Pellet Code Gridification

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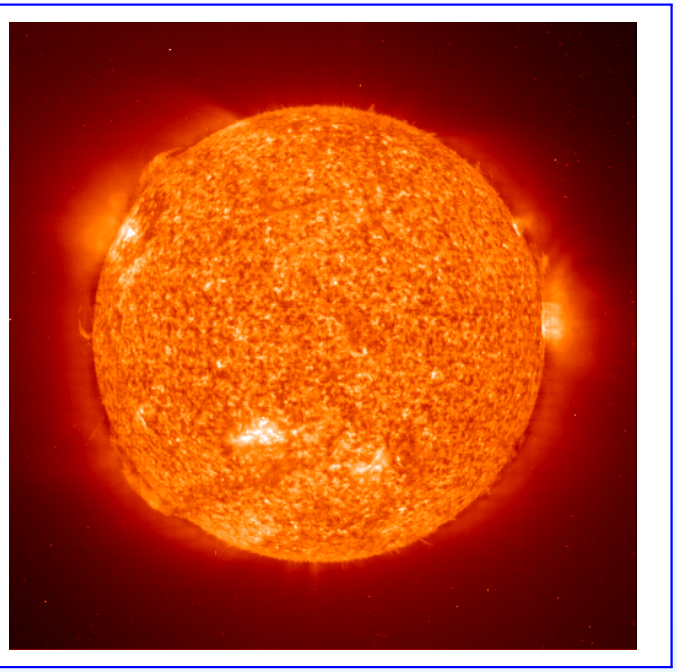
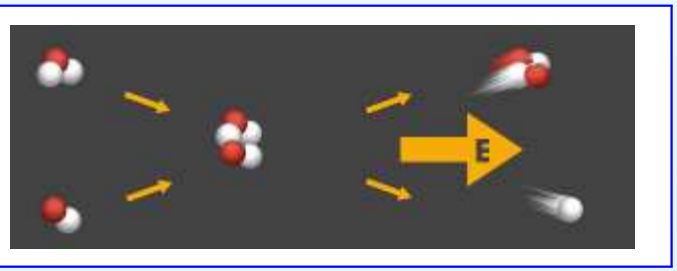
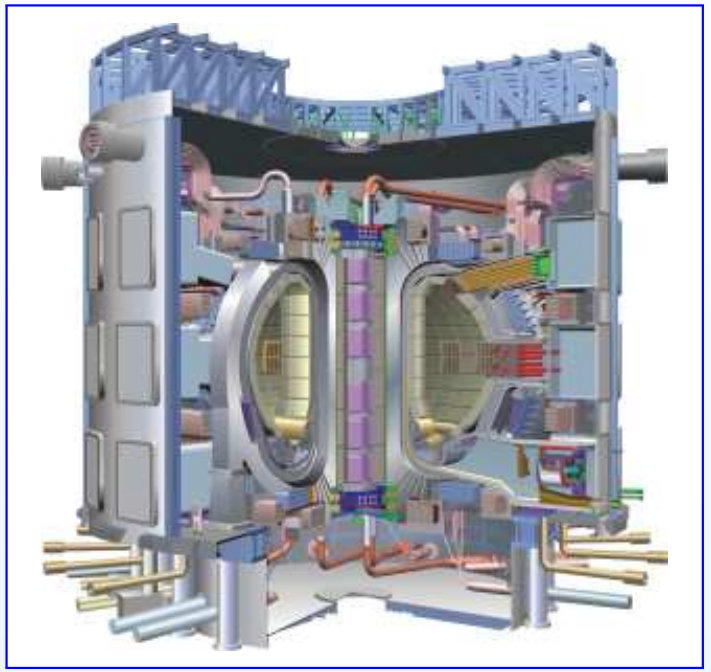
Introduction - Fusion





$$D + T \longrightarrow {}^4He + n$$



International Thermonuclear Experimental Reactor

- Positive energy balance
- Testing reactor components

Pellets

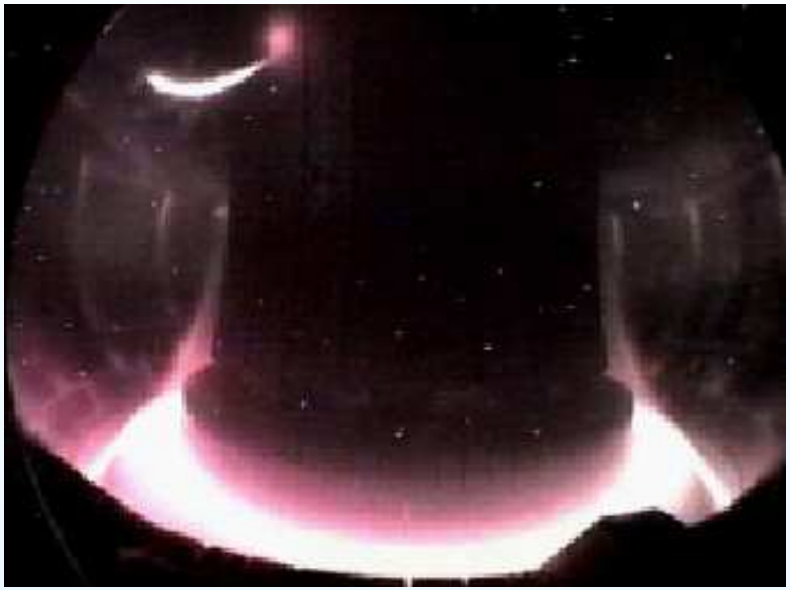
- Small solid piece of matter.
- Typical sizes $\sim$ 1mm.
- They are shot into the plasma at high velocities 100-1000m/s.

Pellets can be used:

- refueling
- instability control

Pellet material:

- deuterium ice (5 Kelvin)
- carbon, neon, etc.

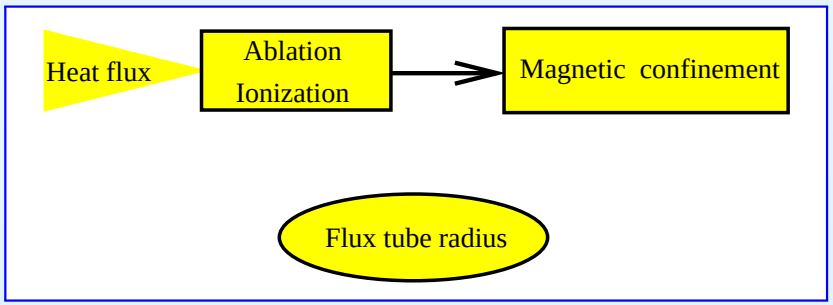


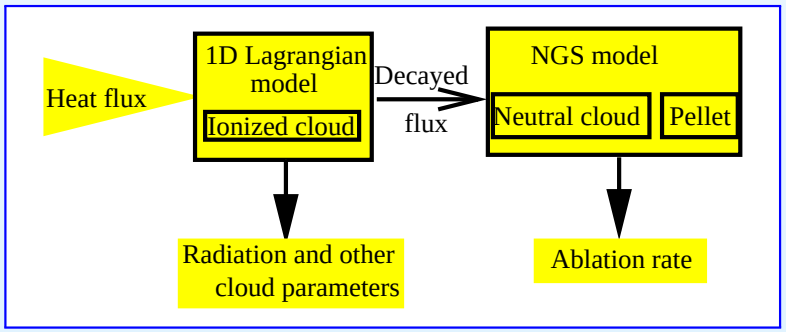
Pellet shot at
ASDEX Upgrade tokamak
IPP Garching, Germany.

Pellet Code

The physics of pellet and plasma interaction is very complex. A simulation is developed in collaboration between IPP Garching and KFKI-RMKI $\rightarrow$ LLP code or pellet code.

1. Lagrange cell hydrodynamic code describes the cloud expansion along the magnetic field lines.
2. atomic processes in the cloud (ionization, radiation)
3. penetration of ambient plasma particles
4. heat diffusion into the cloud
5. electrostatic shield formation at the cloud periphery





Pellet Code II

1. written in fortran
2. more than 18 000 lines
3. large program, not well structured – hard to understand
4. sequential code
5. no special services required
6. one binary
7. execution time around 2-3 hour (P4 2 GHz)

Gridification

The pellet code are often used for parameter studies.

During the PS the plasma and pellet parameters are changed in the shot.in input file, the other input files are constant.

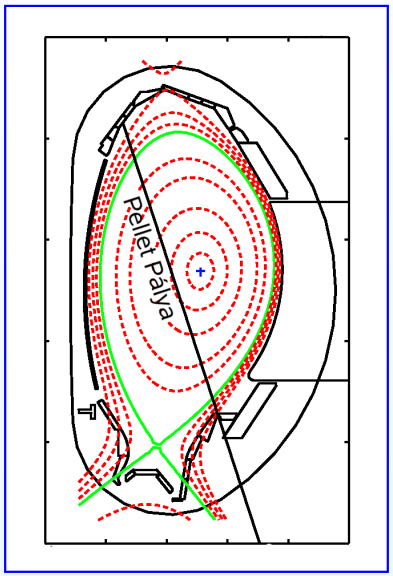
Parameter studies can test the following:

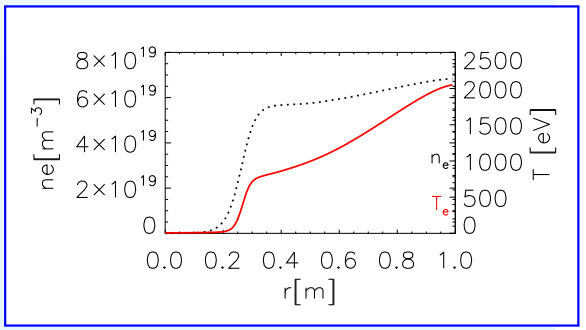
- different size/velocity pellets in the same plasma
- different plasma temperature, density with the same pellet
- different shape of the temperature and density profiles .

Input

There are 8 input files:

- general.in – main simulation parameters
- diagnostics.in – describes what output files will be generated
- perpex.in, prllex.in – a few plus settings for the two main parts of the code
- ctot.in, h_plt.in, h_prb.in – data from an atom-physical database to calculate the radiation
- shot.in – describes the pellet (size, velocity, material) and the plasma (radius, magnetic field, temperature and density profiles)

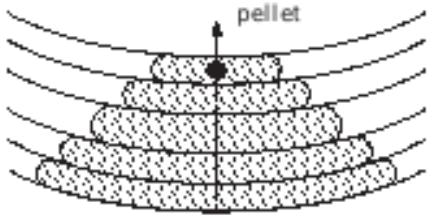


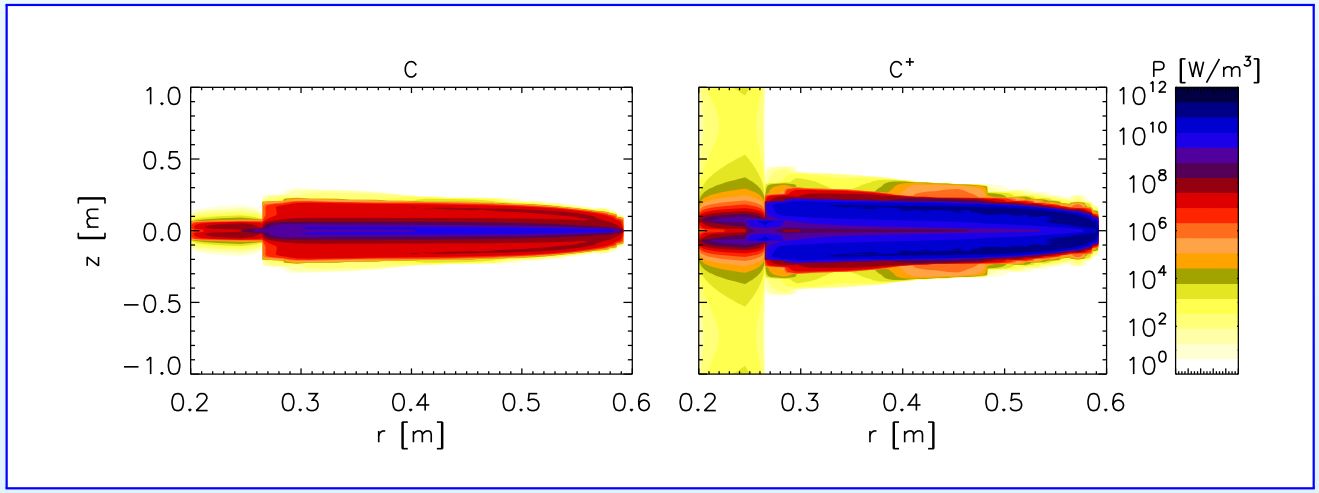


Output

There are several output files depending on the specifications in diagnostic.in and general.in.
Total output size: 1 MB - 100 MB.

- output.dat – ablation rate, penetration depth
- tube001.dat, tube002.dat, . . .
- cloud_length001.dat, cloud_length002.dat, . . .
- tube001_en_cons.dat, . . .





First Step

The source code and the makefile was given.

GNU fortran compilers can not compile the code correctly.

PGroup fortran is used to compile.

A trial version of the compiler was installed to one of the test machines here.

The code was compiled successfully. The makefile had to be changed to link static PG fortran libraries.

Tasks:

- Deal with the large number and size of the input and output files.
- Facilitate PS with P-GRADE portal