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Investigations of the concept of a multibunch dielectric wakefield accelerator

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Theoretical and experimental investigations of the physical principles of multibunch dielectric wakefield accelerator creation that is based on wakefield excitation in the dielectric structure by a sequence of relativistic electron bunches are presented. The purpose of the concept was to enhance wakefield intensity due to multibunch coherent excitation, multimode summation of transversal modes, and wakefields accumulation in a resonator. The sequence of bunches can be divided into exciting and accelerated parts in any proportion by means of its displacing into decelerating/accelerating phases of wakefield at the proper detuning of bunch repetition frequency relative to the frequency of the excited wakefield principle mode. A periodic sequence of 6000 electron bunches, each of energy 4.5MeV, charge 0.16nC, duration 60psec, diameter 1.0cm, and angular spread 0.05 mrad was produced by a linear resonant accelerator. Bunch repetition frequency 2805 MHz can be varied within 2MHz by means of changing master oscillator frequency. The sequence of bunches was injected into copper waveguide/resonator of cylindrical or rectangular cross-section partially filled with dielectric. Also the change of the permittivity and loss tangent of dielectrics under the influence of 100 MeV electron beam radiation exposure was studied.

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