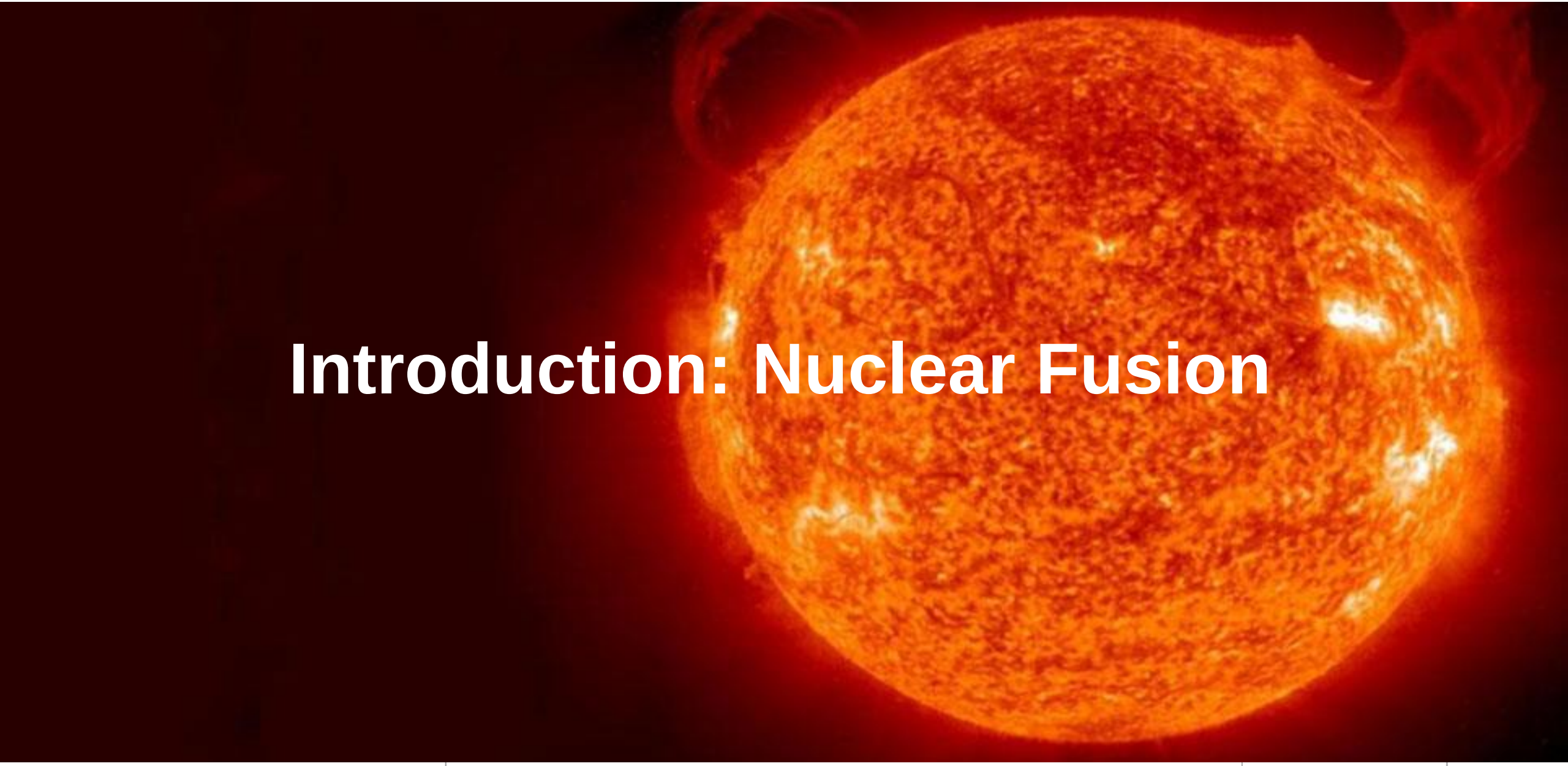
The ITER Project: international collaboration without borders

Dr. Vladimir Tronza
Manufacturing & Assembly Engineer
ITER Organization

Disclaimer: The views and opinions expressed herein do not necessarily reflect those of the ITER Organization

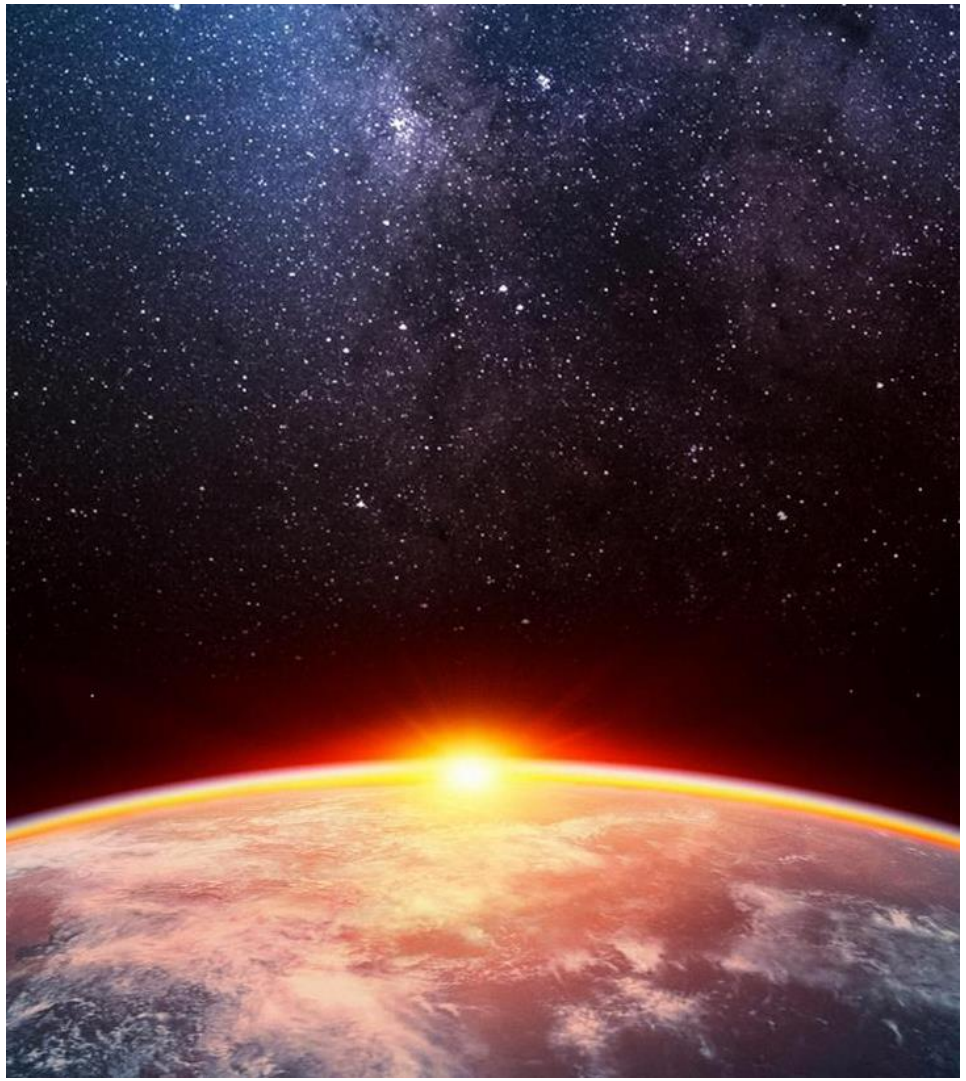
Outline

- Introduction: Nuclear Fusion
- The ITER Project
- History of the Project
- Project Organization
- People of ITER
- Summary



Introduction: Nuclear Fusion

Fusion in the Universe



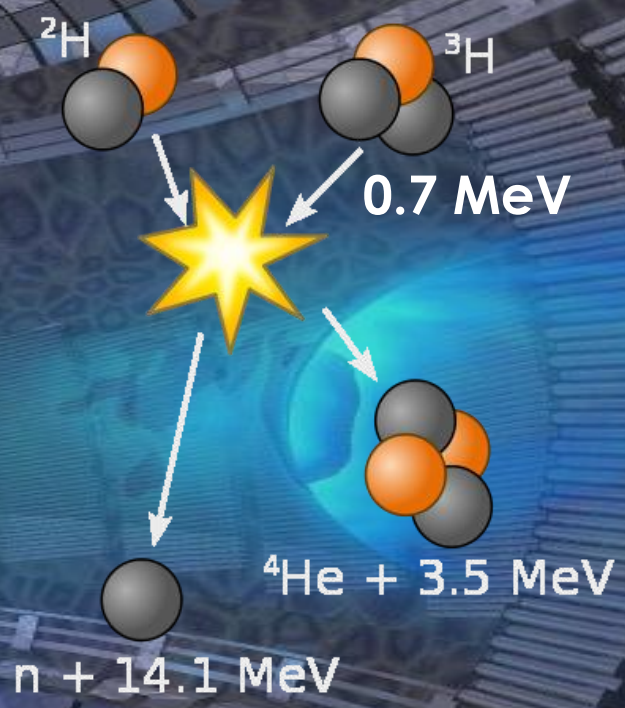
- Fusion powers the Sun and stars;
- In a fusion reaction, two light atomic nuclei combine, form a heavier nucleus and release energy;
- The Big Challenge: to reproduce a similar reaction on Earth.

Disclaimer: The views and opinions expressed herein do not necessarily reflect those of the ITER Organization

Fusion on Earth

1 gram of fusion fuels = 8 tons of oil

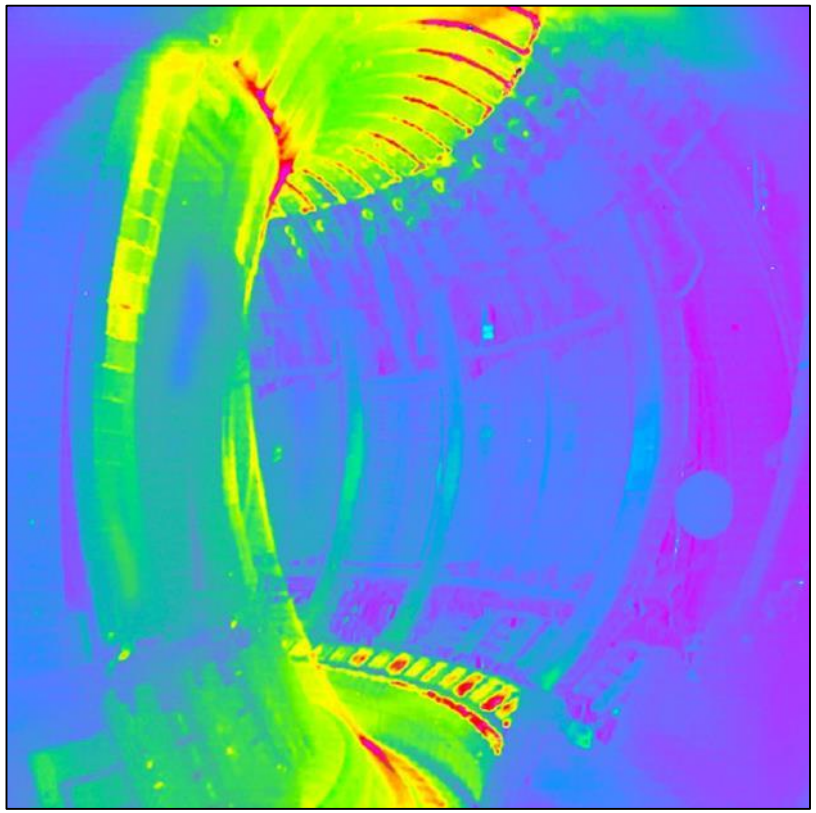
- A plasma of Deuterium + Tritium (hydrogen isotopes) is heated to more than 150 million °C.
- The hot plasma is shaped and confined by strong magnetic fields.
- Helium nuclei sustain burning plasma.
- Neutrons transfer their energy to the Blanket .
- In a fusion power plant, conventional steam generator, turbine and alternator will transform the heat into electricity.



Disclaimer: The views and opinions expressed herein do not necessarily reflect those of the ITER Organization

Courtesy of L. Coblentz

Fusion’s advantages



A plasma in the European tokamak JET

Courtesy of L. Coblentz

- **A new energy source of massive, predictable and potentially continuous or variable power complementary of the renewable energies;**
- **Safe, environmentally responsible;**
- **Almost limitless supply of fuel for hundreds of millions of years, widely distributed around the globe;**
- **No CO2 or other greenhouse gases;**
- **No long-lasting high-activity radioactive waste**

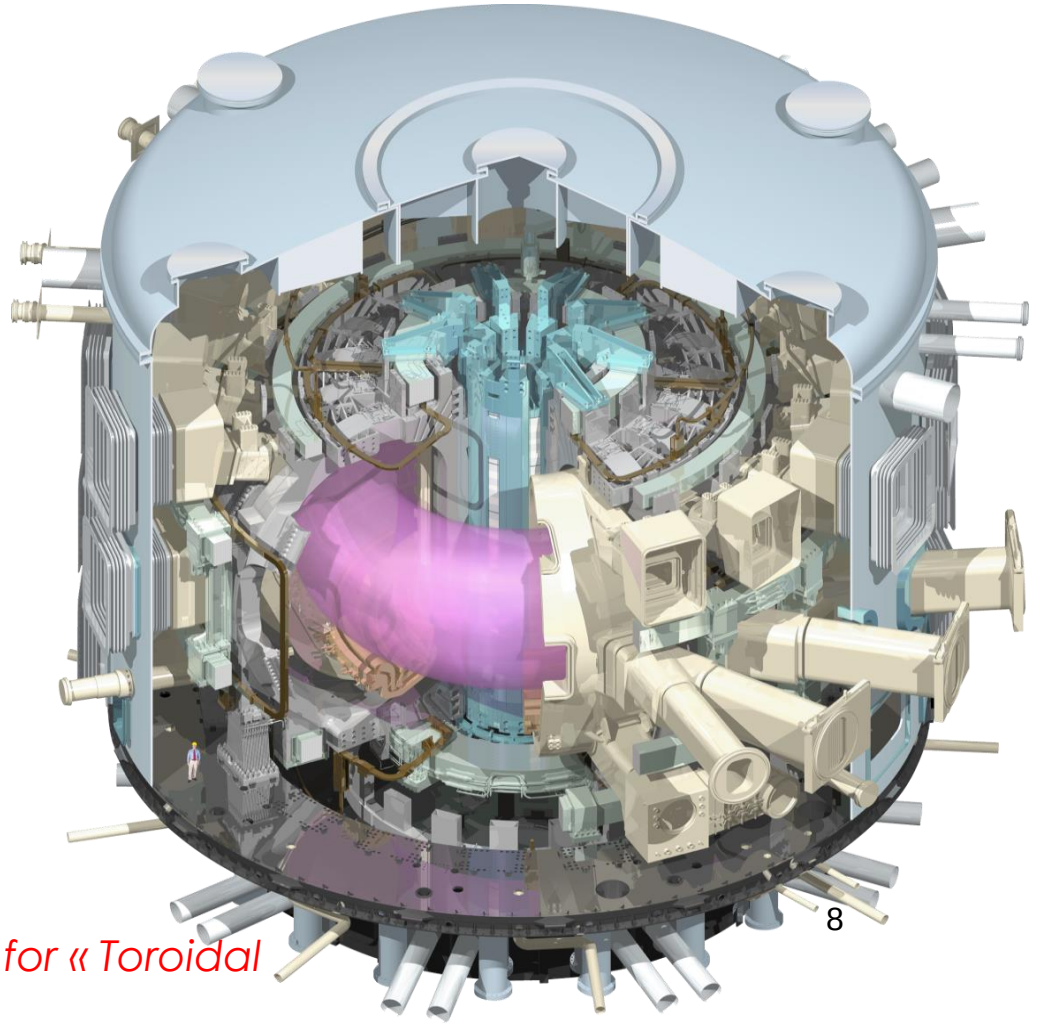
The ITER Project

What is the ITER Project?

ITER is a **Tokamak*** - machine that makes **fusion possible** on Earth.
The meaning of the Latin word ‘Iter’ is a path. The ITER Project is a way to the new energy.

ITER Mission is to demonstrate the scientific and technological feasibility of fusion power for peaceful purposes:

- to achieve **extended burn of the D-T plasma**, with steady state as the ultimate goal;
- to integrate/test all **critical fusion power reactor** technologies/components;
- to demonstrate **safety and environmental acceptability** of fusion.



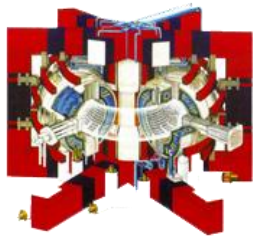
8

** Tokamak: a Russian acronym for « Toroidal Chamber, Magnetic Coils ».*

Size matters

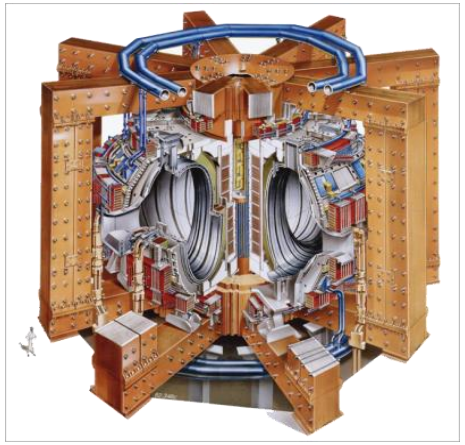
ITER weight = 3,5 x  = 23,000 tons!

Although ITER is not the first Tokamak being built in the world, it is the largest and the most advanced one so far.



Tore Supra (CEA-Euratom)

V_{plasma} 25 m^3
P_{fusion} ~0
$P_{heating}$ ~15 MW
T_{plasma} ~400 s
I_{plasma} ~ 1.7 MA

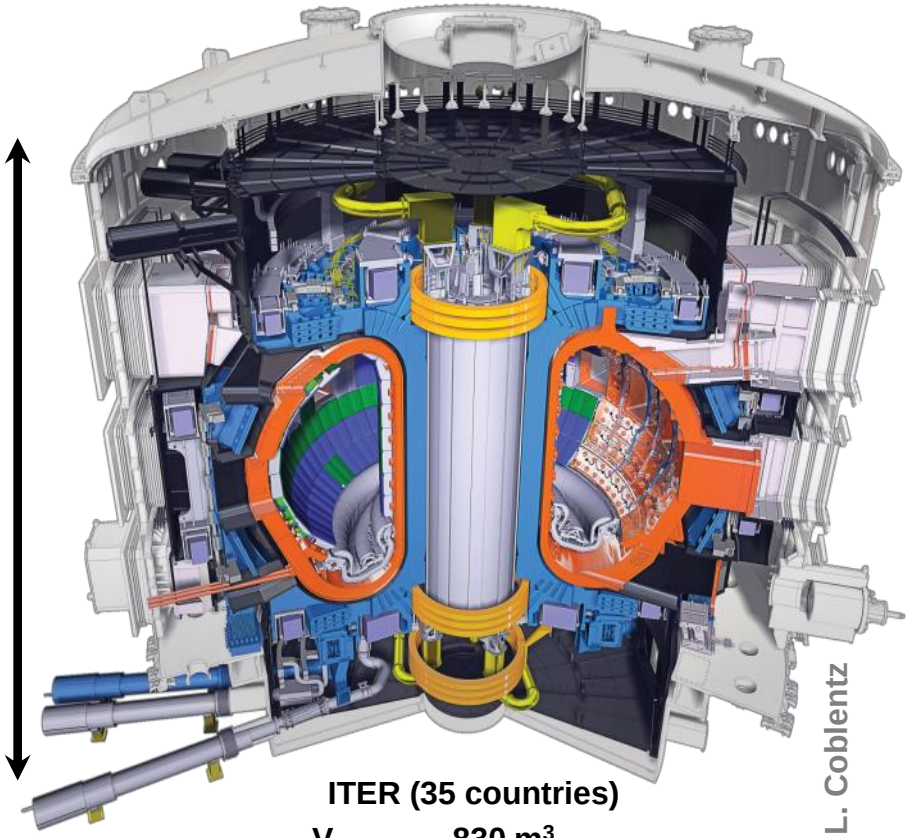


JET (Europe)

V_{plasma} 80 m^3
P_{fusion} ~16 MW
$P_{heating}$ ~23 MW
T_{plasma} ~30 s
I_{plasma} ~ 5-7 MA

29 meters in dia

28 meters tall

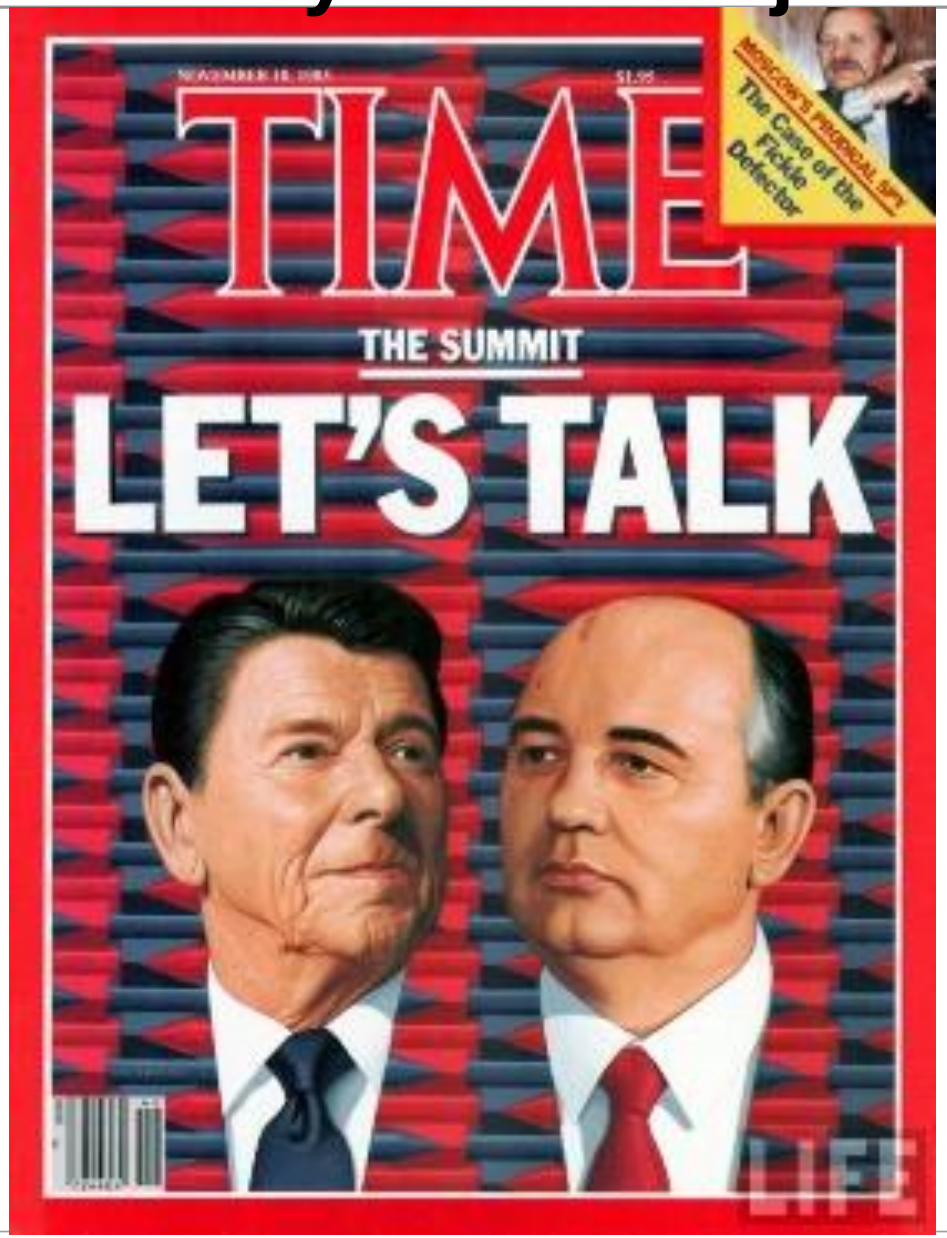


ITER (35 countries)

V_{plasma} 830 m^3
P_{fusion} ~500 MW
$P_{heating}$ ~ 50 MW
T_{plasma} > 400 s
I_{plasma} ~ 15 MA

Courtesy of L. Coblentz

History of the Project



History of the project

November 1985
At the Geneva Summit President Reagan and Secretary General Gorbachev give a decisive political push to an international collaboration on fusion "*for the benefit of all mankind*"…

2005
India joins the Project

October 2007
The ITER organization is oficially established

Today
Construction on the ITER site and components manufacturing by the ITER Members are progressing.

1980s | 1990s | 2000s | 2010s

1988
Conseptual design work begins with participation of EU, Japan, Russia and the US

2003
China and Republic of Korea join the Project

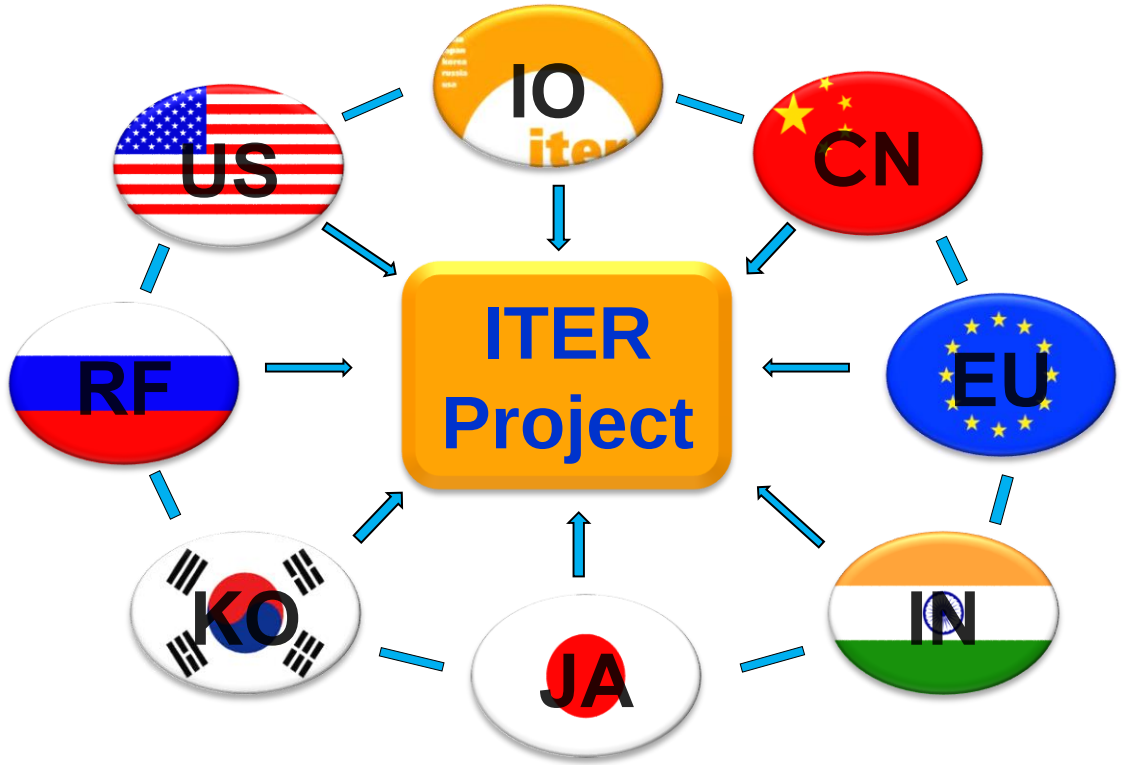
November 2006
The ITER agreement is officially signed by 7 parties at the Elysée Palace in Paris

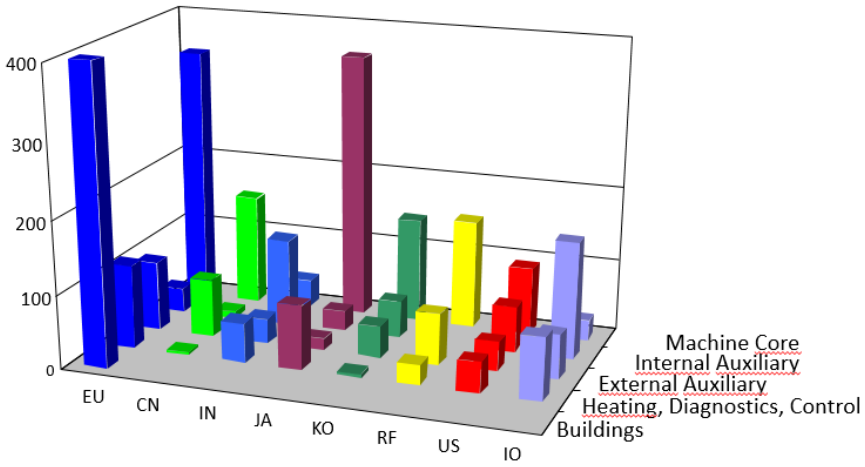
August 2010
Construction works begin on Cadarache site.

Project Organization

How does ITER work?

- The 7 ITER Members make cash and in-kind contributions (90%) to the ITER Project. They have established Domestic Agencies to handle the contracts to industry.
- The ITER Organization Central Team manages the ITER Project in close collaboration with the 7 Domestic Agencies.
- The ITER Members share all intellectual Property generated by the Project.

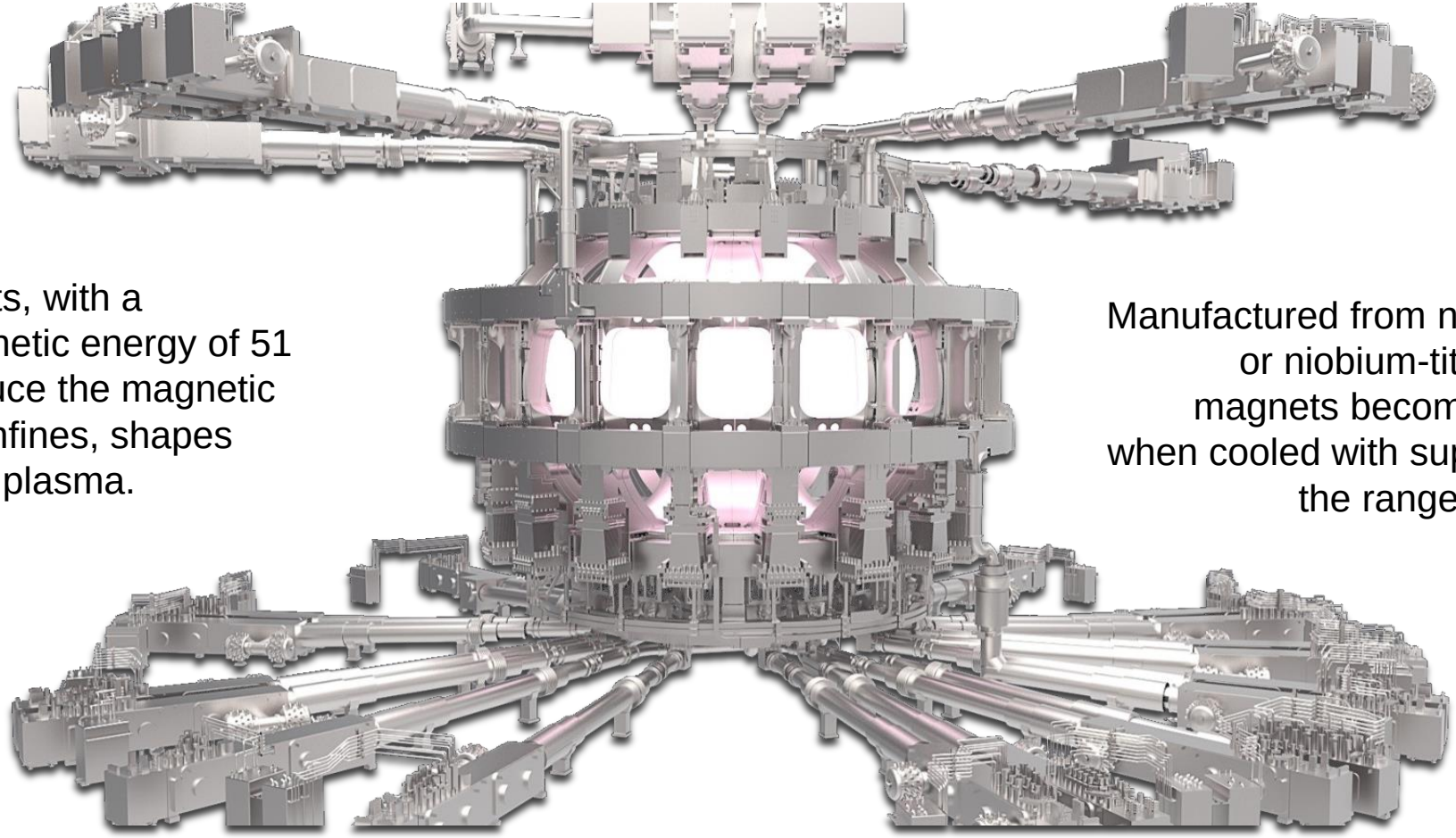




- Europe's share, as Host Member, is ~ 45% (construction and manufacturing).
- China, India, Japan, Korea, Russia and the United States each have responsibility for ~ 9% of procurement packages.

Courtesy of L. Coblentz

Magnet system: ultimate collaboration



10,000 tons of magnets, with a combined stored magnetic energy of 51 Gigajoules (GJ), produce the magnetic fields that initiates, confines, shapes and controls the ITER plasma.

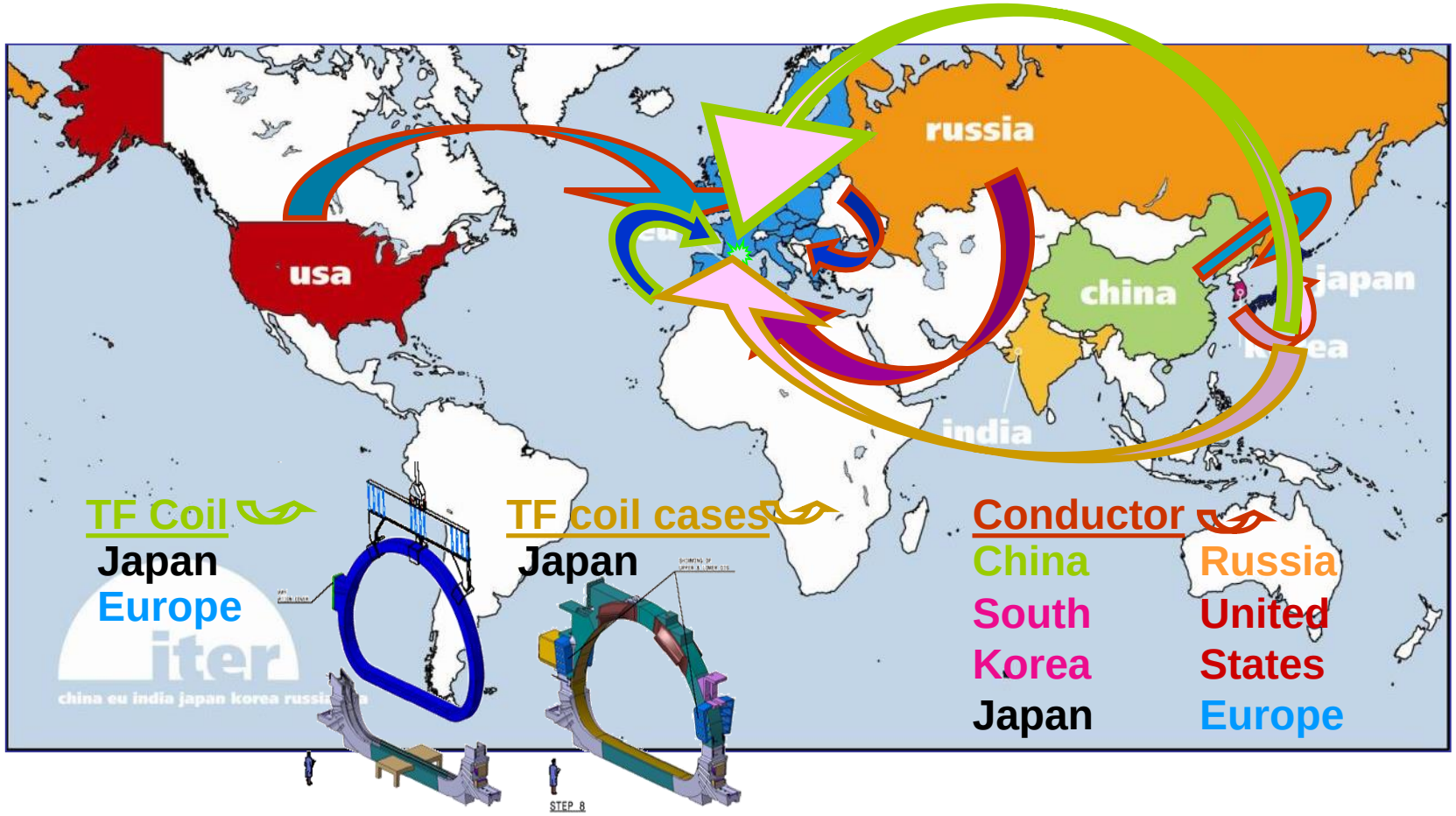
Manufactured from niobium-tin (Nb3Sn) or niobium-titanium (Nb-Ti), the magnets become superconducting when cooled with supercritical helium in the range of 4 K (– 269 °C).

6 out of 7 ITER members work closely together to create the most powerful magnet system in the world and demonstrate unexampled level of collaboration.

Courtesy of L. Coblentz

Manufacturing Geography

(The TF Coils example)

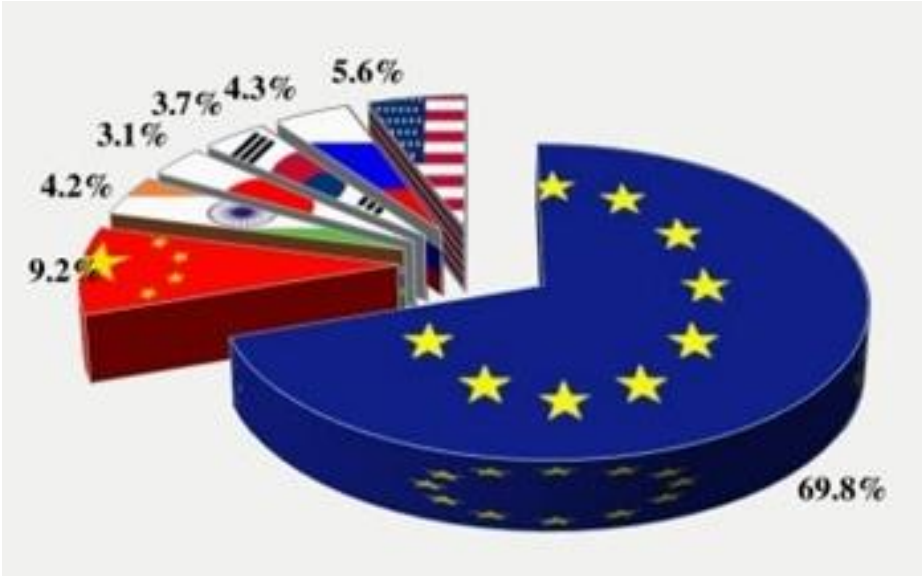


Courtesy of L. Coblentz

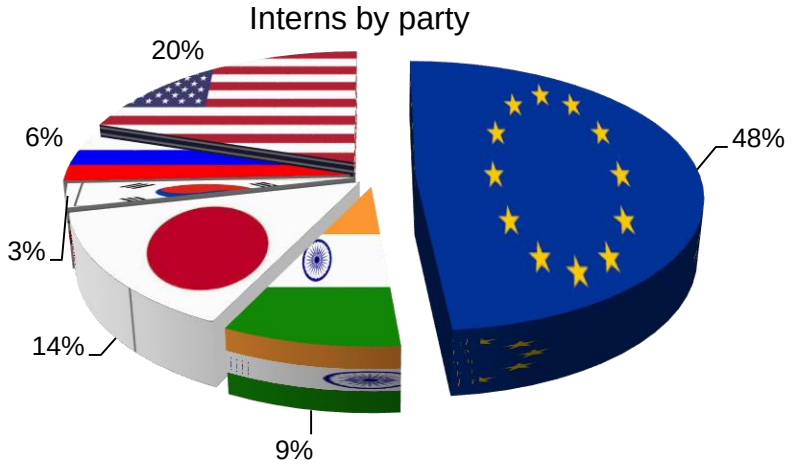
People of ITER

Who makes it happen?

- Today more than 850 people are employed by the ITER Organization;
- Representatives of 7 ITER members bring their expertise in various fields forming multicultural environment;
- 35 nationalities speaking 40 languages are brought together by a common goal;
- Joint efforts for benefit of the whole humankind.

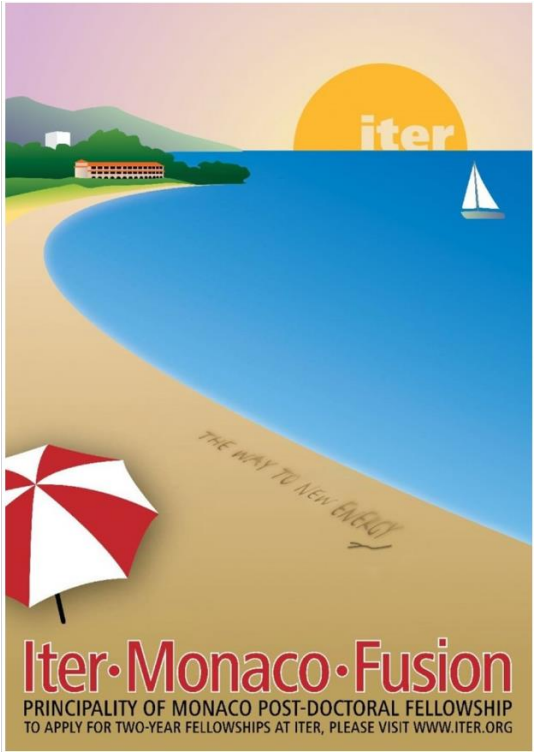


Opportunities for students and young engineers



- The Internship Program was launched five years ago;
- The program has been recognized as a useful scheme both for the IO and for students;
- More than 120 students from the member states participated in the program during last 3 years.

- A Partnership Arrangement with the Principality of Monaco provides the financing for Postdoctoral Fellowships in science and technology at ITER;
- Five young scientists or engineers from the member states or Monaco are selected every two years for two-year assignments to the ITER Organization;
- The Postdoctoral Fellowship Program allows young researchers to participate in one of the great scientific and technical challenges of the 21st century and to work closely with leading experts in fusion science and technology within a unique international setting.



Summary

- The ITER project was born with a spirit of an international collaboration and this spirit keeps growing;
- Today the ITER Project as incredible example of international collaboration for the technical and scientific purpose;
- More than 35 nations all around the globe are working for the success of the project;
- The member states representatives bring the best expertise to the ITER site. Together they form a truly multicultural environment;
- International environment as great opportunity for young people to gain international experiences and basis of global collaboration.

Thank you for your attention