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High energy photon production in bent crystals: status and perspectives.

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Bent crystals are devices able to deflect ultrarelativistic particle beams, exploting the electric fields, present at the atomic scale, which are equivalent to a magnetic field of hundreds of tesla. For this reason they are currently used in particle accelerators for beam extraction, splitting and collimation. Inside a bent crystal, several particle trajectories are possible as a function of the crystal orientation, dimension and curvature; a positron or an electron following these trajectories emits a high energy radiation spectrum; compared with the bremsstrahlung one these spectra are about 10 times larger in intensity and have a peaked structure thus becoming a photon source of great interest. In this work the results of a series of measurements performed on the CERN H4 SPS beam line with 120˜GeV/c positrons are presented. The setup consists of a three layer silicon microstrip telescope to measure the crystal deflection properties, two 9.5x9.5˜cmˆ2 silicon beam chambers which act, in combination with a bending magnet, as a spectrometer and two electromagnetic calorimiters, one for the positron identification and the other to measure the photon energy. During the tests, different effects have been studied in detail. Planar channeling and volume reflection have been characterized as a function of the crystal radius and compared in terms of emitted radiation and angular acceptance; the results are in agreement with the theoretical prediction. Moreover for the first time the axial orientation has been investigated from the radiation emission point of view providing interesting results in terms of intensity both for the axial channeling and the multi volume reflection phenomenon. A beamtest to investigate the axial phenomena more deeply is foreseen in June 2010 completing the scenario that will be presented at the conference.

Author: Dr HASAN, Said (Universita dell'Insubria - Como and INFN Milan-Bicocca)

Presenter: Dr HASAN, Said (Universita dell'Insubria - Como and INFN Milan-Bicocca)

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