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The energy loss of relativistic heavy ions in a gadolinium foil below and above the ferromagnetic Curie temperature

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We report on high-precision measurements (relative accuracy $3 \cdot 10^{-5}$) with the high-resolving mass spectrometer FRS at GSI. Bi ions with an energy of 52 GeV traversed a polycrystalline Gd foil of a thickness of 1.2 mm placed in an external magnetic field of 450 Gauss. The energy loss of these ions after passage the foil was measured as a function of the foil temperature T below and above the ferromagnetic Curie temperature T_C of about 19°C . Further, the macroscopic magnetization M of the used Gd foil was measured as a function of the foil temperature T . The data showed the well-known drop of M approaching T_C from lower temperatures. Due to an applied external magnetic field, M does not disappear at T_C but exists up-to much higher temperatures reaching 90°C . Subtraction of effects due to the thermal expansion and due to a measured asymmetric change of the appearing charge-state distribution of the Bi ions when traversing the Gd foil, the remaining relative energy-loss change $(\delta E/dE)_{\text{corr}}$ increased between 5°C and 98°C from 0 to $1.1(5) \cdot 10^{-3}$. Between 13°C and 15°C a sharp increase of $0.26(3) \cdot 10^{-3}$ was observed. A presentation of $(\delta E/dE)_{\text{corr}}$ as a function of the negative logarithm of M , namely $-\ln M$, showed an interesting regular step-wise behavior.

Recent Publications

1. Title (2006) Nuclear Instruments and Methods in Physics Research B 243:103-108.
2. F. Nickel (2007) IAE Monographs: Energy loss of swift ions in polycrystalline targets, Vol. 11, Otwock-Swierk, 2007, Poland.

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