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Identifying correct counterparts to high-energy sources by ”multiwavelength educated guesses” imbibed in a Bayesian statistic environment

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The identification of the counterparts to sources detected by
instruments with large positional uncertainties can not be done using match in coordinates, due to the very high number density of the ancillary source catalogs.
In addition, given that now the entire sky is literally covered by a plethora of multiwavelength surveys, the search for the counterparts by using a single band at a time is outdated. Instead, the entire SED for every single source in the sky can be created and used for discriminating the actual emitter from the field population.
Finally, at least with respect to X-ray observations, we have more than 20 years of XMM and Chandra detection with a secure counterpart that can be used for creating a training sample to educate our guess.
This is the basis of NWAY, a cross-matching code based Bayesian statistics that works with arbitrarily many catalogs, can handle varying positional errors, can incorporate additional prior information (the educated guesses and works accurately and fast in small areas and all-sky catalogues. In my talk, I will present how NWAY is now routinely used in the determination of the counterparts to Xray sources detected by e.g, ROSAT, XMMSlew, NUSTAR, and eROSITA. In particular, I will show how the prior (based on photometry, colors, parallax, and SNR of the detection) was built for eROSITA using Random Forest and tested on a validation sample providing 96% completeness and purity. The final goal is to discuss with the audience how a similar approach could be built for CTA.

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