P09

Simultaneous Plasma Absorption Measurements from XUV to IR

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Here we present a proposed method of simultaneous absorption measurements in laser produced plasmas (LPPs) across a range of spectral regions from IR to XUV to rapidly acquire mutually corroborating sets of atomic data. The accurate interpretation of astrophysical spectra using atomic structure calculations and radiative transfer models requires as complete as possible a set of atomic data across a large spectral range. Particularly for the analysis of Kilonova spectra, elements of $Z > 26$ which are thought to be formed via the r-process in binary neutron star mergers have very little atomic data available [1]. The UCD Atomic, Molecular & Plasma Physics group has done extensive work in the past in probing LPPs to measure relative absorbance [2, 3], particularly in the EUV region where ion populations can better be identified, and is currently working on IR and VUV photoabsorption experiments.

My PhD research is part of a broader effort funded through the IRC project GOIPG/2023/5067 and the ERC Synergy Award HEAVYMETAL. The focus of my work will be construction of an experiment which combines various probes and detectors to simultaneously take absorption measurements in multiple spectral regions. A soft x-ray probe, such as an LPP can be combined with a back illuminated CMOS to image the density profile of the plasma and measure uniformity. In tandem with this, a series of probes such as an OPO (600-2100nm) or Supercontinuum (400-2100nm) for VIS/IR or LPPs (<1nm – 400nm) for VIS/UV/EUV can be implemented with respective spectrometers and detectors to acquire absorption spectra. The experiment can be equipped with an ultrafast ICCD camera to acquire spectra with ps resolution, allowing the use of probes with temporal profiles longer than the plasma expansion time. Narrow band probes can also be used to image the spatial distribution of single ion stages. Combining all of these observation techniques allows extensive plasma diagnostics and the ability to obtain a large set of atomic data very rapidly.

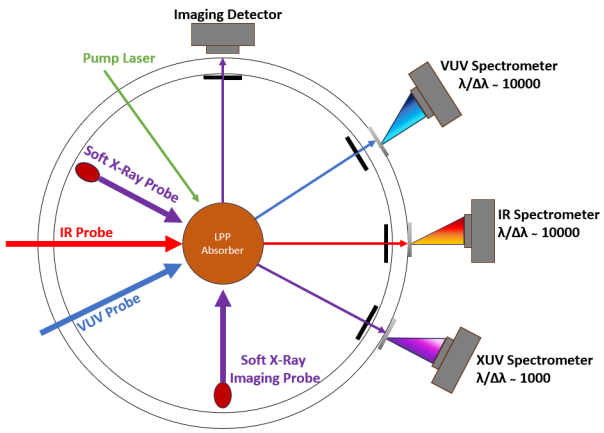

Figure 1: A probe-detector combination allowing absorption measurements in IR, UV & EUV simultaneously, with Soft X-Ray density imaging

[1] J.H. Gillanders, M. McCann, S. Sim, S. Smartt, C. Ballance, Mon. Not. R. Astron. Soc. **506**, 3 (2021)

[2] R. Stefanuik et al., Phys. Rev. A **101**, 3 (2020).

[3] E. Doyle, G. O'Sullivan, P. Hayden, P. Dunne, J. Phys. B **56**, 13 (2023).