An important part of measurements on atomic species is the measurement of photoionisation cross sections. Such data are essential for modelling plasmas and energy transfer processes in the outer layers of stars, as well as fundamental tests of atomic theory. Nevertheless, absolute measurements in the vacuum ultra violet are a severe experimental challenge, particularly for neutral species where, in an absorption cell, the vapour pressure is very difficult to define accurately, apart from the rare gases. Heat pipes have been used for metal vapours with varying degrees of success, but the fact remains that for most atoms which are not vapours at room temperature very few absolute measurements exist.

In the case of ionic species the situation is more favourable because the ion density can be determined by counting the ions, for example in a Faraday cup. The downside is that the ion density is several orders of magnitude less than it would be in a vapour cell, so the count rates of the ions resulting from ionisation of the parent beam is low. This diffculty was overcome by a technique brought to the SRS by Newcastle University. In their experiments for some years they had been merging ion beams with electron beams, thereby enhancing the count rates of the ionised species.

By applying the same technique using a monochromatic photon beam at the SRS, it was possible to see a much more informative spectrum rich in structure. The experimental layout is shown in figure 1, and a region of the data taken for the Ba^+ ion in figure 2. By knowing precisely the geometry of the photon/ion beam interaction region, the density of the parent ion beam and the photon intensity by means of a calibrated photodiode, absolute measurements of the cross section could be determined.

These were the first experiments worldwide of this kind, and in the case of the singly charged alkaline earth ions showed spectacular new structure due to autoionisation. In figure 3 are shown the np - nd autoionising lines in Ca^+ (n=3), Sr^+ (n=4) and Ba^+ (n=5); these lines have large oscillator strengths. The data proved quite a challenge to theoretical analysis, finally resolved by calculations done at Queen's University Belfast.

Newcastle University continued their measurements on other ions, but were limited to working at photon energies below 40ev at the SRS. However the merged beam technique was widely copied elsewhere, in France, Denmark, Japan and the USA, where experiments were extended to higher photon energies and also to studies of more highly ionised ions in the parent beam.

(References and diagrams to be added)