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Determining the spectroscopic quadrupole moment (Q_s) of the first 2⁺ state in ⁴⁰Ar

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Abstract content
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The present study aims at determining the spectroscopic quadrupole moment Q_s, for the first 2⁺ excited state in ⁴⁰Ar by carrying out the first order Coulomb-excitation reorientation-effect measurements of ⁴⁰Ar beams at safe energies. Only one such measurement [1]was done in the 1970's with unsafe beam energies. We have used the ²⁰⁸Pb (⁴⁰Ar, ⁴⁰Ar*)²⁰⁸Pb* reaction at 143.2 MeV, for which the minimum distance of closest approach between the nuclear surfaces is ˜ 6.6 fm. The first 2⁺ state at 1460 keV in ⁴⁰Ar is populated via Coulomb-excitation and the de-excited γ-rays are detected using the AFFRODITE clover detector array[2] which comprises of 8 HPGe detectors (5 at 90° and 3 at 135°). The scattered particles are detected in coincidence with γ-rays using a double sided S3 silicon detector which consists of 24 rings (for angular distribution) on one side and 32 sectors (for Doppler correction) on the other. These measurements were done at low beam currents of ˜0.5 nA and with the target (1mg.cm⁻² ²⁰⁸Pb) positioned at 10.05 mm from the S3 detector at backward angles to be sensitive to Q_s. The integrated γ-ray yields per ring carry information about the Q_s(2⁺) value and will be compared with the semi-classical coupled-channel Coulomb-excitation code GOSIA.

References :
1)R. H. Spear, Phys. Rep. 73, 369 (1981).
2) M. Lipoglavsek et al., Nucl. Instr. Meth. Phys. Res., A557, 523 (2006).

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