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Michigan Institute for Plasma Science and Engineering

Joint CUOS-MIPSE Seminar

Friday
October 26, 2012
12:00 pm
Room 1121
LBME Building

Dr. Chris Ridgers

University of Oxford

Exploring QED-Plasmas with High-Intensity Lasers

With construction beginning this year on several next-generation 10 PW lasers as part of the European Union's Extreme Light Infrastructure (ELI) project, an exciting new frontier will soon be reached in high-power laser-plasma physics. 10 PW lasers will create strong enough electromagnetic fields to access non-linear quantum electrodynamics (QED) processes usually only seen in particle physics experiments. Particle physics experiments are arranged such that these QED scattering processes can be studied in isolation (and their cross-sections compared to QED calculations). By contrast, the fields in a 10 PW laser's focus will directly access non-linear QED processes and create a completely novel plasma state: a 'QED-plasma', similar to that predicted to exist in the atmospheres of pulsars. Here the microscopic QED processes are inherently entwined with the full complexity of a macroscopic laser-plasma interaction and neither may be considered in isolation. As a result the fundamental plasma physics must be re-examined in the QED-plasma regime. In particular I will present calculations showing that strong (~50%) laser-absorption into gamma-rays and electron-positron pairs can occur by new absorption mechanisms, and that for high enough intensities an avalanche of electron-positron pairs can be initiated. However, experimental investigation of the QED-Plasma regime and the resulting constraint of these theoretical calculations is highly desirable. I will discuss several possible experiments which could begin such an investigation using today's high-power laser facilities such as GEMINI or HERCULES.

About the Speaker: Christopher Ridgers is a Post-Doctoral Research Assistant in the Department of Physics, Clarendon Laboratory at the University of Oxford. His recent work has addressed the creation of dense electron-positron Plasmas and intense bursts of gamma rays in 10PW laser-plasma interactions. He is an Invited Speaker at the 2012 Division of Plasma Physics Meeting.