

European XFEL Joint Theory Seminar

Thursday, 23 April 2026, 16:00 – 17:00 CET

CFEL/DESY (Building 99), Seminar Room IV, O1.109



Olivier Peyrusse

Aix-Marseille University, CNRS, Laboratoire LP3,
UMR7341, 13288, Marseille, France

Complex atom physics and radiative emission of plasmas : from laser-produced plasmas and solid-density XFEL-produced plasmas to Tokamak plasmas

Within the context of plasmas, atomic physics is involved in calculating various quantities such as charge distribution and radiative properties. These quantities are in turn used to calculate transport properties, radiative losses, spectroscopic diagnostics, etc. Calculating these quantities requires a preliminary calculation of the population distribution of the numerous atomic or ionic energy levels. Whether in natural or laboratory plasmas, this distribution is rarely given by the laws of thermodynamic equilibrium. Also, for heavy elements, enumerating and calculating these energy levels is a difficult task, not to mention the calculation of the collisional and radiative rates.

The difficulty lies in the fact that we are faced with situations of varying complexity, ranging from simple atomic configurations with almost closed shells to open-shell configurations with many electrons. This is the domain of complex atomic physics, where global properties emerge from these large sets of levels.

After presenting the differences between ‘high-density’ plasmas (e.g., laser-produced plasmas and solid-density XFEL-produced plasmas) and ‘low-density’ plasmas (e.g., plasmas in the core of tokamaks) in terms of collisional-radiative modeling, we will present the standard methods for approaching the atomic physics of heavy elements.

Next, we will go over some details concerning the calculation of the emissivity of high-Z plasmas and, in particular, the issue of completeness of the list of included atomic configurations. Concrete examples will be:

- the calculation of the emission of a heavy element irradiated by laser,
- the calculation of the ionisation and of the fluorescence of a heavy material irradiated by intense monochromatic X-ray radiation,
- the calculation of the ionisation and of the radiative emission of tungsten in tokamak plasmas.

Hosts: Beata Ziaja-Motyka & Ruslan Kurta



Virtual participation (via Zoom):

<https://xfel.zoom.us/j/62595298126?pwd=eyAKwIAn9AiYkRlkYcYyW5smp6oG6d.1>

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