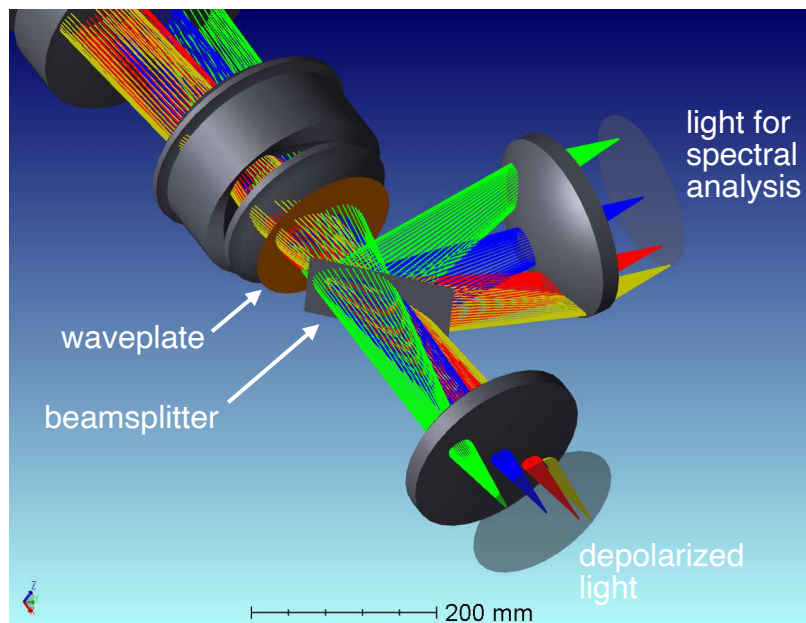


Polarimetric Thomson scattering to reduce T_e and n_e measurement uncertainty in high performance ITER operating regimes

D. J. Den Hartog* and M. A. Thomas

Department of Physics, University of Wisconsin–Madison, Madison, WI 53706 USA

The ITER Core Plasma Thomson Scattering (CPTS) system is the primary diagnostic for the electron temperature (T_e) and electron density (n_e) profiles. For high performance ITER operating scenarios in which core $T_e > 20$ keV, the conventional spectral CPTS will not provide measurement accuracy sufficient for advanced machine control. Addition of polarimetric measurement capability to the CPTS diagnostic is projected to increase measurement accuracy in high temperature / low density plasmas to required levels. The need to develop Polarimetric TS is Issue A.17 in the 2020 ITER Technical Report on Required R&D [1]. Polarimetric TS measurements have been made in JET high T_e plasmas [2]; further tests of Polarimetric TS could also be made in other high T_e plasmas such as JT60-SA or W7-X. To determine the feasibility of Polarimetric TS implementation on ITER, the polarization characteristics of the CPTS scattered light collection system have been modeled as part of a conceptual design study [3]. When linearly polarized light is propagated through the CPTS collections optics, polarization is rotated and ellipticized. This characteristic of the ITER collection optical system complicates separation and analysis of the depolarized component of the Thomson scattered light that is produced at high T_e . To address this challenge, a custom waveplate and polarizing beamsplitter should be mounted before the final lens in the CPTS collection optical system (see figure below). Additionally, polarization performance should be one of the criteria by which materials and coatings are selected for the CPTS collection optical system.



- [1] A. Loarte *et al.*, *Required R&D in Existing Fusion Facilities to Support the ITER Research Plan* (2020) ITER Technical Report **ITR-20-008**.
- [2] R. Scannell *et al.*, *Rev. Sci. Instrum.* **94** (2023) 013506.
- [3] D. J. Den Hartog and M. A. Thomas, *Final Report for Task Agreement IO/21/TA/4700000231 - Pre-Conceptual Design for Polarization Thomson Scattering Diagnostics 55.C8* (2022) IDM UID **8ANU2R**.

*Presenting author: djdenhar@wisc.edu