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Corrugated Waveguide Based Wakefield Accelerator for an XFEL

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A highly efficient compact wakefield accelerator is being developed at Argonne National Laboratory for a future multiuser x-ray free electron laser facility [1]. A cylindrical metallic structure with a 2 mm internal diameter and fine corrugations on the wall is used to cause a Čerenkov radiation by a “drive” bunch at ~ 180 GHz in the fundamental mode and to obtain accelerating gradients on the order of 100 MV/m for the “witness” bunch. Each corrugated structure will be approximately a half meter long and the entire accelerator will span a few tens of meters. An ultra-compact transition region between accelerating structures has been designed to accommodate an output coupler, a notch filter, an integrated offset monitor, bellows, pumping and water cooling ports. The accelerator will decelerate a 1-GeV, 10-nC electron drive bunch to approximately 200 MeV and accelerate a 300-pC witness bunch to 5 GeV in order to generate hard x-rays in the small-aperture FEL undulator. The design of most of the components has reached a pre-construction phase, and we plan to fabricate a full module of the compact accelerator for a test with the electron beam at the AWA facility.

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