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Bayesian Spatio-spectral Imaging of SN1006 in X-ray

The supernova remnant SN1006 has been studied extensively by various X-ray instruments and telescopes due to its historical record, its proximity, and its brightness. In order to accurately study the properties of this remnant itself, it is essential to obtain a detailed and denoised view of its small-scale structures, given the existing observations. Here, we present a Bayesian spatio-spectral image reconstruction method, based on information field theory, that aims to separate the emission of the remnant from that of other sources in the field.

We describe our priors using generative models that incorporate knowledge of the spatial and spectral correlation structure of the remnant and of other sources, such as point sources and background radiation. Combined with a likelihood model that allows the fusion of multiple data sets and instrument descriptions, we obtain the posterior distribution of the remnant's emission at each point in space and frequency. Furthermore, we introduce a multi-step approach where the spatial reconstruction obtained for a single energy range is used to derive an informed starting point for the full spatio-spectral reconstruction in order to speed up the imaging process.

The developed method is applied to the latest merged Chandra data available to date on SN1006, providing a high quality visualisation of its complex features.

Keywords: SN1006, information field theory, X-ray imaging, Bayesian imaging, spatio-spectral reconstruction, component separation, generative models

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