Wake field in dielectric acceleration structures

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In this study we present a general approach for the analysis of the wake field of a point charge moving in a vacuum tunnel bored in dielectric material that is uniform in the direction parallel to the motion of the bunch. In the transverse direction the structure surrounding the dielectric may have arbitrary geometry. A quasianalytic expression that relates the decelerating force with the first dielectric layer, the radius of the vacuum tunnel where the charge moves, and the reflection characteristics of the structure has been developed. Simulation results for a simple structure indicate that, if the effective location where the reflection occurs in the dielectric is sufficiently apart from the edge of the vacuum tunnel, it has no effect on the point charge. In fact, the decelerating field converges exponentially as this distance increases, to the asymptotic value determined by the first dielectric layer. An estimate of the trailing wake when the structure supports a specific mode is also provided.