

Helical Accelerating Structure with Controllable Beam Emittance

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A new helical RF accelerating structure, which can provide emittance control of the electron beam, is proposed. This structure combines properties of a linear accelerator and a damping ring simultaneously. It makes acceleration of straight on-axis beam as well as beam cooling due to the synchrotron radiation of particles. These properties are provided by specific slow eigen mode which consists of two partial waves, TM₀₁ and TM₁₁ (near to cut off). The longitudinal field of the first wave is synchronous with electrons, the transverse fields of the second wave are far from synchronous condition and they cause electron wiggling like it occurs in RF undulator. As a result the emittance control might be employed at linear trajectory of the high-energy beam without decrease of the average gradient. Calculations show that surface electric field at level ~0,31 (relative to accelerating field) and shunt impedance ~20 MOhm/m at 30 GHz are achievable. Cooling rate at gradient 100 MV/m corresponds to the equivalent magnetic field ~0,75 T. Additional appealing properties are beam focusing by ponderomotive force, the shape does not contain neither narrowing nor widening, the mass production seems possible without brazing of short segments.

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