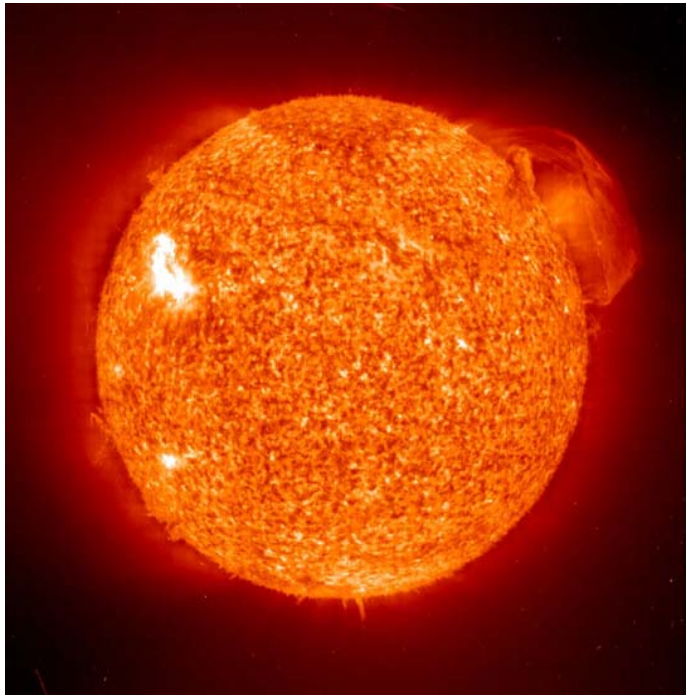
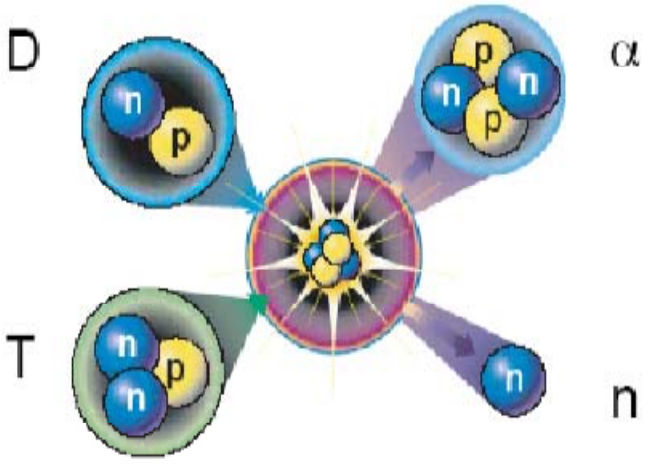
Cryogenics for Inertial Fusion





$$D + T \rightarrow \alpha + n$$

3.5 MeV 14.1 MeV

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With the courtesy of Institute of Physics of Prague

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Many issues have to be solved

Targets mass production

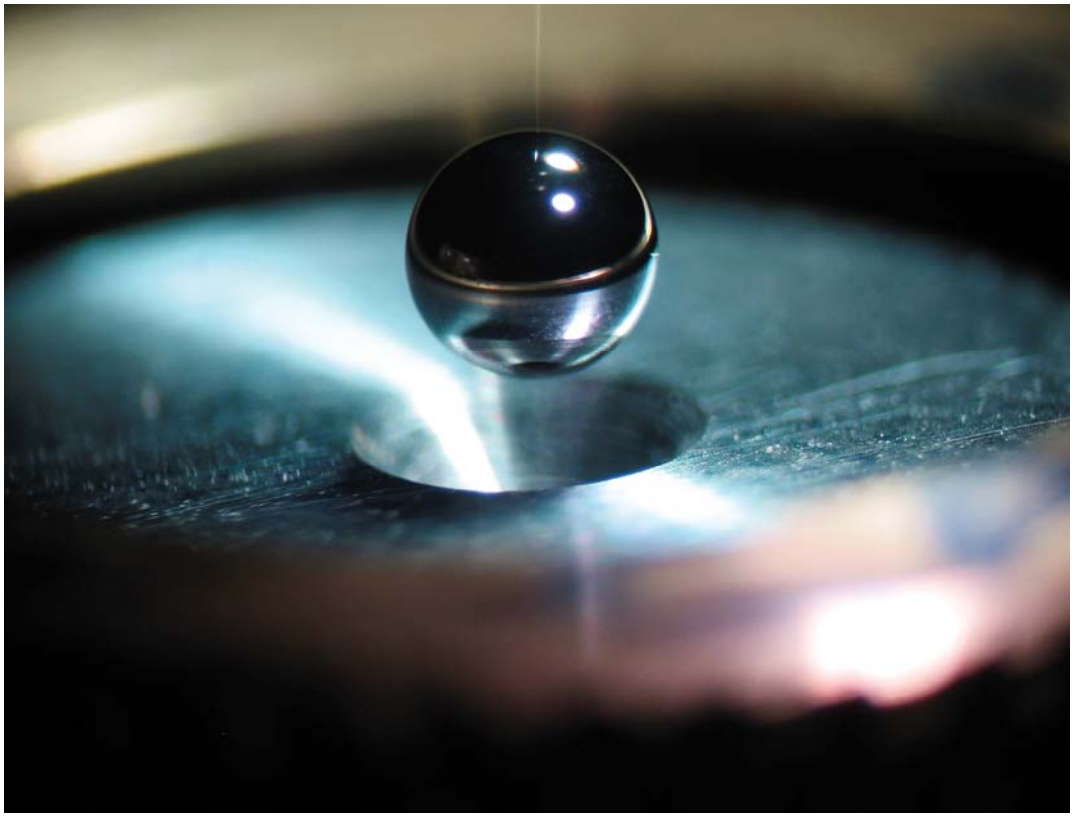
Filling

Layering

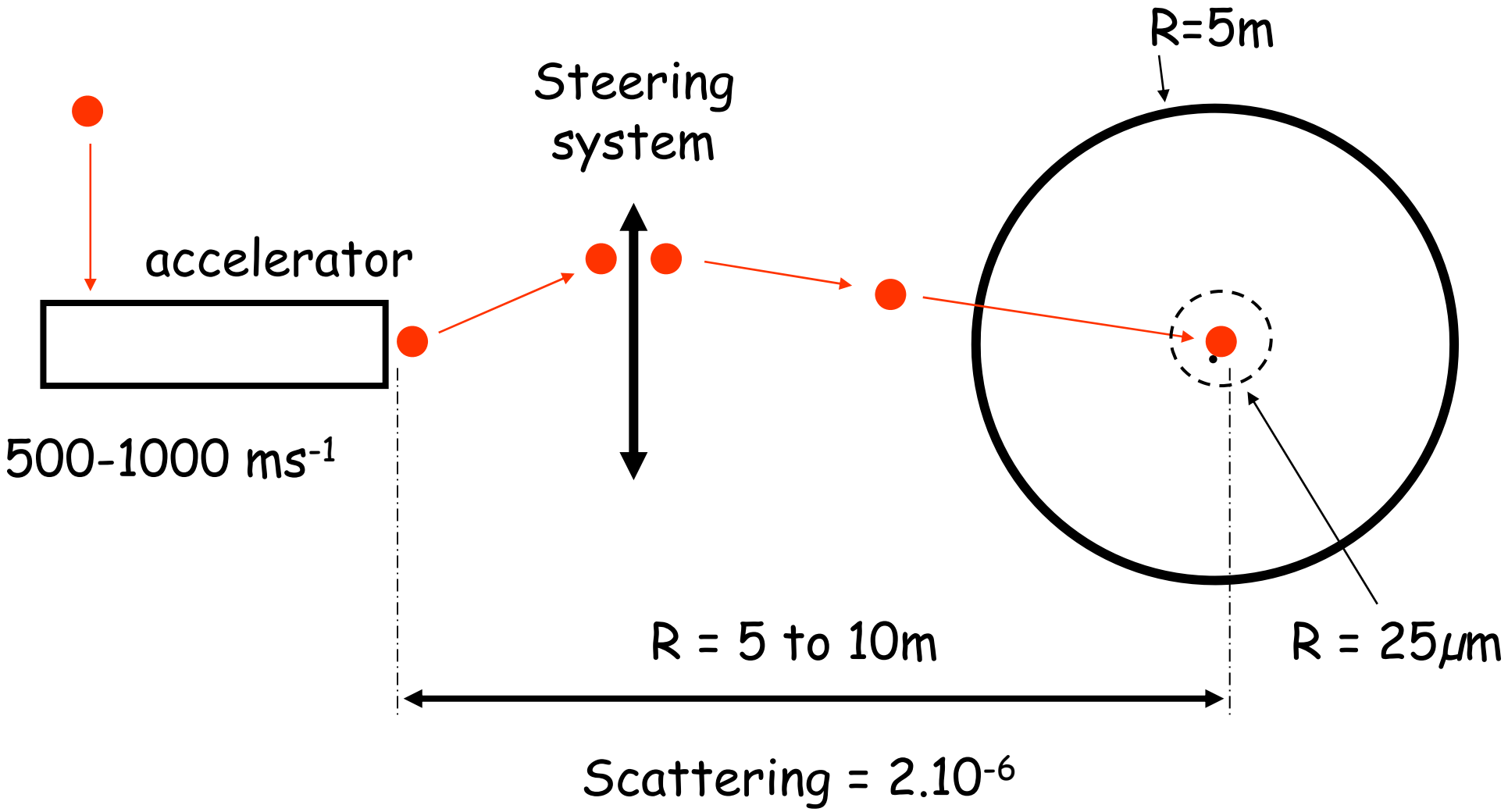
Coating

Acceleration

Steering



Requirements recall



Main issues for the targets

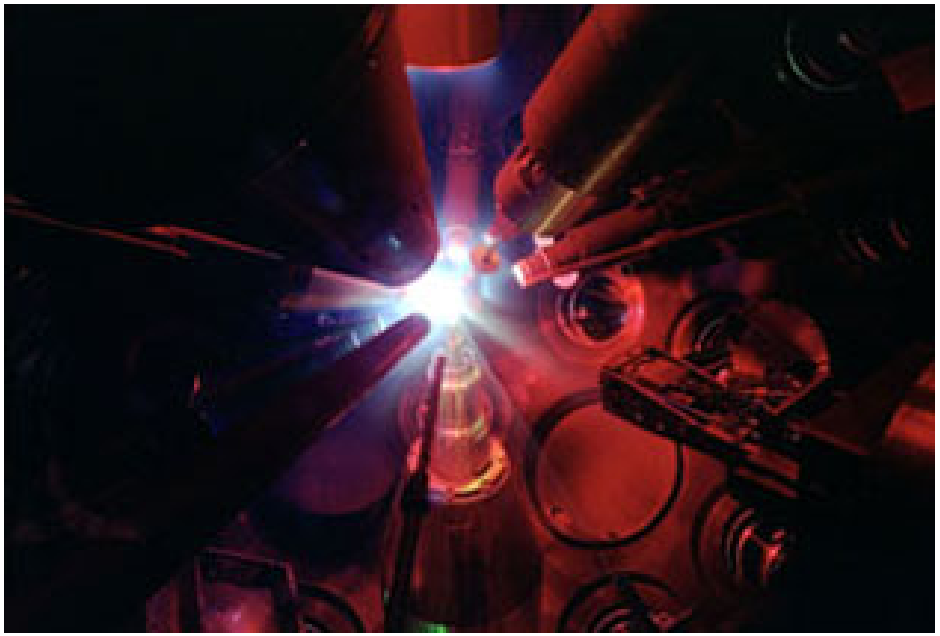
The goal is to find a compromise between :

First wall conditions of the experimental chamber

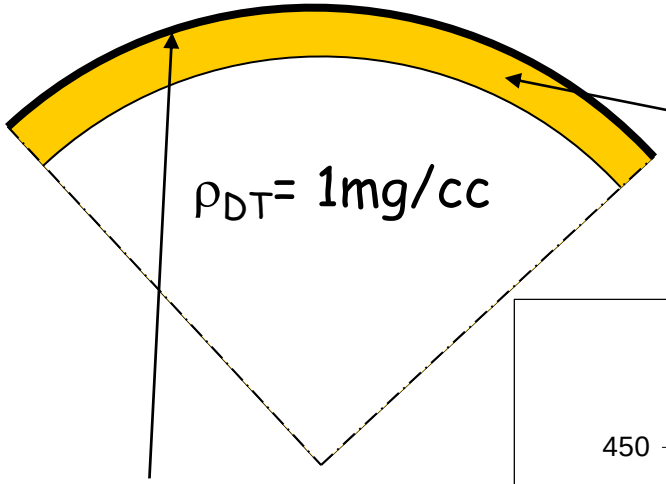
Requirements for the implosion parameters (T, P)

Microballoon materials (CHx, coating)

DT ice roughness

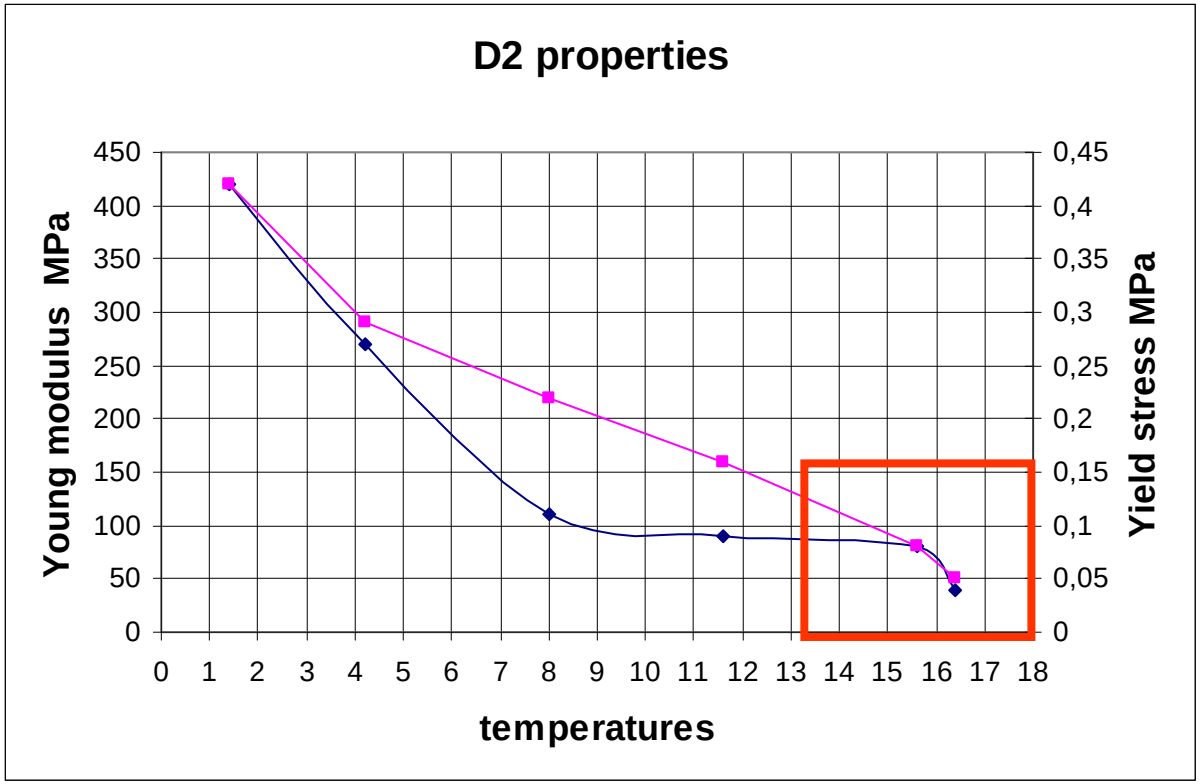


Targets

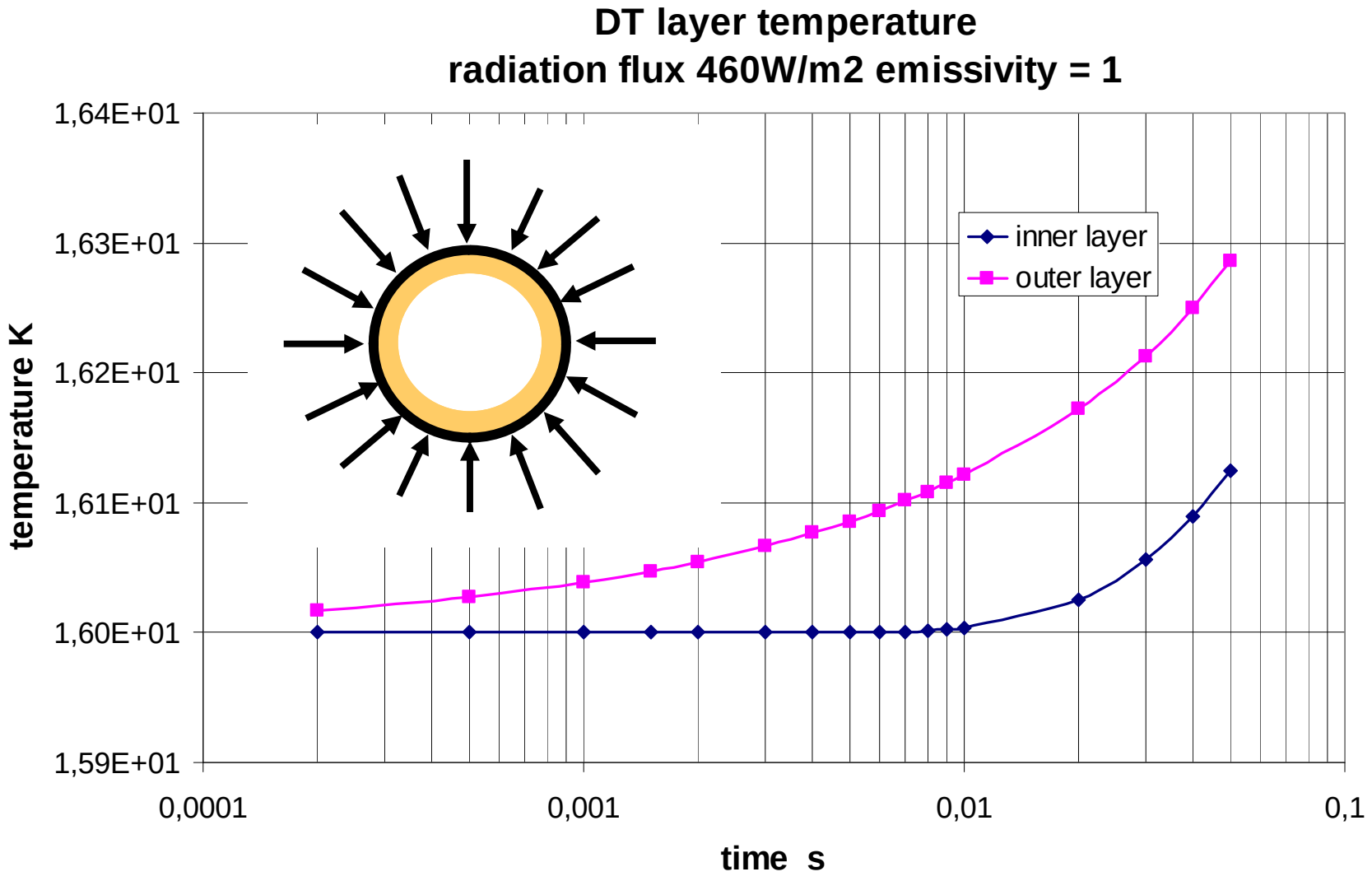


DT
R_{in}=833 µm
R_{out}=1020µm

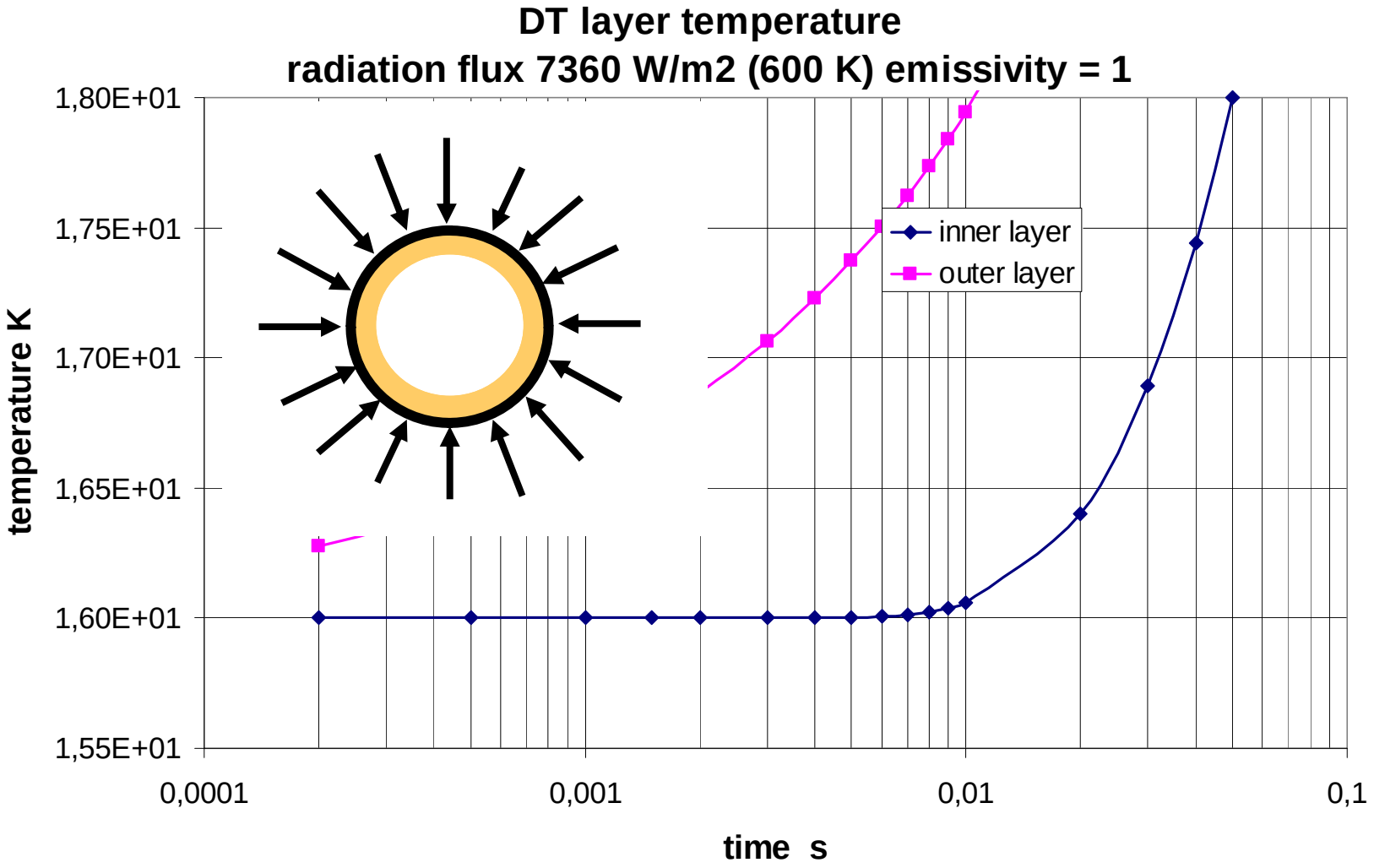
shell
R_{in}=1020µm
R_{out}=1023µm



First thermal calculation (1/3)



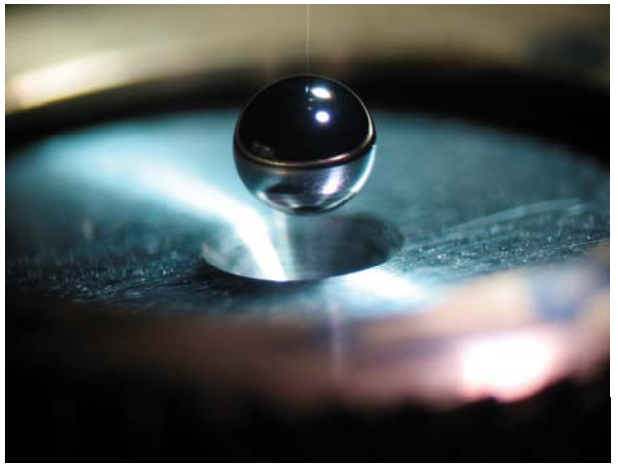
First thermal calculation (2/3)



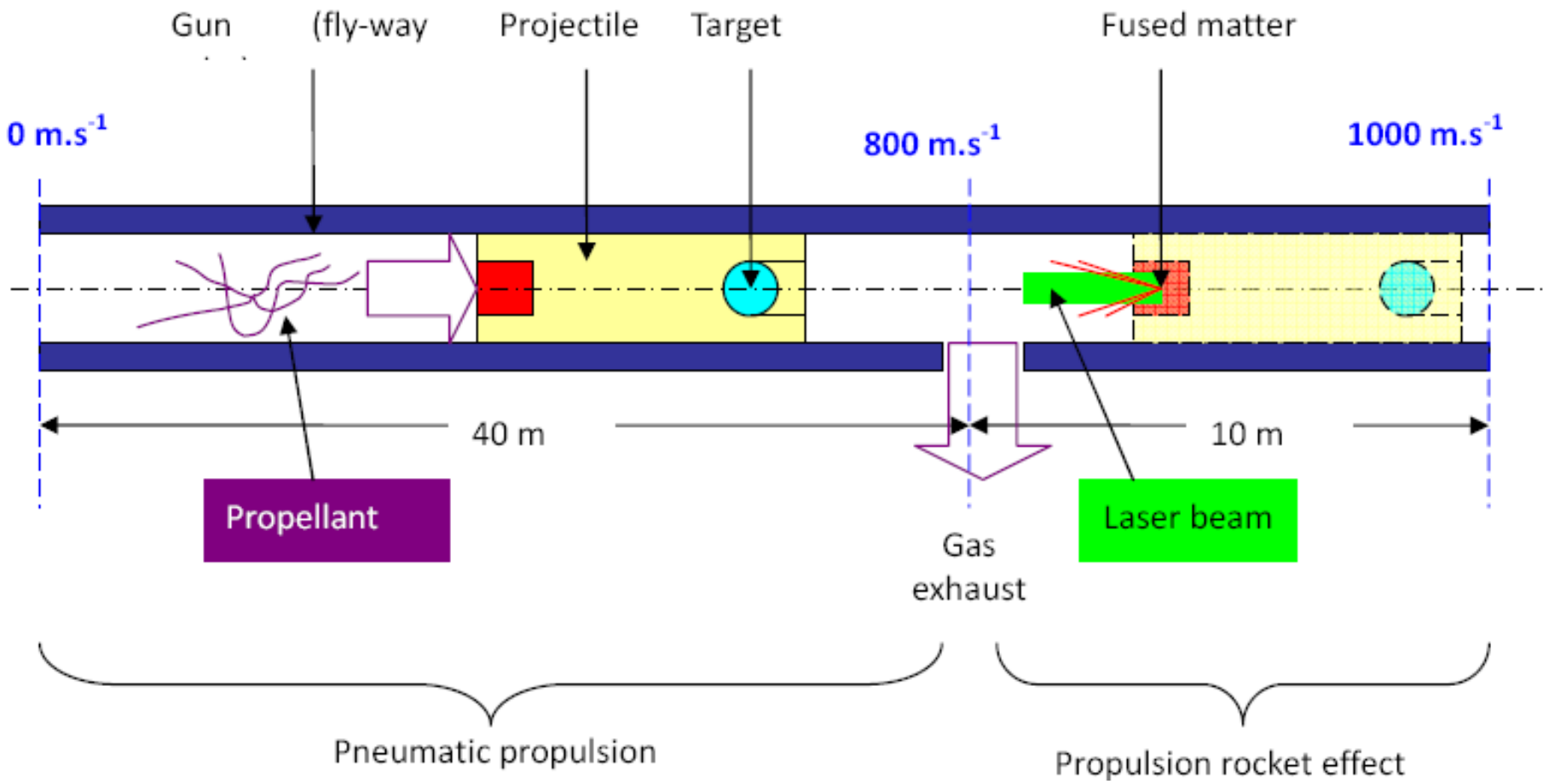
First thermal calculation (3/3)

These preliminary calculations show that the thermal constraints are not dominant with respect to the temperature.

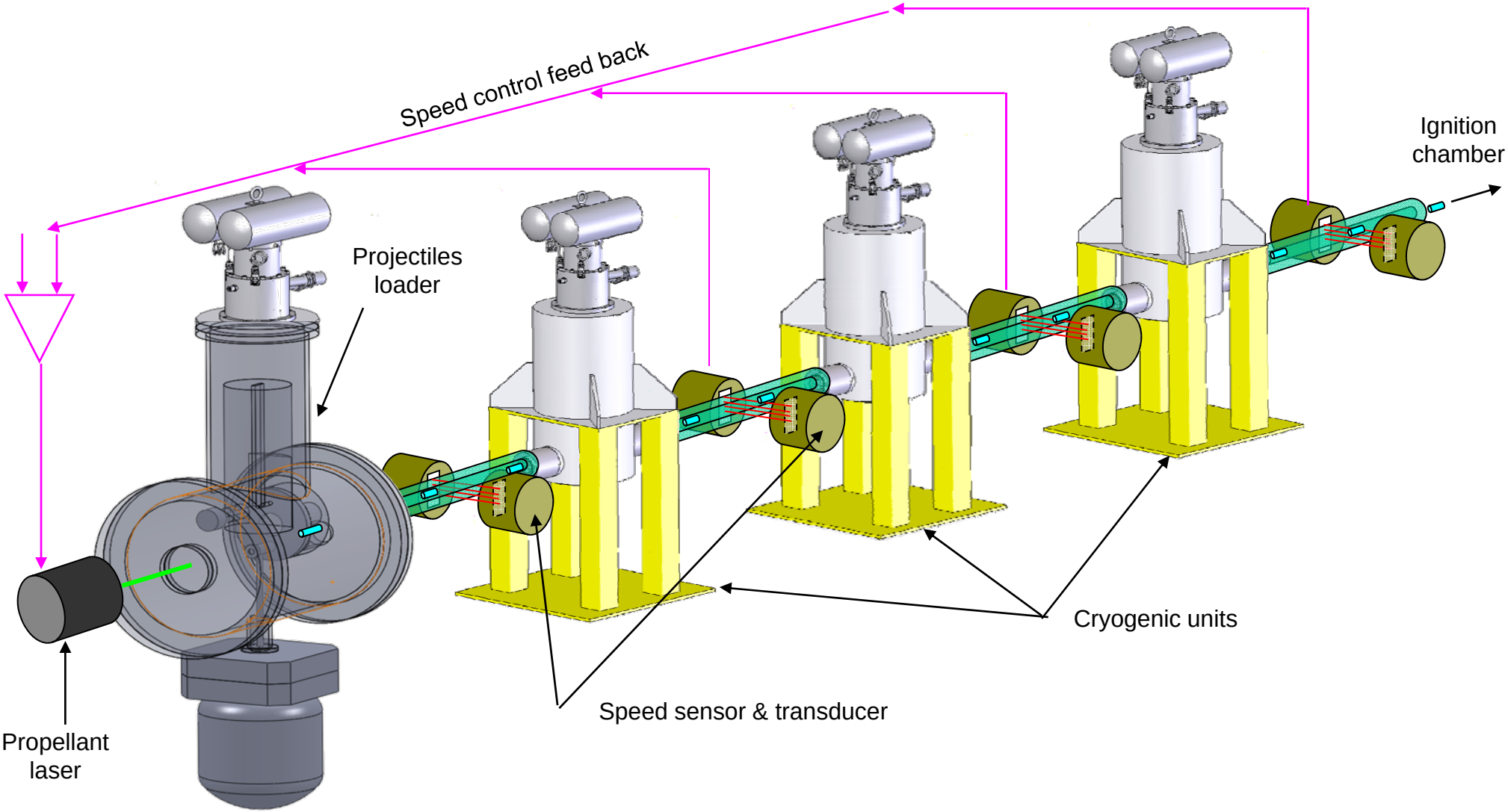
The main point will be the roughness dependence and stability as a function of temperature.



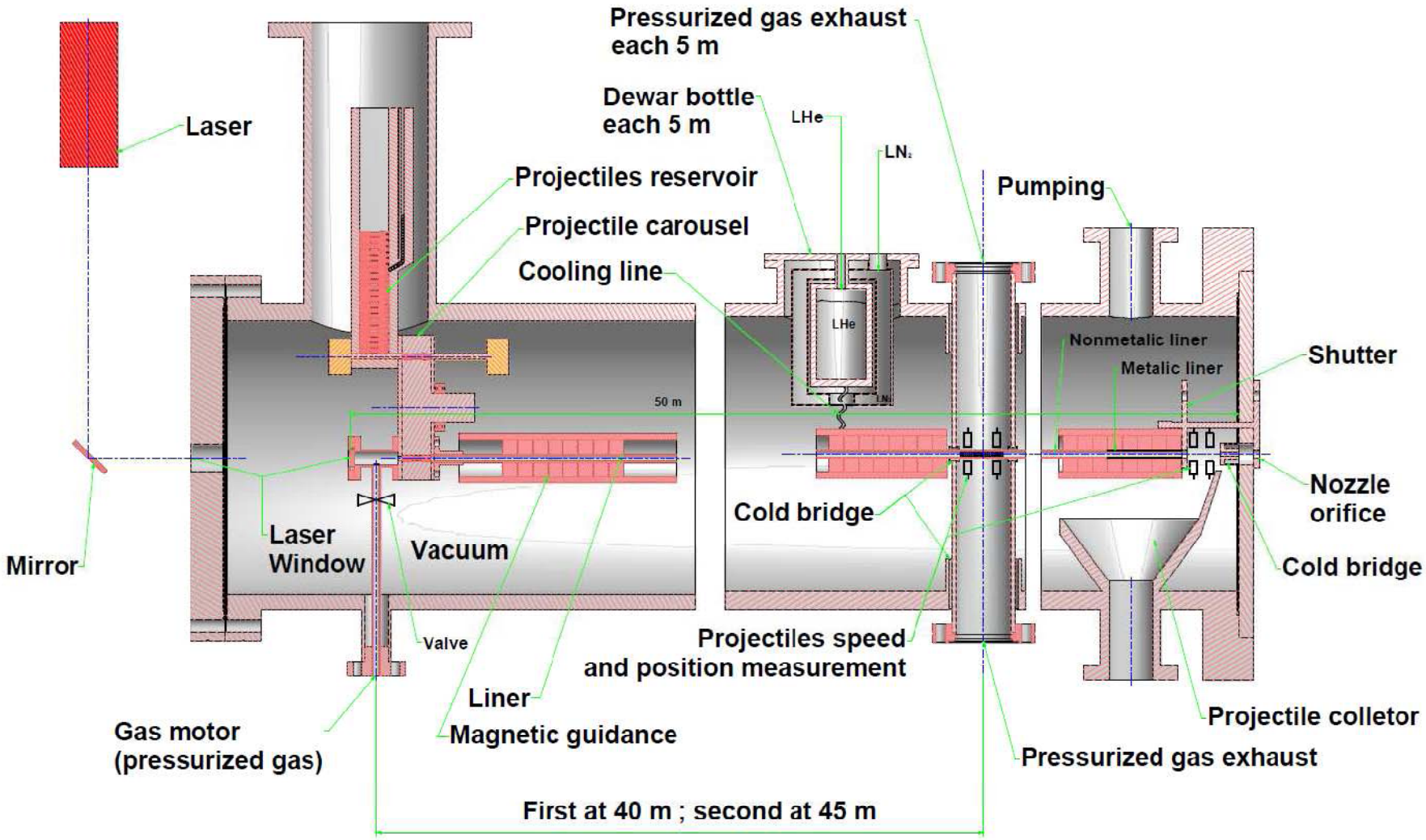
Acceleration and velocity control



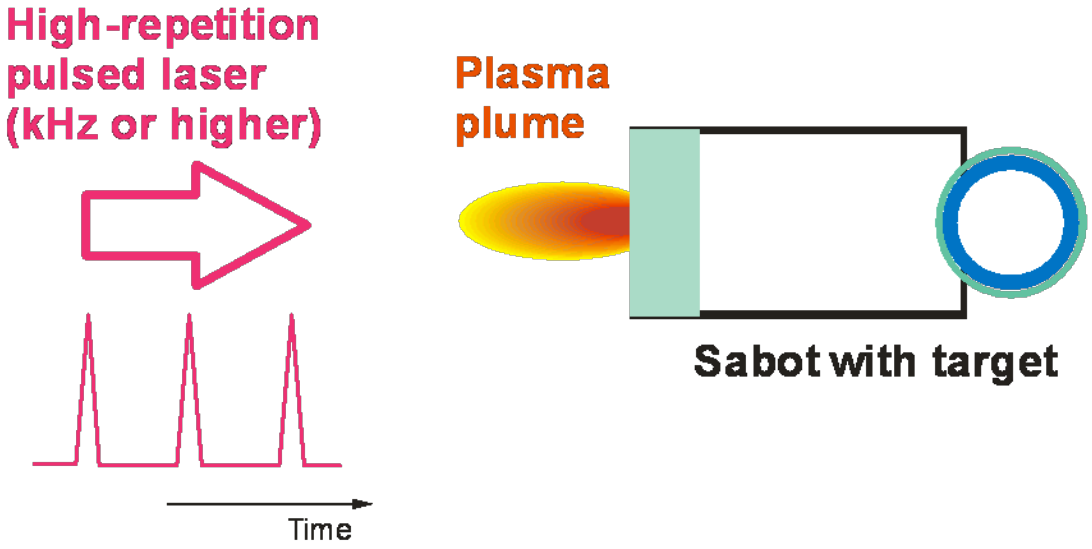
Projectiles launcher overview

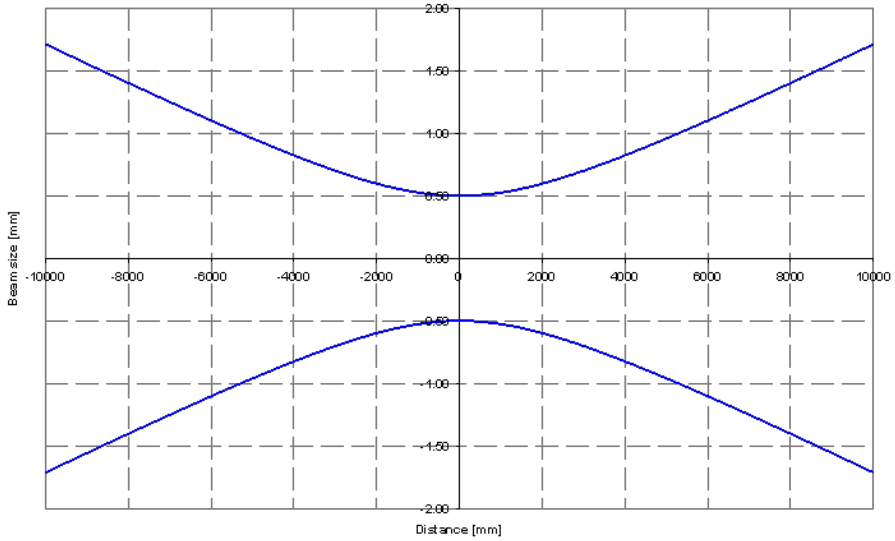


Acceleration



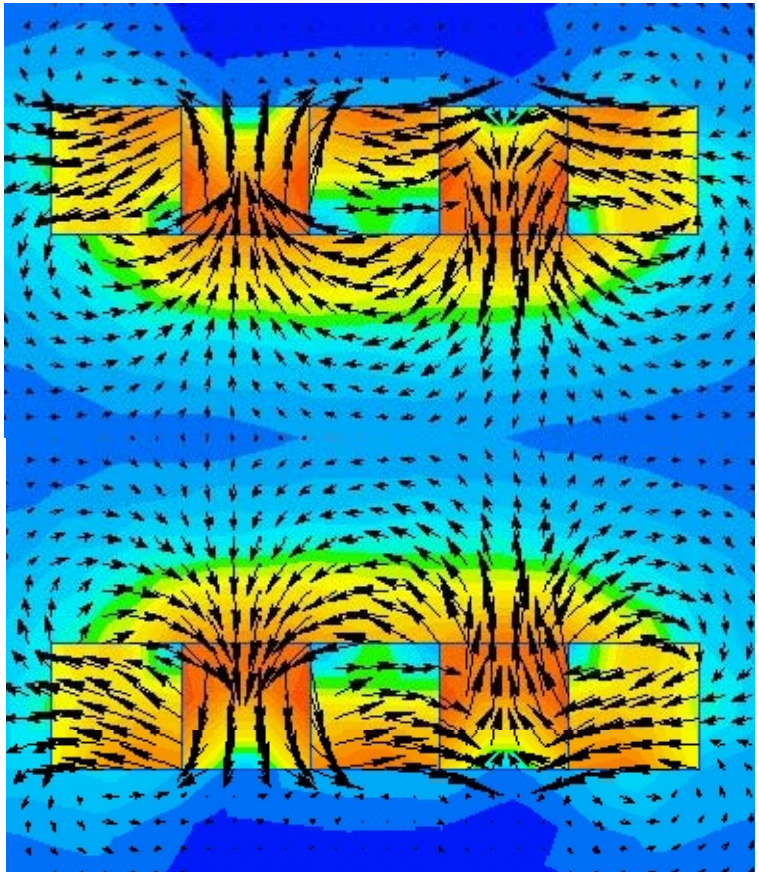
Acceleration and velocity control

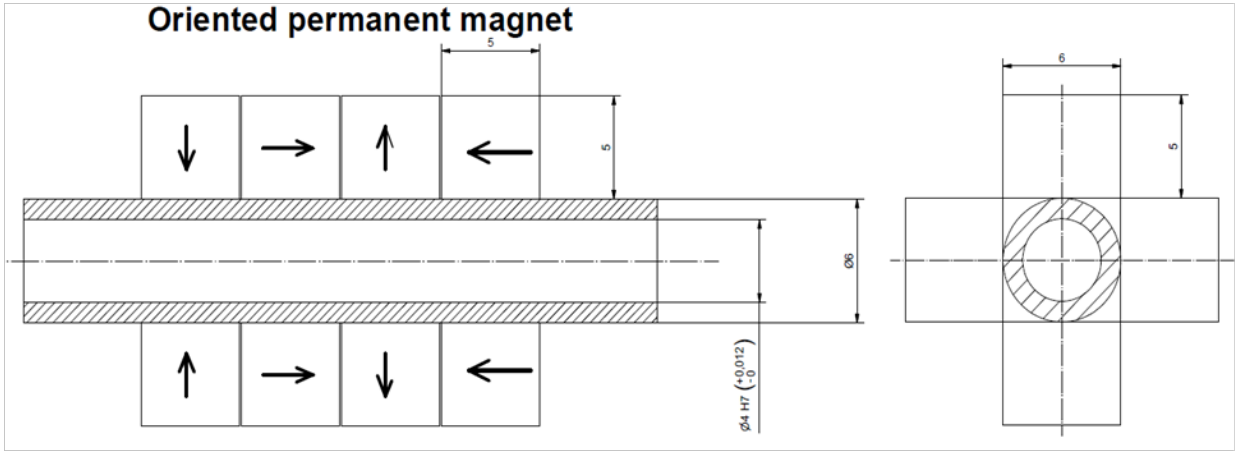




For the 4th harmonics (1030 nm / 4 = 257.5 nm) it is **possible to keep the diameter of the laser within the 4-mm aperture of the accelerator over a distance of about 24 m**

Sabot and guiding



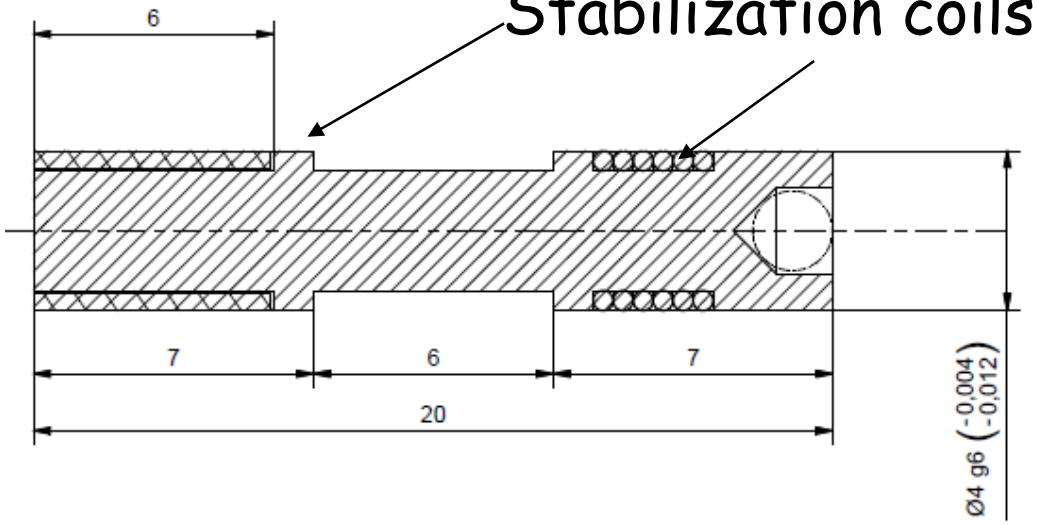


Maglev principle

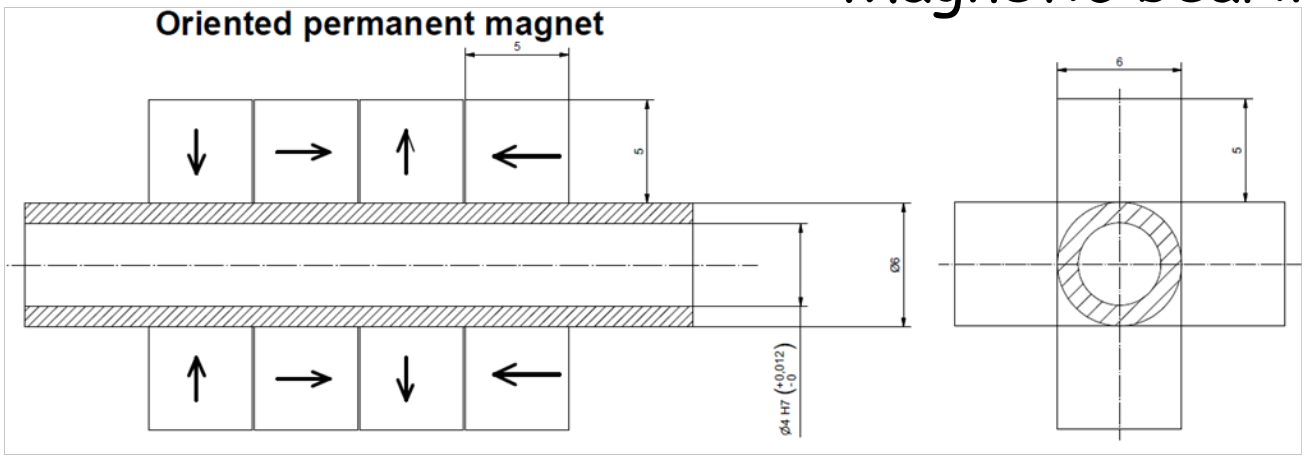
Halbach configuration

Sabot and guiding

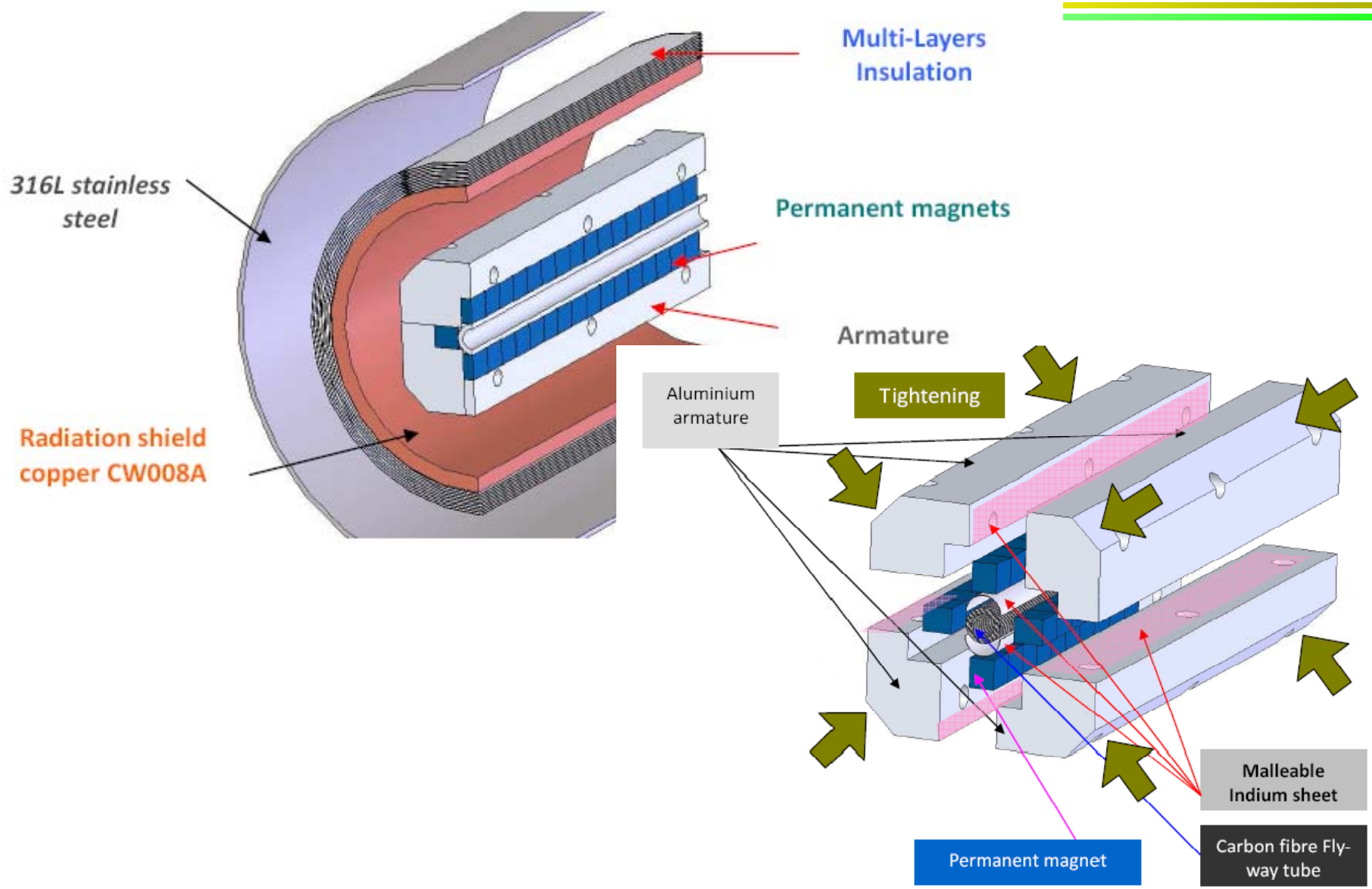
Stabilization coils



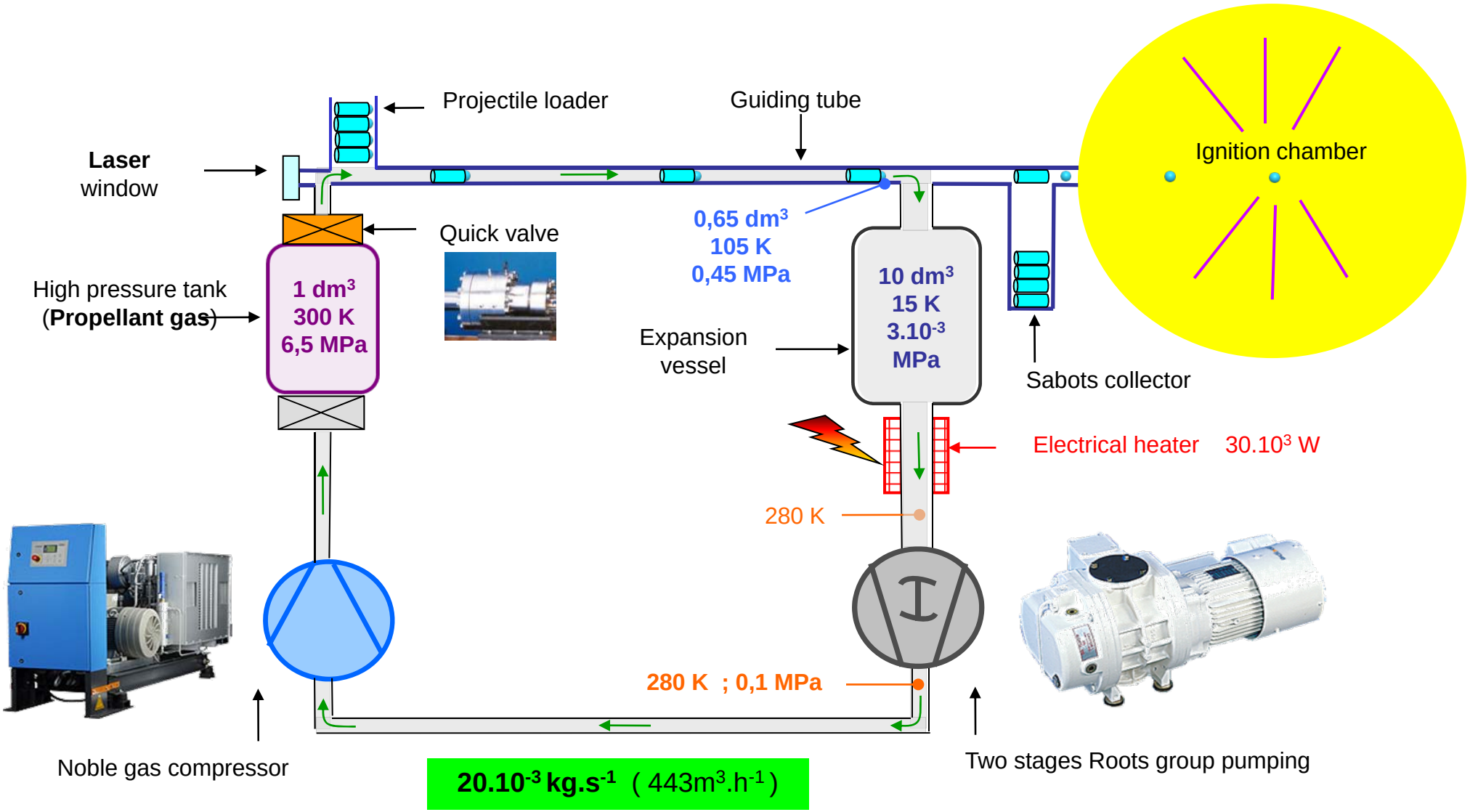
Magnetic bearing



Guiding system



Propellant gas cycle management



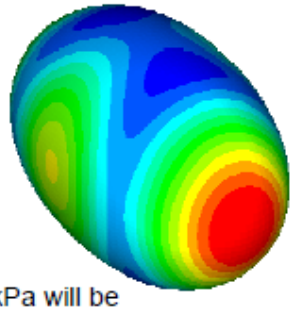
Acceleration

Analysis of hollow sphere

7.6.2010

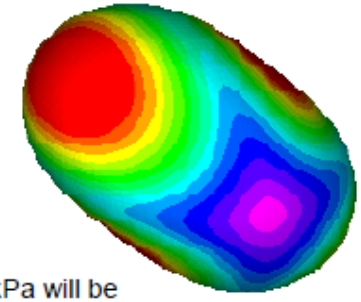
Modal analysis – eigen shapes

Eigen shape No.1
real f = 66893 Hz



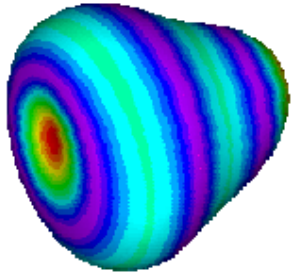
At maximal stress σ_{HMH} = 90 kPa will be maximal displacement u = 1.01 µm

Eigen shape No.3
real f = 66893Hz



At maximal stress σ_{HMH} = 90 kPa will be maximal displacement u = 0.88 µm

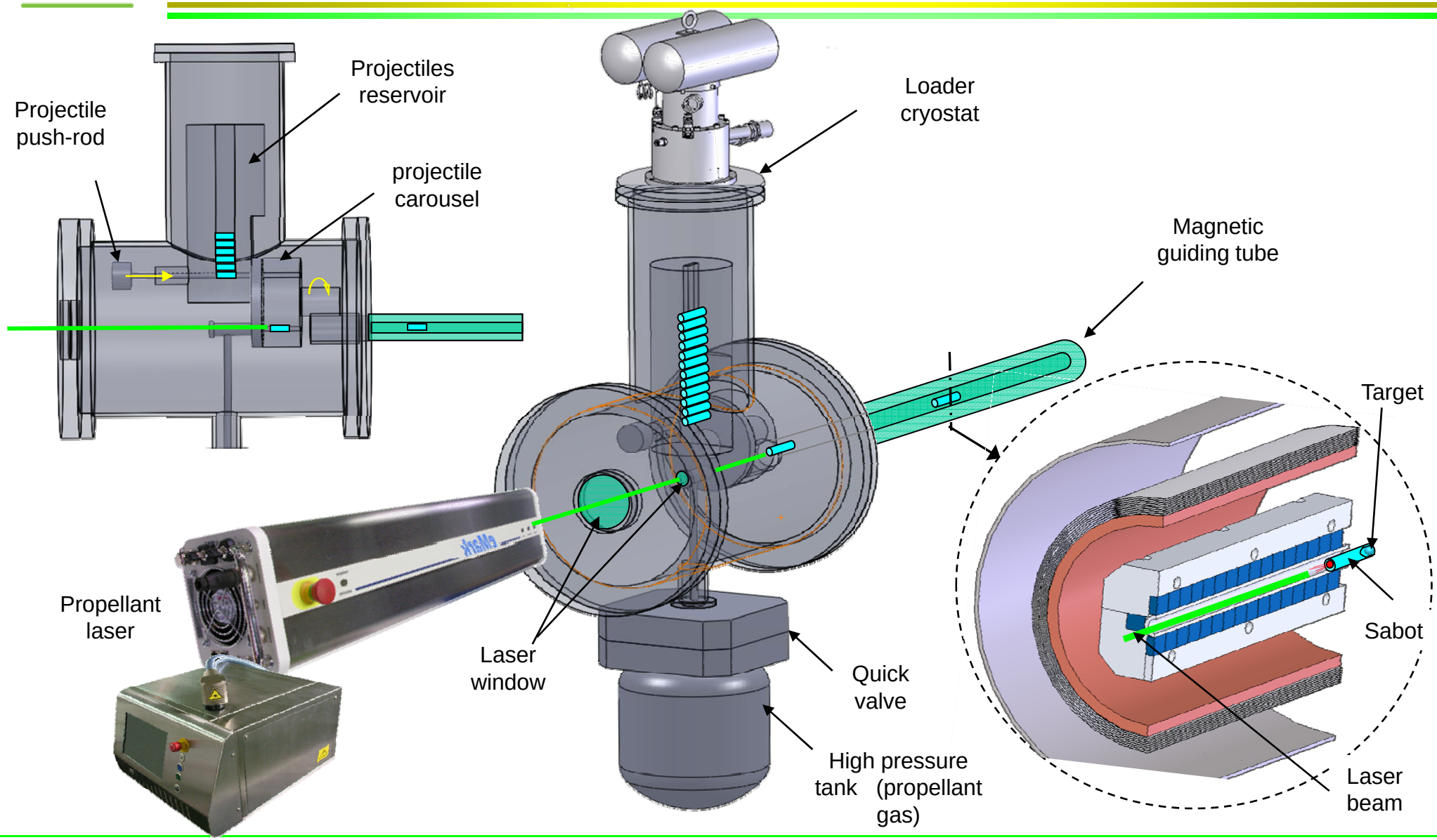
Eigen shape No.7
real f = 90368 Hz



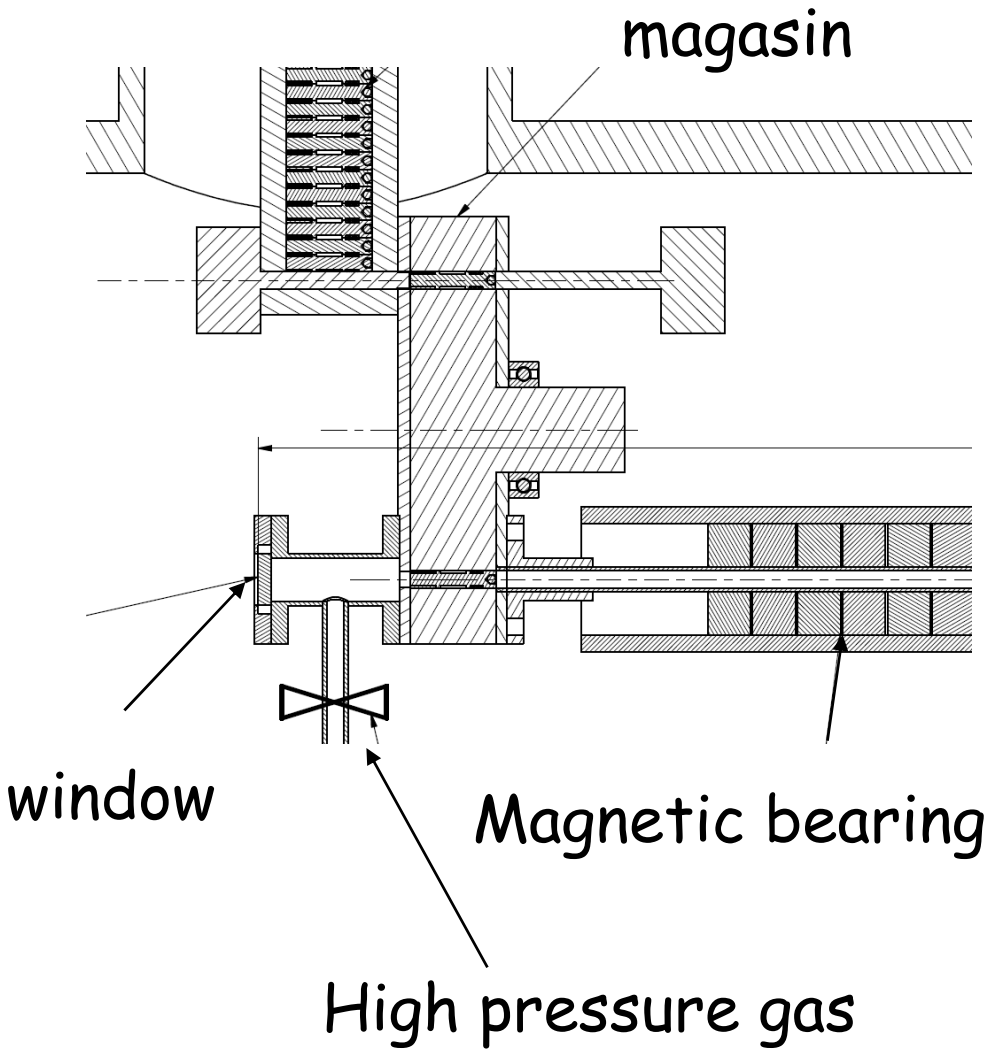
At maximal stress σ_{HMH} = 90 kPa will be maximal displacement u = 0.98 µm

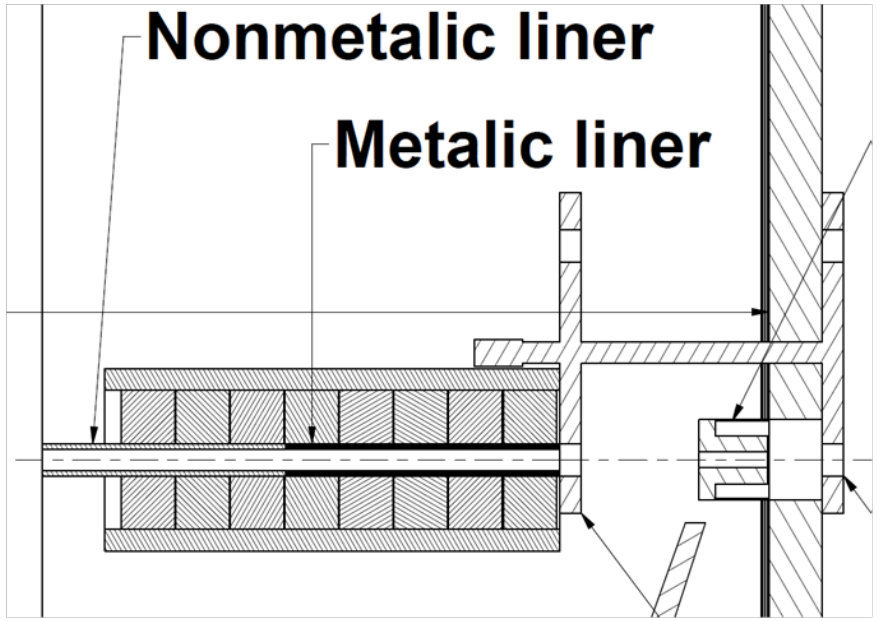
The pellet can oscillate approximately with maximal displacement u = 1 µm, it means only 0,1% of the pellet's radius. Larger displacements are not possible, because the pellet would overstep maximal stress and would be destructed.

Projectiles loader

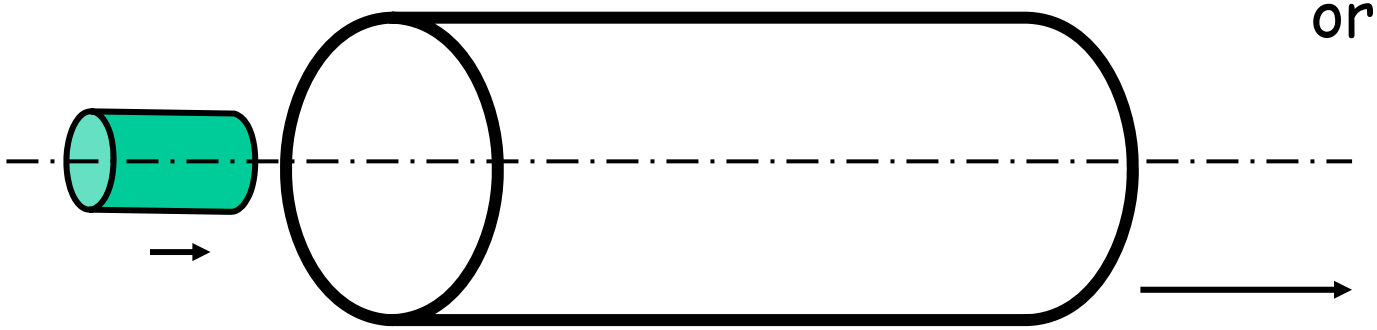


Target loading and sabot separation





Sabot separation principle

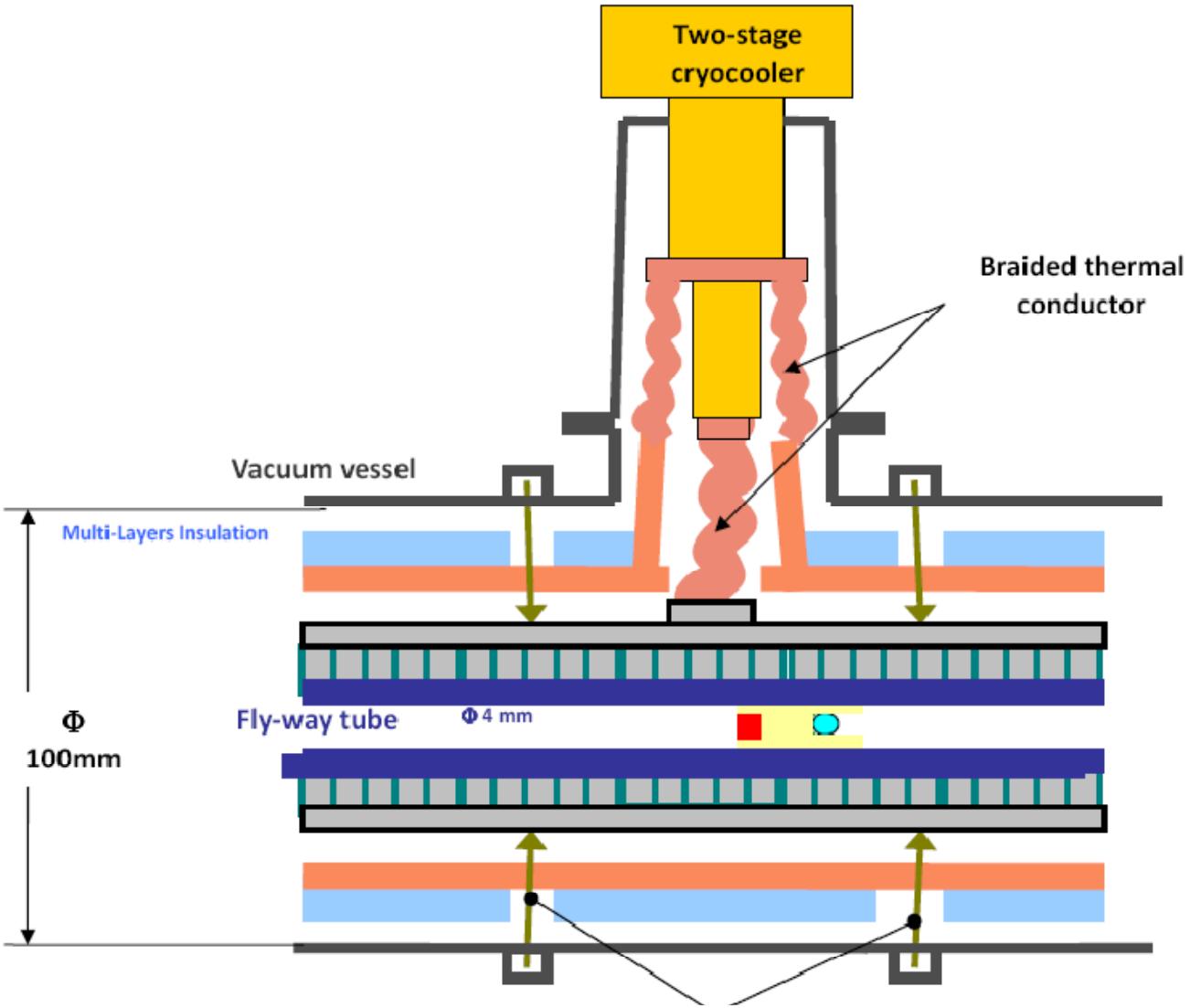


Conductive cylinder or superconducting material

Time constant of the sabot 1 -2 ms

Eddy current appear in the outer cylinder skin in clocker wise of the sabot current, a braking effect appears

Cooling



One crycooler

per 10 m

5W/11K

80W/76K

Summary

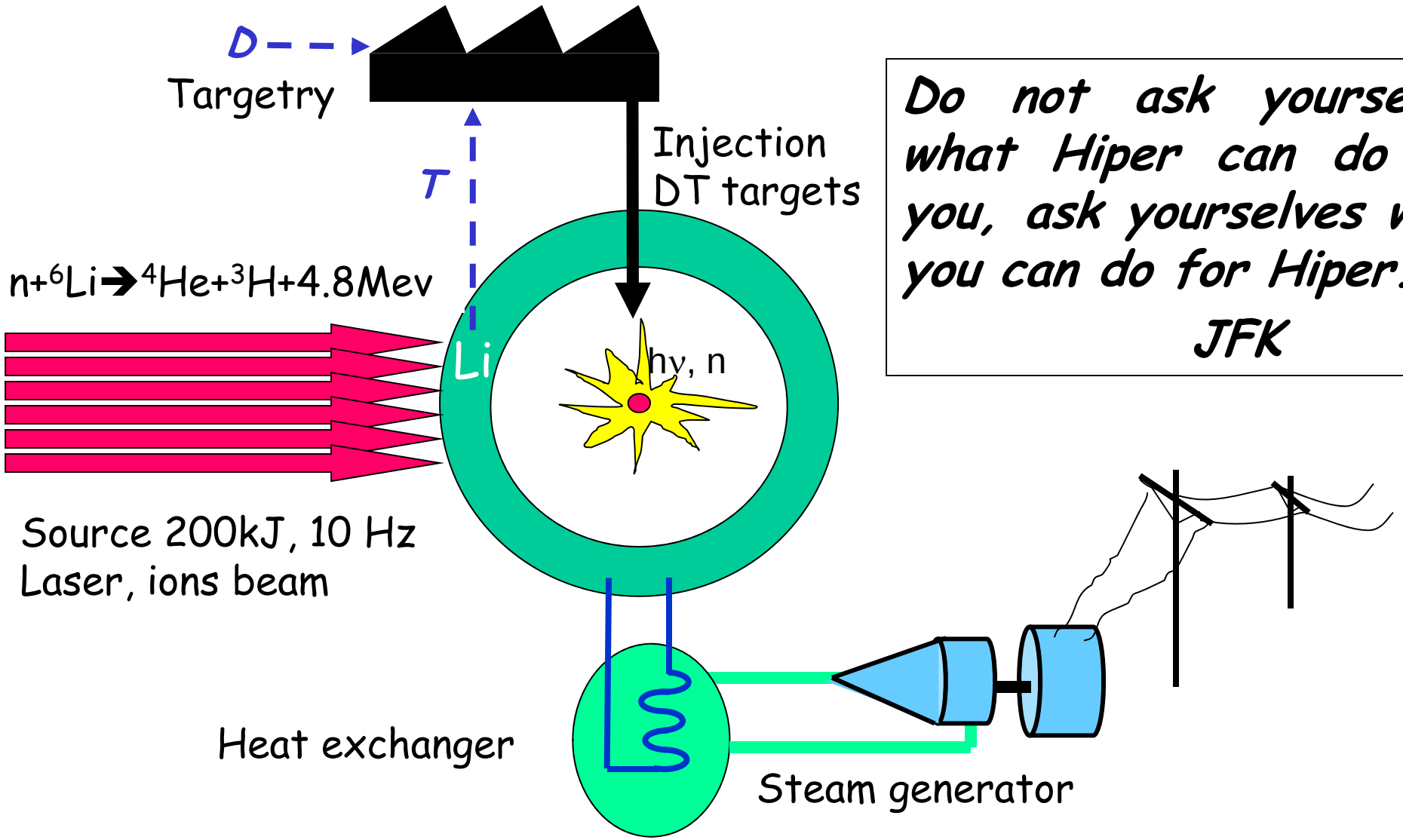
The preliminary analysis that the mechanical stresses and deformation are not the main key issues

The heat load seem acceptable for a wall temperature till 600K

We have to focus the future on

- Velocity control
- Sabot separation
- Scattering

The end



Do not ask yourselves what Hiper can do for you, ask yourselves what you can do for Hiper.

JFK