INTENSE COHERENT BREMSSTRAHLUNG LIGHT SOURCE UTILIZING COMPACT ELECTRON ACCELERATORS

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A bright, CW(continuous-wave), tunable source of X-rays and gamma-rays is proposed here. As illustrated in Fig.1, the X-rays and gamma-rays are obtained from coherent bremsstrahlung (Ueberall Effect[1]) or the crystal-enhanced, monochromatized, and polarized variant of ordinary bremsstrahlung) of the highly-intense, highly-bright, monochromatic, and CW electron beam being accelerated using a small superconducting rf linac like the driver for the JAERI FEL. In the JAERI superconducting rf-linac driven FEL, hard X-rays of several tens keV and gamma-rays of a few MeV would be generated using a 15MeV electron beam energy and a slightly- inclined thin single crystal. Like a klystron tube with a so-called depressed geometry, two main superconducting accelerator modules of the JAERI superconducting rf-linac could be adjusted, and out of phase each other to recover the rf energy, and to stabilize the rf field in the accelerator cavities during beam acceleration.

Such an X-ray and gamma-ray source would be constitute a low cost and high performance compact alternative to the more traditional plasma X-ray laser, synchrotron rings, X-ray tubes and so on. The coherent bremsstrahlung has about 100 times stronger intensity than the medium-sized synchrotron light source in the several tens keV energy range[2]. In comparison with PXR(parametric X-ray radiation) as another highly-intense X-ray source recently being proposed in the reference[2], the coherent bremsstrahlung has a forward-peaked along the electron beam direction, and a similar angular distributions of $\sim 1/\gamma$ (γ =total electron energy in unit of electron rest mass). We can realize narrower bandwidth X-ray radiation with the use of proper aperturing or collimating without the necessity of monochrometers. In the Fig.2[3], the theoretical calculations are shown with photon collimation of $\theta_c=1/2°$ and the uncollimated, and the experimentals the uncollimated.

Spatially Coherent Bremsstrahlung

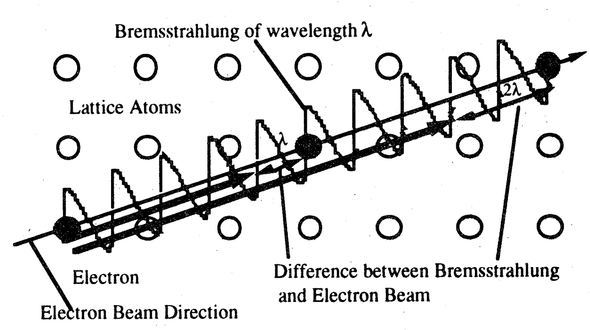

Fig.1, An illustrated explanation of coherent bremsstrahlung, that is, a so-called Ueberall Effect[1,3].

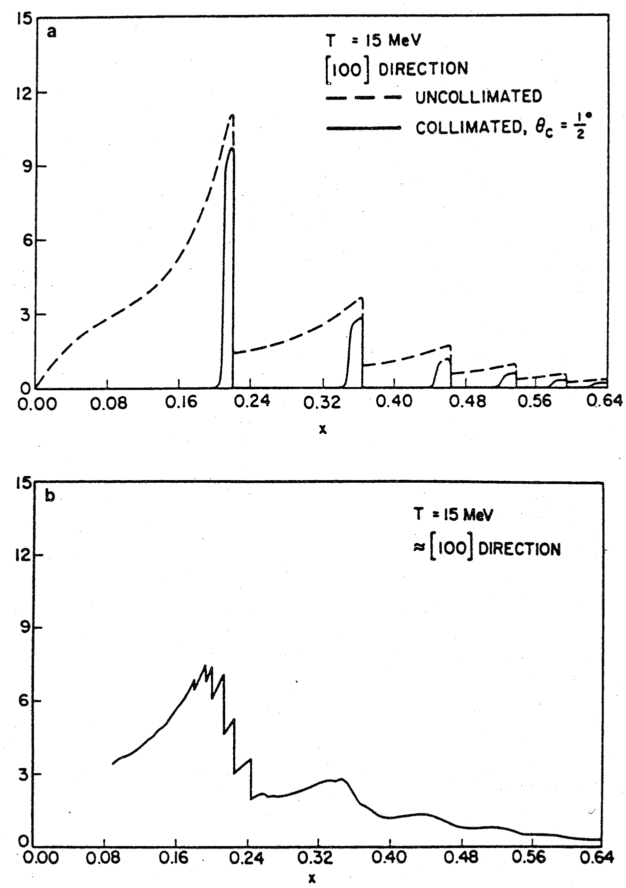

Fig.2, a) Coherent part of bremsstrahlung spectrum of T=15MeV electrons incident along the<100> direction of a Si crystal at room temperature* with photon collimation(---), and with photon collimation of $\theta_c=1/2°$ (—). b) As(a)(uncollimated), but with the electrons incident in the (001) plane at an angle of $\theta_c=2°$ with the <100> direction[3].

References
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