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Focusing of Drive and Witness Bunches in Dielectric Waveguide Filled With Inhomogeneous Plasma

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Here we report the results of PIC numerical simulation of focusing of witness and drive bunches in dielectric waveguide filled with radially inhomogeneous plasma. Wakefield was excited by electron bunch in quartz (permittivity is 3.8) dielectric tube with outer and inner diameters of 1.2 mm and 1.0 mm, respectively, inserted in cylindrical metal waveguide. Energy of drive bunch electrons was 5 GeV, drive bunch charge was 3 nC, its length was 0.2 mm, bunch diameter was 0.9 mm. Witness bunch had the same parameters as drive bunch for exception of the charge equal to 0.3nC. The internal area of dielectric tube was filled by plasma with different transverse density profiles: homogeneous density, density profile created at capillary discharge, inhomogeneous radial density profile with vacuum channel along the waveguide axis. Plasma density for all considered cases was so low that the plasma frequency is less than the frequency of the main dielectric mode. The results of PIC numerical simulation show the drive bunch is focused both in homogeneous, and in inhomogeneous plasma. Acceleration and focusing of witness bunch when using inhomogeneous transverse plasma density can be improved in comparison with homogeneous plasma case.

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