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Tracks, Pores, Cylinders and Cones: SAXS as a tool to study high-energy ion modified materials

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Heavy ions with MeV to GeV energies (also termed 'swift heavy ions') interact predominately through inelastic interactions with the target electrons when penetrating a material. The resulting intense electronic excitation can produce narrow trails of permanent damage along the ion paths, so called 'ion tracks'. Ion tracks are generally between 5-20 nm in diameter, tens of micrometers long and have been observed in many materials. They have numerous applications across a variety of scientific areas such as materials science and engineering, nanotechnology, geology, archaeology, nuclear physics, and interplanetary science. For example, nanopores in polymer membranes are commercially produced using ion tracks by preferential chemical etching of the damaged material in the tracks. Tracks also naturally occur in minerals such as apatite and are widely used to determine the age and thermal history of geological sites.

Small angle x-ray scattering (SAXS) provides a powerful tool for characterizing both ion tracks and track etched nano-pores and enables *in situ* measurements in high-temperature, high-pressure and corrosive environments. Over the last decade we have developed a number of SAXS experiments and analytical methods to characterize ion tracks and track etched nano-pores with unprecedented precision. The presentation will give an overview over some of the developments including *in situ* nanopore etching in polymers, temperature induced track recovery in minerals under high-pressure and the temperature dependent elastic response of cylindrical tracks in silica.

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