ISOL BEAM R&D FOR FUNDAMENTAL PHYSICS

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From the 1930's to the late 1950's, studies of nuclear beta-decay have played a decisive role for the development of the present theory of the weak interactions. Today still, precision experiments studying nuclear beta-decay complement high-energy physics measurements searching for signatures of physics beyond the Standard Model. With the beta-asymmetry measurement as originally carried out by C. S. Wu, the most direct way of probing the nature of weak interaction in nuclear beta decay is the measurement of the beta-neutrino angular correlation. The best constraints so far on the possible existence of tensor or scalar interaction, neither predicted nor excluded by the theory, are presently inferred from such measurements.

Radioactive ion beams produced with the so-called Isotope Separation On Line (ISOL) method have an optical quality which is comparable to this of the stable ion beams. In turn, the ISOL low energy radioactive ion beams can be easily manipulated in electromagnetic traps. The development of such electromagnetic traps for nuclear physics in the past two decades has permitted to reach unprecedented precisions for a variety of spectroscopy measurements: for the mass measurement of radioactive nuclides, for collinear laser spectroscopy, or for new types of experiments studying beta-decay. At GANIL, the SPIRAL facility delivers radioactive beams of gaseous elements of unique purity and intensity. Since 2005, LPC Caen leads an on-line experiment in the low energy beam lines of SPIRAL aiming at the beta-decay of trapped $^6He^+$ ions. In such pure Gamow Teller decay, the β-ν angular correlation parameter is sensitive to the existence of tensor interactions. During the last two beam-times, enough statistics could be collected to set the lowest limit on such exotic interactions in nuclear beta-decay. The corresponding data is still under analysis. It was recently realized that the setup used for this experiment could additionally be used for the study of the beta-decay of T=1/2 nuclides, contributing to the tests of CVC and of the unitarity of the CKM matrix.

A number of new candidates for beta-neutrino angular correlation measurements will be soon delivered from an upgraded SPIRAL facility, able to produce new beams from more than 20 condensable elements compared to the 7 gaseous ones readily available. Such upgrade, relying on state − of − the − art ionization techniques in hot plasma sources, and of charge breeding for the purpose of post-acceleration, is one of the major directions taken by GANIL in the transition period to SPIRAL 2. The scientific interest for the SPIRAL upgrade has been recently attested in the fields of nuclear astrophysics, nuclear reactions, nuclear structure and tests of fundamental symmetries as developed above, by letters of intent which were submitted to the GANIL Physical Advisory Committee.

In this seminar I'll present latest results from the LPC trap experiment, the status of the SPIRAL 1 upgrade and in what this upgrade and ISOL beam R&D at SPIRAL and SPIRAL 2 contribute offering unique perspectives for this kind of precision experiments at the present GANIL facility, and for the future DESIR facility at GANIL.