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Measurement of fundamental ion-atom interaction parameters for heavy ion beam materials analysis

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The interaction of high-speed ions with target atoms in solid matter continues to be of both fundamental and practical interest. In materials research and development, one of the key ion-atom interactions of interest is the energy loss of the incident ion to target nuclei and the electron cloud. Accurate theoretical description of ion energy loss processes in matter is key to the development of ion beam analytical and materials synthesis/modification techniques. Rutherford Backscattering Spectrometry (RBS), Elastic Recoil Detection Analysis (ERDA and Particle Induced X-ray Emission (PIXE) spectroscopy are now well-stablished ion beam analysis (IBA) techniques in materials research. For IBA using light ions (Z = 1, 2) existing theoretical models for the energy loss per unit depth (i.e. stopping force) for RBS, ERDA, and X-ray production cross section for PIXE fare quite well in the range of beam energies used in analysis. Recent developments in IBA are geared towards using heavy ions (Z>6) for analyses. This, however, has come with analytical challenges in that the predictive accuracy of existing theories and models for both stopping force and X-ray production cross sections is largely inadequate for heavy ion IBA work. There is a therefore a continual need for experimental data to aid further development and validation of theory. This presentation describes the contribution made by our group to the global databases of stopping force and X-ray production cross section data for applications in heavy ion beam analytical techniques

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