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A New Paradigm in X-ray Spectral Analysis

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X-ray spectral analysis is a powerful tool available to astronomers to study differing astrophysical phenomena from X-ray binaries, galactic black holes, and the intracluster medium.
A new Bayesian paradigm is emerging in the field of X-ray spectral analysis. However, continued concerns over the choice of priors dominate the conversation. With our new machine learning methodology employing Mixture Density Networks (MDN), we use posterior target distributions calculated by an MDN as the priors for a full Bayesian inference approach to X-ray spectroscopy. Additionally, we discuss the potential of deconvolving observed X-ray spectra from the instrumental response using a Recurrent Inference Machine (RIM). Our findings indicate that using a RIM to deconvolve the spectrum and then passing the deconvolved spectrum to well-tuned MDN results in inaccurate estimates of the temperature and metallicity values which are critical in the study of galaxy clusters, plasma physics, and feedback astrophysics. In this talk, we will also discuss the implications for use cases and demonstrate the power of this exciting new methodology in our exploration of galaxy clusters.

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