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Optimization of deconvolution in Compton profile measurements

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Abstract. The method of generalized least squares has been used to deconvolute the Compton profile measurements in nickel. The method depends on two arbitrary parameters namely the cut-off parameter K and the damping factor λ. This has been discussed and a method suggested to optimize the damping parameter.

Keywords. Deconvolution; Compton profile.

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1. Introduction

Deconvolution in Compton profile measurements has been the subject of discussion in the past by many investigators. Among the many convolution schemes available in literature, the well-known ones are the Fourier analysis based on Stokes method (Cheng *et al* 1971) and the successive approximation using different kinds of smoothing functions (Reed and Eisenberger 1972) and the method of generalized least squares (Paatero *et al* 1974a). The generalized least squares is the most commonly used method and depends on variable parameters namely those which control the frequency and hardness of cut-off. The cut-off characteristics were discussed in detail by Cheng *et al* (1971). The parameter which controls the frequency is known as damping factor and is taken arbitrarily by different authors. The purpose of this paper is to reinvestigate this damping factor.

2. Experimental set-up and data

In order to calculate the Compton profile we have used the method of generalized least squares, the details of which were given by Paatero *et al* (1974a, b). The K value is usually taken to be 0 or 2 (Towmey 1963) but is taken as 2 in the present analysis. A program for deconvolution based on the above method has been developed on the DEC 2050 computer. The apparatus used for the experimental study of Compton profile consists of various components (see figure 1). The Compton profile of Ni metal is measured using 59·54 keV γ-rays from a 1000 mCi annular source ^{241}Am obtained from the Radio Chemical Centre, Amersham, UK. The experimental set-up consists of a scattering chamber, an intrinsic germanium detector (Canberra model