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Beam Steering and Radiation in Ultrashort Silicon and Germanium Bent Crystals at the MAinzer MIkrotron

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In this work we report the observation of 855 MeV electrons deflection and radiation by ultrathin silicon and germanium crystals, bent along (111) planes, at the MAinzer Mikrotron MAMI. The crystal length of 15 μm of length was chosen to be comparable with the dechanneling length of electrons. In order to make the measurements for different values of bending radius of the same crystal we used a piezo-actuated dynamical holder, allowing one a remote change of the crystal curvature.
The channeling efficiency, the dechanneling length, the volume reflection angle as well as the radiation spectra were measured in dependence on the crystal curvature and its orientation for both silicon and germanium bent crystal. All the results were critically compared with our simulations by CRYSTAL and RADCHARM++ simulation codes.
For silicon the measured channeling efficiency exceeded 35 %, being a new record for negatively charged particles. On the other hand, for germanium the efficiency turned out slightly below 10% due to the stronger contribution of multiple scattering. However, this is the first evidence of negative beam steering by planar channeling in a Ge crystal at sub-GeV energies. These results are relevant for crystal-based beam steering as well as for the propagation of e.m. radiation in bent and periodically bent crystals.

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