FDIT217uj Wave equation and propagation of laser pulses in plasma

Description:

This course should provide an overview of the fundamental processes taking place during interaction of intense laser pulses with gaseous (low-density) plasma. I will focus on the propagation (and evolution) of the laser pulses. The topics covered here are essential and required for the laser wakefield acceleration course.

Topics:

1. Quick overview of EM wave propagation in vacuum and dielectrics

   Phase velocity, group velocity, GVD

   Paraxial wave eq. Gaussian beams. Laguerre Gaussian modes

2. Maxwell's equation in plasma: no bound charges, only free charges; Wave equation in plasma, plasma dispersion
3. Low-intensity, long pulses for plasma diagnostics, interferograms

   2D FFT, Abel inversion

4. Plasma waves driven by intense laser pulses. Self-generated nonlinear index of refraction

   Introduction of the ponderomotive force, fluid description of the plasma

5. Self-focusing and guiding of laser pulses in plasma

   Transverse (radial) evolution of the laser pulse

6. Self-phase modulation and self-compression of intense laser pulses in plasma

   Longitudinal (temporal-spectral) evolution of the laser pulse

References used to prepare the lectures:

Laser Physics, PETER W. MILONNI and JOSEPH H. EBERLY

Papers of E. Esarey and the Proceedings of the 2019 CERN–Accelerator–School from Johannes Wenz and Stefan Karsch

Short Pulse Laser Interaction with Matter, Paul Gibbon