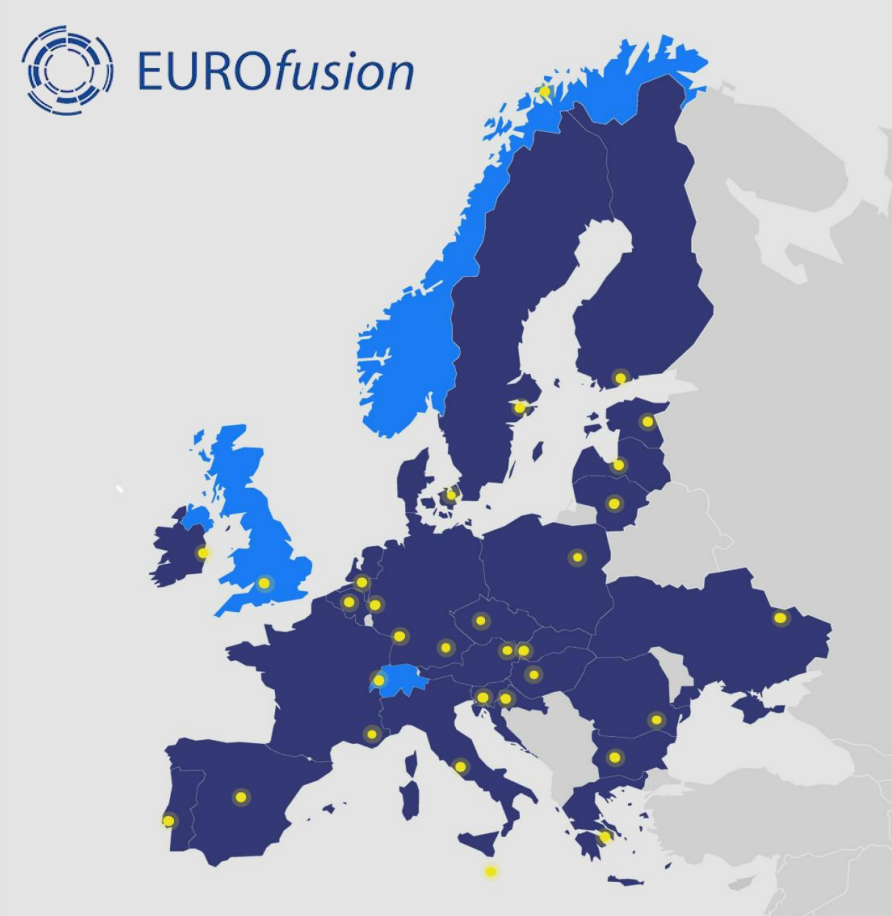
Prezența Universității Tehnice din Cluj-Napoca în programul EUROfusion

Conf. dr. Traian PETRIȘOR

Centrul de Supraconductibilitate, Spintronică și Știința Suprafețelor (C4S), c4s.utcluj.ro
Departamentul de Fizică și Chimie - Facultatea de Ingineria Materialelor și a Mediului

Conferința Cercetării și Inovării UTCN - 21.03.2025



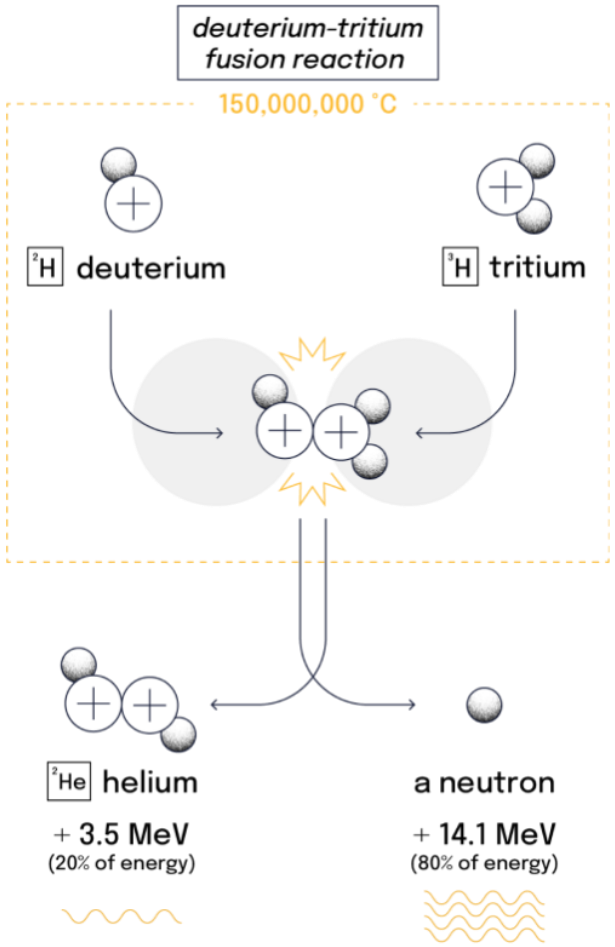
- Consorțiul European pentru Dezvoltarea Energiei de Fuziune (EUROfusion) fondat în 2014
- 31 de organizații de cercetare + 162 entități afiliate (28 state)
- Finanțare: Euratom Horizon Europe + contribuția statelor membre (aprox. 50/50)

Obiectivele EUROfusion:

- Pregătirea experimentelor ITER (International Thermonuclear Experimental Reactor)
- Dezvoltarea conceptului unei centrale nucleare de fuziune de tip demonstrator DEMO

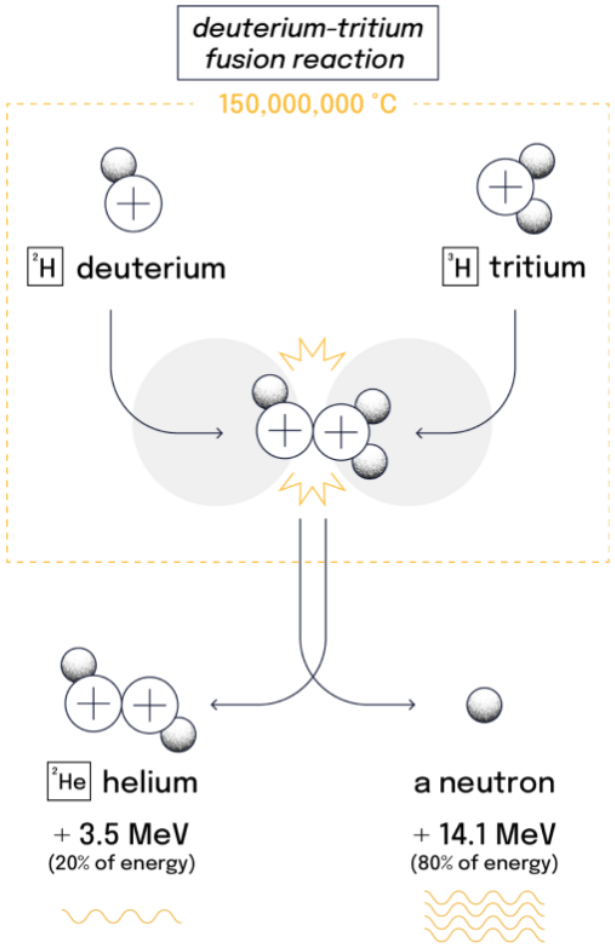
sursa: euro-fusion.org

ITER (International Thermonuclear Experimental Reactor)



sursa: iter.org

ITER (International Thermonuclear Experimental Reactor)



sursa: iter.org

- *Sustenabilitate:* Deuteriul poate fi distilat din apă, iar tritiul este produs în timpul reacției de fuziune prin interacțiunea neutronilor cu litiul (rezervele terestre de litiu ar permite funcționarea centralelor de fuziune >1000 ani)
- *Nu se generează deșeuri radioactive*
- *Nu există riscul accidentelor nucleare*
- *Costul de producție al energiei electrice*: similar cu cel al centralelor nucleare de fisiune (după dezvoltarea tehnologiei de fuziune)

ITER (International Thermonuclear Experimental Reactor)

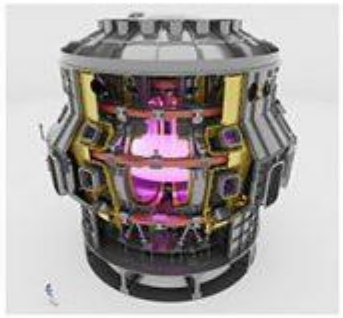
JET

80 m³

24 MW

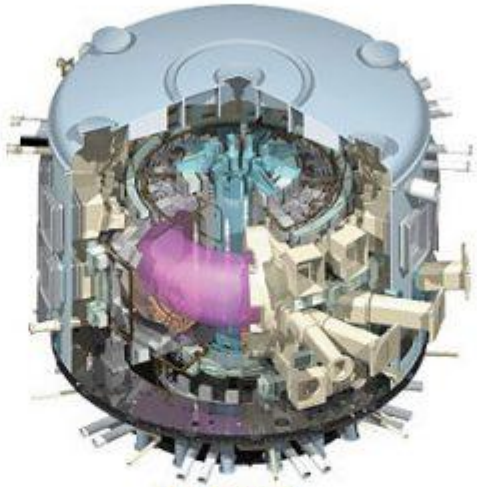
Q=0.67

16 MW



JT-60SA

135 m³



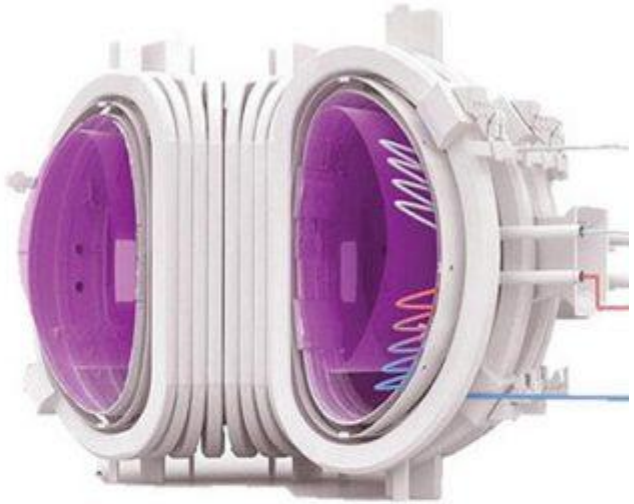
ITER

800 m³

(one-third the size of an Olympic swimming pool)

~ 500 MW_{th}

Q>10



DEMO

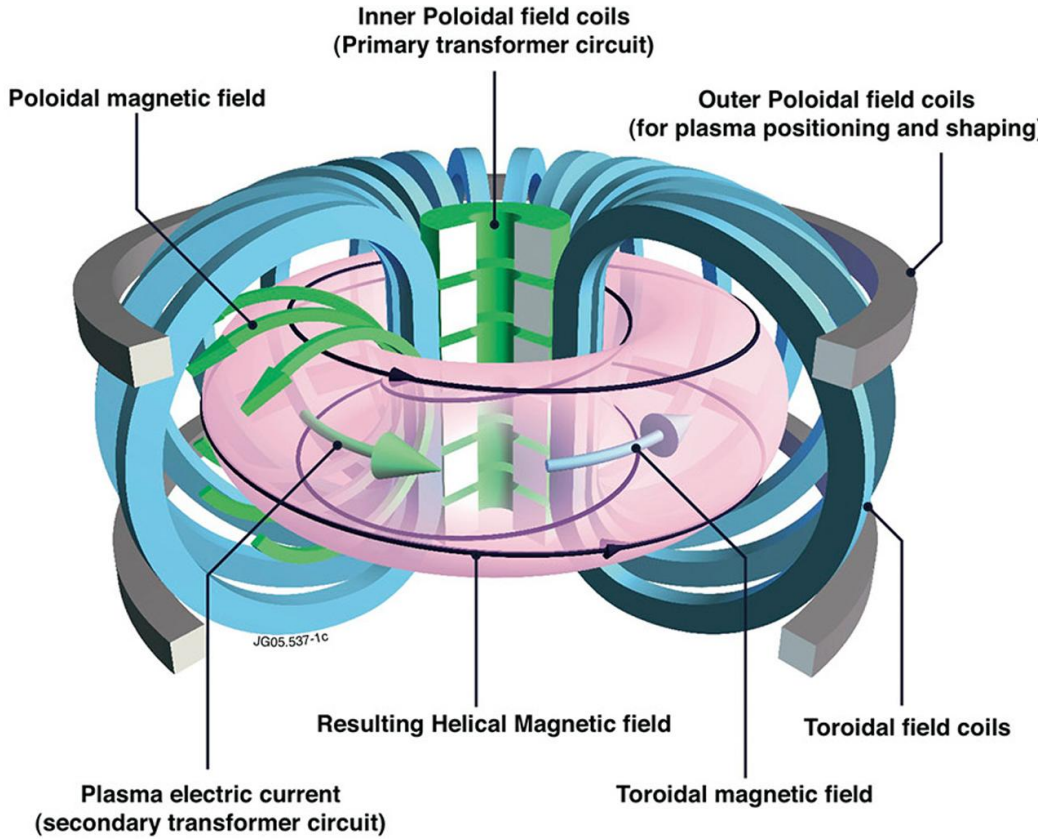
~ 1000 – 3500 m³

(half to one and a half times the size of an Olympic swimming pool)

~ 2000-4000 MW_{th}

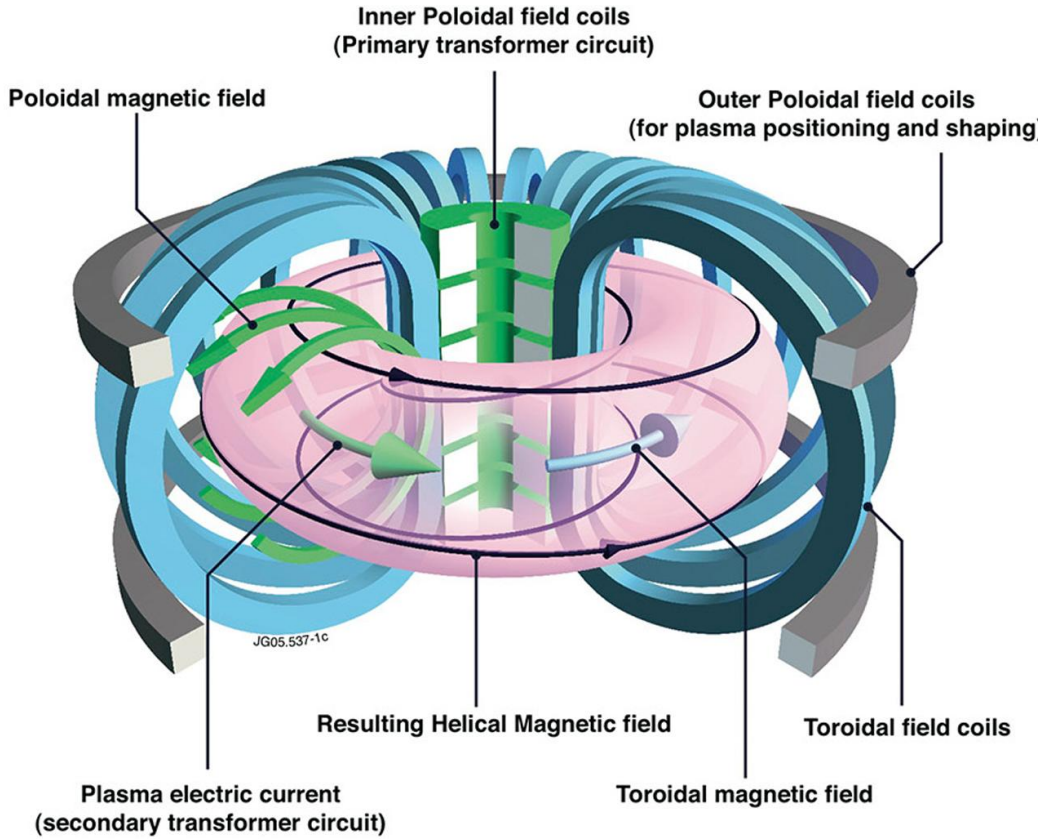
sursa: fusionforenergy.europa.eu

ITER (International Thermonuclear Experimental Reactor)



sursa: EUROfusion/F. Romanelli, *Fusion energy*, EPJ Web of Conferences 246, 00013 (2020)

ITER (International Thermonuclear Experimental Reactor)



sursa: EUROfusion/F. Romanelli, *Fusion energy*, EPJ Web of Conferences 246, 00013 (2020)

- Geneva, 1985
- UE (45,6%), China, Rusia, Japonia, Korea, SUA, India
- Concept: Tokamak
- Producerea de 500 MW în pulsuri de 400 s;
- Demonstrarea funcționării integrate a tehnologiilor dezvoltate pentru un reactor de fuziune
- Producerea plasmei deuteriu-tritiu
- Testarea producerii de tritiu, *tritium breeding*

sursa: iter.org

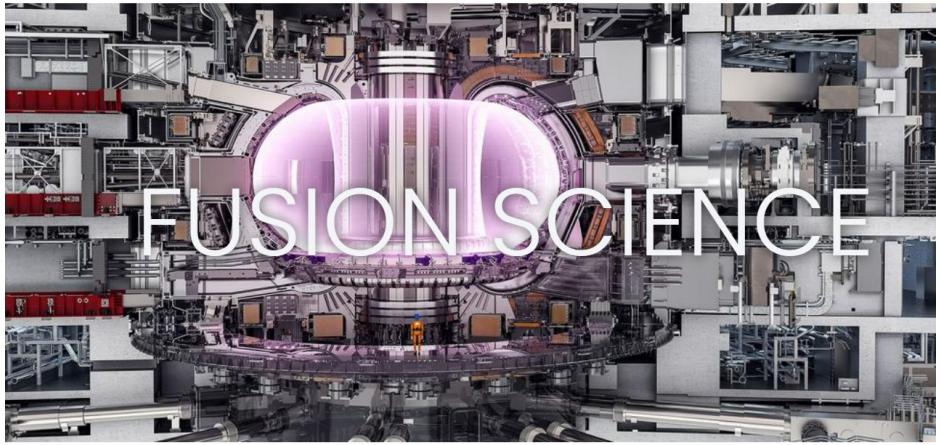
ITER (International Thermonuclear Experimental Reactor)

ITER Timeline

2005	Decision to site the project in France
2006	Signature of the ITER Agreement
2007	Formal creation of the ITER Organization
2007-2009	Land clearing and levelling
2008	Component fabrication begins
2010-2014	Ground support structure and seismic foundations for the Tokamak Complex
2012	Nuclear licensing milestone: ITER becomes a Basic Nuclear Installation under French law
2010-2024	Construction of ITER plant and auxiliary buildings (excepting the Hot Cell Facility)
2015...	Largest components are transported along the ITER Itinerary
2020	Machine assembly begins
2023	Completion of Tokamak Complex civil works
2024	Updated ITER baseline proposal reviewed by the ITER Council; overall approach approved
2033	Cryostat closure
2033-2034	Integrated commissioning
2034	**Start of Research Operation**
2036	Full magnetic energy
2039	Start of Deuterium-Tritium Operation

The Fusion Science Programme

- Coordinate the pan-European scientific research and experiments following the EUROfusion Roadmap to gather
- Ensure the efficient experimentation in ITER
- Designing of the future machines like DEMO

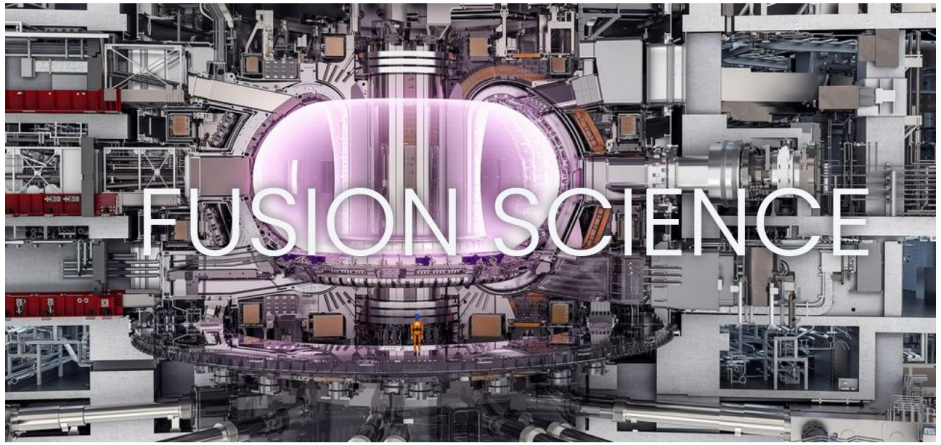


sursa: euro-fusion.org

The Fusion Science Programme

- Coordinate the pan-European scientific research and experiments following the EUROfusion Roadmap to gather
- Ensure the efficient experimentation in ITER
- Designing of the future machines like DEMO

- WPTE: Tokamak Exploitation
- WPSA: Commissioning and exploitation of JT-60SA
- WPWX: Exploitation of Wendelstein 7-X
- WPPrIO: Preparation of ITER Operation
- WPPWIE: Plasma Wall Interaction & Exhaust
- WPENR: Enabling Research
- WPAC: Advanced Computing



sursa: euro-fusion.org

The Fusion Science Programme

- Coordinate the pan-European scientific research and experiments following the EUROfusion Roadmap to gather
- Ensure the efficient experimentation in ITER
- Designing of the future machines like DEMO

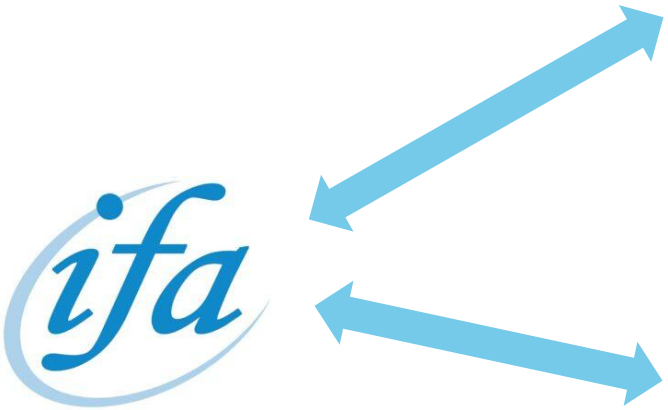
- WPTE: Tokamak Exploitation
- WPSA: Commissioning and exploitation of JT-60SA
- WPWX: Exploitation of Wendelstein 7-X
- WPPrIO: Preparation of ITER Operation
- WPPWIE: Plasma Wall Interaction & Exhaust
- WPENR: Enabling Research
- WPAC: Advanced Computing

Enabling Research (ENR) provides a special path to bring new ideas and techniques into the programme in ways not easily achieved within the strongly goal-oriented main Work Packages (WPs). Only topics with relevance for fusion research are eligible for joint programme funding and are assessed on the basis of excellence. The structure of the ENR activities for covers four major areas: Materials, Technology & Systems, Theory & Modelling and Inertial Fusion Energy.

sursa: euro-fusion.org

Activități de cercetare:

Institutul Național pentru Fizica Laserilor, Plasmei și Radiației (Măgurele) – Partener principal/Coordonator



Institutul de Fizică Atomică (Măgurele)

- Semnatarul acordului EUROfusion
- Coordonatorul activităților EUROfusion

Parteneri/Coordonatori:

- Institutul Național pentru Fizica Materialelor (Măgurele)
- Universitatea Tehnică din Cluj-Napoca
- Institutul Național de Cercetare-Dezvoltare pentru Tehnologii Criogenice și Izotopice (Rm. Vâlcea)
- Institutul Național pentru Fizică și Inginerie Nucleară ”Horia Hulubei” (Măgurele)

1	2000 **PC5**	Development of High Temperature Superconducting Coated Conductors. **Euratom Nr.3/03.07.2000**
2	2001 **PC5**	Development of High Temperature Superconducting Coated Conductors. **Euratom AA Nr.1/CF/3.03.02.2000**
3	2003 **PC6**	Joining development: Production of brazing alloys and SiC/SiCf joints for irradiation. **Euratom - TT8**
4	2003 **PC6**	Development of unreacted NbAl multifilamentary strands for fabrication of Nb_3Al superconducting conductors for high-field applications. **Euratom - UT3**
5	2003 **PC6**	Development of Chemical Deposition Methods for the Fabrication of YBCO High Temperature Superconducting Coated Conductors for High-Field Applications. **Euratom - UT2**
6	2004 **PC6**	Development of $Y_{1-x}Ca_xBa_2Cu_3O_y$ targets for PLD thin films deposition and chemically CeO_2 buffered biaxially textured Ni-W substrates for the development of high temperature superconducting coated conductors. **Euratom -UT2**
7	2004 **PC6**	Measurement of electrical resistivity for SiC/SiC_f composites in the temperature range from 20 to 1000°C. **Euratom -TT8**
8	2005 **PC6**	Manufacturing and characterization of silver free braze material for Be braze. **Euratom -TW5-TVM-BRAZE**
9	2005 **PC6**	Processing of long length CeO2 buffered Ni-5at%W and Ni-5at%W-5at%Cr tapes for the high temperature superconducting tape fabrication. **Euratom -UT2**
10	2005 **PC6**	Measurement of the electrical resistivity and the degree of isotropy from RT to 1000°C of irradiated 2D and 3D SiC/SiCf composites. **Euratom - TW5-TTMA-001-D13.**
11	2006 **PC6**	Manufacturing and characterization of Be/CuCrZr junctions using eutectic and Cu-based silver free brazing alloys. **Euratom-TW5-KVM-BRAZE**
12	2015-2017 **H2020**	Unexplored magnetic vortex regimes relevant for fusion applications of superconductors. **AWP15 –ENR-01/ENEA-08**
13	2019-2020 **H2020**	Nano-engineered REBCO Superconducting Tapes for High Fields Applications. **ENR-MFE19.ENEA-04**
14	2024-2025	irOn-based supeRconducting wIres for fusiON (ORION) **CfP-FSD-AWP24-ENR-04**

irOn-based supeRconducting wIres for fusiON (ORION)

”...development and refinement of technological methodologies to produce superconducting wires for fusion applications made via the Powder In Tube (PIT) method with Iron Based SuperConductors (IBSCs)...”

irOn-based supeRconducting wIres for fusiON (ORION)

Proiect principal:

Proiect complementar:

- 2025-2026
- Continuarea cercetărilor din tema proiectului principal, cu activități care nu sunt cuprinse în acesta

Echipa de implementare a proiectului (C4S):

Traian Petrișor
Ramona Bianca Șonher
Mircea Năsui
Mihai Gabor
Cristina Davidaș (ETTI)
Traian Petrișor Jr.

UNIVERSITATEA TEHNICĂ DIN CLUJ-NAPOCA

EUROPEAN UNIVERSITY OF TECHNOLOGY

Facultatea de Ingineria Materialelor și a Mediului

Conferința Cercetării și Inovării UTCN - 21.03.2025

Vă mulțumesc!