

Channeling 2018



Contribution ID: 186

Type: Poster

On the Use of Electron Diffracted Diffraction Radiation at X-ray Mirrors for Electron Beam Parameters Diagnostics

Thursday, 27 September 2018 18:40 (1 hour)

Projected International Linear Collider [1] and Compact Linear Collider [2] need new measurement methods of parameters of relativistic electron beam with size of some nm and divergence about $10\text{-}40\ \mu\text{rad}$. Using of fast electrons diffracted transition radiation (DTR) in thin crystals for beam divergence measurements [3] is really impossible because of the crystals destroying [4]. Using of diffracted diffraction radiation (DDR) of electrons in crystals [5] is practically unrealized also because of small wavelength λ and necessity of $b < 0.1\gamma\lambda$ condition fulfilment, where γ and b are relativistic factor and the distance between the crystal and the electron beam, respectively.

Decision of the problem may be the wavelength increasing by means of using of multilayer X-ray mirror providing a rather high selectivity $\Delta\lambda/\lambda \sim 0.04$ and reflectivity up to 30-40% [6]. Analysis of known methods of X-ray mirrors parameters calculation such as reflectivity and angular resolution and their dependence from the mirrors composition and observation angle are performed. Calculation of the DDR angular distributions was made for the selected method and measurement condition. The proof-of-principle experiment may be performed on already existing electron accelerators. Desirable X-ray mirror parameters and needful experimental equipment for the experiment at Mainz microtron and KEK-ATF accelerator are discussed.

References

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Primary author: Prof. VNUKOV, Igor (Belgorod state university, Belgorod, Russia)

Presenter: Prof. VNUKOV, Igor (Belgorod state university, Belgorod, Russia)

Session Classification: PS3 - Poster session