PRODUCTION OF PHOTON BEAMS WITH ALIGNED CRYSTALS

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Traditional sources of high energy photons come from either the bremsstrahlung process in an non-crystalline material or the synchrotron radiation produced by bent electron beams. It is difficult to get photons with energy close to that of the beam. It would be helpful if we could enhance the photon beams by the use of a crystal. The radiation associated with channeling motion is peaked at too low an energy and is not useful. Based on the coherent bremsstrahlung process in crystals, calculations by Tannenbaum[1] of the photon spectrum produced by 20 TeV electrons, show a photon spectrum peaked sharply near the beam electron energy. This spectrum shape is certainly very desirable compared with the broad spectrum due to bremsstrahlung process as observed at present accelerator energies (a few hundred GeV's). However, this calculation was based on the Born Approximation which is definitely not valid at the SSC energies. Recent experiments[2] on photons produced by electrons and positrons in aligned crystals at energies up to 150 GeV showed that calculations based on the Born Approximation yielded results in disagreement with experimental data. Theory of "Crystal-Assisted Process" by Kimball and Cue[3] fitted the spectra better. The most recent experimental result[4] on a thin Ge crystal did produce photon spectra with photon energy peaked near the electron beam energy in contrast to those obtained at lower electron energies. However, the crystal is still not thin enough to assure single photon production by an electron in going through the entire thickness of the crystal. Further experiments on thinner targets should establish the true shape of the photon spectrum and perhaps demonstrate that high energy nearly monochromatic photon beams can be produced for use in the fixed target experiments.

References

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