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Highlights from the X-ray all-sky survey eROSITA mission on AGN

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A). Ionized Gas Outflows in AGN from the gravitational radius scale up to the kiloparsec scale:

We present the first look to the spectral and timing analysis of Narrow-Line Seyfert 1 Galaxies (NLS1s) with eROSITA based on the SDSS DR12 catalogue. The SDSS DR12 spectral analysis is based on a power-law model using XSPEC fit with a Principal Component Analysis (PCA) background model. The photon index distribution is asymmetric with a mean value of about 3, as expected from previous X-ray studies. Interestingly, about 10 per cent of the sources are in the super-soft tail with photon indices reaching values between 4 and 10. These sources are of further interest as the source counts run into the X-ray background at values at around 1 keV.
We argue that ultra-soft ionized X-ray outflows have been detected eROSITA, which is supported by subsequent XMM-Newton DDT observations of 4 of the most extreme objects. By analyzing the asymmetry index of the optical emission lines in combination with X-ray eROSITA and XMM-Newton spectral properties, we detect outflows from the innermost few gravitational radii up to the kiloparsec scale.
We analyzed intrinsic X-ray variability using standard and Bayesian methods and correlate the variability to the multi-wavelength properties during the individual survey scans as well as between the survey scans.

B). The nature of extreme ultra-soft X-ray variability in 1H0707-495 first detected by eROSITA:

One of the most prominent AGNs, the ultra-soft Narrow-Line Seyfert 1 Galaxy 1H0707-495, has been observed with eROSITA as one of the first CalPV observations on October 13, 2019, for about 60.000 seconds. The 2019 spectrum is drastically different from other AGN spectra observed so far, as it is much more variable at low energies up to only 0.8 keV, which has been referred to by Parker et al. (2022) as a new AGN ultra-soft state.

The simultaneous XMM-Newton spectra show the same basic shape. We showed that the unusual soft X-ray variability, first detected by eROSITA, is due to a combination of an obscuration event and strong suppression of the variance at 1 keV by photoionized emission. An ionized partial coverer and strong relativistic reflection explain the unique X-ray softness.

During the eROSITA observations, 1H 0707-495 showed, in addition, a dramatic flux drop by a factor of about 100 in just one day. This variability is primarily in the soft band and is much less extreme in the hard band. Such extremely large-amplitude variability has been observed in the past only in a few AGNs such as IRAS 13224-3809 (Boller et al. 1997), GSN 069 (2019Miniutti et al. 2019), and RX J1301.9+2747 (Giustini et al. 2020).

In the combined eROSITA and XMM-Newton observation, 1H 0707-495 was caught in the historically lowest hard-flux state-observed so far.

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