

Channeling experiments at the Mainz Microtron MAMI and the new Positron beam line

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The Institute for Nuclear Physics of the University of Mainz operates the accelerator complex MAMI which supplies an electron beam with a maximum energy of 1.6 GeV and a beam current of up to 100 μA . Outstanding qualities of MAMI is the continuous beam with an excellent beam quality of 4 pi nm rad emittance, a very low energy spread of less than 10^{-4} , as well as its extremely high reliability. All kind of channeling experiments require such a high quality beam with a low divergence.

The possibility to produce undulator-like radiation in the hundreds of keV up to the MeV region by means of channeling in periodically bent crystals is well known. A diamond superlattice with a period length of 3.54 μm was grown on a high quality straight (100) diamond plate with the method of Chemical Vapour Deposition (CVD). A sinusoidal varying boron doping profile resulted in a periodic variation of the lattice constant, and in turn four sinusoidally deformed (110) planes with a period length of 5.0 μm and an amplitude of 0.138 nm. A channeling experiment was performed with the 855 MeV electron beam. The impinging electrons perform sinusoidal oscillations resulting in the emission of quasi-monochromatic γ radiation. For the first time a clear peak was observed close to the expected photon energy of 1.33 MeV. Gross properties like photon energy, width and intensity of the peak can be reproduced fairly well by idealized Monte-Carlo simulation calculations.

Positrons, however, are more preferable because they have a significant longer de-channeling length. A new project was started to produce a high-quality positron beam using the MAMI accelerator. Positrons will be created by pair conversion of bremsstrahlung, produced by the 855 MeV electron beam of MAMI in a 10 μm thick tungsten converter target, and energy selected by an outside open electron beam-line bending magnet. First channeling experiments with the new positron beamline at MAMI will be presented.

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