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Parametric X-ray radiation in the backward geometry under interaction of relativistic electrons with crystals

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Parametric X-ray radiation (PXR) appears during coherent scattering of the charged particle Coulomb field on the atomic structures. PXR was studied theoretically and experimentally in different geometries, in a wide range of charged particles energies and several crystalline targets (crystalline, polycrystalline and multilayer mirrors). Nevertheless, the backward geometry for the PXR observation represents a lacuna where both theoretical and experimental works need to be performed.
The presented study is devoted to the PXR research in the backward geometry. The PXR is generated under interaction of a 7 MeV electron beam with highly oriented pyrolytic graphite (HOPG) crystals and a textured tungsten foil. HOPG crystals have mosaic angles 0.4°, 0.8° and 1.7°; the angular size of texture spread for the tungsten target is 5.4°.
The PXR spectral peaks for four diffraction orders are observed and the corresponding orientation dependencies are measured for the HOPG crystals. Diffracted photons related to parametric X-ray radiation produced by relativistic electrons are detected below the low energy threshold for the X-ray diffraction mechanism in crystalline structures for the first time for the HOPG crystals and textured tungsten foil. The model developed for the studied process and its comparison with the experiments are presented in the work also.
The developed experimental approach can be applied to separate the contributions of real and virtual photons to the total diffracted radiation generated during the interaction of relativistic charged particles with crystalline targets.
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