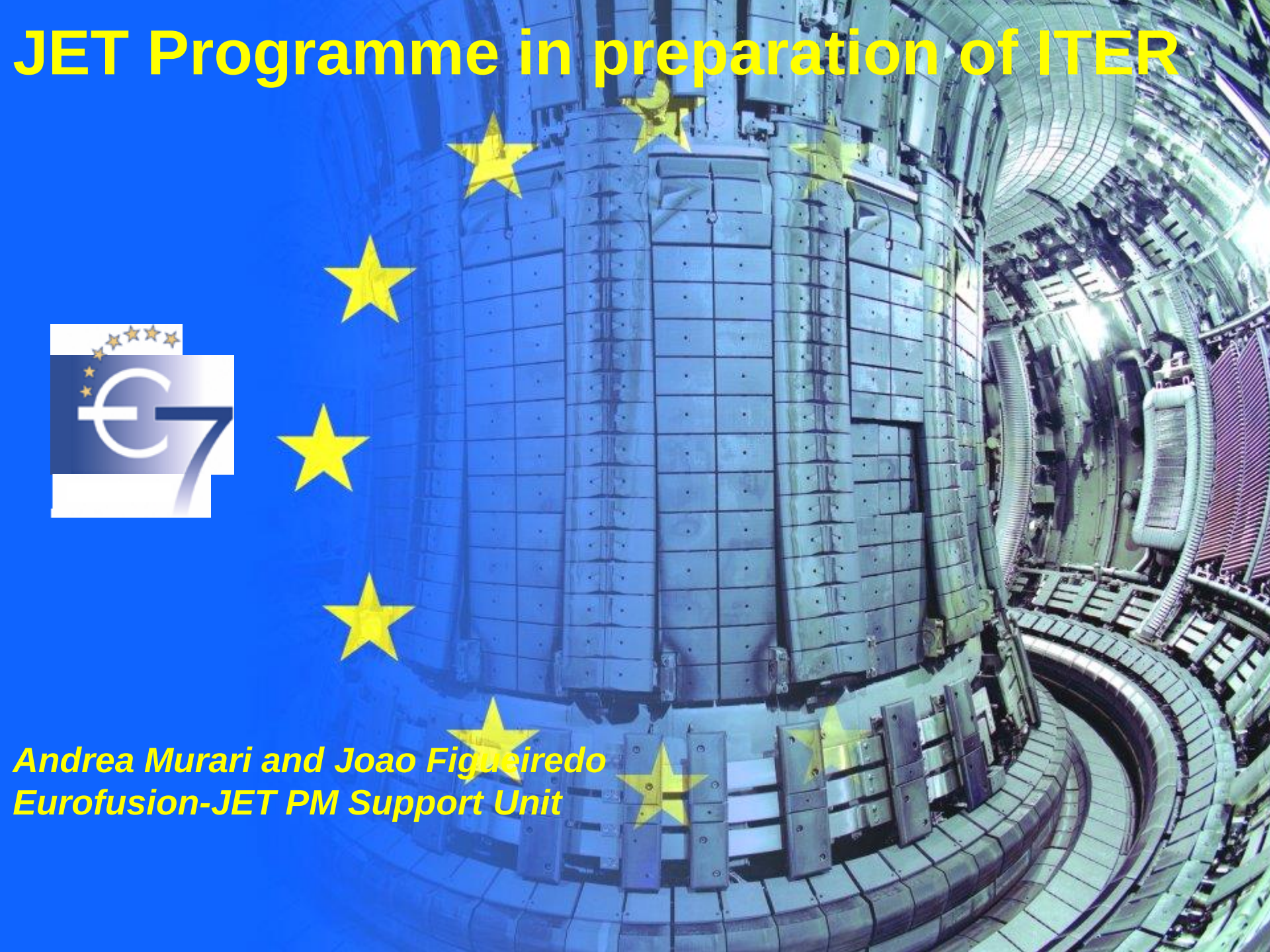
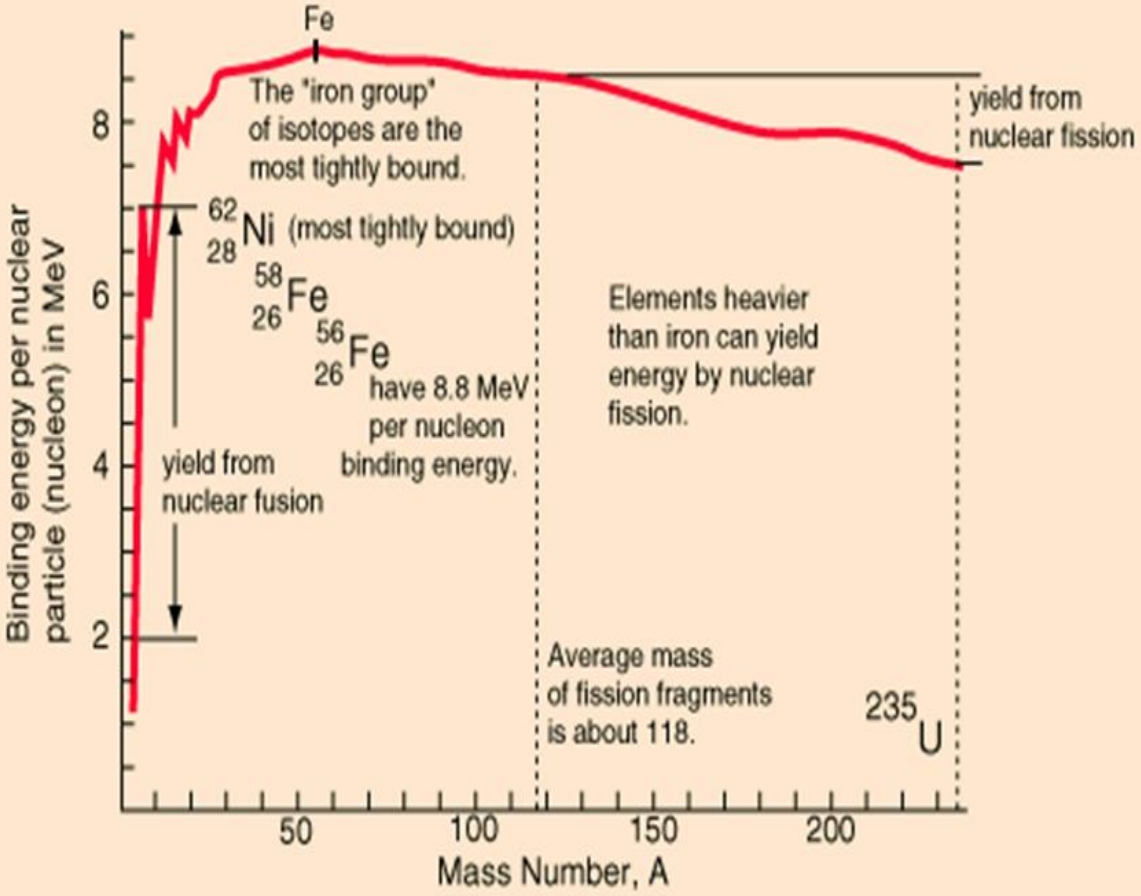
JET Programme in preparation of ITER

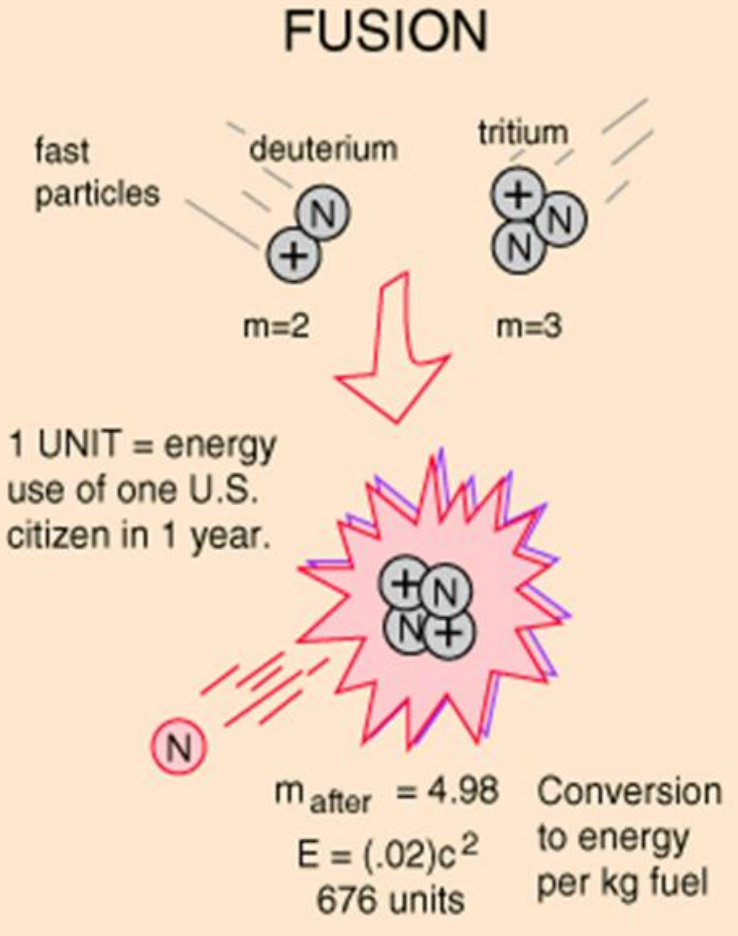


Andrea Murari and Joao Figueiredo
Eurofusion-JET PM Support Unit

The fusion process

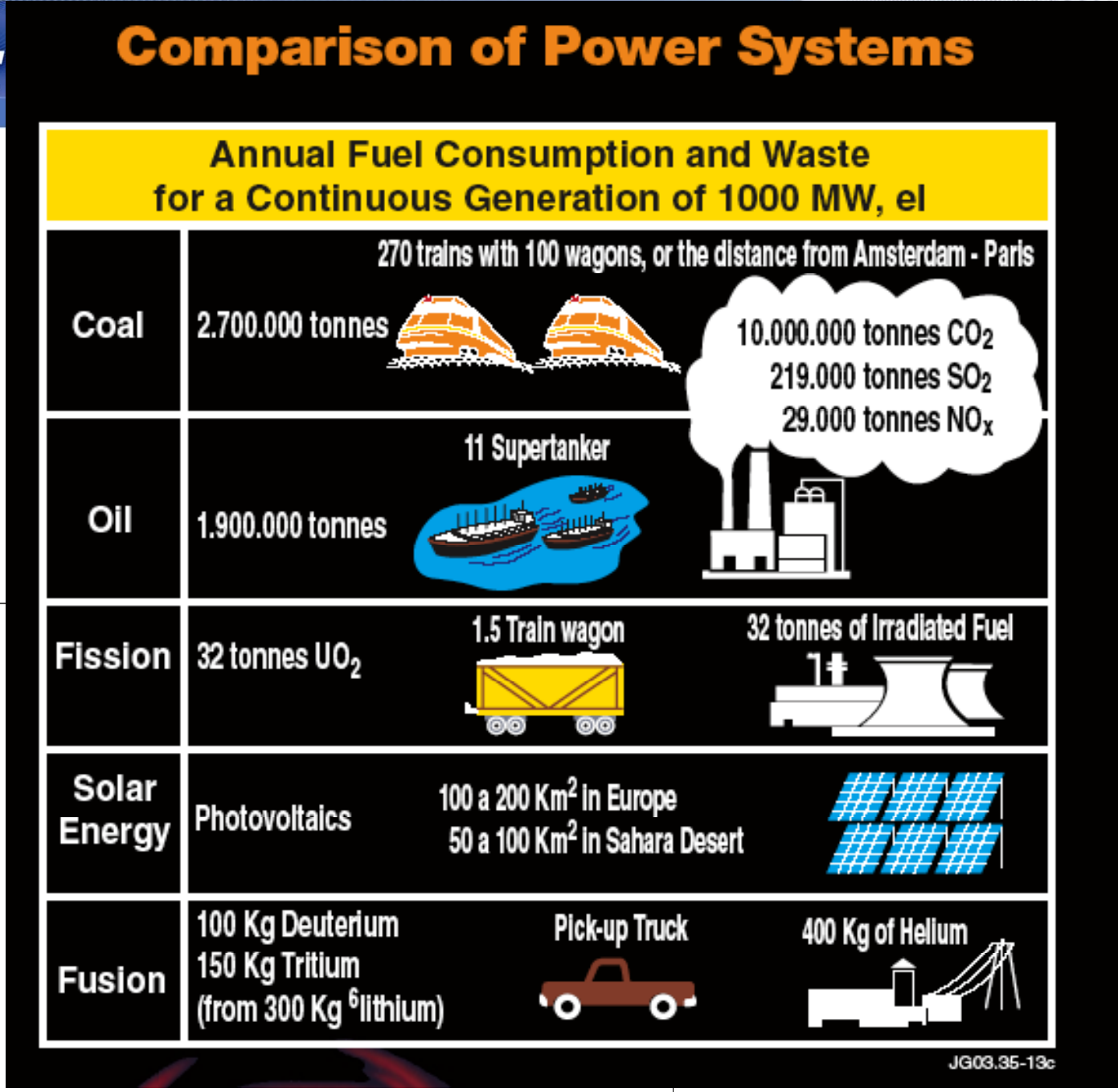
- Light nuclei fuse into heavier nuclei





- Fusion products; 14.1 MeV neutron and 3.5 MeV alpha particle

- Why fusion?
- Most exoenergetic reaction in the known universe
- Highest power density per Kg
- Lowest emission of greenhouse gases
- Technically safe



Road Map to the Reactor

P_{fusion}/P_{add}	Q ~ 0	Q ~ 1	Q ~ 0	Q ~ 10	Q ~ 30
duration	~400s	2s	~100s	400-3600s	•Continuous
self-heating	0%	10%	0%	70%	80 to 90%
bootstrap	20%	20%	>60%	<50%	>60%


JET is the world's largest magnetic fusion device
Closest in design to ITER, with unique capability to use beryllium wall materials and D-T reactor fuel
30 years of investment in high technology research and development
JET remains the most ITER-relevant device world-wide
1973
1975
1979
1983
1997
1999
2000

EURATOM : KEY ACTION FUSION Associated Laboratories, parties to EFDA

26 Associates have Contracts of Association with EC, consolidated under the umbrella of the European Fusion Development Agreement

One level of EFDA membership: Associates

EFDA Associates use JET Facilities collectively

Third-Party (non-EU MS) involvement in EFDA-JET:

- **Switzerland (1979), Japan (1988), U.S. DOE (2001), *Ukraine* (2002), Russia (2002), *Kazakhstan* (2004), Republic of Korea (2006), *India* (2009), Brazil (2009)**
- **Negotiations with China are ongoing**

Euratom Fusion Programme: Main actors

European Fusion Programme conducted under EURATOM Treaty

European Commission

- Euratom is represented by European Commission which is also responsible for overall management of fusion programme, including funding

Joint Undertaking for ITER and the Development of Fusion Energy, so-called "Fusion for Energy" (F4E) (located in Barcelona, Spain)

- Euratom Domestic Agency for ITER and Implementing Agency for "Broader Approach" projects

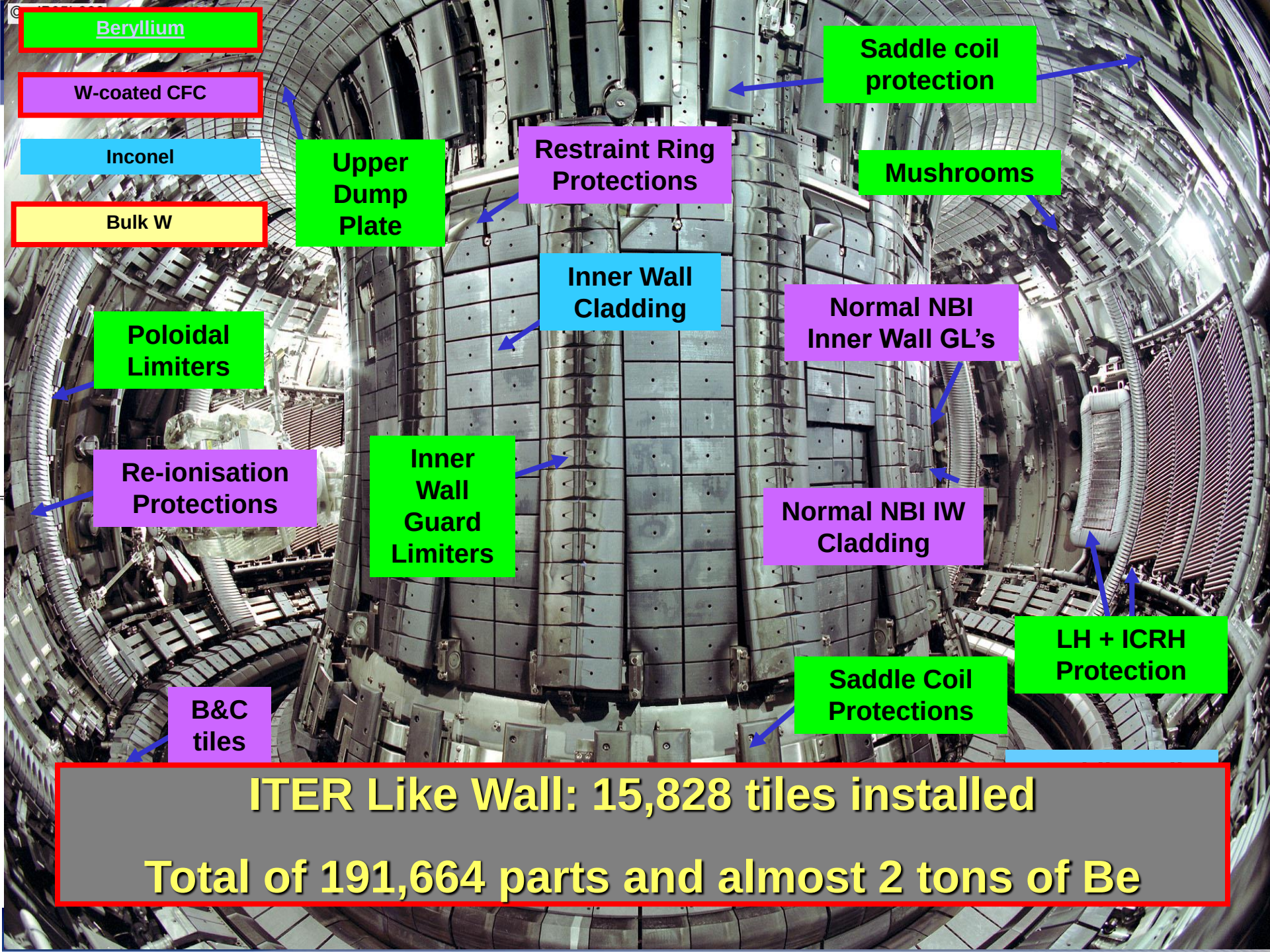
Euratom Fusion Associations

- 26 "Contracts of Association" (CoA) between Euratom and laboratories of EU Member States (plus Switzerland) → R&D performed in these laboratories

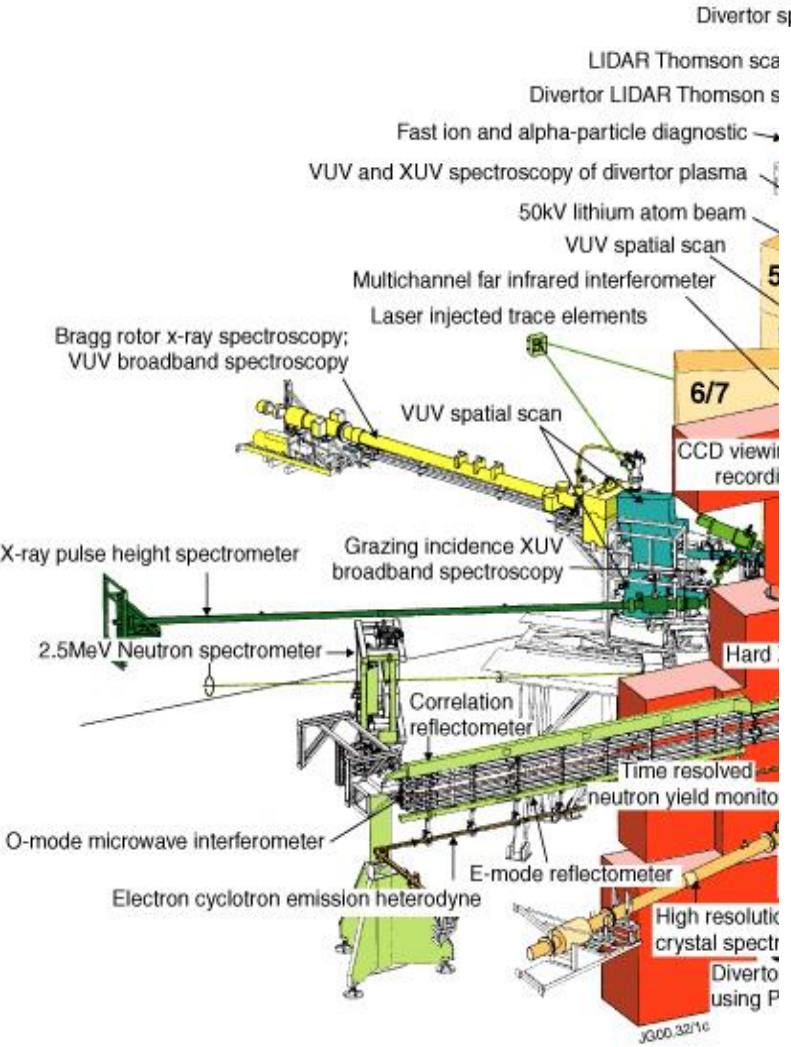
EFDA (European Fusion Development Agreement)

(located in Garching, Germany and Culham, UK)

- Multi-lateral framework **partnership agreement** among all **Associates** and Euratom, to co-ordinate physics and emerging technology research activities, **exploit collectively JET Facilities** and promote training and career development of researchers


Beryllium
W-coated CFC
Inconel
Bulk W
Upper Dump Plate
Restraint Ring Protections
Saddle coil protection
Mushrooms
Inner Wall Cladding
Normal NBI Inner Wall GL's
Poloidal Limiters
Re-ionisation Protections
Inner Wall Guard Limiters
Normal NBI IW Cladding
LH + ICRH Protection
Saddle Coil Protections
B&C tiles
ITER Like Wall: 15,828 tiles installed
Total of 191,664 parts and almost 2 tons of Be

•JET diagnostics



- All major measurement techniques in physics are represented
- At JET about <u>100 diagnostics</u> operational and about 20 more in the design phase
- About 60 new or improved systems installed during EFDA
- Already acquired <u>a maximum of more than 50 GBytes</u> of data per shot. Database: <u>more than 250 Tbytes</u>

Conclusions

- European fusion programme focuses on ITER
- JET is best machine to prepare for ITER joint exploitation, conducting highly ITER-relevant experiments and training international scientific teams from all ITER Members, thereby facilitating the start-up of ITER
- JET has a 5 year perspective, with programmatic basis to 2018 (

JET's experience in this area is of direct relevance to ITER which is being constructed at Cadarache, France