



Fusion Physics Application

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EDGeS Summer School
2009, Budapest

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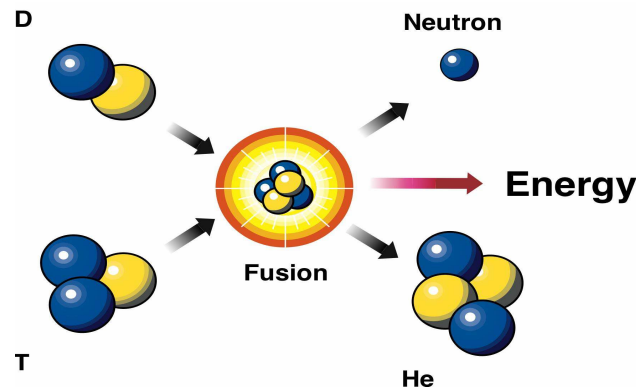
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Nuclear fusion



Fusion: process by which multiple atomic particles join together to form a heavier nucleus. Nuclear fusion occurs naturally in stars.



To avoid electrostatic repulsion, high temperature (10 KeV \sim 100.000.000 °C)

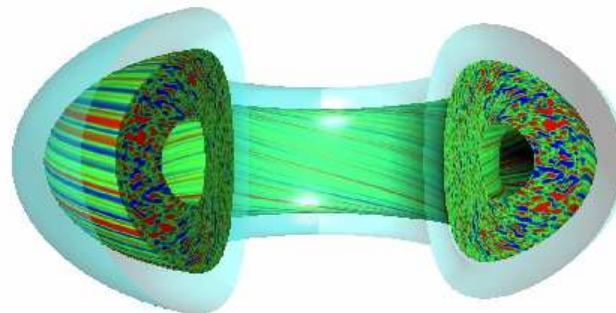


Nuclear fusion



□ **Plasma**: ionized gas, in which a certain proportion of electrons are free. It is considered to be a distinct state of matter.

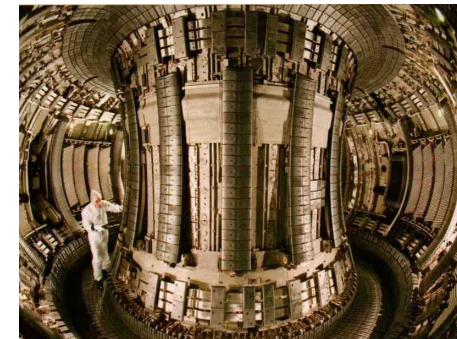
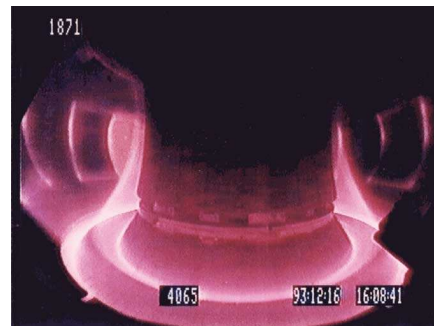
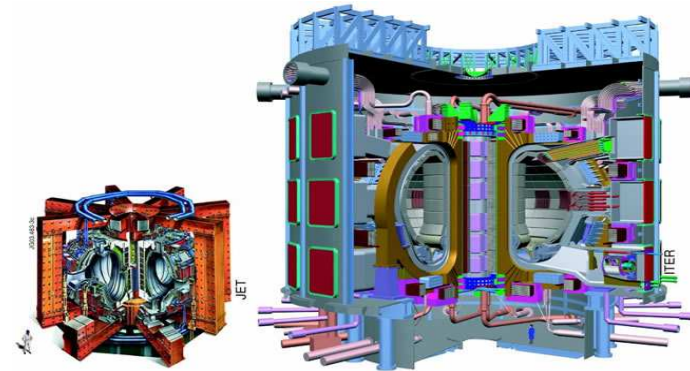
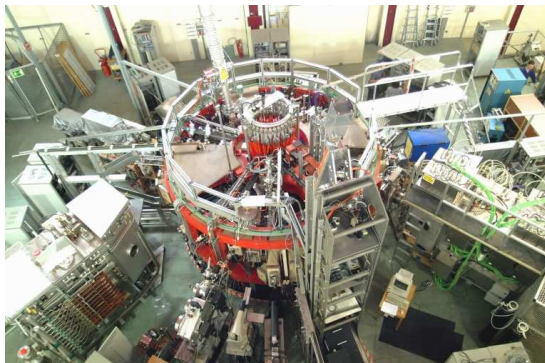
- Electrically conductive
- Low number of collisions
- Collective Phenomena



Nuclear fusion



- Physicist try to confine plasma in **devices**, placed correctly by electromagnetic fields without melting the container.
 - ▶ **Confinement problem**
 - ▶ Geometry is fundamental



Simulation



ISDEP: Integrator of Stochastic Differential Equations in Plasmas

- ▶ C Code that aims to solve the dynamics of a fusion plasma starting off of first principles.
- ▶ The equations that govern the plasma are extremely difficult to solve, they are nonlinear equations in partial derivative in many dimensions.
- ISDEP launches ions and make them evolve with the background and extern electromagnetic fields
- ITER – International Thermonuclear Experimental Reactor





Trajectories are independent

Each trajectory (job) is calculated in one different node

Runs in PCs clusters, Grids and Desktop Grids

- A trajectory is a set of 3D positions + info:
 - ▶ Energy, spacial issues, etc

 Time of confinement

ISDEP in EDGeS description



□ Input files fixed ~80 MB (sent only once)

- magnetic field configuration file
- parameters file
- measurement times
- density, temperature and electric potential file

**BOINC
version**

□ Input files variables <1KB (sent with each WU)

- configuration file

□ Output files ~100K

- configuration file
- output
- histogram

**Configurable:
length and
requirements**

□ RAM needed ~300MB

□ Execution time ~30 minutes





ISDEP in EDGeS status

- Desktop Grid → Service Grid
- ISDEP ported to BOINC
 - ▶ API, multiplatform compilation, work generation, validator, assimilator
- Runs in Ibercivis
 - ▶ Public Desktop Grid developed
 - ▶ Based on BOINC
 - ▶ ~7000 cores/day
- EDGeS bridge
 - ▶ As Ibercivis client, it receives fusion jobs
 - ▶ Send them to the Worker Nodes
 - ▶ Return results to Ibercivis servers



ISDEP in EDGeS status



- Desktop Grid → Service Grid
- ISDEP ported to XtremWeb
 - ▶ Task carried out by LAL
- First simulations launched and worked



ISDEP in EDGeS status



- ❑ Service Grid → Desktop Grid
- ❑ ISDEP gLite version
 - ▶ Compilation, JDL, user certificates, files transfer
- ❑ Runs in EGEE Fusion VO
- ❑ EDGeS bridge (work in progress)
 - ▶ As Fusion VO CE, it takes selected jobs
 - ▶ Send them to the Desktop Grid (BOINC version)
 - ▶ Return results



Links



- ❑ BIFI www.bifi.unizar.es
- ❑ CIEMAT www.ciemat.es
- ❑ ITER www.iter.org
- ❑ EGEE www.eu-egee.org
- ❑ Ibercivis www.ibercivis.net



Thanks for your attention

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