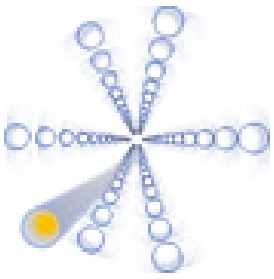

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Investigation on the Radiation Emitted by Sub-GeV Electrons in a Bent Crystal

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We report an investigation on the electromagnetic radiation emitted by channeled and volume reflected sub-GeV electrons in an ultra-thin bent crystal performed at MAMI accelerator (Germany).
In the last years, different studies on the coherent interactions of negative charged particles with bent crystals have been carried out at CERN at ultra-high energies (~100 GeV) [1]. In particular, the effect of channeling and volume reflection were deeply investigated in connection with high-energy beam collimation (for LHC or future ILC) both in terms of steering capability and high intensity electromagnetic radiation generation.
On the other hand, an interest on such effects is present also at lower energies (~GeV) for which one of the most appealing application is represented by the possibility to realize an innovative intense source of X-ray via channeling in a periodically bent crystal. However, since the contribution of dechanneling scales with the particle energy, to efficiently deflect a GeV negatively charged beam a very thin crystal is required (some tens of microns vs. some millimeters for the CERN energies).
Thanks to the exploitation of the quasi-mosaic effect caused by the crystal anisotropy, it was possible to bent a ultra-thin Si crystal along the (111) crystallographic planes; the crystal thickness (30.5 μm) is of the order of the dechanneling length (15-20 μm) that was later measured directly with the same crystal [2]. The deflecting power of the crystal was measured with a high-resolution Si microstrip detector, while the emitted electromagnetic radiation was measured by a NaI detector. Two different collimators were used to study different portions of the electromagnetic spectra.
An evident channeling peak and an intense volume reflection region have been found in the deflection profile of the 855 MeV MAMI electron beam. The deflected beam distribution vs. the beam-to-crystal orientation very much resembles the one obtained in the hundreds-GeV energy range [1]. The measured electromagnetic radiation resulted to be much more intense than for the amorphous case both for channeling and volume reflection. The high intensity of radiation accompanying volume reflection is maintained in the whole angular acceptance, which is equal to the bending angle of the crystal.
The experimental results on the dynamics and on the radiation generation were critically compared to Monte Carlo simulations. It was shown that, on the contrary to the higher energy case, the rechanneling mechanism plays an important role by increasing both the deflection efficiency and the electromagnetic radiation generation.

References

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