

Energia prin fuziune nucleara, la indemana ?

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Joi 30 Octombrie 2014*

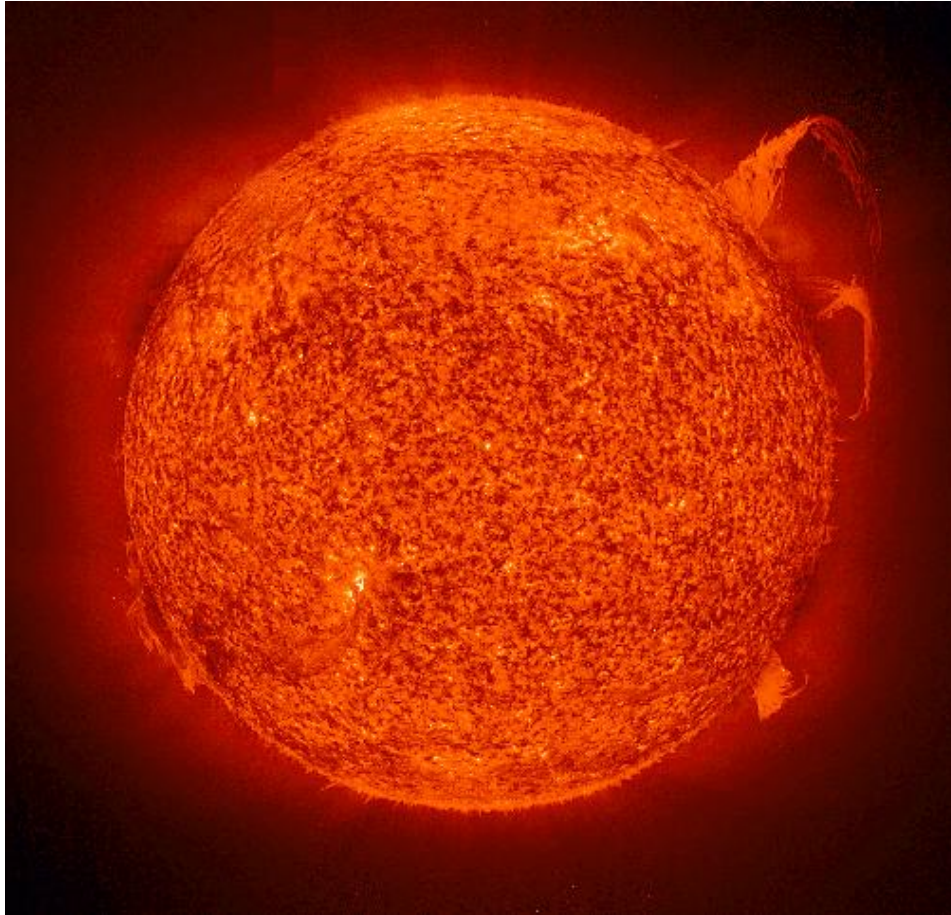
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Agentia Britanica de Energie Atomica (UKAEA)**

Fuziunea nucleara

Motorul stelelor si energia viitorului

Puterea fuziunii nucleare



Atomii necesita, pentru a fuziona, temperaturi si energii foarte mari capabile sa invinga fortele de repulsie.

Materia devine o.....

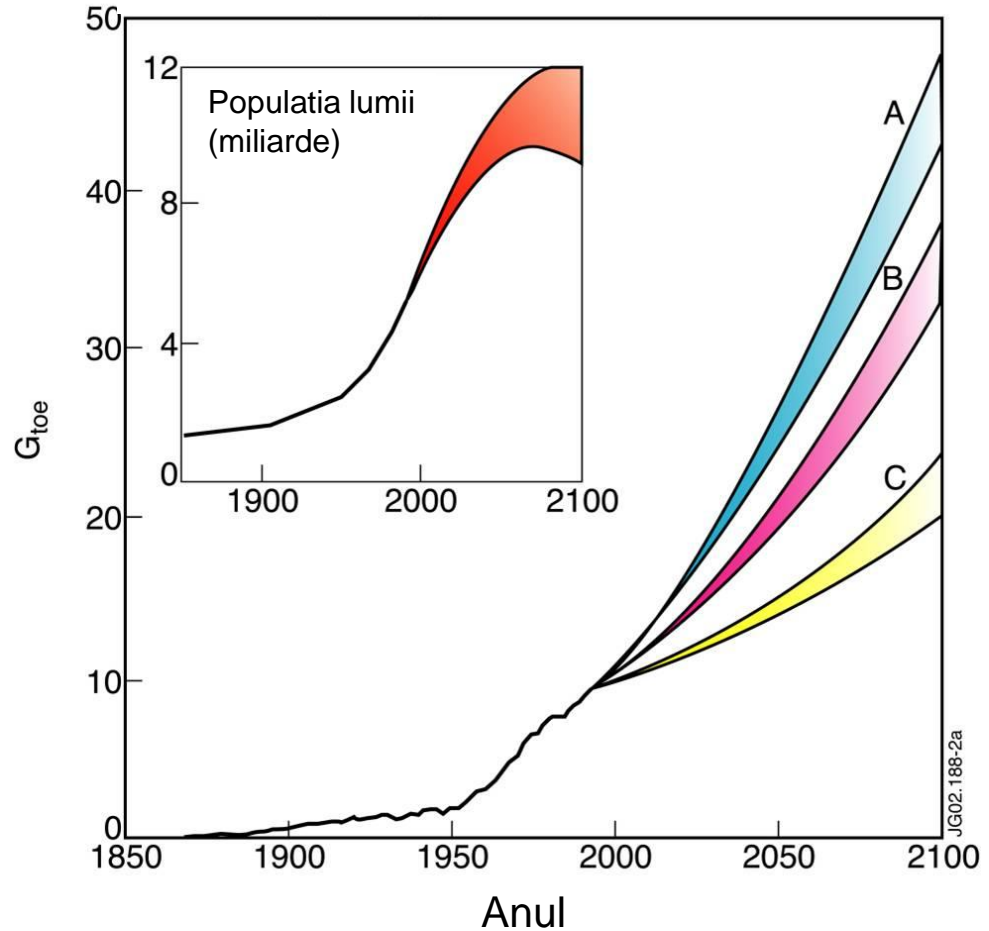
PLASMA

Gravitatia face acest proces posibil in Soare

Cresterea globala a populatiei si a consumului de energie

Populatia lumii si cererea de energie sunt in crestere continua chiar si in cele mai optimiste scenarii

Evolutia globala a consumului de energie

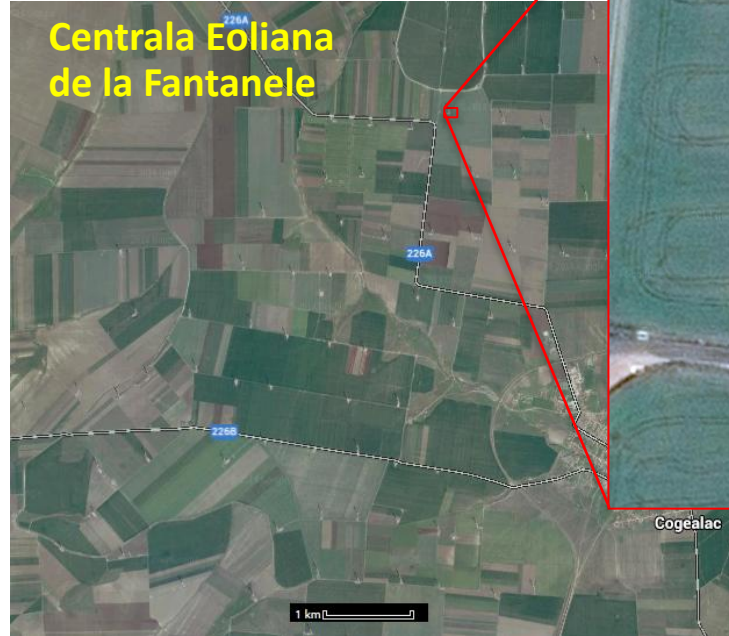


Cum vom produce energie electrica in viitor ?



Combustibili fosili

Surse regenerabile

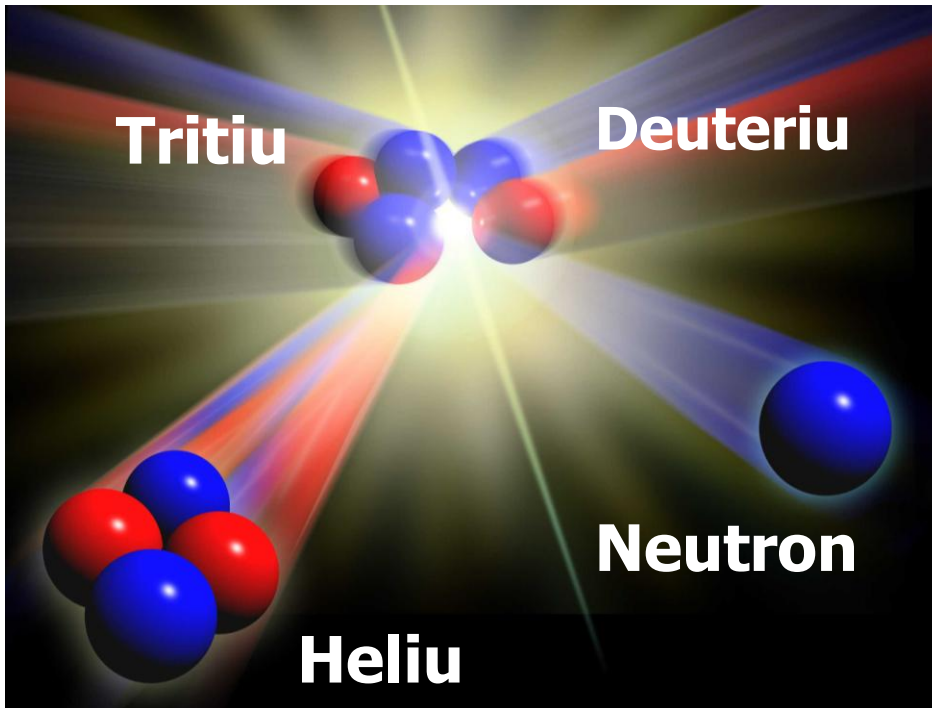


**Fisiune
nucleara**



Reactia de fuziune nucleara

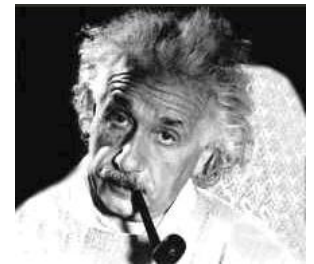
...are loc cand doua nuclee sunt fortate sa fuzioneze, producand un nucleu mai greu si un neutron



Masa combinata a celor doua nuclee mici este mai mare decat masa nucleului rezultat.

Diferenta de masa s-a transformat in energie.

$$E = mc^2$$



Cum se poate face ?

1) Gravitate

**2) Fuziune
inertiala
(laseri)**

**3) Fuziune prin
confinare
magnetica**

**O sa discutam numai de a
treia optiune !**

Ce conditii trebuie indeplinite sa o facem aici pe Pamant ?

Legea lui Lawson (Lawson criterion)

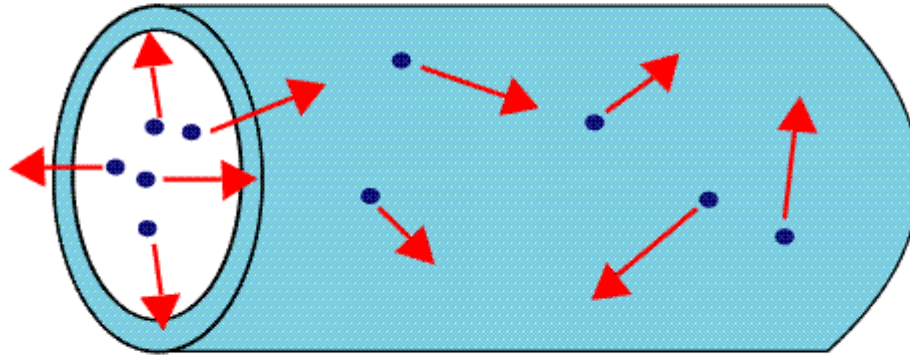
Reprezinta conditiile necesare ca un reactor de fuziune sa ajunga in starea de autosustinere(ignition) a reactiei de fuziune

$$nT\tau_E > 3 \times 10^{21} \text{m}^{-3} \text{keVs}$$

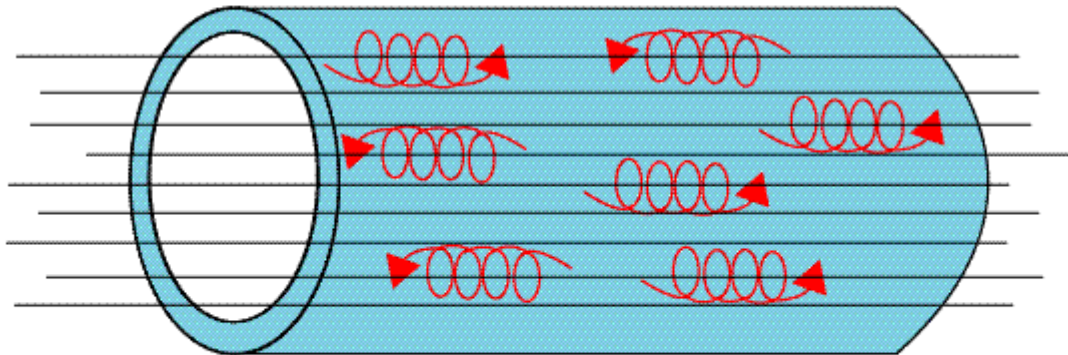
- **Densitati mari (n)**
- **Temperaturi inalte(T)** **200 milioane grade Celsius**
- **Timpi de confinare ridicati (τ_E)**

Fuziunea prin confinare magnetica

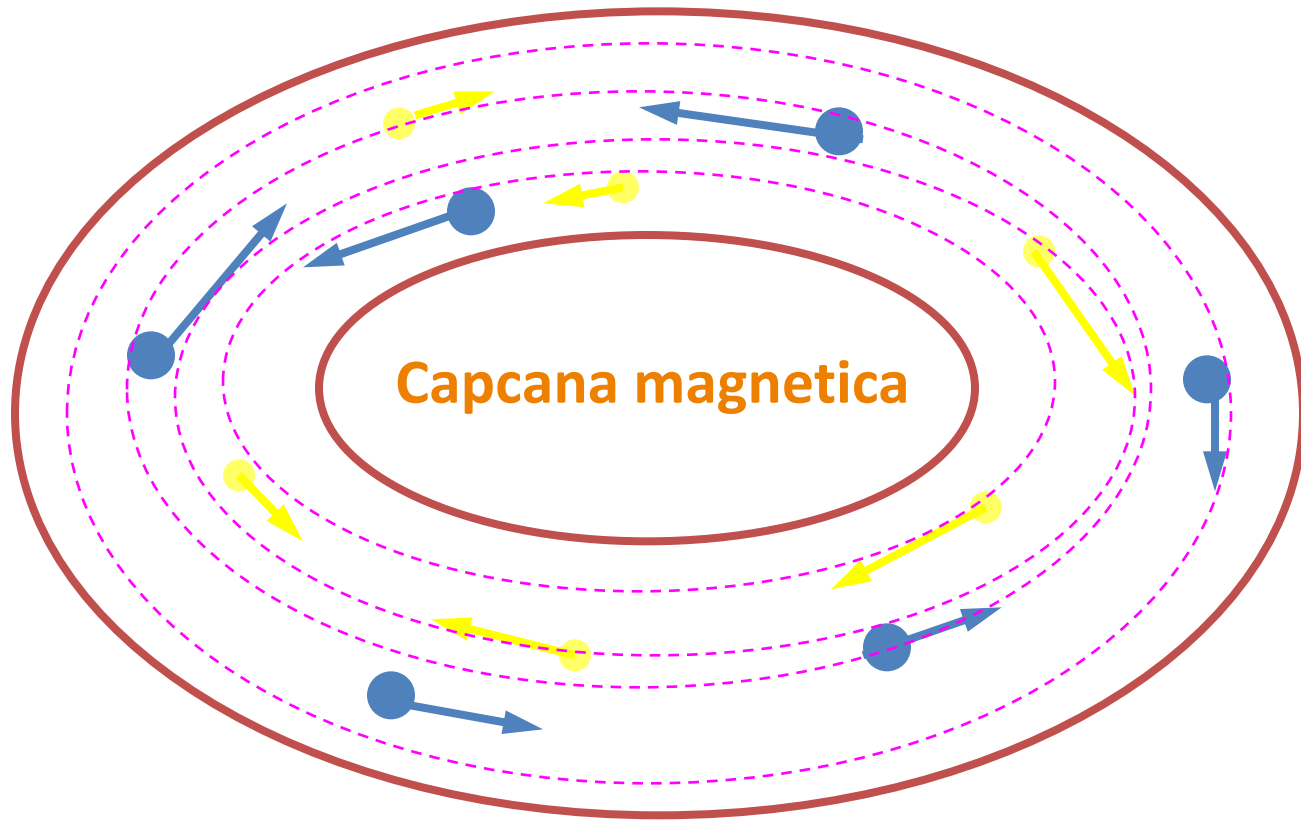
Fara camp magnetic



Cu camp magnetic

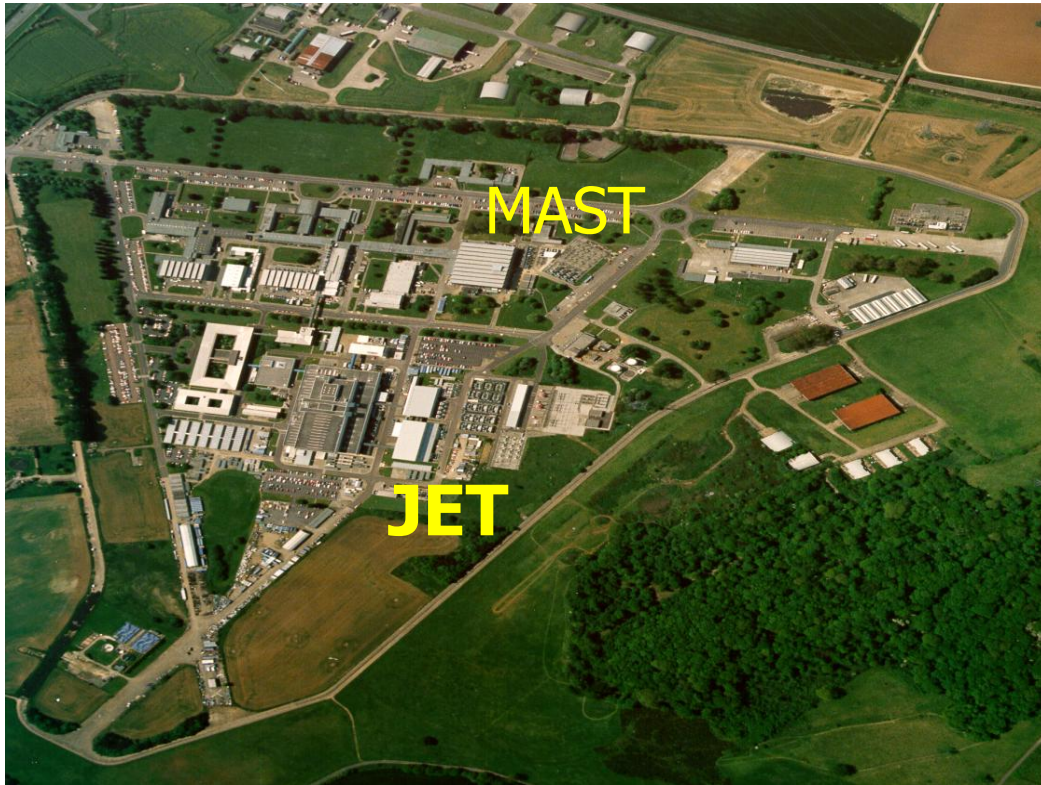


Fuziunea prin confinare magnetica



Termenul stiintific: torus sau camera toroidala

Institutul de Cercetare in domeniul Fuziunii Nucleare de la Culham(CCFE)



- Peste 1000 de angajati
- Doua experimente de fuziune: JET(Eurofusion) si MAST(UK)
- Au fost primii care au masurat temperatura plasmei in experimentul Tokamak T3(URSS) in anul 1969.



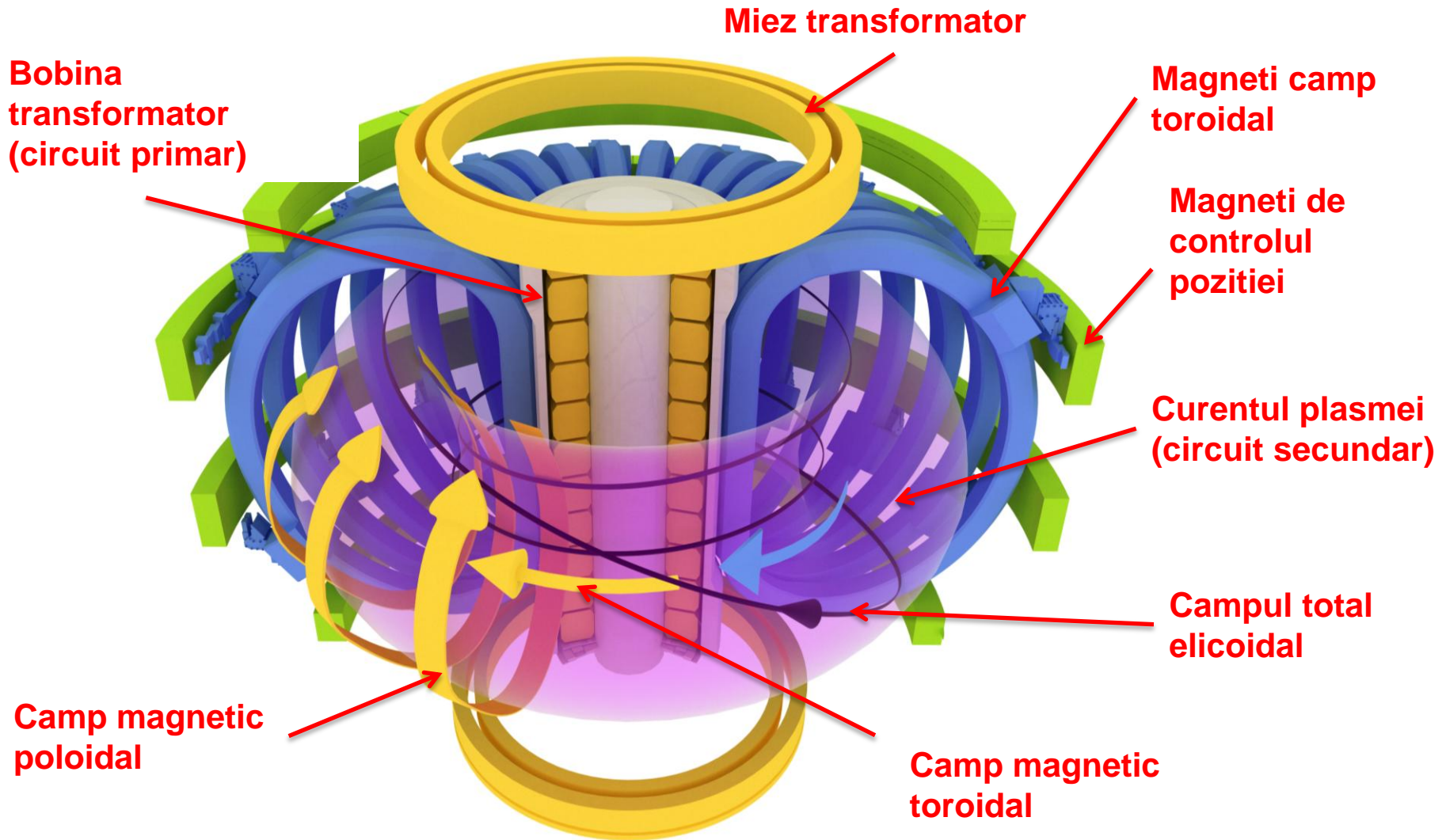
Spectrometrul britanic a masurat temperaturi de 11 milioane grade Celsius.

- Centre noi in constructie
 - Studiul materialelor pentru reactorul demonstrativ DEMO
 - Centru de robotica RACE

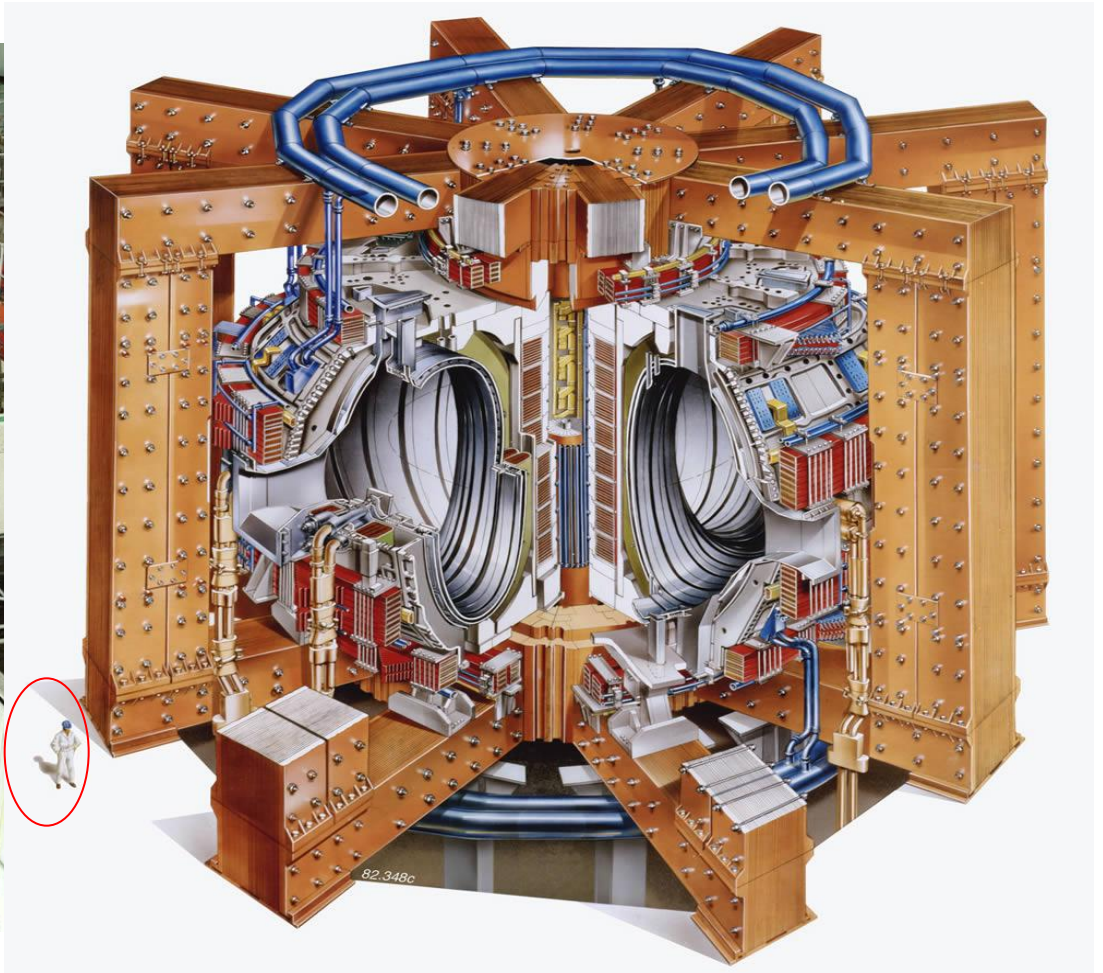
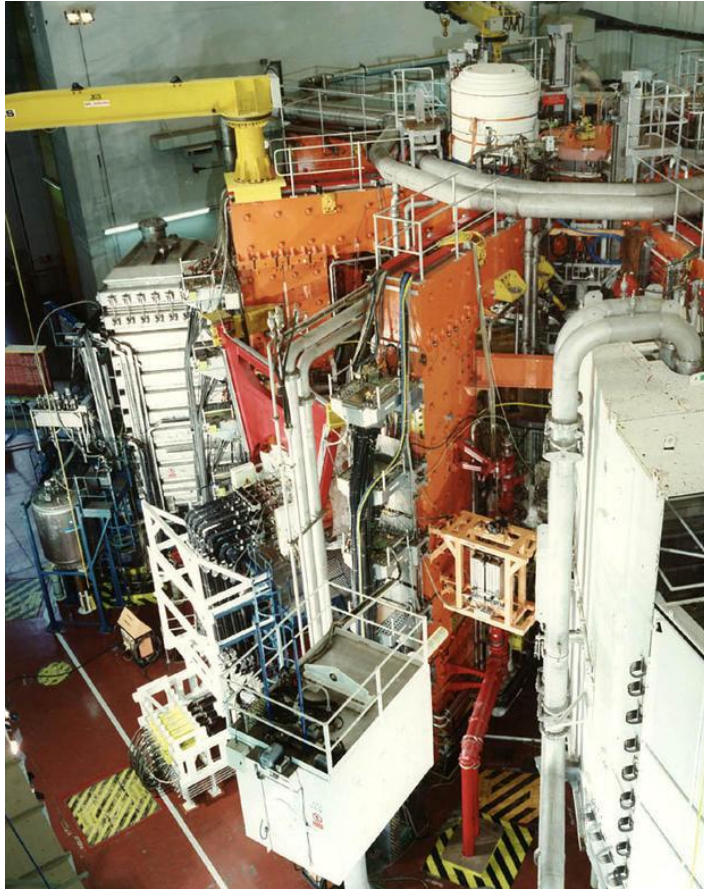
Locatie: Oxfordshire, Marea Britanie.

Parte a Agentiei Britanice de Energie Atomica (UKAEA)

Masina /instalatie/ numita Tokamak



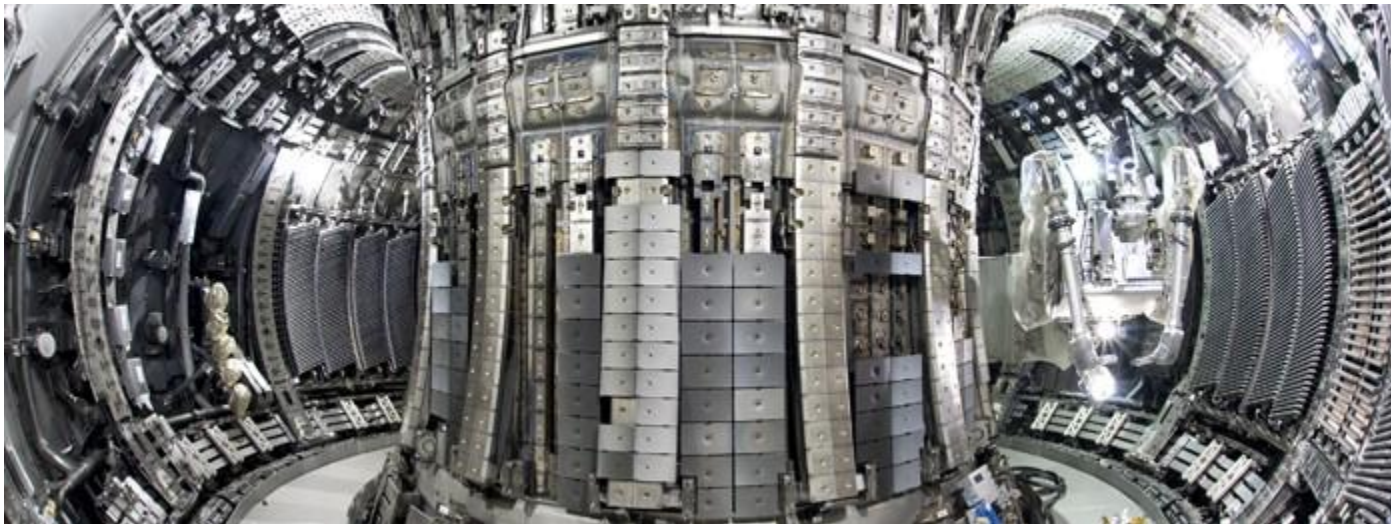
JET Tokamak



Totul s-a schimbat la JET



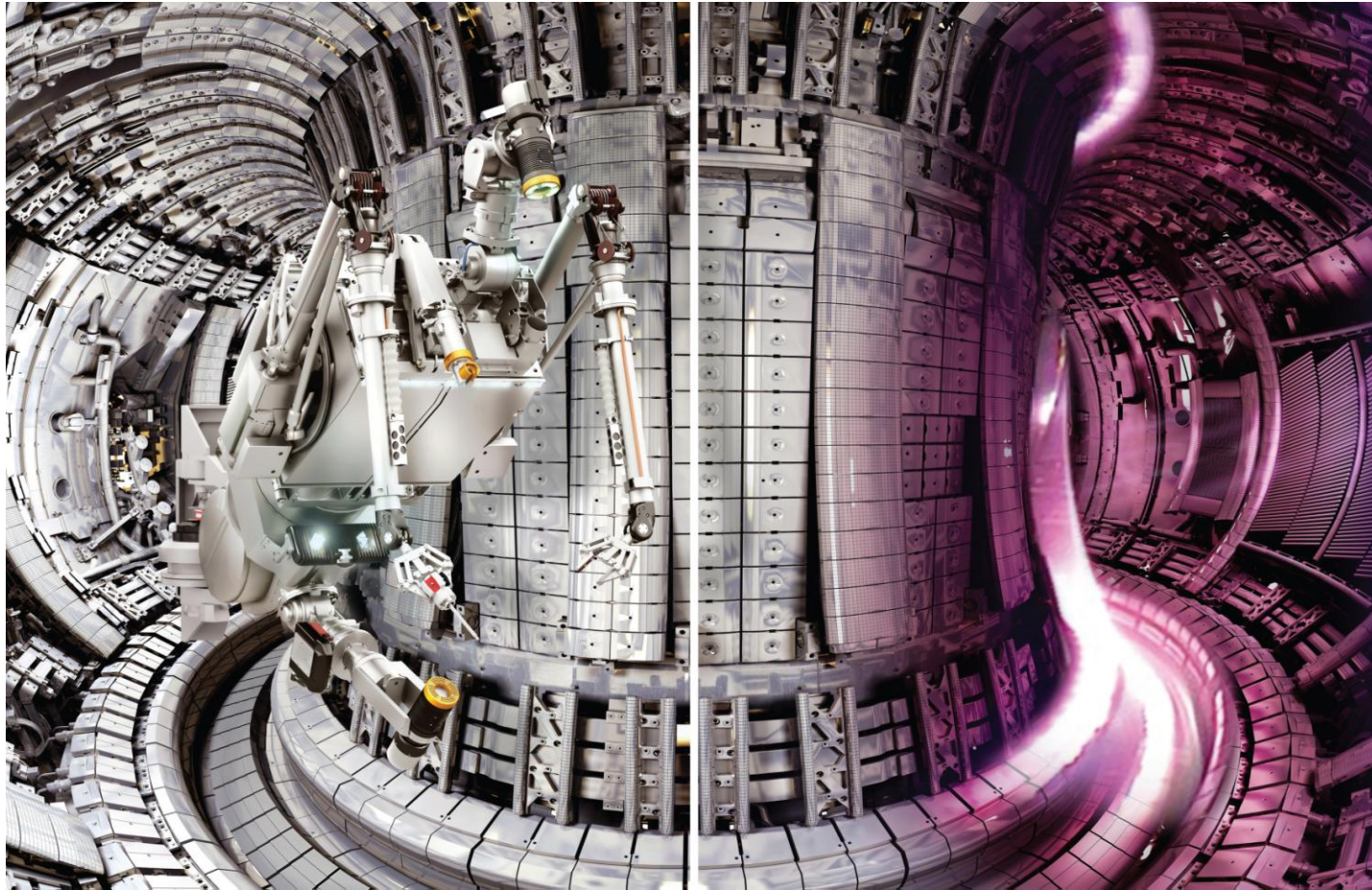
**Camera de
vid initiala
din otel
(1983)**



**Camera de
vid acoperita
de caramizi
de grafit*
•(2000)**

* Similare cu cele
folosite la scutul termic
de la navele spatiale

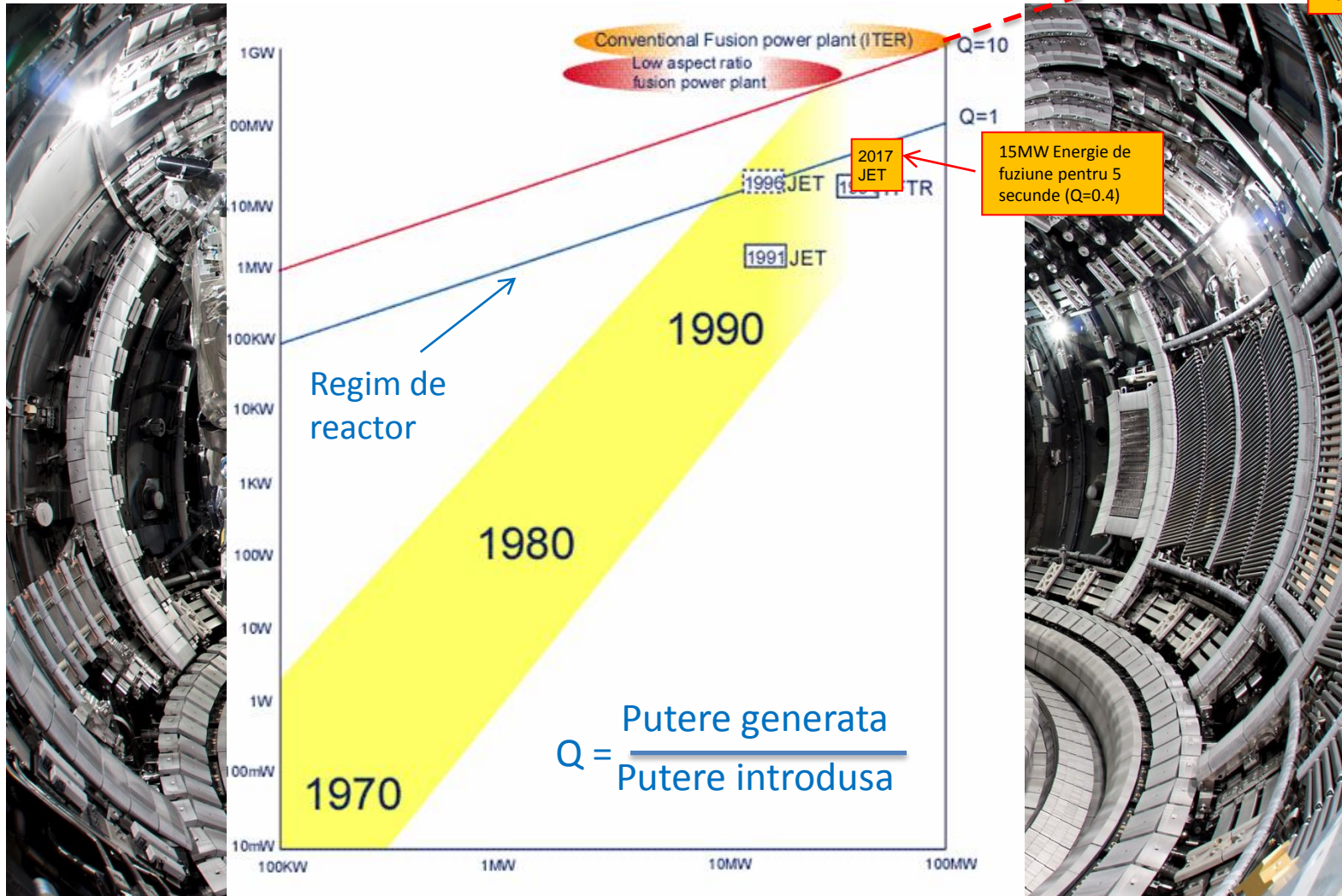
Totul s-a schimbat la JET



Camera de
vid acoperita
de caramizi
de beriliu si
tungsten
(2012)

....90% din
caramizi sunt
facute in..
Romania la
Magurele si
Mioveni

Progresul cercetarii in fuziune



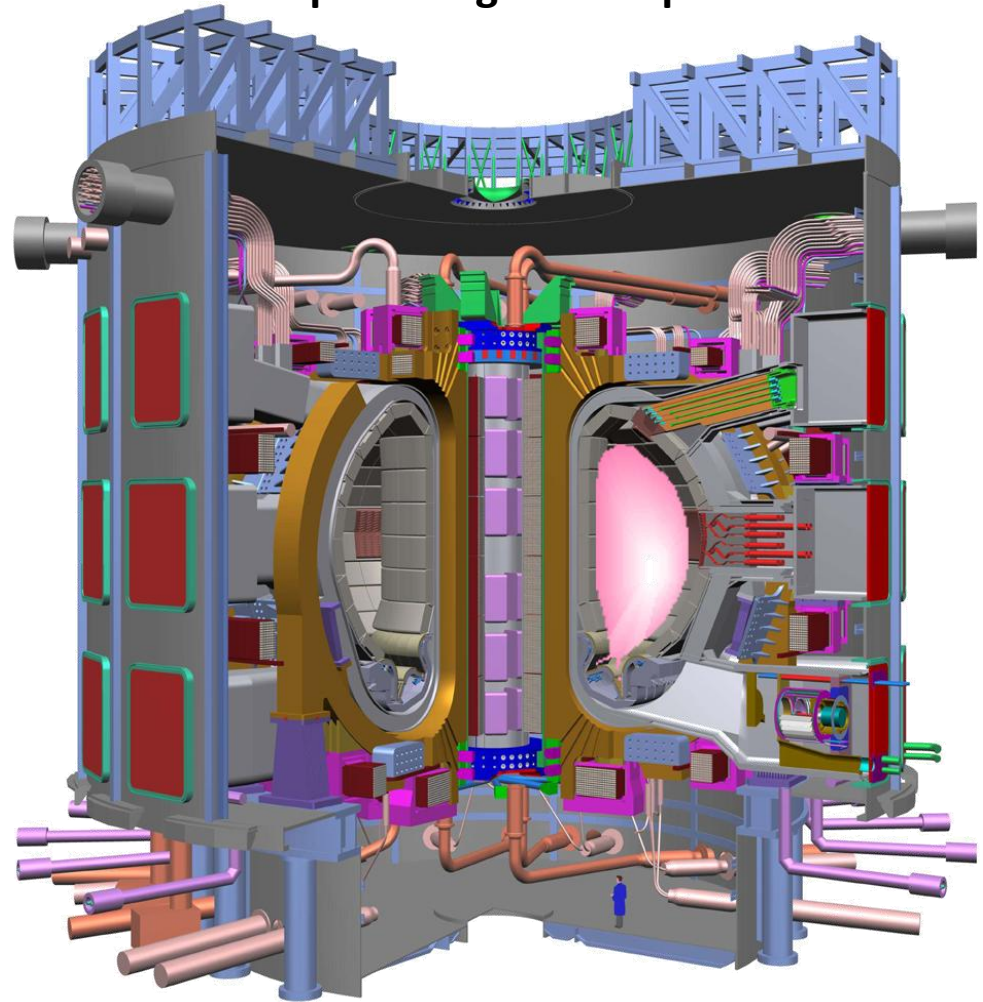
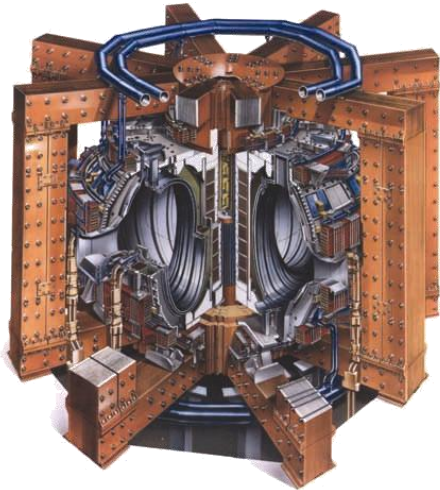
ITER – Pasul urmator

50 MW puterea de pornire

500 MW puterea generata pentru 400 secunde

De ce ne trebuie unul
mai mare ?

Pentru a controla turbulentele,
plasma trebuie sa aiba un
volum foarte mare*

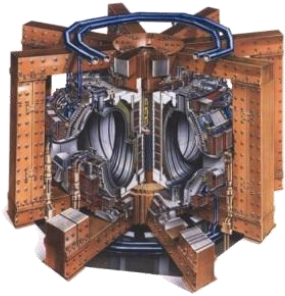


*diametrul plasmei mult mai mare ca orbita de
giratie a particulei α care este de 25cm)

DEMO– Pasul decisiv

Comunitatea stiintifica din EU are un program in fuziunea nuclear foarte agresiv pentru realizarea primului prototip COMERCIAL in 30 de ani (DEMO).

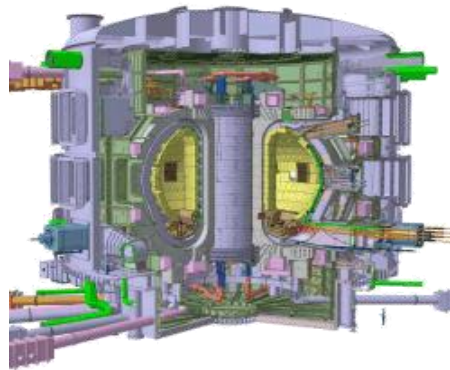
1983- ?



JET

Joint European Torus
 $V=90\text{m}^3$
 $Q=0.65$
 $P=16\text{MW}$
 $T=30\text{ s}$

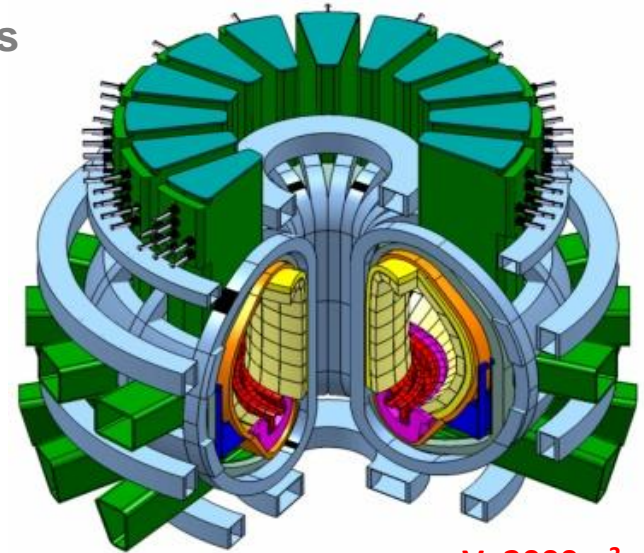
2020s



ITER

$V=840\text{m}^3$
 $Q=10$
 $P=500\text{MW}$
 $T=400\text{s}$

2040s



DEMO

$V=2000\text{m}^3$
 $Q=15-40$
 $P=2\text{GW}$
 $T=24\text{ ore}$

Cercetare
fundamentala

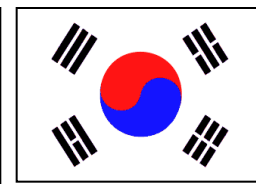
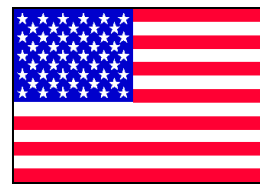
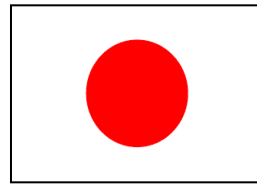
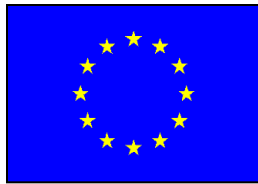
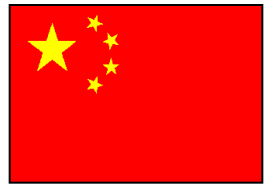
Cercetare
Tehnologica

ITER – stadiul actual



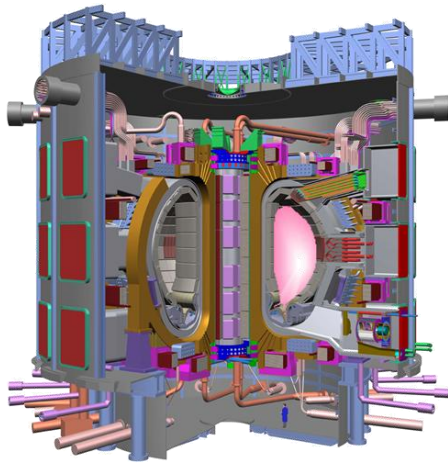
- Costul de constructie este de 14.4 miliarde de Euro
- Locatie: Franta, Cadarache
- Constructia a inceput in 2008
- Functional in anii 2020..

Cladirea reactorului este lunga de 1km



Merita efortul ?

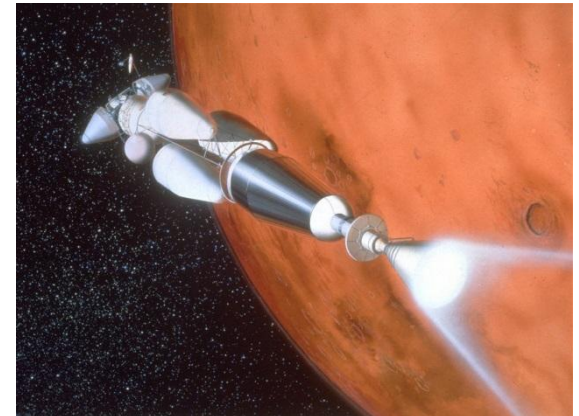
Costul
ITER-ului:
€14 miliarde



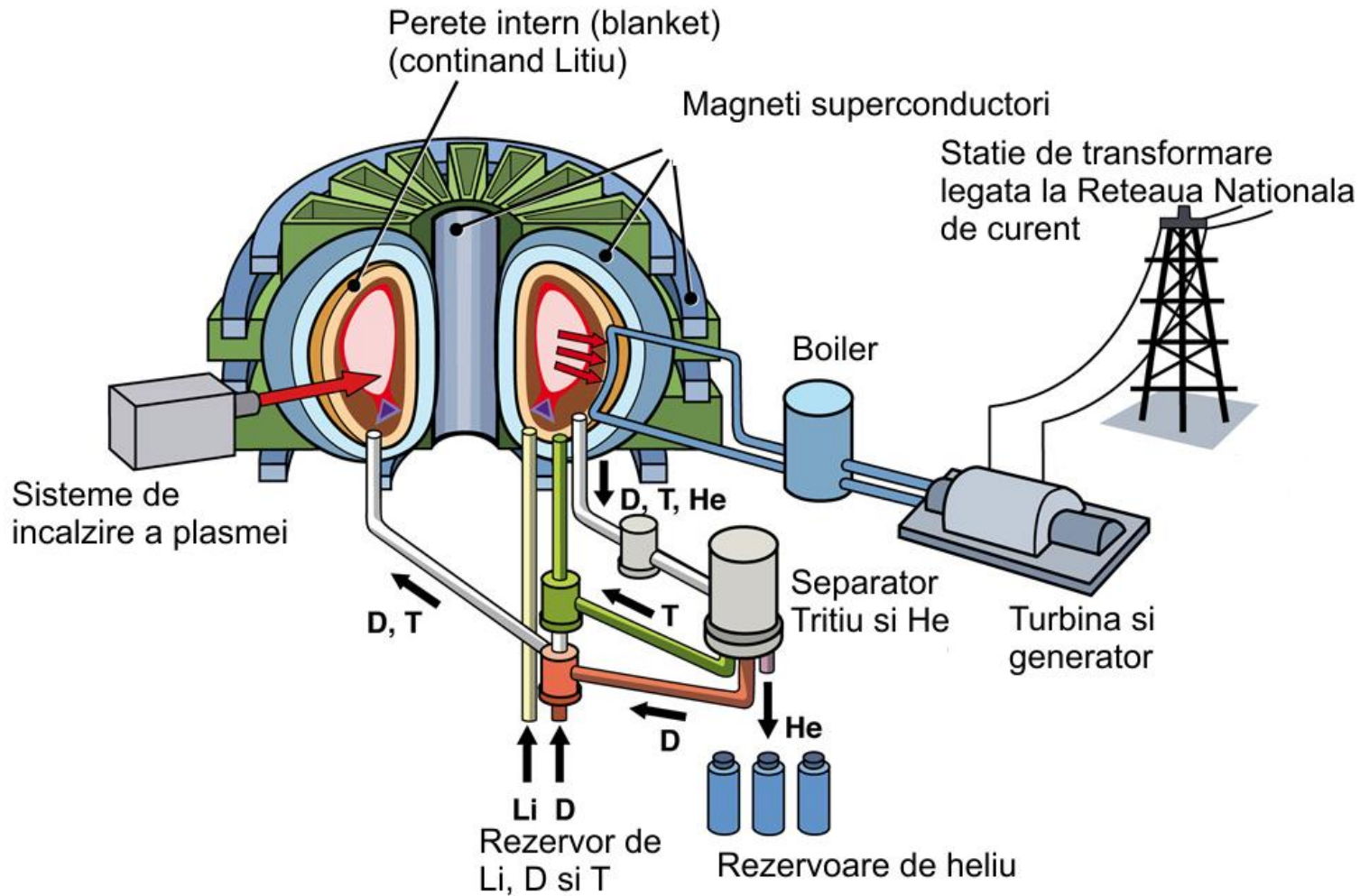
Olimpiada de la
Beijing:
€29 miliarde



Primul om pe
Marte:
€160 miliarde



O centrala de energie electrica de fuziune



Avantajele fuziunii nucleare....

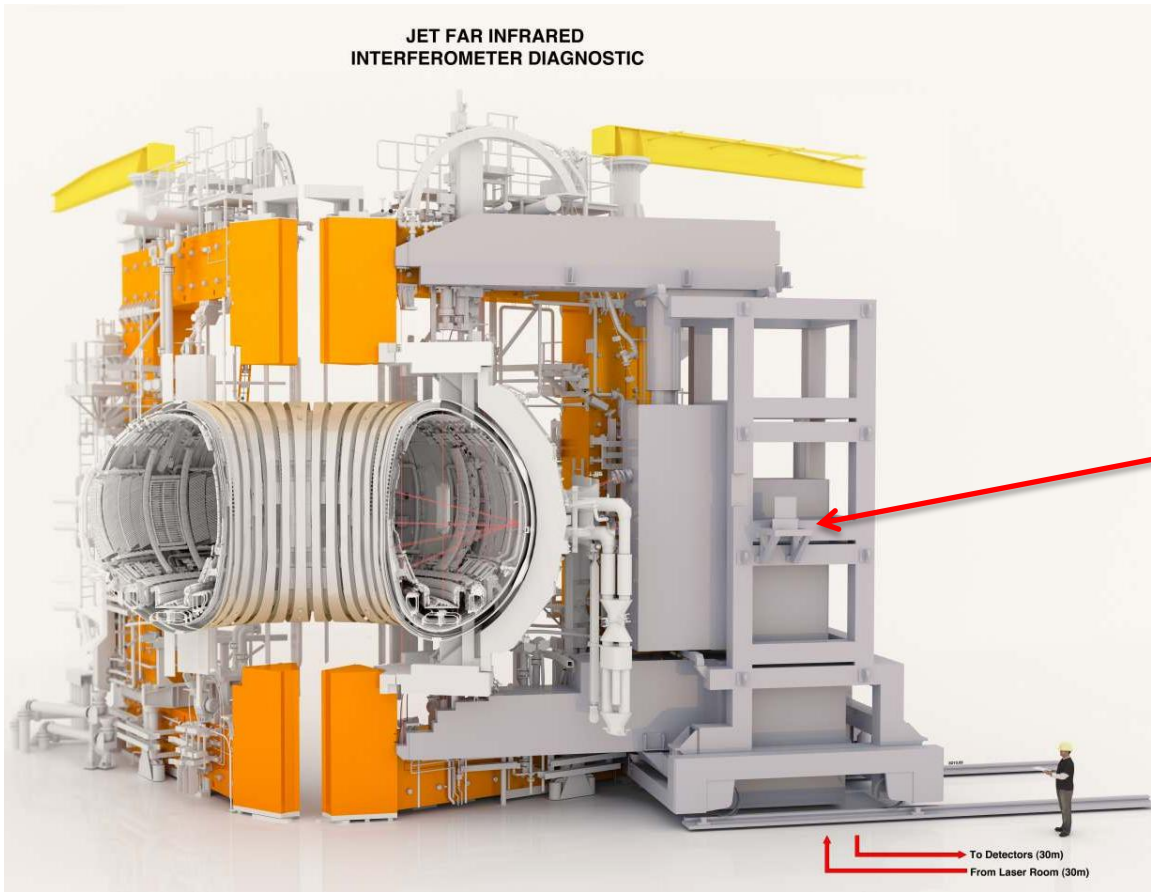
- Impact minimal asupra naturii (emisie zero de CO₂)
- Nu exista riscuri de siguranta (de ex. explozie necontrolata)
- Fuziunea nu produce deseuri cu radioactivitate pe termen lung
- Combustibilii sunt practic nelimitati
- Deuteriul se gaseste in



Locul meu in fuziune

Raspund de un sistem de diagnostica pe baza de laseri: interferometrul/polarimetrul pentru masurarea densitatii plasmei si a structurii magnetice interne

JET FAR INFRARED
INTERFEROMETER DIAGNOSTIC



Parametri sistem:

Laseri: infrarosu indepartat
(cu lungime de unda 195 si 118 micrometri)

Canale: 8

Componente: 5000

Cale optica: 80m

Cea mai mare componenta: turn de 14m inaltime, masa de 70 tone

Timpi de functionare: 16 ore/zi

Clasificare: diagnostica esentiala pentru operarea JET-ului

Pentru mai multe informatii:

www.ccfе.ac.uk

www.euro-fusion.org



Facebook
Culham Centre for
Fusion Energy



Twitter
[@fusionenergy](https://twitter.com/fusionenergy)

Stiri "Oxford Mail" din 22 Oct 2014



http://www.oxfordmail.co.uk/news/11549615.Watch__Baffled_by_nuclear_fusion__It_s_child_s_play_as_Lego_video_explains_all/

Va multumesc pentru atentie !

Intrebari ?

