NUCLEAR AND ATOMIC DATA DETERMINATION WITH METALLIC MAGNETIC CALORIMETERS

M. Loidl[1], E. Leblanc[1], M. Rodrigues[1], B. Leprince[1], L. Eglin[1], H. Rotzinger[2], M. Linck[2], A. Burck[2], T. Scarbrough[2], A. Fleischmann[2], C. Enss[2]

[1] LNE - LNHB, CEA / Saclay, 91 191 Gif-sur-Yvette Cedex, France
[2] Kirchhoff–Institut für Physik, Universität Heidelberg, IF 227, 69120 Heidelberg, Germany

ABSTRACT

Nuclear and atomic data determination with a very low uncertainty require a detection efficiency close to 100 % in the entire energy range emitted by the nuclide to be studied. For low energy emitting nuclides, a very low detection threshold is of prime interest. In many cases conventional detectors cannot fulfil these requirements and often fail to collect the total energy of the emitted electrons. We are developing metallic magnetic calorimeters for nuclear and atomic data determination in the frame of ionising radiation metrology.

Establishing electron capture probabilities of ^{55}Fe ideally involves complete detection of both photons and electrons over more than two decades of energy, which cannot be achieved with conventional detectors. With a metallic magnetic calorimeter containing a source in a 4π geometry, we have obtained an experimental spectrum from which we have inferred a preliminary value for the ratio of capture probability on the K and L shells of Mn. The detector has a detection threshold around 20 eV, detection efficiency close to 100 % from 20 eV to 6.5 keV for electrons and photons and a base line energy resolution equal to 4 eV. The spectrum demonstrates excellent energy determination for electrons.

Hence we explore this technique also for beta spectrometry at higher energies. The aim is to determine shape factors for pure beta emitters for which theoretical calculation requires approximations that are difficult to validate and for which conventional detector measurements fail. We have realised a prototype detector to measure the shape factor of ^{36}Cl. The measurement will be compared with the result of a Monte Carlo simulation of the calculated emission spectrum interacting in our detector (7 keV - 700 keV).