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# NCSR activities at JET in support to ITER nuclear analyses

T. Vasilopoulou, M.I. Savva, P. Tsavalas, A. Lagoyannis  
V. Ioannou-Sougleridis, K. Mergia, I.E. Stamatelatos  
& JET contributors  
NCSR “Demokritos”, Greece



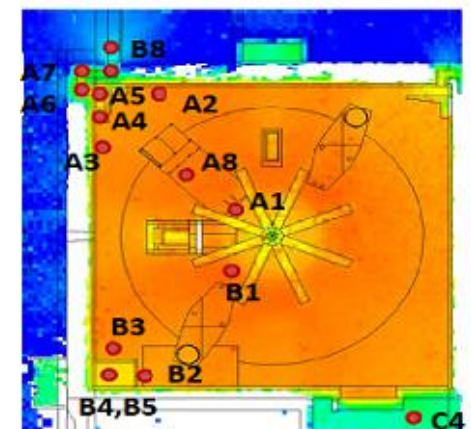
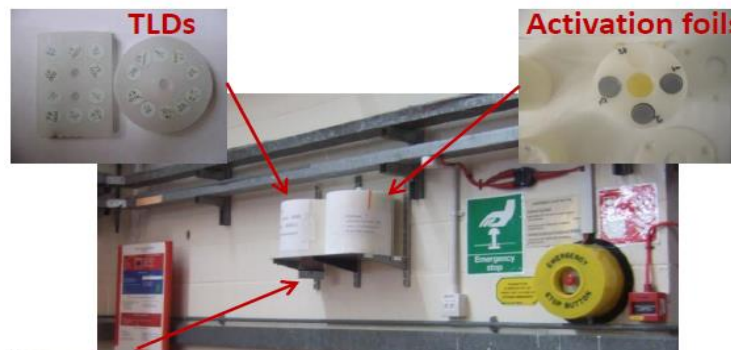
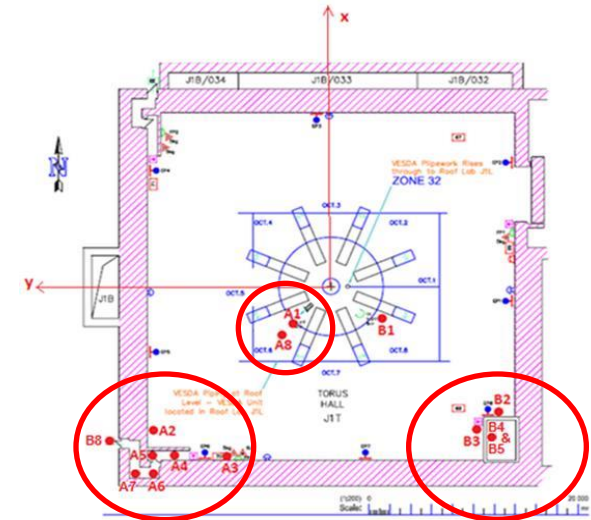
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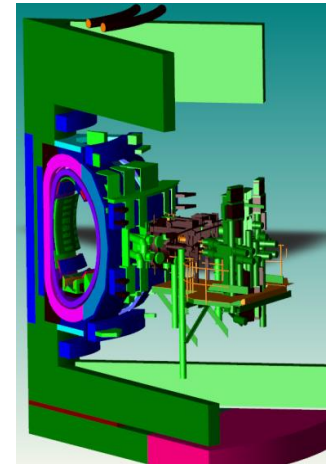
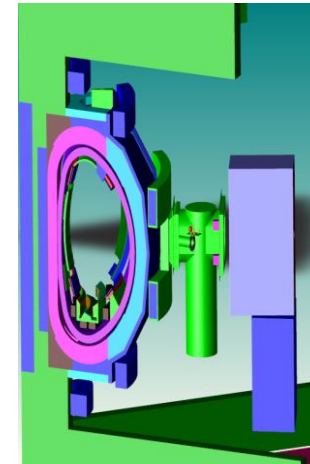
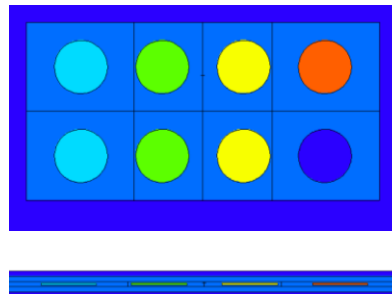
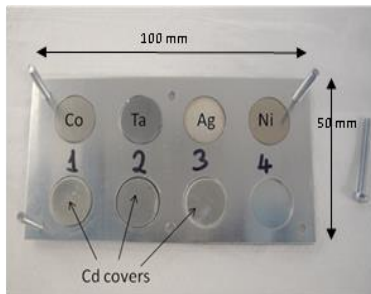
Validation of numerical tools and data to accurately predict neutron fluence through ducts and labyrinths in the JET biological shielding

- **Neutron fluence measurements** in the JET Hall using **activation foils** within PE moderators
- Irradiations during JET 2015-2021 D-D, T-T & D-T campaigns
- SW entrance labyrinth, SE chimney, Octant 6
- Comparison against **TLD measurements** & **MCNP calculations**



Estimation of neutron fluence and spectra to complement shutdown dose rate measurements

- **Neutron fluence measurements** in Octants 1 & 2 **using activation foils** in Aluminum holders
- Irradiations during JET 2015-2021 D-D, T-T & D-T campaigns
- Comparison against **Ionization Chamber measurements & MCNP calculations**



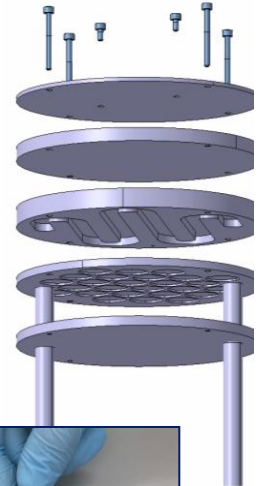
**Octant 1**



**Octant 2**

## Validation of ITER materials nuclear analysis

- **Characterization of activation properties** of materials that will be used in ITER as structural or functional components
- ITER material samples and dosimetry foils irradiated at JET during JET 2015-2021 D-D, T-T & D-T campaigns
- Comparison against **FISPACT calculations**



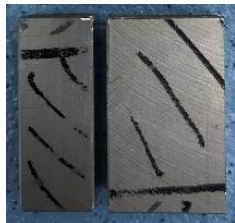
Austenitic steel for blankets



CuCrZr divertor pipes



Divertor W Monoblock



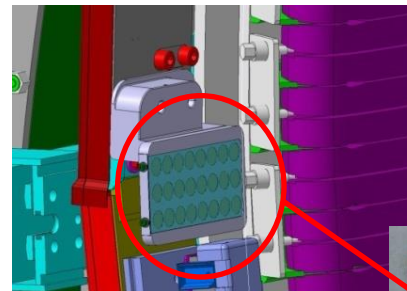
Eurofer 97-3



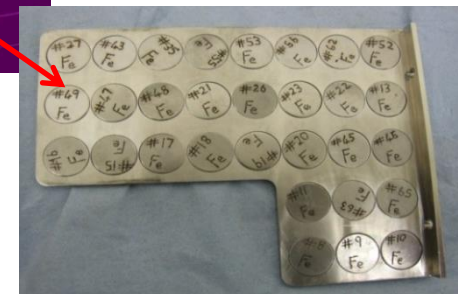
Inconel 718



In-wall shielding

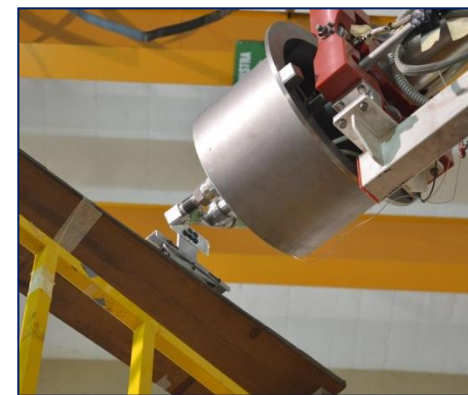
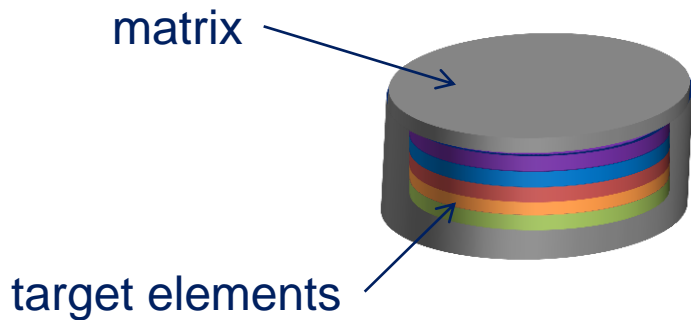


Irradiation position on ITER-like wall



Development of a detector capable to accurately monitor neutrons surviving the harsh conditions of the fusion environment

- **Low activation matrix** capsule able to withstand the fusion environment (high temperature, high and variable neutron fluences / magnetic fields)
- Core of selected **metallic elements** of defined concentration
- Neutron fluence and spectrum inferred by the analysis of the activation products  $\gamma$ -lines



## Irradiations of VERDI detectors

- at the Frascati Neutron Generator 14MeV reference neutron field
- at JET during the 2019-2021 **D-D, T-T & D-T** campaigns

Assessment of neutron effects on mechanical and structural properties of ITER functional materials (sapphire, alumina, diamond, nitrides etc)

- **Dielectric and optical characterization** of materials before and after neutron irradiation

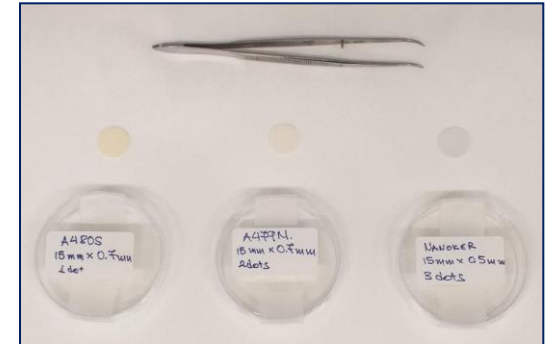
- **Optical methods**

- Raman spectroscopy
- FT-IR transmittance and reflectance
- UV-Vis transmittance, diffuse reflectance
- Photoluminescence and photoluminescence excitation

- **Electrical degradation** probed by

- Dielectric spectroscopy
- Thermally stimulated currents

- Irradiations of ITER functional materials at JET during the 2019-2021 **D-D, T-T & D-T** campaigns



The results of the ITER oriented NCSR experiments at JET

- provide **important information** and **significant experience** to be applied on ITER analyses
- enable the **validation** of codes, models, assumptions, procedures and data currently used in **ITER nuclear analyses**
  - reducing the related uncertainties and associated risks in ITER operation
  - maximizing the scientific and technological preparedness
  - ensuring a successful launch of ITER
- contribute to the validation of the numerical tools employed for the **design and safety of future fusion power plants**

