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Orbital Angular Momentum of Axial Channeling Radiation from Relativistic Electrons in Thin ⟨100⟩ Silicon Crystals

A twisted photon is a quantum state of the free electromagnetic field characterized by a well-defined energy, longitudinal momentum projection, total angular momentum projection, and helicity. In recent years, various schemes for generating twisted photons have been pro-posed. These include the use of undulators [1–5] and free-electron lasers (FELs) [6–8]. In ad-dition, high-energy twisted photons can be produced by relativistic particles channeled in aligned crystals [9–11].

Channeling radiation of plane-wave photons has been extensively studied and has found a variety of applications. The photon energies involved typically lie in the MeV spectral range. Planar channeling radiation offers several advantages over other types of radiation, such as a narrow spectrum and improved focusing.

In [9], we calculated the orbital angular momentum (OAM) per photon generated by electrons undergoing planar and axial channeling as a function of the angle between the inci-dent electron momentum and the channeling plane or axis.

In [11], we described planar channeling radiation in terms of twisted photons. The ener-gy spectrum and the projection of the total angular momentum per photon were calculated. We observed oscillations in the angular momentum projection as a function of photon energy. The distance between the maxima in these oscillations was found to be approximately 25–30 keV.

In this work, we aim to extend our calculation of the OAM to the case of axial channel-ing. Preliminary calculations reveal oscillations in the angular momentum projection in this case as well, and we plan to perform further analysis to confirm these results.

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Track Classification: Compton Scattering and its Applications