Contribution ID: **164**

Type: **Poster**

On a Zone Structure for Channeled Particles in Optical Lattices

Wednesday, 26 September 2018 12:50 (15 minutes)

Recent theoretical studies have shown the possibility of charged particles channeling at their interaction with inhomogeneous laser field, particularly with so-called optical lattices, similar to crystal channeling. Till present we have not yet been related to careful experimental investigations in this field, however, the results on electron diffraction by the light standing wave [1] have demonstrated the feasibility of such a process.

As known due to the periodicity of the effective interaction potential [2] for charged particles in a crystal at channeling, the energy spectrum of channeled particles might reveal a zone structure at well defined conditions. One may expect similar feature at particles channeling in optical lattices but with one very strong difference, i.e., optical lattices are characterized by much wider channel sizes. It results in the use of a single potential approximation without taking into account the potential periodicity [3] and of a classical approximation for a channeled particle as well [4,5].

On the contrary to crystals where the bandwidths of quantum levels are mainly defined by inelastic scattering processes, in optical lattices for light particles the broadening of energy levels takes place because of the life time limit defined by spontaneous radiation. The same is valid for muons in much strong laser fields.
In this report we are going to present our results on zone structure of energy levels for channeled particles in optical lattices, in general.

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Session Classification: W1.2 Channeling in Plasma Physics by Laser and Applications