High Field Gradient with Tightly Focused Laser Wakefield Acceleration to Investigate the Unruh Effect

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Laser wakefield acceleration (LWFA) is an attractive method with a high acceleration gradient. The typical acceleration gradient of ∼100 GV/m is three orders of magnitude higher than that of conventional radio frequency (RF) electron accelerators. Recently, Aniculaesei *et al.* achieved 10 GeV of electron energy over a 10 cm scalelength using LWFA.

Practically, a long focus optic has been used for LWFA to generate high energy electron beams. While on the other hand, a high laser intensity and high electron density are essential for a high acceleration field gradient. When we apply a tightly focused laser for LWFA with high density gas targets for realistic PW class laser parameters, the acceleration gradient reaches beyond TV/m. We will show the results of the tightly focused laser for LWFA using particle-in-cell simulations. This scheme could be potentially an experimental verification method for the Unruh effect, which is connected to Hawking radiation via the equivalence principle and requires a very high acceleration field.