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Polarised Positron Interactions with Cold, Polarised Atoms

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The positron is the antimatter counterpart of the electron. They can annihilate directly, producing gamma rays (e.g., two 511 keV) or form a bound state known as positronium (Ps). The bound state has two forms: a singlet or para-Ps (125ps lifetime), and a triplet state or ortho-Ps (142ns lifetime). These states decay into a number of gamma rays (even or odd, respectively), which can be measured to determine the quantum state of the Ps.

Positrons obtained from nuclear beta decay (e.g., from Na-22) are produced with non-zero helicity. It has been previously demonstrated that positrons retain their spin polarisation when moderated and accumulated. Thus, these positrons can be used to measure spin-dependent scattering processes.

For spin-polarised scattering studies, a desirable choice of target is atoms confined in a Magneto-Optical Trap (MOT). The key benefit of the MOT is the control of the polarisation of the trapped atoms (e.g., Rb-87). Additionally, the trapped atomic cloud provides a uniform target for the positron scattering experiments. These aspects allow for the measurement of the quantum state of Ps as a function of the MOT polarisation.

We will report on experimental progress on our Rb-MOT built for positron scattering experiments. Additionally, we will discuss progress on the integration of the Rb-MOT with the positron beamline.

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