ESRF	**Experiment title:** Circular dichroism in the angular distribution of photoelectrons from oriented molecules.	**Experiment number:** HE 25
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Report: In an investigation during a previous beam time [l] and in following experiments [2,3], angle resolved electron-ion coincidence measurements were shown to be suitable for investigating photoelectron angular distribution of oriented molecules in the gas phase including dichroic effects. To perform systematic circular dichroism studies on several molecules in a reasonable time range, the coincidence count rate had to be increased by at least one order of magnitude. Therefore we have constructed an electron-ion coincidence experiment where both, electron and ion spectrometer, have an acceptance solid angle of 4π without losing the molecular orientation and photoelectron emission direction information.

Fig. 1 shows a schematic illustrating the principle of measurement. A constant electric field is applied to the centre of the interaction region where O_2 molecules are photoionized using circularly polarized synchrotron radiation at a photon energy of 547eV. Due to their low kinetic energy around a few eV, all photoelectrons which originate from K-

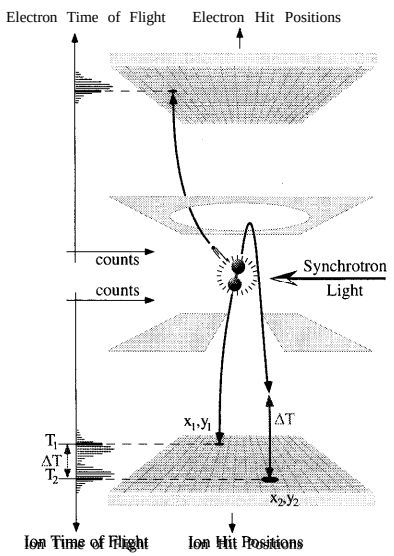

Figure 1: Experimental setup

shell ionization processes are projected onto a position sensitive multi wire anode (upper part). The remaining positive ions $O_2^+, O^+, O^{++}, \ldots$ are projected on a similar anode placed at the opposite end of the coincidence spectrometer (lower part). A dataset containing 6 variables is stored for every coincidence event, namely the electron time-of-flight, the ion time-of-flight and the x- and y-coordinates of the anode hit positions for both, electrons and ions. From this dataset one can derive the emission direction of the electrons and the fragment ions. If we suppose that the ionic fragmentation is fast compared to the timescale of molecular rotation, the 0' emission direction is collinear with the molecular orientation at the moment of photoionization. Thus the experiment does not restrict the detected events to any particular molecular orientations.

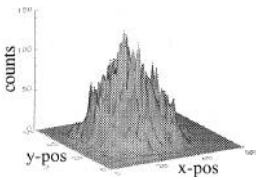

Figure 2: Electron anode hit position distribution

Fig. 2 shows the hit position distribution of the electron anode while in the lower part of fig. 3 ion hit position distributions are presented. The upper part of fig. 3 shows an ion time-of-flight spectrum, containing the O_2^+, O^+, and O^{++} peaks. The comparison of the ion position distributions of O_2^+ and O^+ ion events respectively allowes one to test the experimental setup. The O_2^+ ions have only thermal initial kinetic energies and thus are projected directly on the ion anode. The sharp peak in the centre of the anode is an image of the centre of the interaction region, restricted to the area which is cut out of the light beam by the ion slit aperture. However the position distribution of the 0' ions is quite different, due to the fact that these fragment ions have initial kinetic energies of several eV instead of thermal energies in the range of meV. Thus during their time of flight these ions spread over a wide area of the anode. Beside this broadening of the ion position distribution one can also see that the rectangular shape of the slit aperture leads to a hit position area with a rectangular shape.

In conclusion, we have performed angle resolved electron-ion coincidence measurements with an acceptance solid angle of 4π for both, electron and ion events. Systematic studies on the circular dichroism in the photoelectron angular distribution of oriented molecules in the gas phase can be performed in future experiments using this setup.

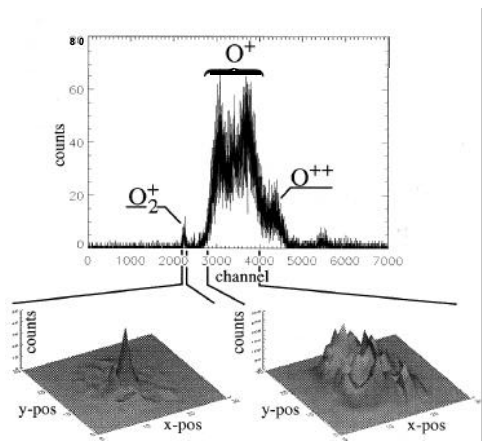

Figure 3: Ion time-of-flight spectrum (upper part) and ion anode hit position distributions (lower part) for O_2^+ (left side) and O^+ ions.

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[2] F. Heiser, 0. Geßner, J. Viefhaus, K. Wieliczek, R. Hentges, and U. Becker, Phys. Rev. Lett. 79, 2435-2437 (1997)

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