A regularization approach for the analysis of X-ray solar spectra: blind tests and applications to RHESSI data

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Abstract

The Ramaty High Energy Solar Spectroscopic Imager (RHESSI) is currently yielding solar flare hard X-ray spectra with unprecedented energy resolution. Such spectra enable the reconstruction of an effective mean source electron spectrum by solution of a Volterra linear integral equation of the first kind. We describe a software tool implementing the Tikhonov regularization algorithm for the solution of this linear inverse problem with discrete data. In this approach an appropriate rescaling procedure is adopted for reducing the huge dynamical range of the photon data and a statistically-based criterion for the optimal choice of the regularization parameter is applied. The effectiveness of this method is assessed by comparing its results with the ones produced by three other reconstruction techniques in the case of blind tests characterized by physically significant synthetic photon spectra. Finally applications to real data recorded by RHESSI are considered.

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