



# **WP PWIE SP E: Kick-off meeting, 23rd January, 2024:**

**ENEA activities in 2024: Participation in the LIBS experiment at VTT and at JET using RH, and in the data analysis of CF LIBS - plans**

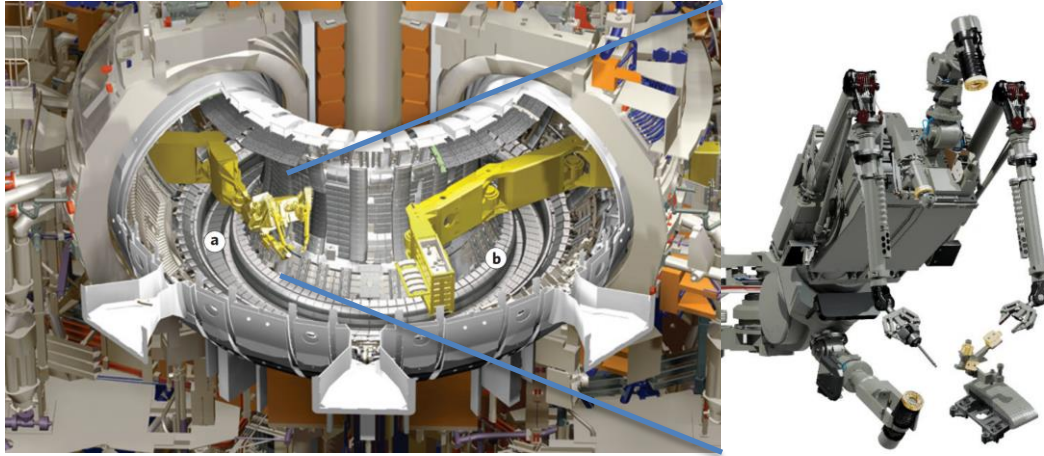
**Salvatore Almagiva**



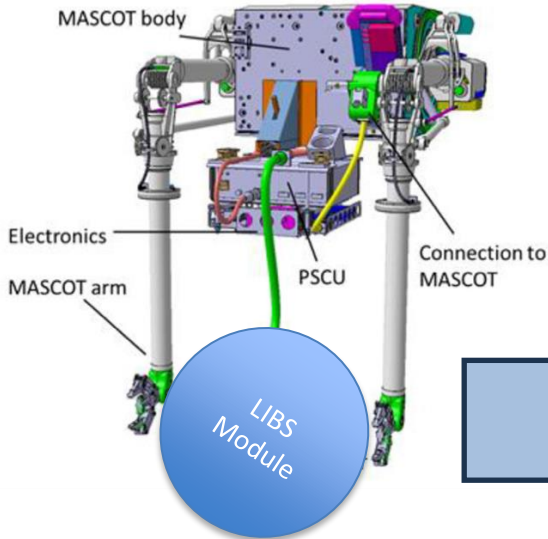
This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.



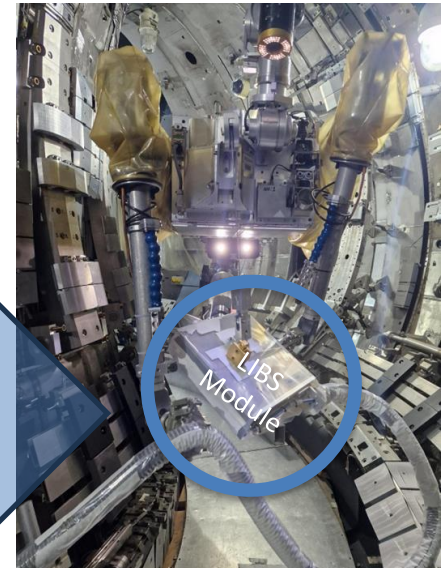
# The Remote-Handling-System at JET



The MASCOT telemanipulator robot is a two-armed machine with back-drivable actuators and a large dexterous workspace in which each arm can operate within the full 6 degrees of freedom. The manipulator is remotely operated from a control room, where a kinematically similar master manipulator is used to control motions, and provide high-fidelity force feedback



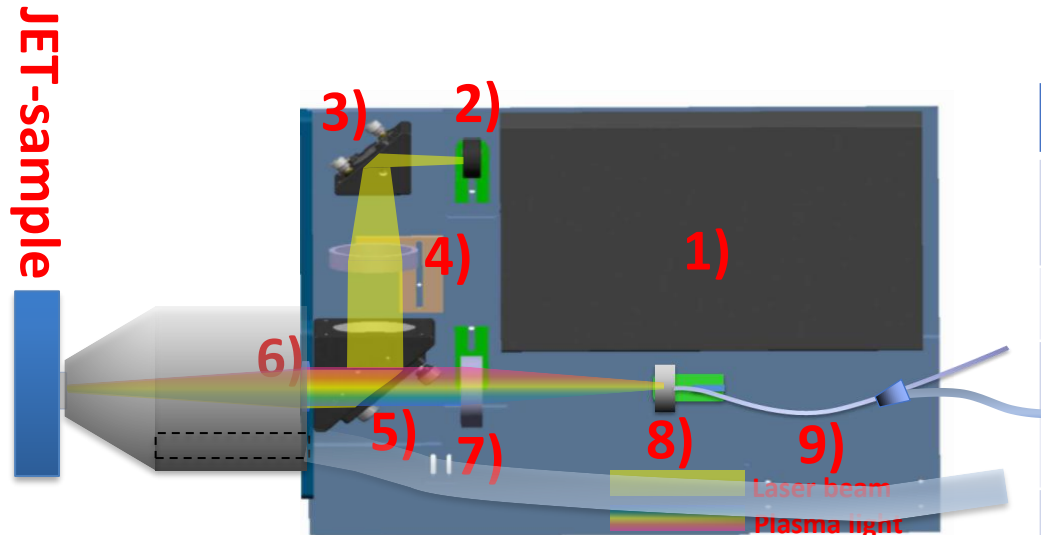
**MASCOT has recently been used for deploying a prototypal LIBS tool inside the JET mock-up, where a dedicated mechanical support has been designed and realized with attachment points to allow the MASCOT arms to grip the tool.**





# Participation in the LIBS experiment at VTT and JET

- The prototypal LIBS tool developed is at VTT and it will be equipped with the optical fiber and one of the spectrometer to be used at JET. The setup will be tested at VTT on JET relevant samples.



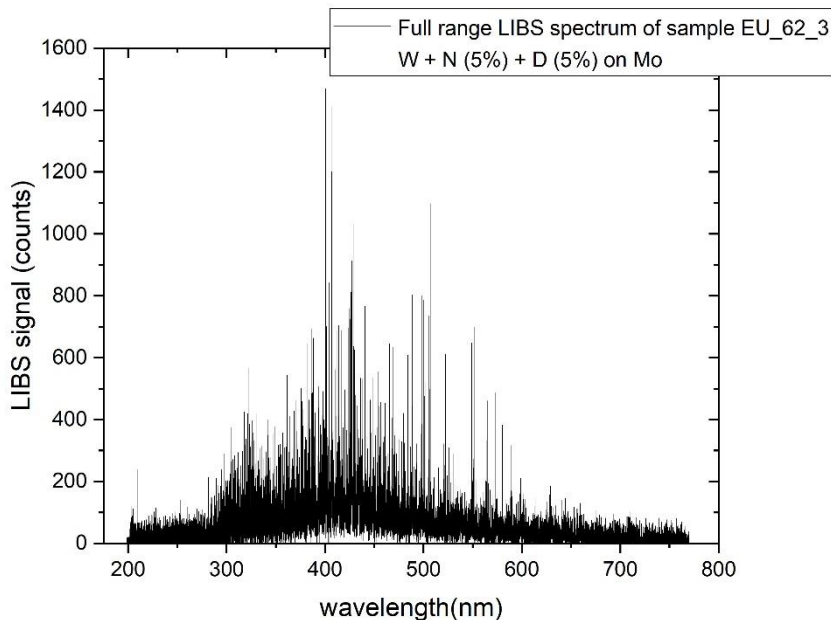
	Description
1)	Ps – laser ( $\lambda = 1064 \text{ nm}$ )
2)	1" dia. lens ( $f = -75 \text{ mm}$ )
3)	1" dia. HR-IR 45° mirror (45°)
4)	2" dia. lens ( $f = 200 \text{ mm}$ )
5)	2" dia. HR-IR HT-VIS dielectric mirror (45°)
6)	2" dia. lens ( $f = 75 \text{ mm}$ ) inside the cone
7)	2" dia . Lens ( $f = 150 \text{ mm}$ ) collecting the LIBS light on the optical fiber
8)	Optical fiber holder
9)	Multibranch ( $\geq 20 \text{ m}$ ) optical fiber

# Participation in the LIBS experiment at VTT and at JET: data analysis with CF LIBS



The LIBS system at VTT includes an Aryelle full range (200-750 nm) Echelle spectrograph connected with an Andor ISTAR camera DH-334 18F-E3. The detected spectral range is 200 – 750 nm. Many atomic and ionic emission lines from all the chemical species can be detected in this range and a Calibration Free (CF) analysis can be performed.

Example: LIBS spectrum of a W+N+D coating (5.5 μm thick) on Mo



Optical design	echelle spectrograph
Aperture	f/10
Focal length	200 mm
Slit width	40 μm
Wavelength range	200-750 nm / 210-850 nm
Spectral resolving power	9,000
Spectral resolution FWHM	22-83 pm / 23-94 pm
Absolute accuracy	spectral resolution / 4
Detector	CMOS / CCD / ICCD , 13 x 13 mm <sup>2</sup> image area
Dynamic range	15 bit, AD conversion 16 bit
Light coupling	SMA fiber coupling
Wavelength calibration	with mercury lamp
Computer	PC incl. monitor or laptop with Microsoft Windows
Software	Sophi, Sophi Server for integration
Dimensions without detector (L x W x H)	(260 x 160 x 185) mm
Weight without detector	7.3 kg

