



HAL
open science

Experimental characterization of double pulse laser-induced plasmas on Aluminum and Tungsten targets

Aurélien Favre, Vincent Morel, Christian Grisolia, Arnaud Bultel

► To cite this version:

Aurélien Favre, Vincent Morel, Christian Grisolia, Arnaud Bultel. Experimental characterization of double pulse laser-induced plasmas on Aluminum and Tungsten targets. EMSLIBS 2019, Sep 2019, Brno, Czech Republic. 2019. hal-02314860

HAL Id: hal-02314860

<https://hal.science/hal-02314860v1>

Submitted on 14 Oct 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Experimental characterization of double pulse laser-induced plasmas on Aluminum and Tungsten targets

AURÉLIEN FAVRE¹ ‡, VINCENT MOREL¹, CHRISTIAN GRISOLIA², ARNAUD BULTEL¹

¹ CORIA, UMR CNRS 6614, Normandie Université, 76801 Saint-Étienne du Rouvray, FRANCE

² CEA, IRFM, Site de Cadarache, 13108 Saint-Paul-lez-Durance

‡ aurelien.favre@coria.fr

CONTEXT & OBJECTIVES

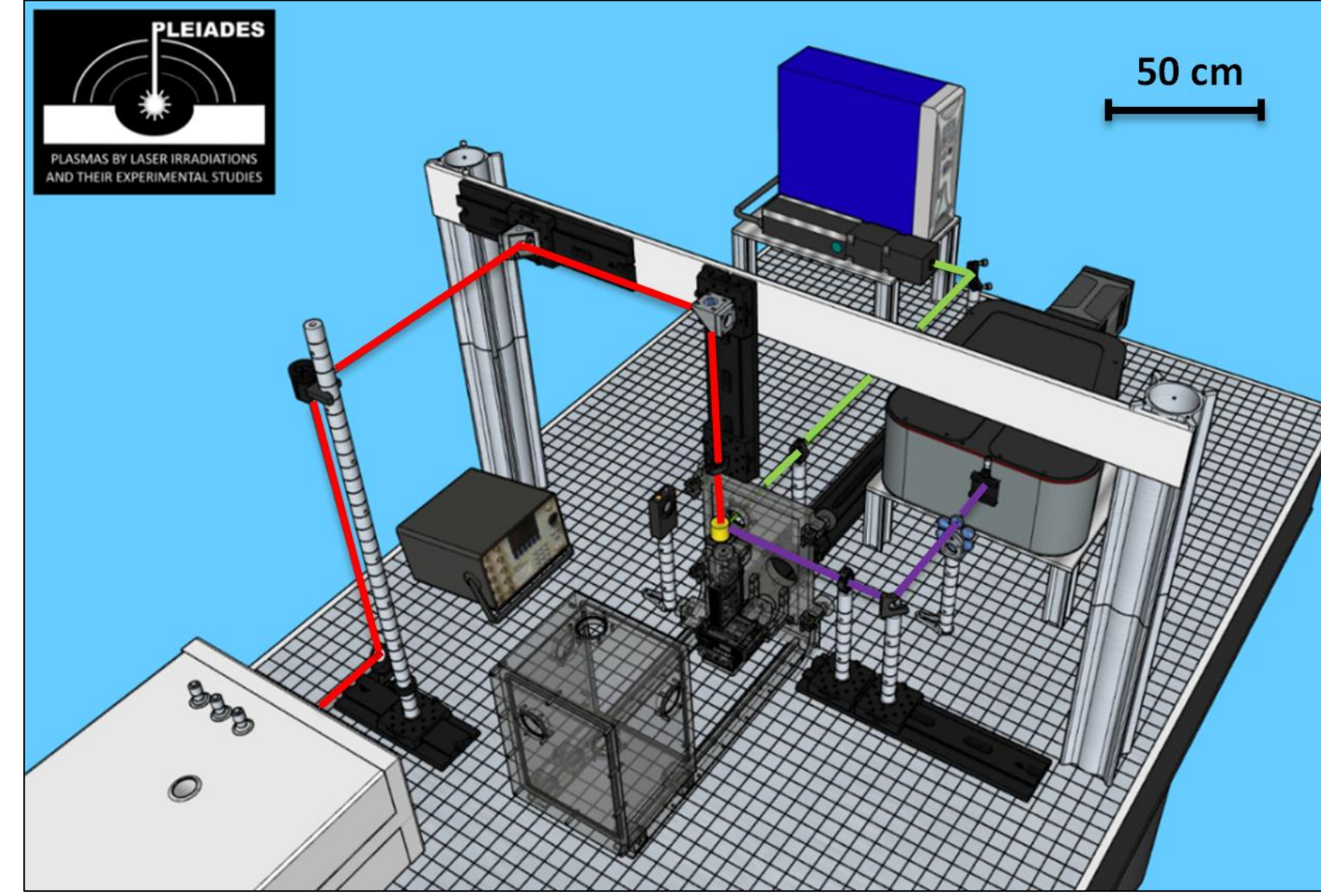
Diagnostic technique LIBS (Laser-Induced Breakdown Spectroscopy)

LIBS enables concentrations determination in a target using optical emission spectroscopy. For a target composed of elements in very low concentration or whose upper levels of common transitions are at high energy (10 eV or more) the maximization of the output signal is mandatory. One efficient technique is to heat up the plasma with a second pulse shifted in time. This experimental process is called *double pulse (DP)*.

Objectives

- Obtain an experimental setup accurately controlled in time and space
- Estimate the improvements in terms of output spectral radiance
- Quantify roughly electron and low level number densities

EXPERIMENTAL SETUP

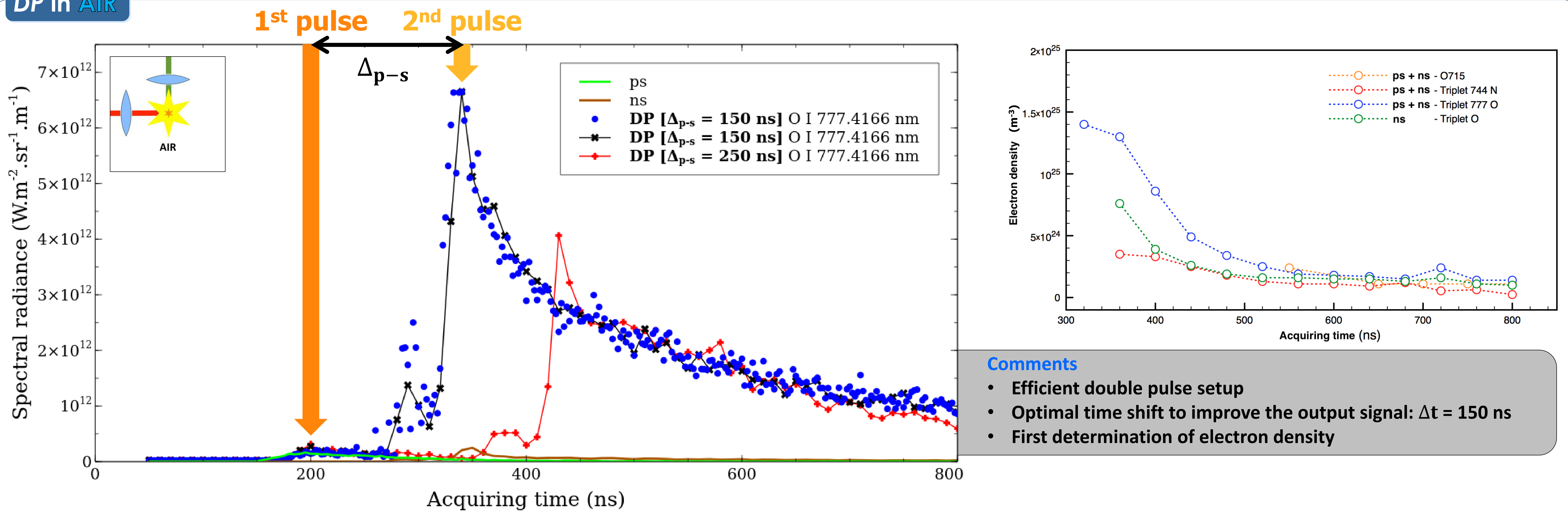


The **first pulse** (1064 nm, 30 ps, 14 mJ) is focused to produce a plasma. The **second pulse** (512 nm, 6 ns, 65 mJ) is focused in this plasma with a temporal shift of Δt . **Heated plasma's** radiation is collected along a **third optical axis** to be analysed with our SCT-320 spectrometer.

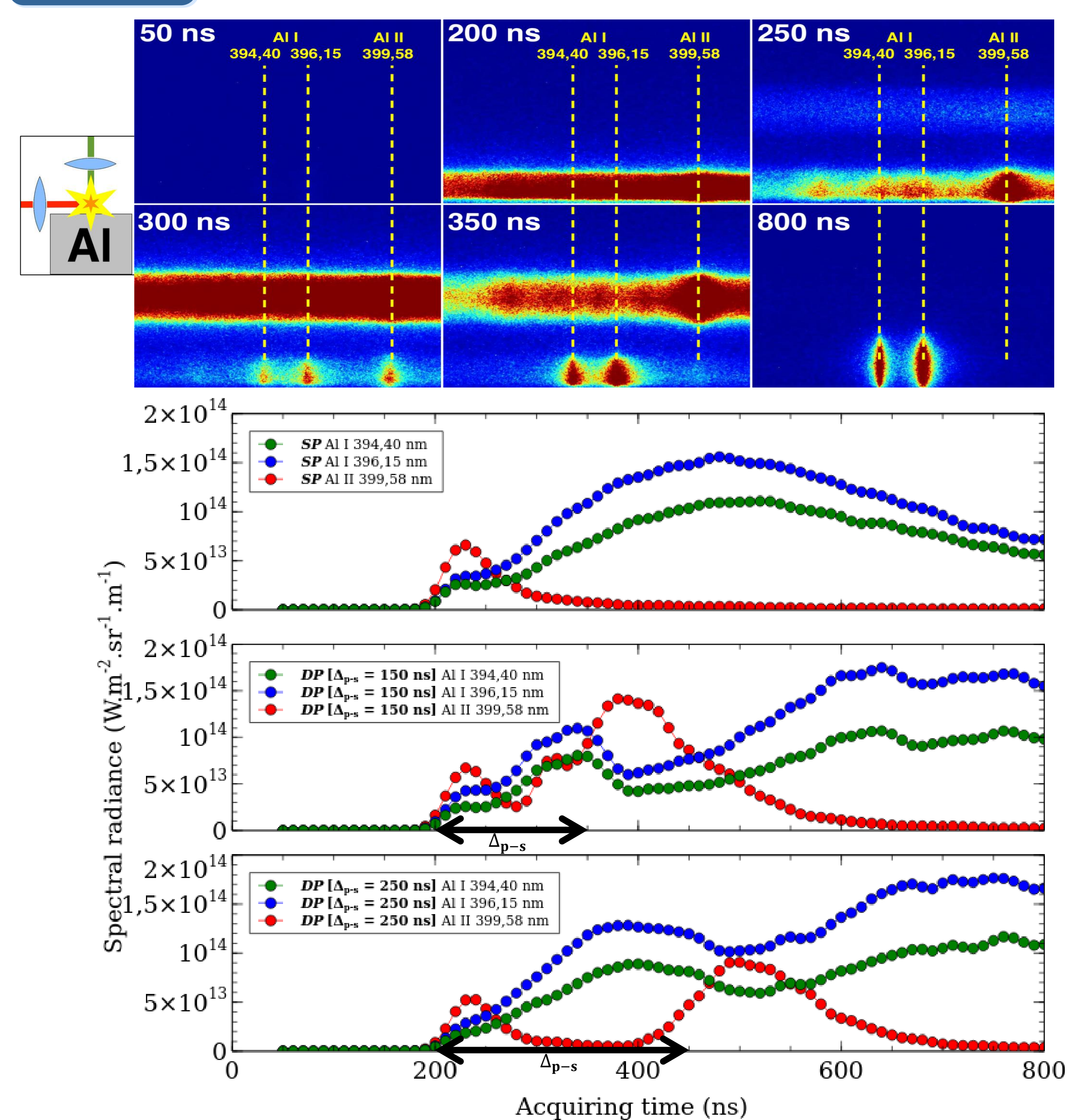
LASERS:

- EKSPLA PL-2251: **30 ps**
- QUANTEL U100: **5 ns**

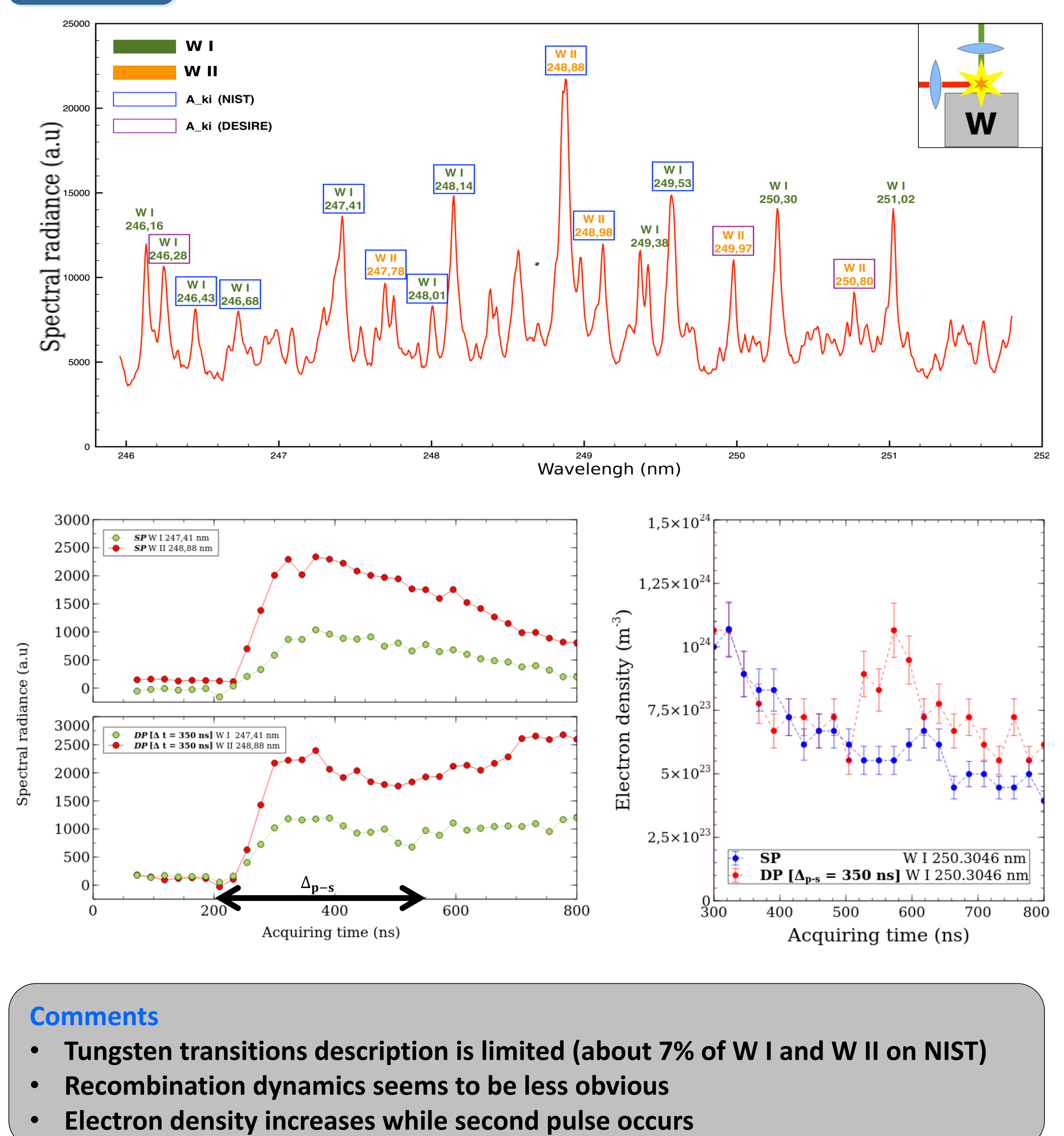
DP in AIR



DP on AL



DP on W



CONCLUSIONS & PERSPECTIVES

- Efficient temporally and spatially controlled double pulse setup
- Detection limits are strongly enhanced, output signal is at least 5x multiplied
- Determination of electron density
- Possible characterization of states with lower energy by absorption spectra

- Accuracy can be strongly improved by working with a higher spectral resolution and signals with accumulations
- Absorption efficiency can be significantly enhanced by heating the plasma with an infra-red pulse (Inverse Bremsstrahlung)
- Detection of light elements such as H isotopes in heavy matrices like W remains our long-term objective