

High precision measurements in mirror beta decays at GANIL

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The LPCTrap setup, presently installed at the low energy beam line (LIRAT) of the SPIRAL facility at GANIL, was designed to perform precise beta-neutrino correlation measurements in nuclear beta decays [1]. The radioactive nuclei are confined in a transparent Paul trap, allowing the detection of the recoil ions in coincidence with the beta particles. The beta-neutrino angular correlation parameter is deduced from the time-of-flight distribution of the recoil ions.

Experiments with ^{35}Ar and ^{19}Ne were successfully performed. The final data analysis is ongoing, based on the development of new simulation tools [2]. The statistics recorded during the experiments should enable the determination of the beta-neutrino correlation coefficients with unprecedented precision in these decays. These coefficients constitute sensitive observables to search for new physics beyond the Standard Model or to test its consistency. The precise measurement of such a coefficient in a mirror transition allows the accurate determination of the mixing ratio [3]. The matrix element V_{ud} can be deduced from the latter with a high precision to test the unitarity of the CKM matrix, if the masses of the involved nuclei, the half-life and the branching ratio of the transition are also well known. For ^{35}Ar , the result should induce a significant gain (~ 1.7) on the V_{ud} precision deduced from the study of mirror decays. This perspective motivates future measurements at GANIL, using new beams which are presently under development, such as ^{33}Cl and ^{37}K . In these two cases, precisions similar to the ^{35}Ar experiment are expected, considering an upgraded LPCTrap setup with increased detection efficiency, which is currently under investigation. The first experiments would be performed at LIRAT in the coming years, while later, the program will continue at DESIR where LPCTrap will be installed, with other setups dedicated to mass (MLLTRAP), half-life and branching ratio (BESTIOL) measurements.

This program on mirror beta transitions study will be discussed during the conference.

[1] G. Ban et al., Ann. Phys. (Berlin) 525 (2013) 576.

[2] X. Fabian et al., TCP14 conference proceedings, submitted to Hyperfine Interact.

[3] N. Severijns and O. Naviliat-Cuncic, Phys. Scr. T152 (2013) 014018.

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