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Muon Beam Channeling in Laser Standing Wave

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The problem of muon channeling in a standing wave lattice formed by electromagnetic waves is considered. Possible applications of this effect in accelerator physics are discussed.

The charged particles motion in the field of standing electromagnetic wave can undergo the features similar to well-known phenomenon of particles channeling in crystals [1]. While a charged particle enters the field of electromagnetic standing wave at a small angle to the node (anti-node) surfaces its motion represents namely the oscillations between two neighboring surfaces similar to those that take place at crystal planar channeling. The work demonstrates that this effect could be used in accelerator physics for the beam shaping with certain properties. The advantage of particle channeling in a laser field is in the absence of inelastic scattering taking place in a solid matter.

Especially, the use of the laser standing wave could be attractive for muon beams (for instance, beams of the neutrino factories projects [2]). The quality of muon beams still needs to be essentially improved. Channeling is one of the known techniques, which proposes efficient beam shaping, however, in the case of crystal channeling the particle scattering by both atoms and electrons of the solids could significantly worsen the beam characteristics.

This work presents some results of our analysis for the muon beam channeling in the field of a laser standing wave. In the paper for the first time the evolution of a muon beam in the phase space has been evaluated aiming at the beam shaping feasibility. Various examples of the beam shaping are considered for top-flat as well as Gaussian laser pulses.

References

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2. M.S. Zisman, J. Phys.: Conf. Ser. 408 (2013) 012002.

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