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Reinventing the Accelerator

Department of Physics Colloquium



The modern accelerator has undeniably served as an essential, workhorse scientific instrument, underpinning progress in fields from high energy physics through colliding beams, to structural biology, condensed matter, ultra-fast science, and and high energy density physics through light sources. The future of these enterprises is threatened, however, by the size and attendant cost of building the next generation instruments. The urgency of providing a new path in accelerators has been recognized for several decades by now, solutions offered, and dramatic progress made. These solutions include use of direct laser acceleration, and new schemes termed “wakefield accelerators”, in which one may achieve acceleration in plasma with over 1 TV/m electric fields. Thus one may envision shrinking future accelerators by three-to-four orders of magnitude in size. While the ultimate goal of such research is to provide a path to TeV high energy physics machines, this goal is still years off. In this talk, we will therefore discuss frontier results from the advanced accelerator field, and place them in the context of nearer term application to the next generation X-ray free-electron laser.