The Australian Positron Beamline Facility

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A new positron beamline facility has been constructed to take advantage of the opportunities presented by the development of buffer gas trap technology. The basis of the beamline is a two-stage Surko trap which uses combined magnetic and electrostatic fields and a buffer gas of N_2 and CF_4 to trap positrons and cool them to room temperature [1]. The room temperature positrons can then be used as a reservoir to form a pulsed, high-resolution positron beam for use in low energy scattering studies [2].

The first stage of the apparatus is a commercially available unit purchased from First Point Scientific Inc. and provides a neon moderator for use with a ^{22}Na positron source. The beam from this first stage is then directed to the second stage, containing a buffer gas trap, where it is trapped and cooled. The trap incorporates a segmented electrode to provide a rotating electric field, allowing radial compression of the trapped cloud of positrons [3]. By careful manipulation of the trap electric fields, a pulsed beam is formed to be used in experiments. An energy resolution of 25 meV or less should be attainable using this system. After the trap, the positron beam will be directed to one of two experimental stages, for studies of atomic and molecular physics or materials science. The atomic and molecular physics apparatus is currently under construction and should come on line in the latter half of 2005.

Techniques that allow the measurement of scattering cross sections in a high magnetic field (~500 gauss) will be employed to study positron scattering processes at a level of detail that has been unobtainable until recently [4]. Additionally, the beamline will be used to study electron scattering, providing a valuable way to check the operation of the apparatus by comparing measurements with well known electron scattering standards. Electron scattering studies will also make measurements of total inelastic cross sections for processes such as vibrational and electronic excitation, which have been notoriously difficult using conventional electron scattering techniques. The first target to be examined in the new apparatus will be helium, with the goal of establishing new benchmark measurements for comparison with state of the art theoretical predictions. Very low energy (<1 eV) differential elastic cross sections will be measured, as well as discrete excitation cross sections, a first for positron scattering from helium.

Details of the construction and operation of the first two stages of the experiment will be presented as well the design and plans for the experiments in atomic and molecular physics.

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