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Michigan Institute for Plasma Science and Engineering

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Room 1005 EECS

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Munich, Germany

Plasma Wakefield Acceleration of Charged Particles

Plasma-based particle acceleration is one of the high-gradient acceleration techniques that could one day make linear colliders more compact and more affordable. In particular, the beam-driven scheme known as the plasma wakefield accelerator (PWFA) has produced very large energy gain (42 GeV) as well as narrow energy spread for the accelerated bunch together with significant energy transfer efficiency. This scheme is therefore explored experimentally with electron, positron and proton bunches as wakefield drivers. I will give an introduction to PWFA and a brief review of the most important and interesting results in the field. I will then focus on the driving of wakefields through the self-modulation instability (SMI) showing experimental results obtained at the Brookhaven ATF and at SLAC. I will then outline the plans for the AWAKE experiment at CERN which will use the 400 GeV proton bunch produced by the SPS. The first phase of the experiment will focus on the SMI of long proton bunches (~12 cm) in dense plasma (10^{14}-10^{15} cm^{-3}). In the second phase, electrons will be externally injected to sample the wakefields. The expected wakefield amplitude is in the GV/m range. Due to the large proton bunch energy these fields can in principle be maintained over very long distances (10 m plasma length for AWAKE). In a third phase a witness bunch will be accelerated.

About the Speaker: Patric Muggli is the leader of the future accelerators group at the Max Planck Institute for Physics (MPP), in Munich, Germany, and an adjunct research professor at the University of Southern California in Los Angeles. He is leading the Proton-Driven Plasma Wakefield (AWAKE) experiment at CERN, the European Organization for Nuclear Research. As chair of the Physics and Experiment Board, he is also a member of the Management and of the Technical Board of the AWAKE program. He is a Fellow of the American Physical Society, an IEEE Nuclear Plasma Science Society Distinguished Lecturer, and a Fellow of IEEE. He is a member of the panel on advanced and novel accelerators within the International Committee for Future Accelerators (ICFA). He received the 2011 Particle Accelerator Science and Technology Award. His research interests cover all aspects of plasma-based particle acceleration, especially the schemes driven by charged particle beams (PWFA) and their applications to high-energy physics and light sources.