Toroidal Energy- and Angle-Resolved Electron Spectrometer

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The Toroidal Energy- and Angle-Resolved Electron Spectrometer (TEARES) is a state-of-the-art high-resolution electron detector that is being designed, built and developed at Daresbury Laboratory. One of the aims of the project is to provide a toroidal electron analyser based system with simultaneous readout of energy and angle. Experiments which would benefit from such a system include photoelectron diffraction from solid surfaces, magnetic dichroism from solid surfaces, atomic and molecular physics experiments, 'spin-polarised' studies of surfaces, and electron spectroscopy based experiments where the cross-section is low.

A toroidal energy analyser allows both the energy and angle of ejection of an electron to be measured simultaneously. In the TEARES system, electrons that are ejected within ≈ 1º of the plane perpendicular to the main axis of the spectrometer will be transported and focussed by a double-focussing cylindrical slit lens onto the entrance of a toroidal electrostatic analyser. The entrance lens is designed to transport and focus an interaction region of approximately $1mm^3$ to the entrance of the analyser. The toroidal deflector analyser is comprised of an inner and an outer toroidal sector. Electrons are deflected by the electric field between the two toroids in such a way that only those electrons having energies near the pass energy of the analyser will arrive at the exit cone of the analyser. The toroidal analyser disperses and focuses the electrons according to their energy in the radial dimension whilst preserving their initial angular direction. The single-focussing conical slit exit lens transports, demagnifies, and focuses the electrons from the exit of the analyser onto the detector.

The TEARES toroidal analyser is defined by a spherical radius of 125 mm, a cylindrical radius of 120 mm and a sector angle of 142º; these dimensions have been chosen to insure optimum focussing properties. The working distance is defined by a 40 mm radius. The resolution of the toroidal analyser is determined by the spherical radius, and slit heights of the entrance lens window and pupil; a resolution of 4 meV should be possible using 1 mm entrance slits together with a pass energy of 0.5 eV. The TEARES system is designed to operate over the kinetic energy range of 0.5 < KE < 1000 eV. The energy spread that is passed to the detector is ≈10% of the pass energy and the useful angular range is 230º.

Further details of the TEARES system and progress to date will be given.