Scattering of Ions Passing Through Accelerator Grids with Rectangular Repeat Cells: the Approach Angle Dependence of Induced Kinetic Energy Spreads

Mark Lewin[1], Michael Guilhaus[1], Frank Read[2], Jason Wildgoose[3], John Hoyes[3] and Bob Bateman[3]

1. School of Chemical Sciences, The University of New South Wales, Sydney 2052 Australia
2. Department of Physics and Astronomy, University of Manchester, Brunswick St. Manchester M13 9PL, UK
3. Micromass UK, Floats Road Wythenshawe, Manchester M23 9LZ, UK

Recent observations with orthogonal acceleration (oa) time-of-flight (TOF) mass spectrometers have verified earlier predictions that dispersion of ions approaching grids at non-normal angles can significantly reduce resolution. A model describing ion scattering by fields surrounding grids with square or rectangular repeat cells has been developed after extensive simulation of trajectories using the CPO-3D package.

The behaviour of square and rectangular grid apertures has been analysed by separating their intrinsic focusing characteristics, attributable to grid geometry, from extrinsic focusing characteristics resulting from field difference, ion energy, and grid size. Intrinsic focusing functions have been calculated at several points over the grid aperture for a range of grid geometries. The intrinsic focusing characteristic for a chosen grid geometry can be combined with relevant extrinsic factors to predict the corresponding kinetic energy spread induced by the grid in the frame of reference of the TOF experiment. The resulting energy spread can be used to predict the effect of scattering on peak shapes.

Good agreement between predicted and observed peak shapes has been obtained using this model. The results show that grids with rectangular repeat cells can be designed to give greater resolution and/or sensitivity, especially in oa-TOF systems where it is usually essential that ions do not approach grids at right angles.