Optimization of Crystal Orientations for E159, E160, E161

talk by Armen Apyan

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1 Electron beam orientation with respect to the crystal axes and planes.

The chosen three orthogonal axes of cubic crystal are (1,2,3). The beam orientation is defined by angle θ between the axis 3 and the direction of incident electron beam $\vec{n}$ and by the angle α between the projection $\vec{n}$ of on the plane (1,2) and the axis 1. The photon beam polarization direction is defined with respect to the incidence plane containing electron beam direction and axis 3. The indexes $\parallel$ and $\perp$ correspond to cases of $\phi_0 = 0$ and $\phi_0 = \pi/2$ (Fig.1). The coordinate system (x, y, z) connected with the beam direction is chosen as shown in Fig.1.

2 Radiation processes in crystal.

When electron beam traverses a crystal in direction far from major crystal axes or planes the incoherent bremsstrahlung is emitted.

As the direction of incidence is turned towards planar directions, the projectiles start to feel the crystalline structure and coherent bremsstrahlung is appeared.

If the electrons are incident nearly parallel to planar or axes directions, they become trapped in the potential wells then channeling radiation is appeared. The characteristic angle of channeling is given by $\sqrt{(2U/E)}$, where U is the depth of potential well, and E is primary electron energy.

3 Figures

Fig 1. Definition of coordinate system

Fig 2. Spectra for a primary electron energy of 48.3 GeV, $\theta = 40$ mrad, $\alpha = 0.92$ mrad, collimation angle in units is equal to 1.05 m_e/E, corresponding to the "Point effect orientation", using point 220, as in the proposals. a) Number of photons dN/dk. Solid line - Photon beam is not collimated. Yellow part - Photon beam is collimated; b) Radiation intensity kdN/dk; c) Photon beam linear polarization

Fig 3. Same as Fig. 2 but using "Row effect orientation" 220 with $\theta == 1.31$ mrad, $\alpha = 45$ degree. Notice higher intensity of photons compared to Fig. 2.