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Acceleration and Focusing Electron/Positron Bunches in Plasma-Dielectric Wakefield Accelerator

To suppress the BBU instability and improve characteristics of accelerated bunches in Dielectric Wakefield Accelerator one can be used the plasma filling of the transport channel*.
Here we present the results of analytical and numerical studies of the dynamics of accelerated electron/positron and drive electron bunches under wake acceleration in a plasma DWA with a vacuum channel. The wake field is excited by an electron bunch in a quartz dielectric tube inserted into a cylindrical metal waveguide. The inner region of the dielectric tube is filled with plasma with a vacuum channel along the waveguide axis. At numerical simulations the energy and spatial characteristics, acceleration efficiency, emittance, and energy spread for positron and electron bunches is studied for different radii of the vacuum channel and two models of the plasma density dependence on the radius: a homogeneous and an inhomogeneous dependence characteristic of a capillary discharge.
The analytical studies have discovered the presence of two surface eigenwaves, which is absent in corresponding dielectric-loaded waveguide without plasma filling. The main contribution to amplitude of transverse wakefield, responsible for focusing of accelerated electron or positron bunches, brings the backward plasma surface eigenwave. The comparative analysis of the data resulting from analytical studies and the ones obtained by numerical simulation has demonstrated qualitative agreement between the results.
* G.V. Sotnikov, et al., Nucl. Instr. and Meth. in Phys. Res., A740, 124 (2014).

Working group

WG3 : Beam-driven plasma acceleration

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