Cryogenic detectors for rare alpha decays search: a new approach

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Recently, a significant progress in the field of rare alpha decays investigation has been achieved exploiting the cryogenics detectors, namely scintillating bolometers, due to combination of an excellent energy resolution, high detection efficiency, particle discrimination ability, and a wide choice of possible absorber materials. However, it should be noted, that only the use of a proper absorber material containing the element of interest in significant amount allows to profit from the advantages of this experimental technique. For some elements, like Sm, Nd, Os, Hf, Pt, etc., for which appropriate scintillating materials are still under investigation, we propose to use a new approach: a fully understood crystal scintillator is doped with the element of interest as an absorber material.

We report on the precise detection of the 148Sm alpha decay with a half-life equal to 6.4x1015 y and a Q-value of 1987.3±0.5 keV. This result was obtained using a ZnWO4 crystal (22.014 g) doped with enriched 148Sm isotope (less than 2 mg) and operated as a scintillating bolometer at mK temperatures. Our result proves the potential of the double read-out cryogenics detector (phonons and light channels) in combination with the use of the enriched isotope of interest as dopant in order to study of rare nuclear processes with high experimental sensitivity.