The Tungsten atom and Jean-François Wyart: past, present and future

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Short laser pulses (t < a few ns) produce thermal plasmas fairly close to local thermodynamic equilibrium. When they are used on composite metal targets, they form a plasma first emitting a radiation close to that of the black body, then a collection of first ionic then atomic lines according to the composition of the plasma, therefore of the irradiated target. Spectroscopic analysis of the emitted radiation can allow the determination of the composition. Since the appearance of the first laser sources at the beginning of the 1960s, this laser-matter interaction for composition determination has been considerably developed and today bears the name "LIBS" for Laser-Induced Breakdown Spectroscopy.

It is very effective in standard analysis on metal alloys, but is still at the development stage for more specific targets, in particular metals with a significant charge of light atoms such as hydrogen and its isotopes. It becomes particularly challenging for tungsten type matrices implanted in H, D and T such as the divertor of fusion reactors.

However, this technique is the only one likely to provide relevant information in real time, in situ and without preparation. It has been tested in JET, we have implemented this technique on the CEA's WEST tokamak and it is under study for ITER.

The CORIA laboratory is working on this development. The priority targets studied are tungsten. While standard studies are carried out on aluminium whose spectrum of Al I and Al II transitions is not too rich and very well known, working on tungsten is difficult because the spectrum contains many lines resulting from transitions whose Einstein coefficients are unknown as well as the characteristics of higher levels.

Wishing to characterize experimental spectra and calculate them theoretically, we contacted the NIST a few years ago for additional information. The answer we got was to contact Jean-François Wyart from the Aimé Cotton laboratory.

This is how we met Jean-François. In this talk, we will present the contributions of Jean-François to the knowledge of tungsten and place these contributions in a broader context.