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Controlling FEL bandwidth at SwissFEL using a dielectric wakefield structure

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The bandwidth of a free-electron laser (FEL) is increased when the mean energy along the electron bunch varies. In this work, we demonstrate how a dielectric wakefield structure can be used to control the FEL bandwidth by manipulating the beam's energy chirp prior to its injection into undulators. We compare simulations and measurements of the beam's energy spread distribution and find reasonable agreement apart from when the structure is operated at gaps below 1 mm. Using the wakefield structure, we successfully reduce the beam's projected energy spread, leading to a narrower FEL bandwidth. Conversely, we also enhance the effect of an inverted chirp in the electron beam due to overcompression in the main linear accelerator, increasing the FEL bandwidth, showcasing the utility of the wakefield structure in tailoring FEL performance.

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