Seminar

Institute for Plasma Research

Title : Circularly Polarized Light from Magnetized Current Filaments: implications to Gamma Ray Bursts

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Time : 3.30 PM

Venue : Seminar Hall, IPR

Abstract :

We investigate the radiation spectra and degree of circular polarization emitted by plasma electrons due to their motion in the fields generated by Weibel Instability/Current Filamentation Instability (WI/CFI) in magnetized/unmagnetized interpenetrating plasma flows. The detailed kinetic processes, the radiation and its polarization signatures are modelled using a combination of particle-in-cell (PIC) simulations using OSIRIS framework [1] and a post-processing radiation diagnostic, jRad [2]. We explore the role of plasma composition (electron-positron vs electron-ion) and initial magnetization on the degree of circular polarization of the radiation emitted by electrons confined in the current filaments generated due to WI/CFI. It has been found that the field structures in electron-ion plasmas with high ion-electron mass ratios (mi/me>>1) evolve at the ion time scales. When the plasma is magnetized initially, an azimuthal drift in the plasma electron appears at the edge of the filament. The steady motion of the electrons within the magnetized current filaments gives rise to the emission of circularly polarized radiation. We find that the net degree of circular polarization of radiation from multiple filaments is the average of contribution from individual filaments. We also find that the degree of circular polarization increases with the magnetization, and that it saturates at ~20% for very high magnetization values. In addition, the degree of circular polarisation also increases for larger mi/me. This study [3] is of relevance to understand the recent observation of circular polarization in Gamma Ray Burst afterglows [4] as well as for laboratory experiments of colliding plasmas [5, 6].

References:

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2. J.L. Martins, S.F. Martins, L.O. Silva, Proc. SPIE 7359 73590V (2009).
3. U. Sinha et.al, to be submitted, 2016.
4. Weirsema et. al, Nature, 509, 201 (2014).
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6. C. M. Huntington, F. Fiuza, J. S. Ross et al., Nat. Phys. 11, 173 (2015).