TO THE INFLUENCE OF SINGLE SCATTERING ON NUCLEI ON THE EFFICIENCY OF THE FUTURE LHC CRYSTAL-BASED COLLIMATION SYSTEM

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The Large Hadron Collider provides unique conditions for experiments on coherent charged particles interaction with crystals. Due to record the proton energy of 7 TeV the significance of coherent interactions considerably increases in comparison with all the previous experiments. At the same time the r.m.s. multiple scattering angle on crystal atoms in amorphous direction becomes less than 0.5 μrad, what is considerably less than the critical channeling angle. That's why single scattering by nuclei becomes the main process of particle incoherent deflection in crystal.

We consider several types of scattering on nuclei: inelastic, diffractive, elastic nuclear and Coulomb scattering. While incident particles disappear under the inelastic scattering, the other scattering processes will considerably deflect them. Usually the deflection angle of either elastic or diffractive scattering is high enough for particle to achieve the collimator system used for the superconducting magnet and detector protection.

On the opposite, single Coulomb scattering angle is insufficient for immediate particle loss on the collimators. Nevertheless, a relatively high frequency of Coulomb scattering can prevent subsequent particle capture into the channeling regime supposed to be the most efficient mean of halo particle steering.

We simulate the LHC crystal-based collimation system comparing the contribution of different types of scattering in the collimation efficiency for different crystal alignment: channeling, volume reflection and amorphous orientation. We also reproduce this for multiple volume reflection in one bent crystal (MVROC) [1]. Additionally, we compare the collimation efficiency and analyze the role of scattering on nuclei for modifications of the channeling effect with crystal cut [2] and of the MVROC with either application of tungsten crystal instead of the silicon one or combined action of the MVROC and channeling [1].

1. V.V.Tikhomirov, A.I.Sytov // Nucl. Instr. Meth. B. 2013. V.309. P.109.
2. V.V.Tikhomirov // JINST. 2007. V.2. 08006.