Accurate wave length measurement of high energy gamma-rays from the ^{35}Cl(n,γ) reactions

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Despite the improvement of related fundamental constants, and the subsequent re-evaluation of energy calibration standards, the calibration of gamma-ray detectors still remains a problem at high energies. While neutron capture on ^{35}Cl offers a series of regularly spaced gamma lines up to about 8.5 MeV and the cross-section is also sufficiently large, precise energies have been measured with the state of art doubly flat crystal spectrometer, GAMS4, only for a small fraction of the potentially useful gamma lines. In particular, the only high-energy line measured is the 6111 keV gamma ray. Because this gamma ray is a member of a multiplett structure, its high precision energy value is not useful in HPGe energy calibrations.

The goal of our recent wave length measurements of gamma rays from the ^{35}Cl(n,γ) reactions at GAMS4 facility is two fold:

a) To provide precise energies for a set of well-selected gamma rays for energy calibration at neutron capture gamma-spectrometer facilities.

b) To determine more precise neutron binding energies based on recent (n,γ) measurements at the Budapest PGAA facilities.

Two RbCl targets were put near to the reactor core of the High Flux Research Reactor, Grenoble, France. As usual, we re-measured the previously determined gamma-ray energies for calibration reasons coming from ^{35}Cl neutron capture reactions. The energies of the 517-, 786-, 1165-, 1951- and 6111-keV transitions were re-measured at a few times 10^{-7} precision. Furthermore we have measured the most intense high-energy decay cascades of

$$7790 \text{ — } 888 \text{ keV}$$
$$7414 \text{ — } 1165 \text{ keV}$$

with a precision of few times 10^{-6}. The corresponding level energies and the binding energy have been determined from a least-square fit. Three different cascades define the neutron binding energy and its calculated energy values show an agreement within 1 sigma level.

The obtained new energy values are used to recalibrate the gamma ray energies from our (n,γ) measurements at the Budapest PGAA facilities. The impact of these new energy values on the binding energies will be demonstrated.

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