SIMULATION OF X-RAY AND GAMMA-RAY SCATTERINGS IN LIGHT MATRICES

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In the Monte Carlo simulation introduced the histories of the photons are recorded regardless of the number of scatterings. The only limiting factor is the energy threshold. The simulation is applied to XRF analysis of light matrices in the energy range of 20-60 keV. The effect of polarization is also taken into consideration. The simulation can be used for describing the spectrum background and for determining the enhancement of characteristic lines owing to scatterings.

INTRODUCTION

The processes taking place in a sample analyzed with XRF method are well-known and their Monte Carlo simulation seems to be rather simple. If the simulation is expected to provide characteristic intensities only the computation can be performed in a relative short CPU time, because multiple scatterings in the sample can be neglected.

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Our task was to study enhancements caused by scattered photons, therefore the negligence of multiple scatterings would have resulted in considerable inaccuracy. On the other hand, following the history of each photon, regardless of whether it reaches the detector or not, means that the commonly used method of simulation based on "weighed probabilities" cannot be applied. The CPU time is consequently much longer, nevertheless the information obtained from the simulation is not available otherwise.

THEORETICAL

To simulate all possible processes leading to photons detected the following types of events have to be dealt with:
- incoherent or Compton scatterings;
- coherent or Rayleigh scatterings;
- photoeffect /ionization on an inner shell/.

In the last case the history of a photon might end in an Auger effect.

If any of these three types of events take place at a certain point of the sample, then the probabilities of having an incoherent scattering, a coherent scattering or a photoeffect are

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P_{\text{inc}} = \frac{\mu_{\text{inc}}}{\mu_{\text{inc}} + \mu_{\text{coh}} + \tau} \quad /1a/
\]

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P_{\text{coh}} = \frac{\mu_{\text{coh}}}{\mu_{\text{inc}} + \mu_{\text{coh}} + \tau} \quad /1b/
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P_{\text{ph}} = \frac{\tau}{\mu_{\text{inc}} + \mu_{\text{coh}} + \tau} \quad /1c/
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