A FAST AND ACCURATE POSITION SENSITIVE TIMING DETECTOR BASED ON SECONDARY ELECTRON EMISSION FROM THIN FOILS

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Detection of secondary electron emission has been used successfully to measure the impact time of ions on a thin foil. The secondary electrons emitted following ion impact are accelerated toward a fast detection system, a microchannel plate detector (MCP) being a detector of choice. With the MCP signals from a few emitted electrons are multiplied and can provide a very fast time fiducial. Different schemes for foil positioning and electron trajectory control were employed (e.g. [1, 2]). By detecting the position of electron impact on the microchannel plate detector, one could infer the ion position of ion impact at the foil. This has been attempted with a detector similar to the one shown in Fig. 1a [3, 4, 5] with dissapointing results, similar to those shown to the right of Fig. 1a. In a recent publication, [6, 7] the performace of this detector was analyzed and the poor resolution was traced to the electron transport from the ion impact site at the foil to the position-sensitive detector surface. In a move to stem the lateral motion of the electrons during transit from foil to detector, we utilized a magnetic field running approximately parallel to the electric field. In the adiabatic limit the electron will move in spirals along the magnetic field lines. In the example shown in Fig. 1b, two permanent magnets were positioned behind the detector and the foil plains. The resulting two-dimensional position spectrum taken with the same mask is shown at the right of Fig. 1b. The mask employed in these tests had holes with diameters ranging from 0.25 mm to 4 mm and all are visible in Fig. 1b. By changing magnet placement and strength, we can control the field strength at the foil and the detector's front surface. Image magnification and demagnification occurs as a result and the areal magnification depends on the reciprocal of the ratio of the magnetic field strength at the foil and at the detector's surface. This suggests that the motion of the electrons is restricted along magnetic field lines as expected in the adiabatic limit [8].

References

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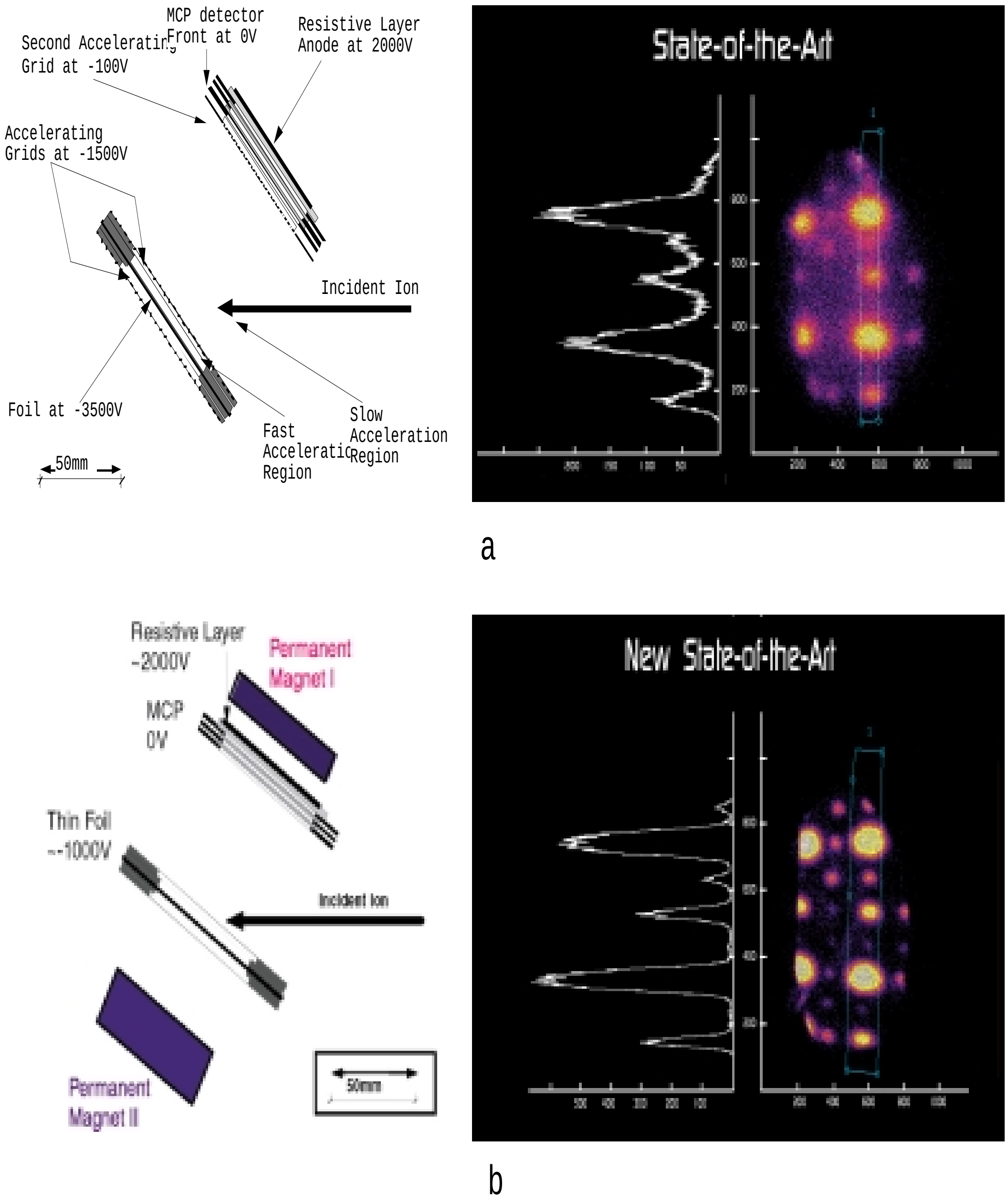

Figure 1: Foil + microchannel plates + resistive layer combinations used in detecting time and position of heavy ion impact. (a) Standard arrangement - only electric field guidance (b) Combined electric and magnetic fields guiding the electrons.