UCLA Department of Physics & Astronomy

COLLOQUIUM

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The Ultra-Compact X-ray Free-Electron Laser

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Recent advances in high gradient cryogenic RF research have opened the door to use of surface electric fields between 250 and 500 MV/m. Such structures can enable a host of new, transformative applications, ranging from TeV-scale linear colliders to an X-ray free-electron laser (XFEL), which has a cost and size more than an order of magnitude below that of the current state-of-the-art instruments. In this talk, we discuss the crisis of success in the XFEL, where the expense and availability of ultra-fast, coherentXx-rays greatly constrains the scientific output of these powerful machines. We present a resolution of this problem through use of very high field accelerators, which have the capacity to enhance the electron beam brightness, and through judicious miniaturization of electromagnetic devices, to create a full XFEL in less than 40 m, as opposed to the km-scale presently found in only a handful of national labs worldwide. In the context of a burgeoning project centered at UCLA to develop this *ultra-compact X-ray FEL* (UC-XFEL), we review physics and technological challenges currently being confronted in the beam, accelerator, magnetics and compact X-ray optics systems involved. To illustrate the potential of such a light source to fundamentally change the current paradigm of XFELs with their limited access, we examine transformative applications in biology, chemistry, materials, and atomic physics.

Undergraduates Welcome!