Simulations and design of a compact beamline for Inverse Compton Scattering at the University of Melbourne X-lab

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As the re-development of the University of Melbourne X-band Laboratory for Accelerators and Beams (X-LAB) nears completion, so does the conceptual design of a compact beamline utilising X-band linear accelerating structures based there. It is expected that one of the future applications of the beamline will include the use as a low emittance beam source for an Inverse Compton Scattering (ICS) X-ray light source.

This beamline simulated will be composed of an initial accelerating section, two high gradient X-band linear accelerating structures operating at an average gradient of $70\,\mathrm{MV\,m^{-1}}$, and a quadrupole focusing array optimised for the smallest possible transverse beam size at an ICS interaction point. Although original designs utilised an S-band RF photogun as the initial section, we were motivated to also consider an alternative layout where the initial section is composed of a DC photogun and S-band accerating structure similar to those used by the Australian Synchrotron group.

We will present simulation results of the beam dynamics and phase space characteristics throughout the length of the beamline, as well as ICS X-ray photon production for an idealised nominal laser source.

[1] S.D. Williams et al., Simulations of the Suitability of a DC Electron Photogun and S-Band Accelerating Structure as Input to an X-Band Linac, in Proc. IPAC'22, Bangkok, Thailand, Jun. 2022, pp. 2445-2448. doi:10.18429/JACoW-IPAC2022-THPOST006

[2] M. Volpi et al., Radiation Shielding Design for the X-Band Laboratory for Radio-Frequency Test Facility - X-Lab - at the University of Melbourne, in Proc. IPAC'22, Bangkok, Thailand, Jun. 2022, pp. 724-727. doi:10.18429/JACoW-IPAC2022-MOPOMS040