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Enhanced electromagnetic processes in oriented crystalline tungsten for high-performance positron production

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The design of future lepton colliders, which would push the beam intensity frontier significatively forward with respect to the current state of the art, paves the way to novel technological challenges. In particular, the need for very high positron yield in the linear (ILC and CLIC) or circular (FCC-ee, CEPC) colliders requires that innovative approaches to the positron production are considered. It is particularly promising to exploit the enhancement of the electromagnetic processes (namely, bremsstrahlung and pair production) obtained in the interactions of $e^{\pm}$ and photons with oriented crystalline matter at the multi-GeV scale to develop a next-generation positron source; in general, the latter would feature lower heating- and irradiation-related damage as compared to the conventional setup, which is based on amorphous matter. Several configurations are feasible, which would exploit one or multiple targets made of high-Z materials such as tungsten. Measurements have been made with electrons impinging on single-crystal tungsten samples at the DESY T21 and CERN H2 beamlines, to extensively characterise these effects at a few GeV and at 20˜GeV respectively.

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