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The acceleration in the system with overlapping resonances

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In this work, we develop a concept of an accelerator arranged as follows: electrons are accelerated by an electromagnetic field in a waveguide immersed in a longitudinal uniform axial magnetic field and a transverse spatially periodical undulator magnetic field. There are several types of resonances in such a system. Namely, cyclotron, undulator, and combined resonances. Herewith, these resonances are of the same type and are realized at different energy values. Thus, by consistently achieving these resonances, electrons can accelerate to sufficiently high energies with a relatively small amplitude of the accelerating field.
The acceleration process is investigated analytically and numerically. According to calculations, with all other conditions being equal, the proposed method turns out to be 4 - 6 times more efficient than cyclotron acceleration. One must note a disadvantage of the discussed method. In comparison with cyclotron acceleration, all particles are accelerated equally, in the system under consideration, particles can "get stuck" at intermediate resonances. This problem is partially solved by optimizing the system parameters.

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