EXPERIMENTS WITH POSITRONS - FROM FUNDAMENTAL TO APPLIED SCIENCE

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Abstract. Since their prediction by Dirac in 1928 and subsequent discovery by Anderson in 1932, positrons have been used in a range of experiments to probe both fundamental and applied science. This has led to the discovery of exotic compounds such as positronium and the positronium ion, as well as leading to the first production, trapping and then spectroscopy of antihydrogen. Positrons have also found use in materials science, probing the nanostructure of solids, and in medical science, through the development of Positron Emission Tomography (PET).

At the Australian National University, we have two positron beamlines, based on Surko trap technology. These provide pulsed positron beams with tunable energy, up to 20 keV, in the case of materials studies. Beams can be conditioned for optimal energy or temporal resolution, to probe a wide range of different physical processes. Since 2008, we have been conducting a range of experiments covering atomic and molecular, materials and medical physics. This covers highly accurate measurements of low energy scattering cross sections to provide benchmarks for theoretical calculations, such as in Sullivan et al. 2008, tracking of material degradation, see Kluth et al. 2014, and measurements of positron scattering from biomolecules, as shown in Edwards et al. 2021.

This talk will provide an overview of the beamlines and their operation, as well as a sample of experimental results covering all three of the previously mentioned areas of study. Plans for future experimental programs will also be outlined, including measurements of positron transport in liquid water.

References

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