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In trap polarization of radioactive ion beams

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In this contribution we discuss the potentials of a new technique of optical orientation of radioactive ions trapped in an open Paul trap, permitting to reach a very high degree of polarization, for beta decay experiments.

More precisely, laser polarization of the alkali-earth ions 23Mg+ and 39Ca+ in a Paul trap and detection of the emitted electron and recoil ion shall enable the measurement of the so-called D correlation. D is a triple correlation of the form <**J**> (**pe** x **pnu**) with pe and pnu being the momenta of the electron and the neutrino, and J the nuclear spin. The D correlation violates Time reversal. While such violation is predicted to occur in the Standard Model via the quark mixing mechanism, experimental constraints are 5 to 10 orders of magnitude lower [1].There is a large window in which D, R correlations and neutron EDM searches can contribute to the search for other sources of CP violation at a much higher level, which could explain for example the large matter-antimatter asymmetry observed in the universe. The best constraints so far on D arise from the neutron decay and are of the order of 2×10-4 on coupling constants of interactions violating T [2]. Lower constraints have been obtained from hyperon, Kaon, and nuclear decays. The latter were derived from the decay of 19Ne yielding a constraint of 6×10-4, limited by statistics [3]. With the expected rates from the upgraded SPIRAL facility at GANIL, an experiment aiming at D-correlation measurement with an unprecedented sensitivity of the order of 10-4 can be conceived. It is envisaged to perform a proof-of-principle of the laser polarization method at ISOLDE, using the COLLAPS laser setup, together with an optimized trapping setup inspired by the one of LPCTrap [4].

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

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