



Contribution ID: 541

Type: Parallel talk

Recent developments and applications of crystal channeling at the CERN Large Hadron Collider

Friday, July 12, 2019 4:50 PM (20 minutes)

A unique experimental apparatus with 4 bent crystals is installed in the betatron collimation insertion of the Large Hadron Collider (LHC) at CERN. This setup is designed to study experimentally the crystal-assisted collimation of high-energy hadron beams and it has been used, with various improvements throughout the years, since 2015. After the first observation of channeling of proton and heavy-ion beams at the unprecedented energy of 6.5 Z TeV, various systematic studies were carried out. With the main focus to demonstrate the feasibility of crystal collimation at the LHC, other applications were studied. In 2018, this apparatus was also used for a low-background run at 450 GeV, where crystals were integrated as a part of the LHC collimation system to optimize loss rates at Roman pots, for the first time in a physics run. The good observed performance motivated studies for other applications of bent crystals with the LHC beams, like possible implementations of fixed-target experiments with 7 TeV beams that are addressed in the framework of the Physics Beyond Collide study at CERN. This paper reviews the status of recent developments on bent crystal applications at the LHC.

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Session Classification: Accelerators for HEP

Track Classification: Accelerators for HEP