

Institute for Nuclear Fusion “Guillermo Velarde”

Official Research Institute of the Madrid Government, in the frame of UPM, since 1982 (BOE nº 73/26-3-1982) as Advisor to Presidency of Government in all Nuclear Affairs. It has groups in three Universities: UPM, UNED and ULPGC. It has been and is mainly devoted to Inertial Confinement Fusion research as energy source in areas of laser-ion interaction with plasma, target design and manufacturing; ICF reactors design including neutronics and safety processes; Materials under irradiation. In addition, it has been a very active collaborator in EU Fusion Technology in general, ITER in particular through its group in UNED University. Partitioning and Transmutation by Accelerator Driven Systems and Neutron (Radiation) Sources based in Spallation has been also part of its research. It is composed by 30 Professors, 7 Post-Docs, 1 Specially Ministry granted “Beatriz Galindo” Guest Professor, 15 PhD Students and 15 engineers under contract with European Spallation Source (ESS) in Bilbao.

Facilities and infrastructures



□ Laboratory focused on Resistant materials to extreme conditions (irradiation, corrosion, thermal load, abrasion).

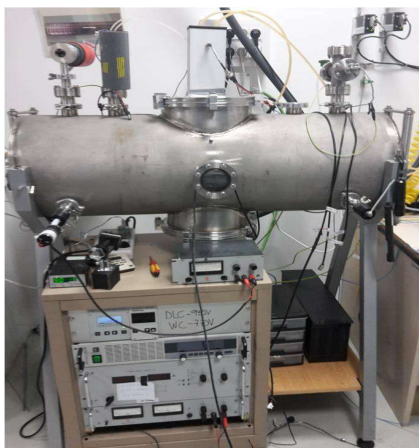
□ Development, characterization and modeling before and after the extreme treatment of:

- Nanostructured coatings of tungsteno.
- Carbon Nanotubes.
- Graphene Foam.
- Diamond-like Carbon.
- Plasmonic particles.

□ The facilities allow:

- Manufacturing by sputtering at different scales.
- Study of gases with permeation equipment and thermal desorption spectroscopy.

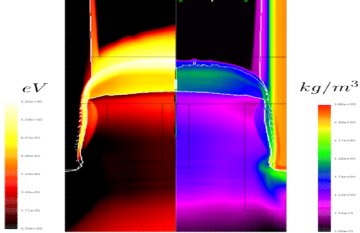
▪ *In situ* optical measurements during radiation experiments.



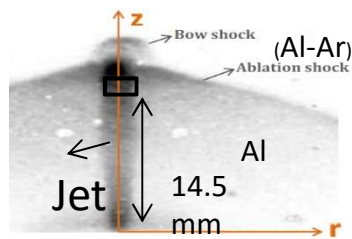
Research areas associated with Big Science

Laser Fusion, X-rays lasers,
Astrophysics,

Radiation-Hydrodynamics

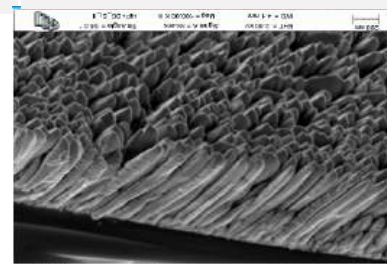


Atomic Physics, Shock Waves



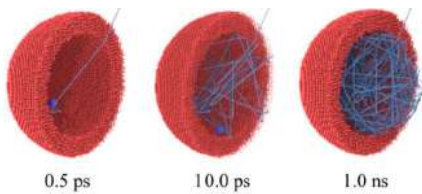
MAGPIE Z-pinch device

Nanostructural Materials

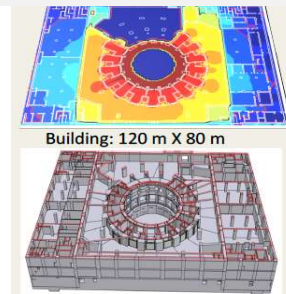


SEM image of W nanocolumns deposited on Si.

NANOPLASMONIC. Trapping of He by Hollow W nanoparticle



3D Neutronics; large structures ITER design Particle transport



Building: 120 m X 80 m

Intense Radiation Sources: collaboration on Target from ESS-Bilbao



Main projects in Big Science

- **ESS**, European Spallation Source: collaboration on Target, Beam Dump, Diagnostic design and manufacturing in ESS Neutron Source through cooperation with Spanish Agency ESS-Bilbao.
- **ITER** magnetic fusion experimental facility. Development, implementation and use of 3D Particles (neutron-gamma-ions) codes linked to detailed CAD/CAM descriptions and contribution to safety in operation and maintenance.
- **HiPER** Project (already ended) for design of Inertial Confinement Fusion Reactor as main coordinator of Work Package related to Technology under contract EU, STFC (UK), Ac. Science (Czech Republic).
- **EUROFUSION** Projects on Inertial Fusion Energy related to Materials, Radiation-Hydrodynamics, Atomic Physics: Computing and Manufacturing & Characterization of Nanomaterials and Nanoparticles.
- **EURATOM** Projects on Nuclear Data and Transport in G-IV fission reactors.

Collaboration with Large European Scientific Facilities

- **ESS and ITER:** (see previous section).
- **IFMIF-DONES:** Neutron Source: Materials Research of Neutron Irradiation in Nuclear Fusion.
- **CERN:** in experiments related to n-ToF project. Previous collaboration in TARC and FEAT Transmutation Experiments related to Accelerator Driven System (ADS) design.
- **ELI:** Extreme Light Infrastructure, during preparation and now with ELI-Nuclear Physics (Romania) with proposal of Training Network and ELI-Czech Republic in Experiments.
- **ISIS:** Spallation Neutron Source in Rutherford Facility, preparation of Experiments and design of new steps.
- **Centre for Laser Pulsed and Ultraintense (CLPU):** design of Laser Neutron Sources and Radiation-Hydrodynamics.

Software, tools or licenses to be applied to Big Science

- **MCUNED, ACAB, R2UNED:** 3D neutron-gamma-ions transport and activation with uncertainties.
- **ARWEN:** 2D AMR radiation-hydrodynamics.
- **MDCASK:** molecular dynamics code.
- **MMONCA:** kinetic Montecarlo diffusioncode.
- Atomic Physics codes for EOS and opacities.

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