Contribution ID: **298**

Type: **talk**

Single-cycle THz signal accompanying laser wake in photo-ionized plasmas and plasma channels

Thursday, September 19, 2019 6:40 PM (20 minutes)

Photoionization by a femtosecond TW laser pulse generates a plasma column in a neutral ambient gas.The 3D laser wake wave extends through the column surface, generating an azimuthally polarized rotational current within a micron-thin shell. This current supports a broad-band, evanescent THz signal accompanying the wake, detectable at a distance orders of magnitude larger than the column radius. Frequency spectrum of the signal bears an imprint of the radial density profile, helping evaluate the ionization state of the gas and thus the efficiency of laser coupling to the plasma. A few millimeters away from the column, rapid evanescence of its high-frequency components turns the signal into a radially polarized, single-cycle pulse. The THz rotational current may be similarly generated in a leaky plasma channel, via coupling the wake electron velocity to the radial density gradient. Also, applying external voltage to the channel induces a slowly-varying, radially non-uniform electron flow (DC). Coupling velocity of this flow to electron density perturbations in the laser wake adds another term to the rotational current. The efficiency of coupling depends on the radial structure of the DC and the plasma wake.
Supported by AFRL through contract FA9451-17-F-0011, and by AFOSR grants FA9550-16RDCOR325, FA9550-19RDCOR023, and FA9550-19RDCOR027.

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Session Classification: WG6

Track Classification: WG6 - Theory and simulations