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Energy and brightness booster stages for the UK XFEL

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The UK XFEL project is pioneering a transformative approach to next-generation X-ray free-electron lasers (XFELs). It is committed to ensuring long-term scientific impact by exploring compact, efficient, and high-gradient plasma-based accelerators to enhance the machine's beam energy and brightness reach as part of a future upgrade strategy. Among the most promising avenues, plasma-based acceleration stages offer a disruptive opportunity to develop ultra-compact, high-gradient electron energy and brightness boosters—crucial for pushing XFEL capabilities beyond conventional boundaries [1]. This contribution outlines a pathway for the self-consistent integration of advanced accelerator concepts into the UK XFEL facility design within the Conceptual Design and Options Analysis (CDOA) project, capitalising on the facility's unique strengths and enabling completely novel research modalities through the combination of conventional and plasma-based accelerators. Preliminary start-to-end simulation results suggest that such booster stages could produce electron beams capable of generating very hard XFEL photons down to the 100 keV scale.

[1] Habib, A.F., et al. Nat Commun 14, 1054 (2023)

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