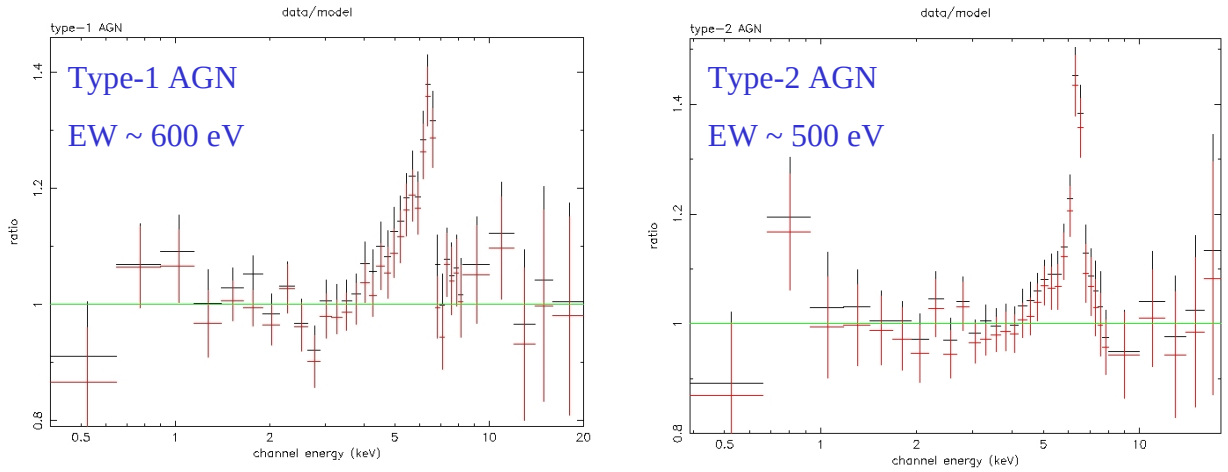
Relativistic Fe lines in the mean X-ray spectra of AGN

We derived average rest-frame X-ray spectra for type-1 and type-2 AGN using the 770 ksec XMM-Newton survey of the Lockman Hole field in combination with extensive optical identifications of the AGN population. In both types of AGN a clear relativistic line profile is revealed, which indicate that the average supermassive black hole has significant spin.

We selected a sample of 94 spectroscopically identified AGN for which more than 200 counts were observed in the 0.5-10 keV band. The sample was divided into 53 type-1, 41 type-2 AGN, based on their optical spectra. Power law spectral fits were performed for all objects and the spectral residuals were transformed into the source frame and co-added for both types of AGN. The resulting mean X-ray spectra show a prominent fluorescent Fe line. In both type-1 and type-2 AGN, a clear relativistic line profile is revealed. A Laor line profile with an inner disk radius smaller than the last stable orbit of a Schwarzschild black hole is most consistent with the data, indicating that the average super-massive black hole has significant spin. Equivalent widths of the broad relativistic lines range between 400-600 eV. We use a disk reflection model to compare the observed strength of the line with the amplitude of the reflection component, concluding that to consistently describe the observations the average iron abundance should be about three times the solar value.



Mean EPIC-PN (black) and MOS (red) residual spectra for type-1 (left) and type-2 (right) AGN show a clear excess between 4 and 8 keV (rest-frame), most probably due to Fe K_α emission from iron in low to moderate ionization states with a mean energy near 6.4 keV (i.e., < FE XVI) The skewed shape of the line is best explained as being due to Doppler and gravitational redshifts of emission originating from the inner part of an accretion disk around a rotating (Kerr-metric) super-massive black hole. We observe a narrow Fe line near 6.4 keV (source-frame), in addition to the broad spectral feature in our type-2 AGN sub-sample. The high relative strength of the Fe line features in our sample is thought to be due to a high metallicity in the average source population of our relatively high redshift samples.

Reference:
A. Streblyanska, G. Hasinger, A. Finoguenov, X. Barcons, S. Mateos, and A.C. Fabian, 2004, XMM-Newton observations of the Lockman Hole III: A relativistic Fe line in the mean X-ray spectra of type-1 and type-2 AGN, submitted to A&A

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