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Sub-THz passive detector performance evaluation with RadiaBeam photoinjector

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The wakefield accelerators, based on THz and mm-wave structures, is an active area of research aiming at a severalfold higher accelerating field and better wall plug power efficiency than conventional linear accelerators. Concurrently to accelerator development additional components are required for constant beam parameters and position monitoring. As the electron beam passes through a metal waveguide with corrugated walls a sub-THz Cherenkov radiation is formed. Using different components (modes) of this radiation one can derive the needed beam parameters. At the same time detecting sub-THz signal has its own challenges both in handling time resolution and peak amplitude.

In this work we report the evaluation results of a candidate passive THz detectors, based on the gate-modulation of the conductance channel by the incoming radiation in field effect transistor (FETs), supplied by TeraSense. The first set of measurements was performed on a bench in the millimeter wave laboratory at the Advanced Light Source (APS) of the Argonne National Laboratory and the second set of measurements was performed using the 4.5 MeV RadiaBeam photoinjector and the 10 cm long corrugated wave guide. The design and performance of the optical system including the polymethyl-pentene (TPX)-based lens and vacuum window used in the electron beam measurements is also described.

Working group

WG5 : Beam sources, monitoring and control

Primary authors: KRAVCHENKO, Maksim (RadiaBeam Technologies); AMOUDRY, Loic (RadiaBeam Technologies, LLC); BURGER, nathan (RadiaBeam Technologies, LLC); KUTSAEV, Sergey (RadiaBeam Technologies, LLC); MUROKH, Alex (RadiaBeam Technologies, LLC.); PRONIKOV, Alexey (RadiaBeam Technologies)

Presenter: KRAVCHENKO, Maksim (RadiaBeam Technologies)

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