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Study of Particle in Cell Method to Obtain Laser Thomson Scattering Spectrum to calculate Density in a plasma same as ITER plasma

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One of the most accurate diagnostic tools in Tokamak plasmas is Thomson scattering (TS) [1]. In this method a laser light passes through a plasma and undergoes Thomson scattering. By investigating the frequency spectrum of scattered light we can demonstrate plasma density and temperature. Here we simulate non- collective Thomson scattering that is related to single particle behavior of system from a plasma with ITER's parameters [2] by using Particle in cell method (PIC) [3] to study PIC ability for simulating non-statistical systems. For studying a system consists of particles it is necessary to solve the motion equation for every single particle, so for N particles N^2 equations should be solved that needs significant memory and processor resources. PIC is a simplifying method in computational plasma physics. It works based on statistical behavior of system. Super particles are considered in PIC method so that every super particle is composed of a number of system's real particles and the motion equations of particles will be solved for these super particles that way the number of motion equation will be reduced.
Here non- collective TS of a polarized laser light passing through a plasma with a density of $3.00 \times 10^{13}\ \mathrm{cm}^{-3}$ same as ITER plasma is simulated using 2D/3V PIC code (XOOPIC). Laser wavelength, intensity and FWHM are $\lambda_i = 0.8\ \mu\mathrm{m}$, $I_i = 5.00 \times 10^{15}\ \mathrm{W/cm}^2$ and 50.00 fs, respectively. Calculated scattered power predicts that the plasma density is about $2.64 \times 10^{13}\ \mathrm{cm}^{-3}$ which is in a good agreement with its real value. The properties of scattered power are dominated by non-collective effects and the polarization of the scattered wave is affected by the non-relativistic condition. Results show that PIC can simulate the non-collective TS so PIC ability to simulate a non-statistical system with a high accuracy is verified. The accuracy of TS as a diagnostic tool to measure the plasma features like density is reconfirmed as a secondary result.

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