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Spatial and Temporal Coherence Effects in Parametric X-ray Radiation

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Coherent emission from an electron bunch moving in magnetic fields is described using the phase shift for each electron in a bunch [1] $\varphi_{SR}^{(i)} = \exp\{i\,\mathbf{k}\,\mathbf{r}_i\}$, where $\mathbf{k}$ the wave vector, $\mathbf{r}_i = \{x_i, y_i, z_i\}$ is radius-vector of i-th electron. For such radiation mechanism as parametric X-ray radiation (PXR) for which atom electrons from crystallographic plane are emission sources the time dependence has to be included into phase shift:

$$\varphi_{PXR}^{(i)} = \exp\left\{i\left(\mathbf{k}\,\mathbf{r}_{pl}^{(i)} - \omega\,t^{(i)}\right)\right\}, \qquad (1)$$

Here $\mathbf{r}_{pl}^{(i)}$ is radius-vector characterizing the point at the plane where i-th electron crosses it, $t^{(i)}$ is the time interval characterizing time of this crossing. The first term in (1) is responsible for spatial coherence, the second one - for temporal. If a crystallographic plane is tilted at the angle θ_B relative to the electron beam then we have: $\mathbf{r}_{pl}^{(i)} = \{x_i, y_i, z_i/\tan\theta_B\}, \omega t^{(i)} = \frac{2\pi}{\beta\lambda}\left(x_i/\tan\theta_B - z_i\right)$
$Influence of both terms on characteristics of coherent PXR produced by microbunched beams is considered in the report$

[1] Y.Shibata, K.Ishi, T.Ohsaka et al. NIM A 301(1991) 161-166

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