# DECONVOLUTION OF BONNER SPHERE DETECTOR DATA USING BAYESIAN INFERENCE

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**Abstract**

Reliable measurements of neutron energy spectra are needed for radiation protection. Bonner spheres spectrometers (BSS) are often used since they are fairly robust against environmental conditions at workplaces. A BSS is a set of moderator spheres of well-selected diameters that contain a central thermal neutron detector. The response functions are fairly broad in energy and their maximum shifts to higher energies with increasing diameters. The inference of the neutron spectrum from the measured counts is therefore an ill-posed inversion problem that requires data deconvolution and cannot be solved without additional, i.e. prior knowledge. However, for most workplaces one knows at least the general shape of the spectra to be measured. Several approaches are found in literature, especially algorithms based on the principle of maximum entropy such as, for example, MAXED [1] are quite capable and largely validated by experiments. The latter and also some other approaches consider the uncertainties associated with the measured counts correctly. However, none takes satisfactory account of the uncertainties associated with the values of the response functions. It may be expected that Bayesian inference provides consistent solutions [2] and allows one to take account of all relevant uncertainties.

In this work we determine the most probable neutron spectrum by using Skilling's entropic prior [3] and a likelihood function with gaussian noise to represent uncertainties. However, as a first step, we consider the uncertainty of the measured data only. To determine a reasonable range of the regularization parameter $\alpha$, the evidence analysis and $\alpha$-marginalization are used and compared. These results are compared to measurements in known neutron fields. This encourages us to extend this work to include the uncertainties of the response functions as the next step.

References:

[1] M. Reginatto et al. Nucl. Inst. and Meth. A **476**, 247 (2002).

[2] V. Dose et al. In Maximum Entropy and Bayesian Methods, ed. by G. Erickson, Kluwer Academic, Dordrecht, p. 147 (1998).

[3] J. Skilling. In Maximum Entropy and Bayesian Methods, ed. by J. Skilling, Kluwer Academic, Dordrecht, p. 45 (1989).

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