High Intensity Laser-Plasma Interactions in the Relativistic Regime

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Robert Fedosejevs is a Professor of ECE at the University of Alberta, Canada. He received his B.Sc. and Ph.D. degrees from the University of Toronto in 1973 and 1979 respectively. His research program has focused on the development and application of lasers and investigation of high intensity laser-plasma interactions in a variety of areas from laser sensors to laser fusion. He has held positions of Senior NSERC Industrial Research Chair in Lasers and Applications at the University of Alberta, Scientific Director of the Canadian Institute for Photonic Innovations (a national photonics research network in Canada), President of the Canadian Association of Physicists and Conference Chair of the IEEE International Conference on Plasma Science. He has been a guest professor and researcher at numerous international institutes including the Max Planck Institute for Quantum Optics in Germany, the Centre for High Intensity Lasers (CELIA) in France and the Centre for High Intensity Pulsed Lasers (CLPU) in Spain.

Using Chirped Pulse Amplification (CPA) technology it is now possible to amplify laser pulses to instantaneous power levels of several petawatts in ultrashort pulses with durations of 20 to 1000 fs. Facilities exist and are being built with such capabilities around the world, opening up a range of exciting and challenging opportunities in particle acceleration, tunable x-ray sources and table top nuclear physics sources. Applications range from 100 MeV class ion sources for cancer therapy to ignition sources for laser fusion energy. The focused intensities currently range from 1018 W/cm2 to 1022 W/cm2 where the motion of electrons in the EM laser field is strongly relativistic. We have been involved in the study and development of laser wakefield acceleration sources of electrons up to the GeV energy level using 200 TW laser facilities located at INRS in Montreal, Canada, and at CLPU in Salamanca, Spain. The oscillation of these electrons in turn generates synchrotron-like betatron radiation which can be used as a broadband femtosecond x-ray probe pulse. We have applied these ultrashort probe pulses to study the ionization dynamics of warm dense solid aluminum at electron temperatures of 20 eV to 30 eV, using x-ray k-shell absorption spectroscopy. For these experiments, thin, 50 nm thick, aluminum foils were heated using separate femtosecond laser pulses. These experiments will be presented and discussed. Finally, initial planning of future experiments to measure the pure photon-photon scattering cross-section at visible wavelengths will be discussed.

Hosted by Zubin Jacob