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Commissioning of hybrid photoinjector at RadiaBeam compact Inverse Compton Light Source

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The generation of high spectral brilliance radiation with electron beam sources relies heavily on the qualities of the electron transverse emittance and its longitudinal compression which significantly affect X-ray generation efficiency in Inverse Compton Scattering. Designing and building such a system in a compact formfactor requires non-trivial solutions starting from electrons generation and ending with the interaction region. RadiaBeam has designed, built and tested a compact photoinjector with a hybrid RF structure combining standing wave and traveling wave components in a C-band configuration. The standing wave section facilitates high-field acceleration from the photocathode, while the traveling wave portion induces strong velocity bunching. This remarkably compact injector system offers the additional advantage of simplifying the distribution of RF power by eliminating the need for the RF circulator. We explore the application of this device in a compact 4.5 MeV electron source for further acceleration up to 100 MeV, enabling both inverse Compton scattering and free-electron laser radiation sources with distinctive and appealing properties.
In this work we review the commissioning of this high field hybrid photoinjector electron source. Step-by-step process of achieving first photoelectrons, performing beam-based alignment, characterizing photocathode quantum efficiency and measuring electron beam parameters such as energy gain and spread, bunch length, charge yield and emittance value are described within the scope of this work. Reported findings substantiate the foundation for further harnessing hard X ray from inverse Compton scattering of the IR laser with 100 MeV electron beam.

Working group

WG4 : Novel structure acceleration

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