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# The Weirdest Objects in the Chandra Source Catalog 2.0. A Machine Learning Approach

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The version 2.0 of the Chandra Source Catalog (CSC2) offers an unprecedented opportunity for serendipitous discovery. Out of $\sim$ 315,000 CSC2 sources, two thirds are detected for the first time in X-rays, while a significant fraction of the remaining objects has never been studied in detail. CSC2 sources are characterized in terms of their X-ray fluxes, hardness ratios, variability, and spectral properties, and include a large variety of X-ray phenomena, from young stars, to compact binaries. Our preliminary investigations show that the CSC2 also includes "weird" sources that could be either examples of these known classes, observed in rare or unknown stages of their evolution, or even instances of previously unidentified X-ray source types. We present a machine learning method to maximize the potential for discovery of CSC2, by exploring the catalog using an anomaly detection algorithm, the unsupervised random forest (URF), and report the most unusual sources in the X-ray universe resulting from this search. We identify several rare X-rays sources, including the re-discovery of a $\gamma$-ray emitting nova, an ultraluminous stellar-mass black hole, and many more interesting sources that are currently unclassified and that could potentially indicate new types of X-ray sources. We show how our method is a robust and straightforward way to select candidates of unknown class for multi-wavelength and spectroscopic follow up. Although applied to the CSC2, this method is easily adapted for other X-ray catalogs, such as the XMM-Newton Source Catalog.

## Topic

Compact and diffuse sources in galaxies and in the Galactic Center

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