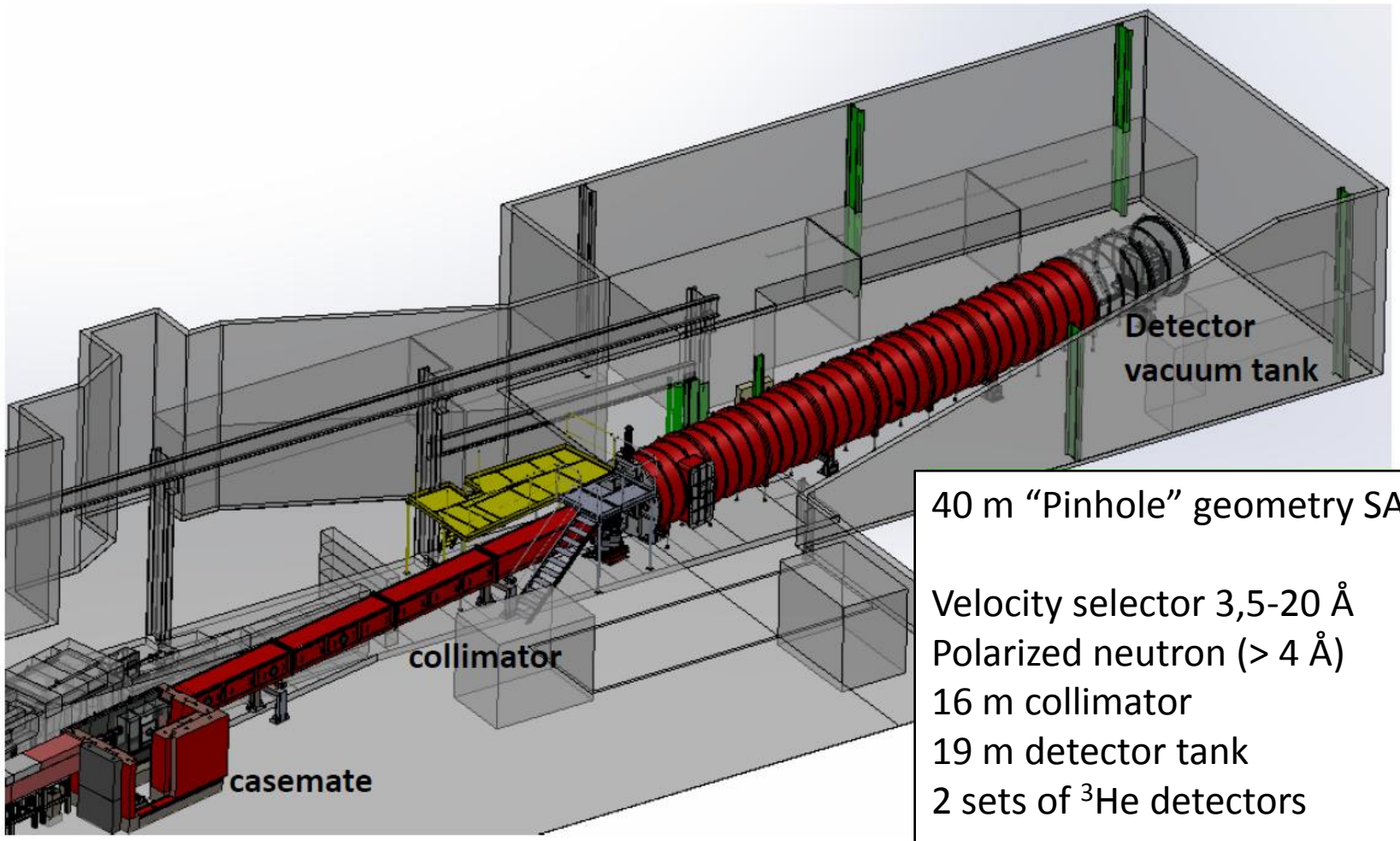
PA20 collimator: design of a multi-purpose collimator for SANS and GISANS at LLB

Sylvain Désert
Instrument Development Group
CEA Saclay, France

PA20 instrument



40 m “Pinhole” geometry SANS / GISANS

Velocity selector 3,5-20 Å
Polarized neutron (> 4 Å)
16 m collimator
19 m detector tank
2 sets of ^{3}He detectors

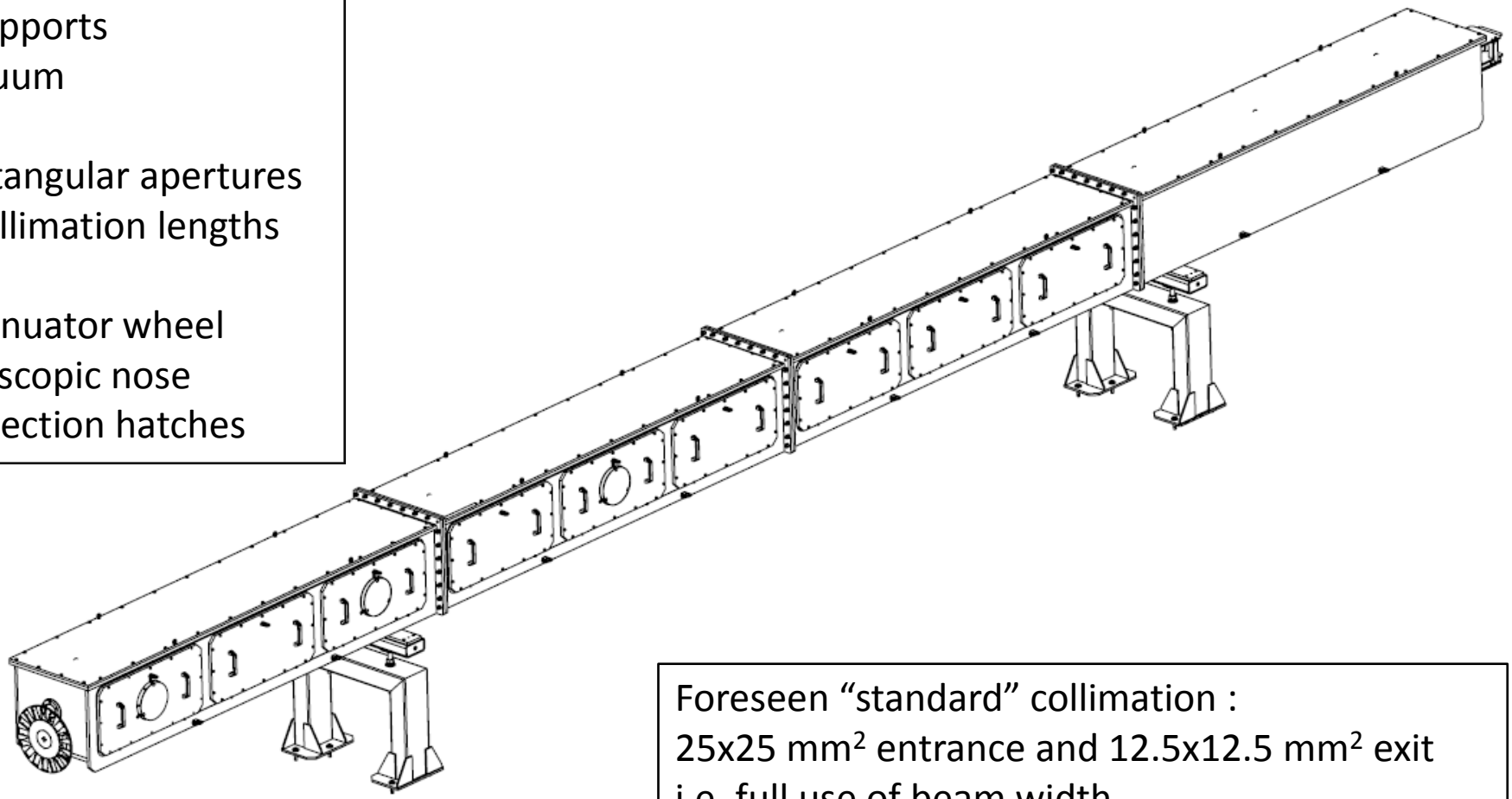
Wide Q range (5.10^{-4} – 0,5 $Å^{-1}$)

Collimator

16 m long
4 sections
2 supports
Vacuum

Rectangular apertures
6 collimation lengths

Attenuator wheel
Telescopic nose
Inspection hatches



Foreseen “standard” collimation :
25x25 mm^2 entrance and 12.5x12.5 mm^2 exit
i.e. full use of beam width

GISANS mode

For surface studies

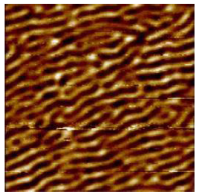
Slit shape beam

Hor. Or Ver. incident angle on the sample

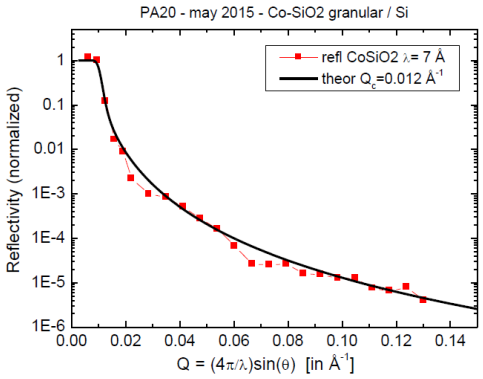
Same options as for SANS mode

x

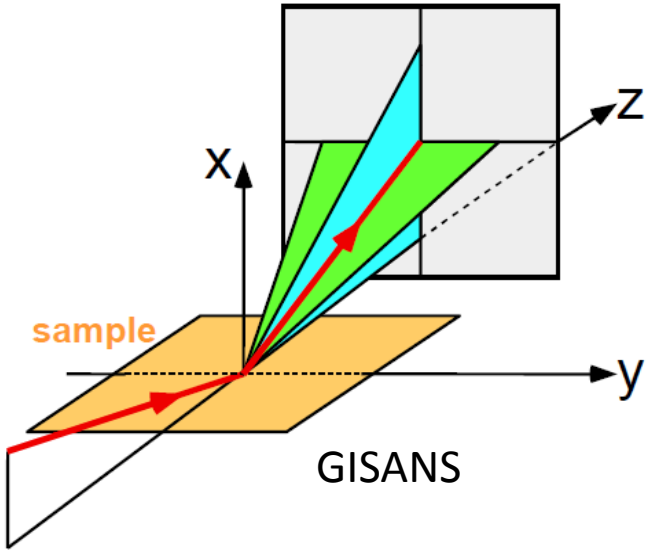
Reflectometry on on nanostructured $CoSiO_2$ / Si wafer



presence of weak stripe domains in the superferromagnetic phase

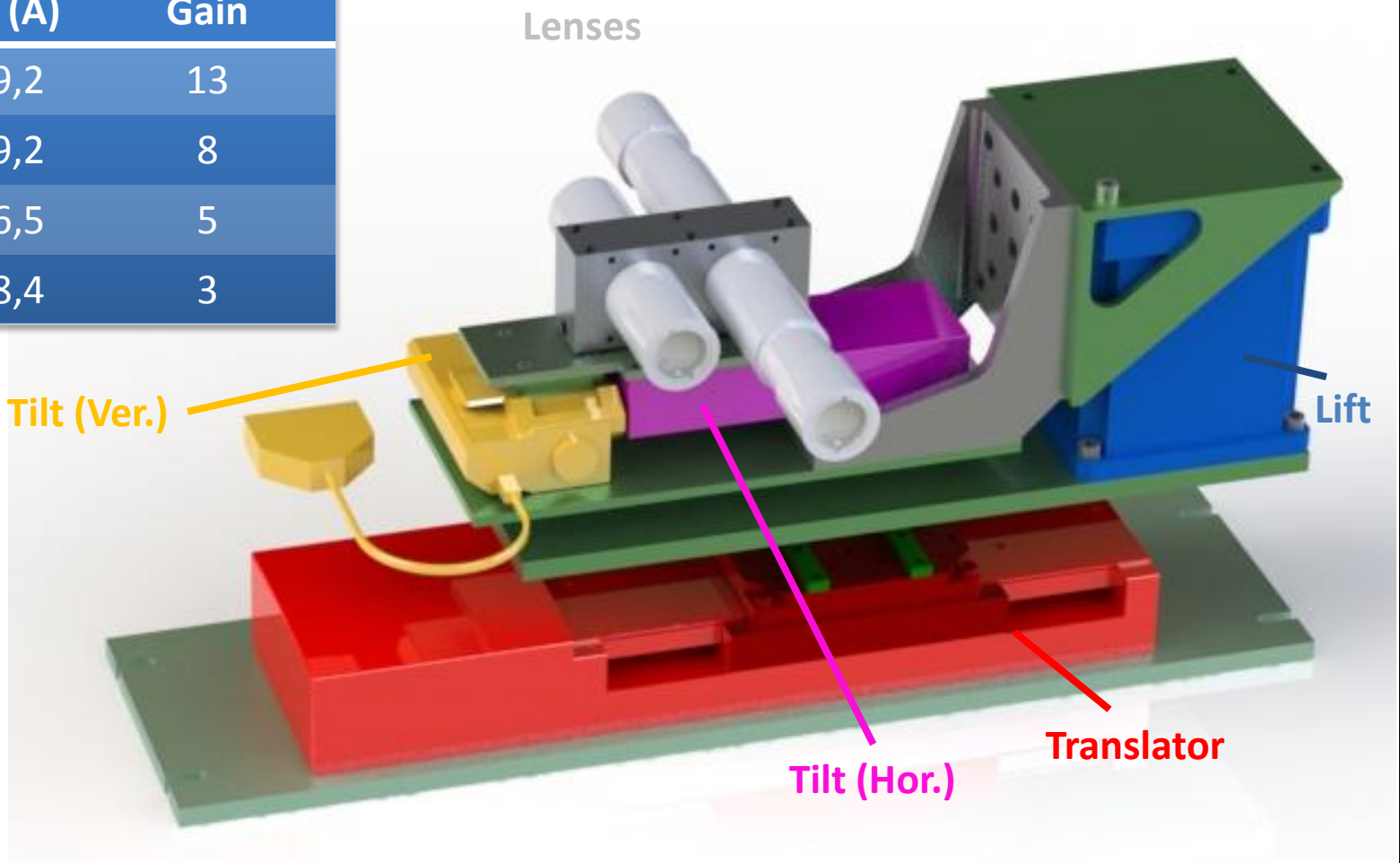


λ= 7 Å
Collimation : 2m
Diaphragmes : 1mm*25mm



VSANS mode

Q_{min} (1/Å)	λ (Å)	Gain
4.10^{-4}	9,2	13
6.10^{-4}	9,2	8
8.10^{-4}	6,5	5
10^{-3}	8,4	3



+ Dedicated free path (multibeam, Söller, reflective, …)

Polarization

For studies of magnetic properties of samples

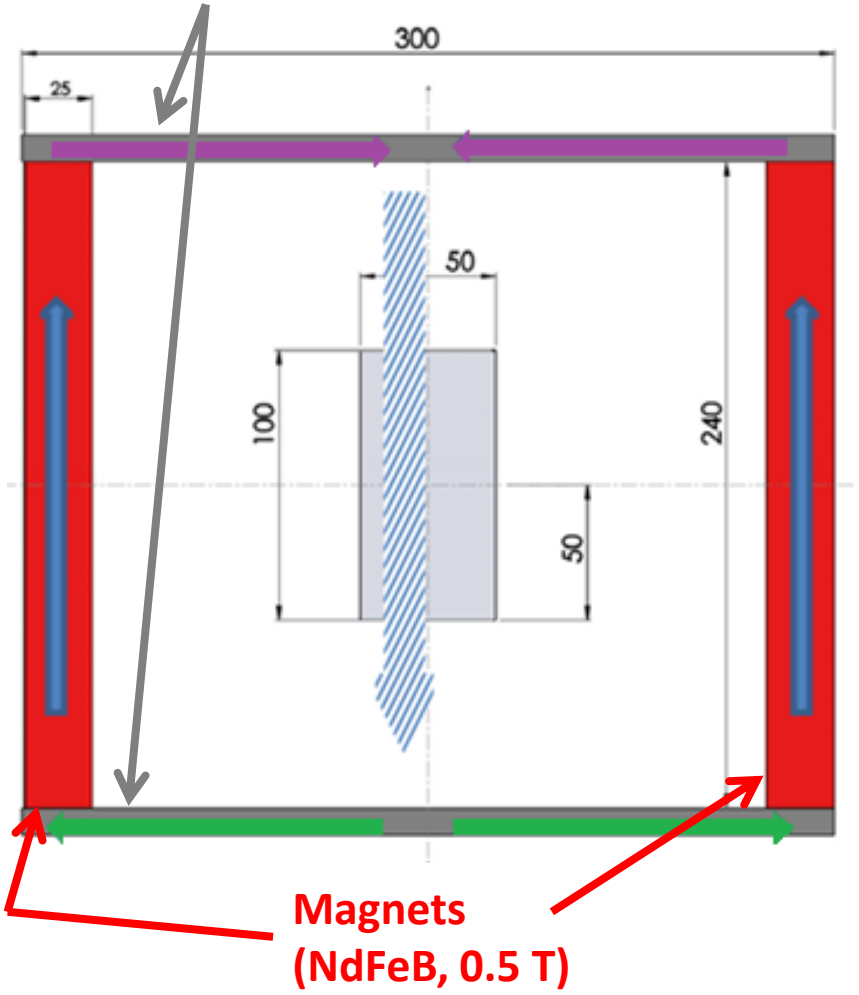
Polarization must be guided to the sample for 4+ Å neutrons

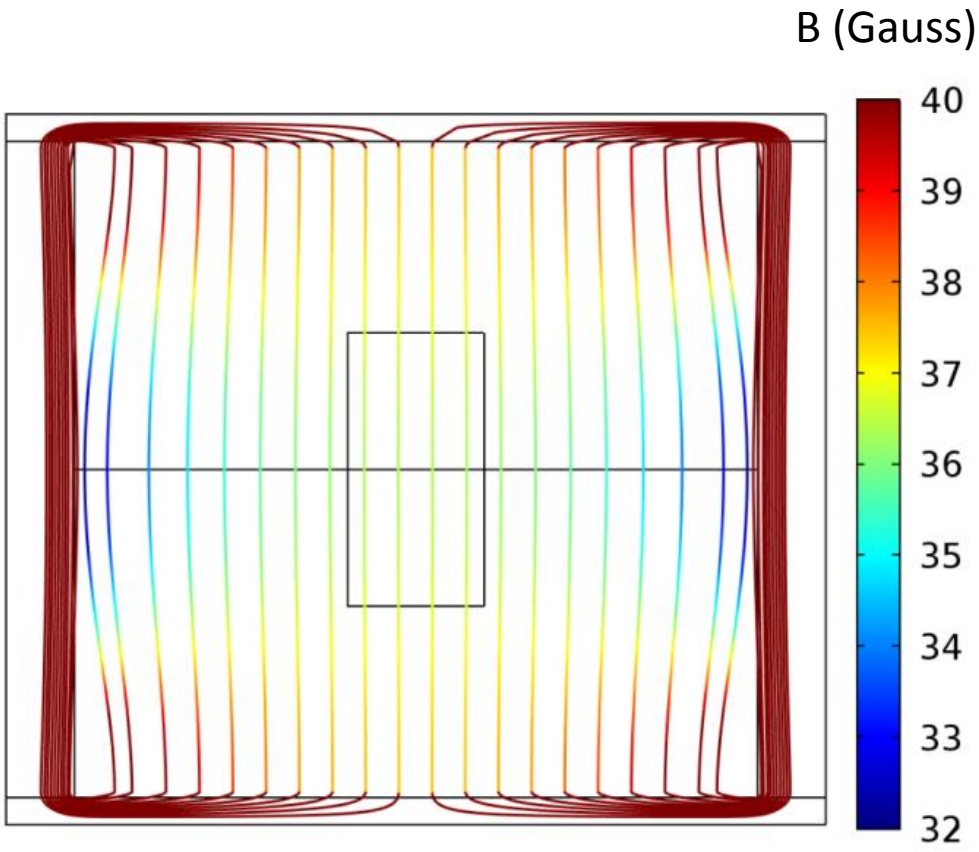
Constraints:

- Fit the guides and diaphragms
- No magnetic parts
- Telescopic part

Guide field / Principle

Soft iron plates





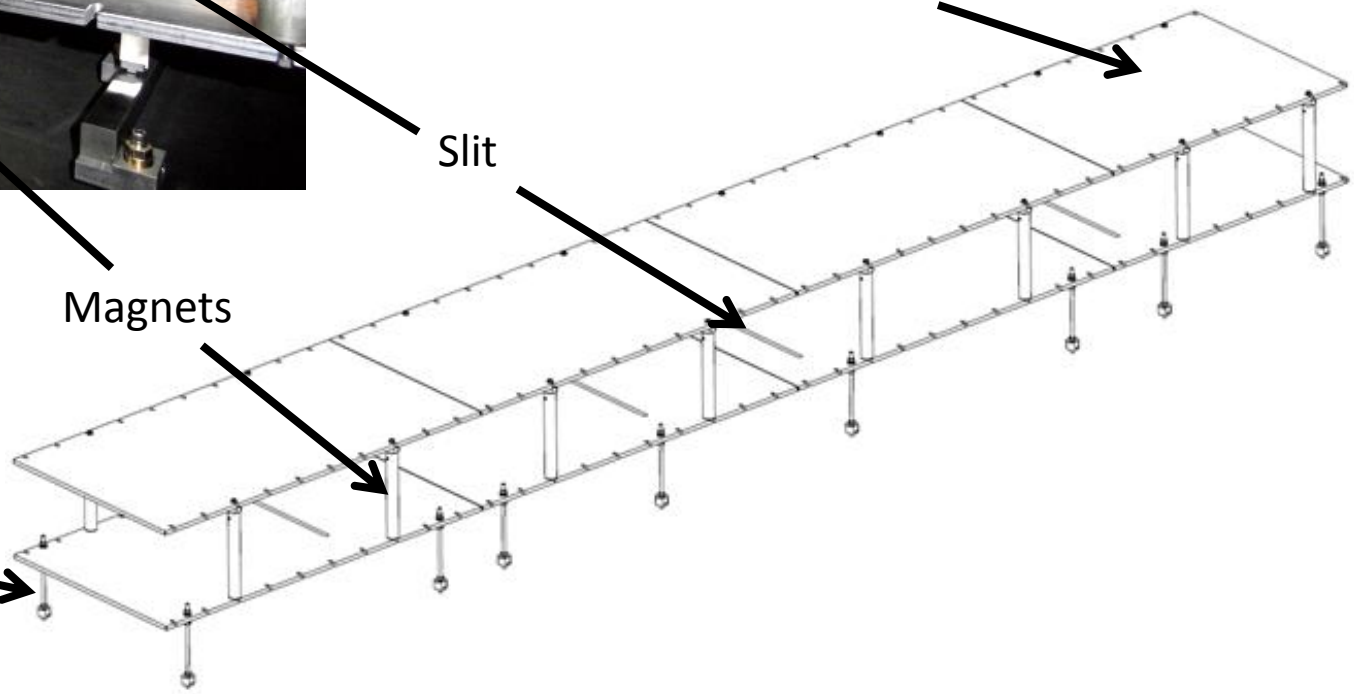
Guide field

Soft iron plates

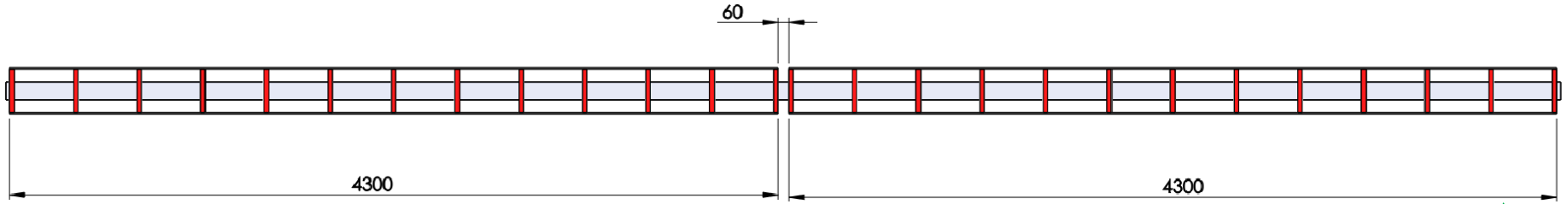
Slit

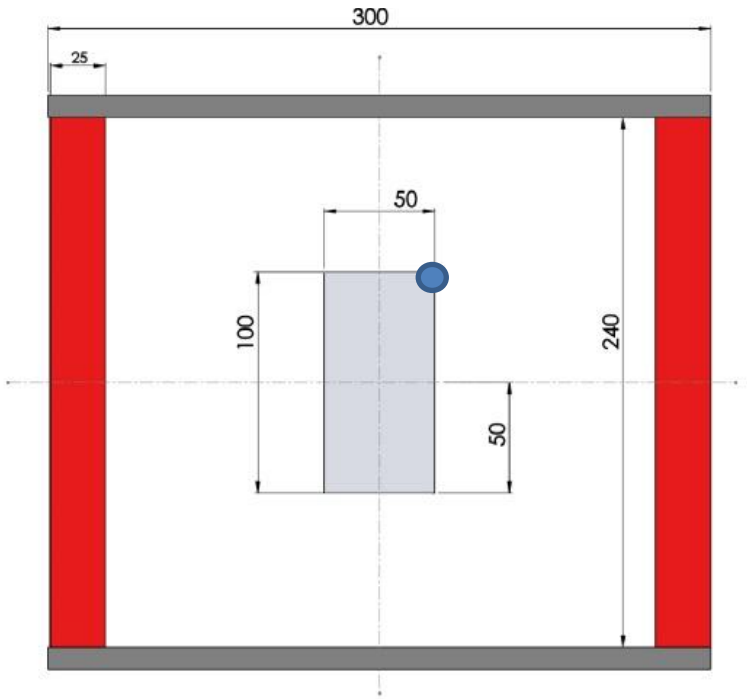
Magnets

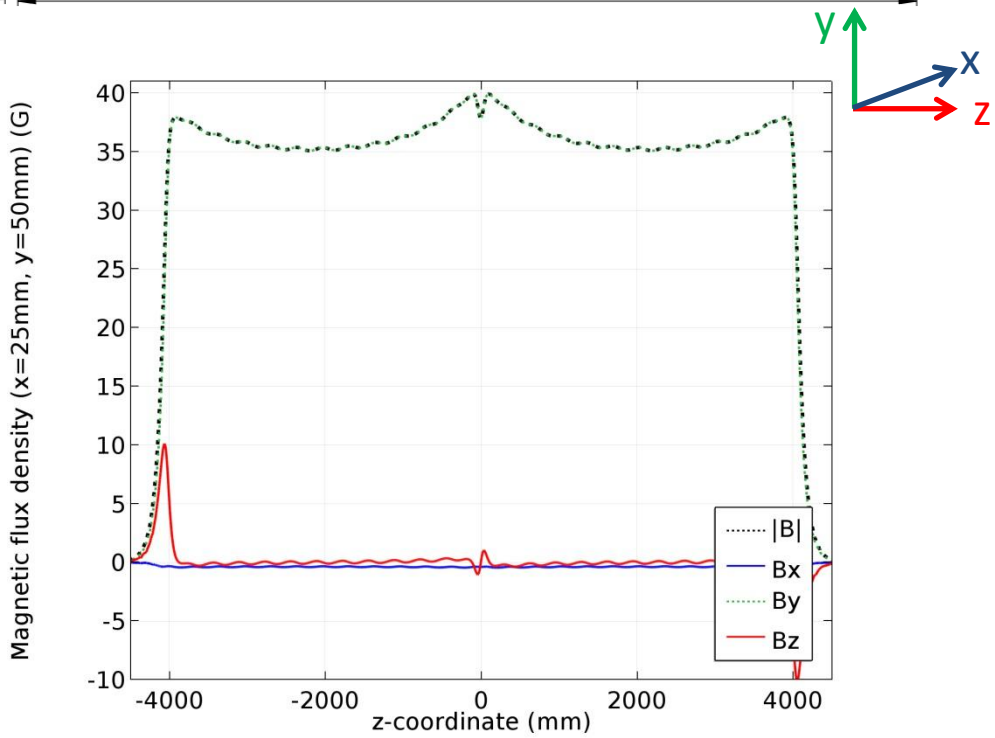
Plate holder



Guide field / Simulation







⇒ 35 G vertical (By) and 2 G (along 30 mm) longitudinal (Bz)
Adiabatic condition fulfilled

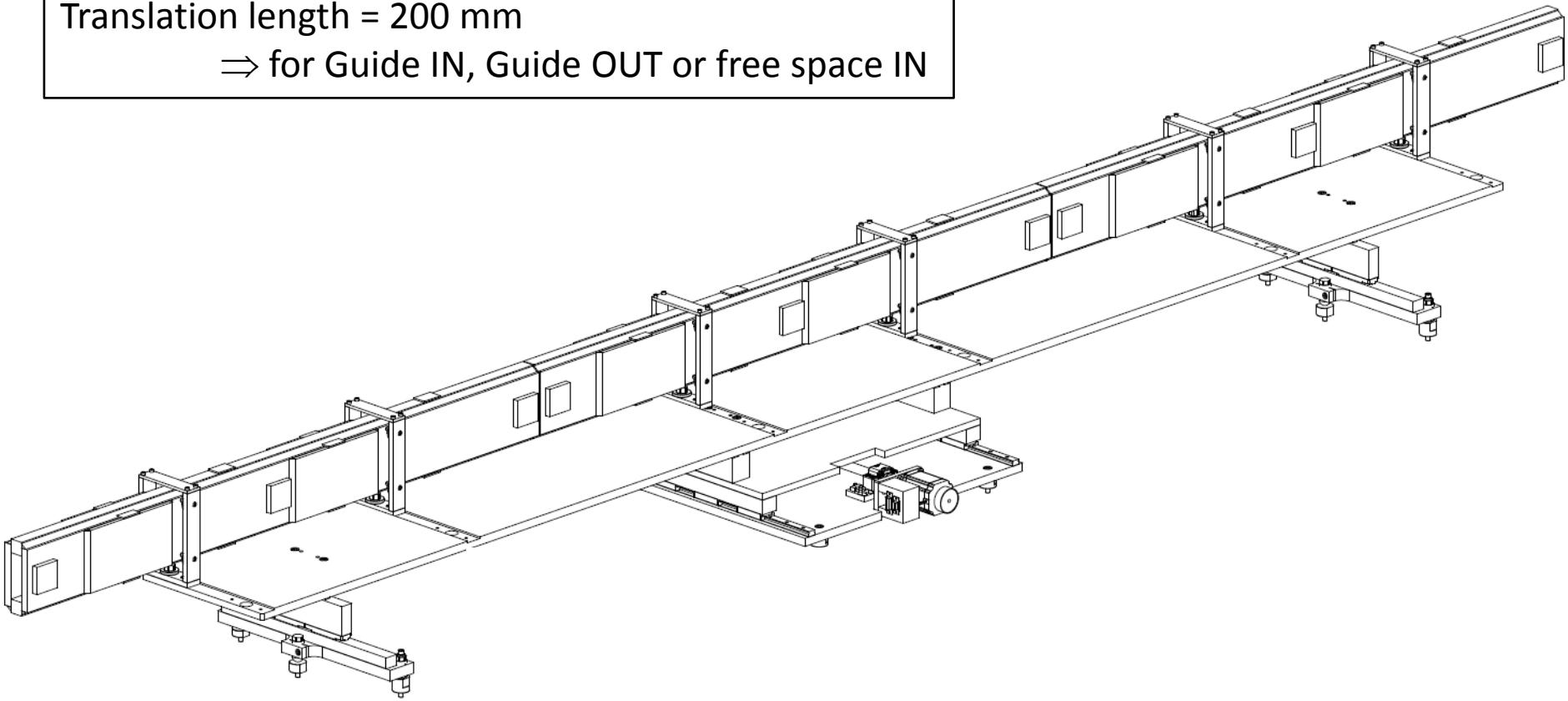
Guide translations

85(H)x25(W) mm^2 inner section

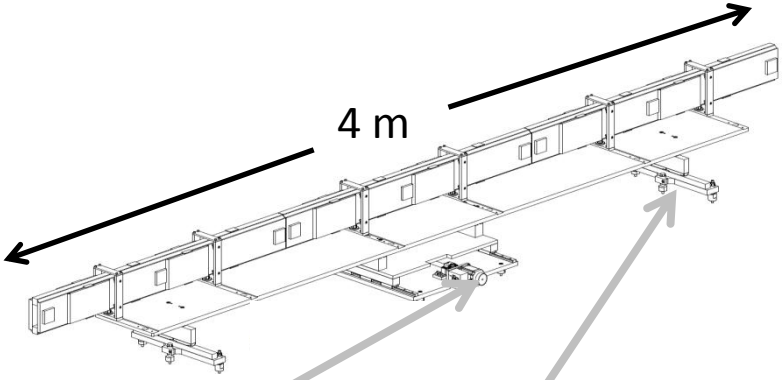
3 elements of 4 m, and 1 element of 2 m

Translation length = 200 mm

$\Rightarrow$ for Guide IN, Guide OUT or free space IN

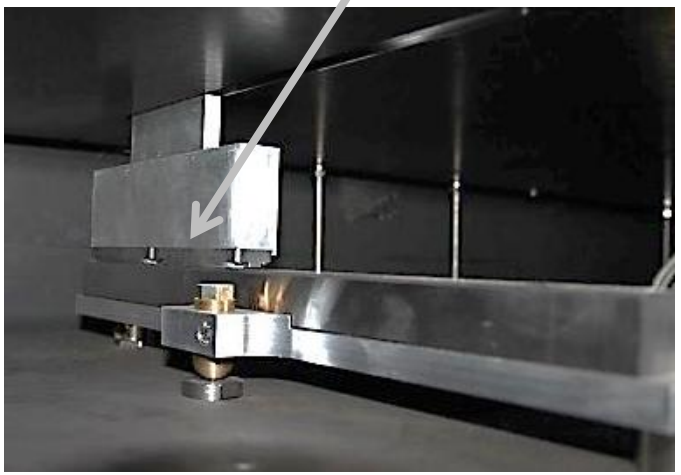


Guide translations

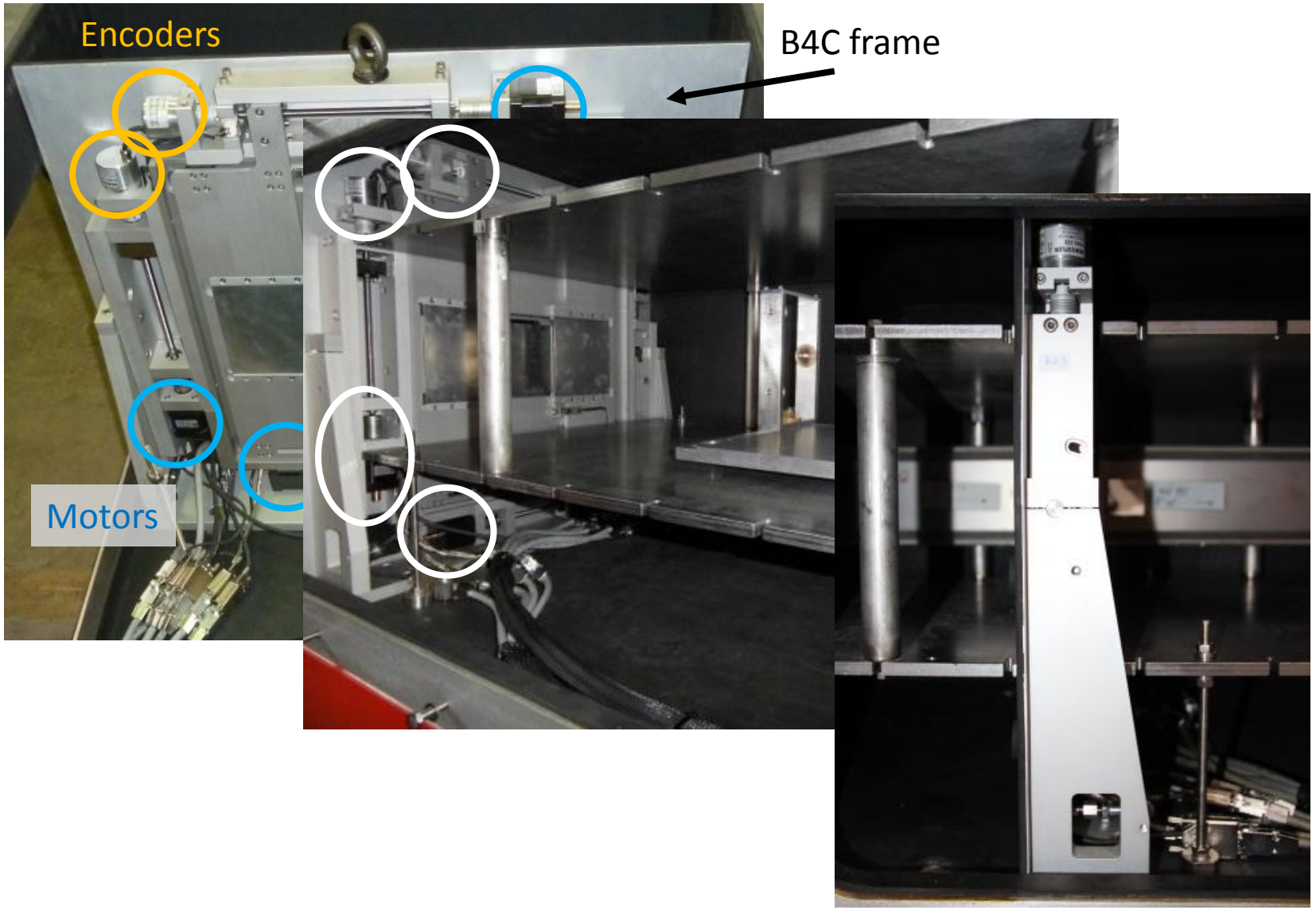


Motorization

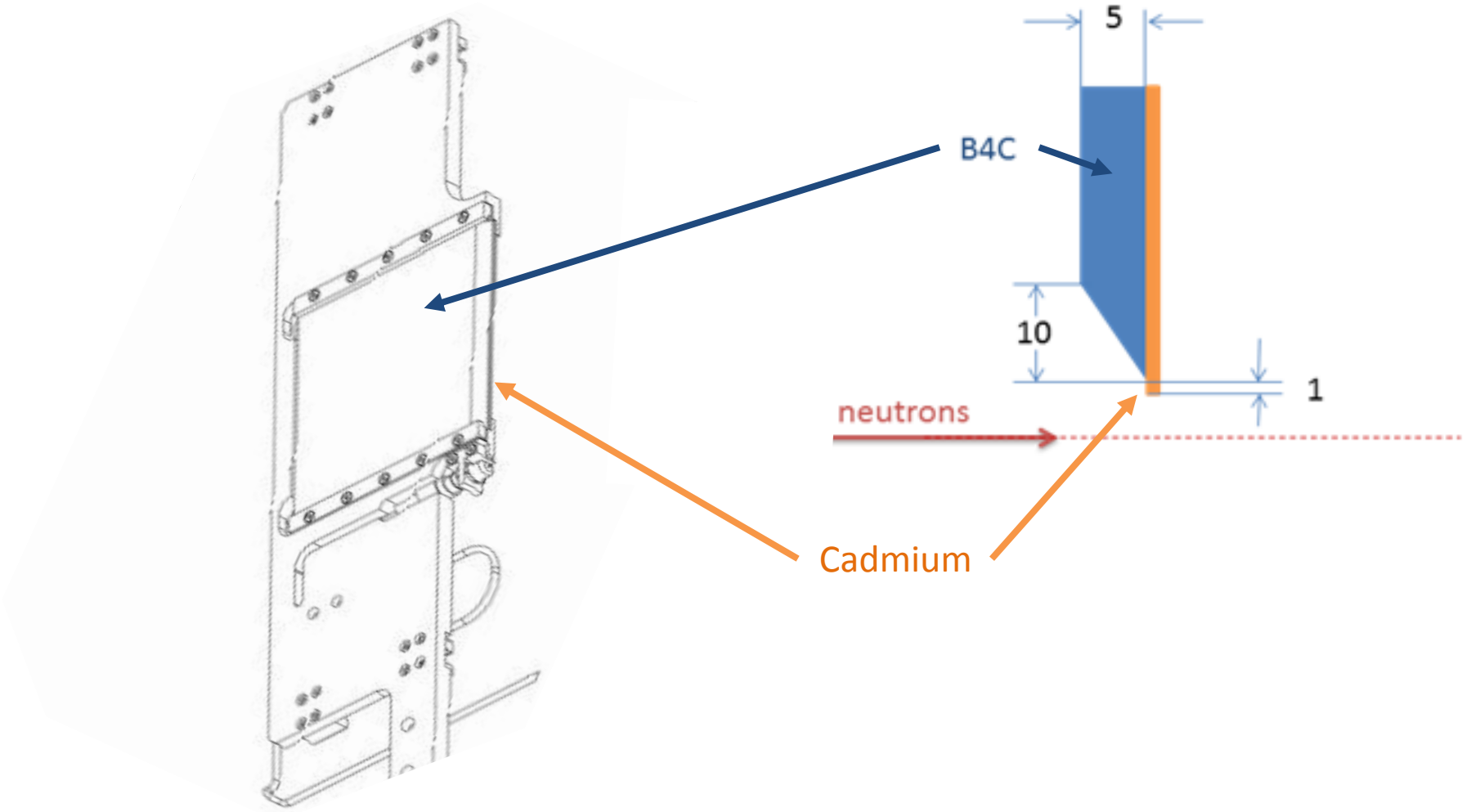
Rail / Ball bearings



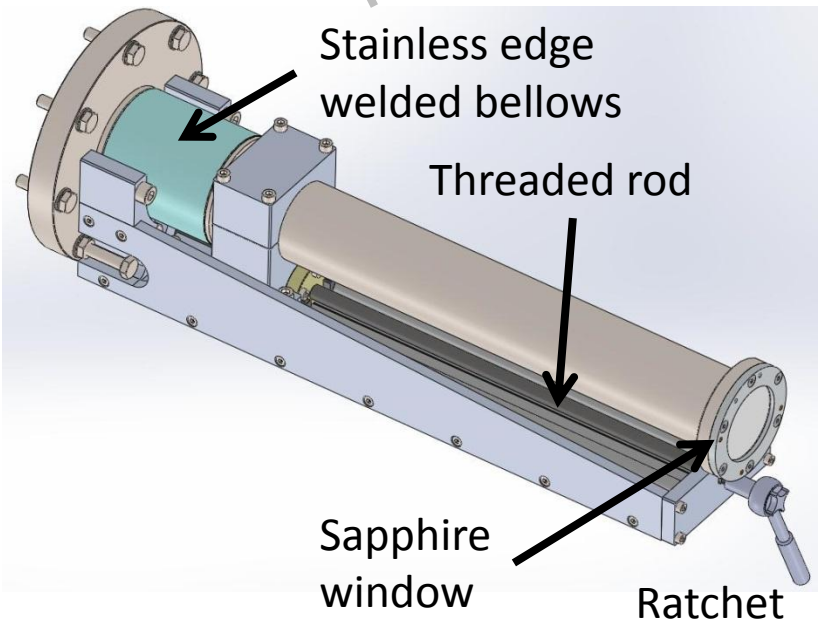
Blinds / Motorization



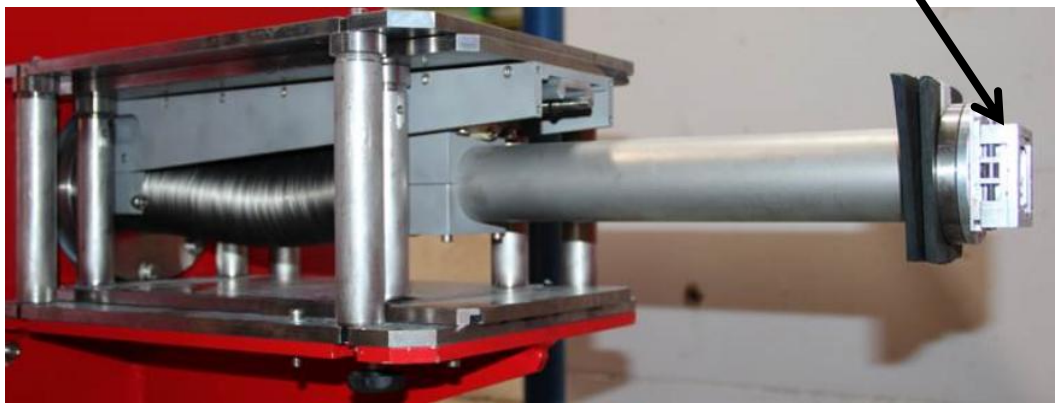
Blinds / Absorber



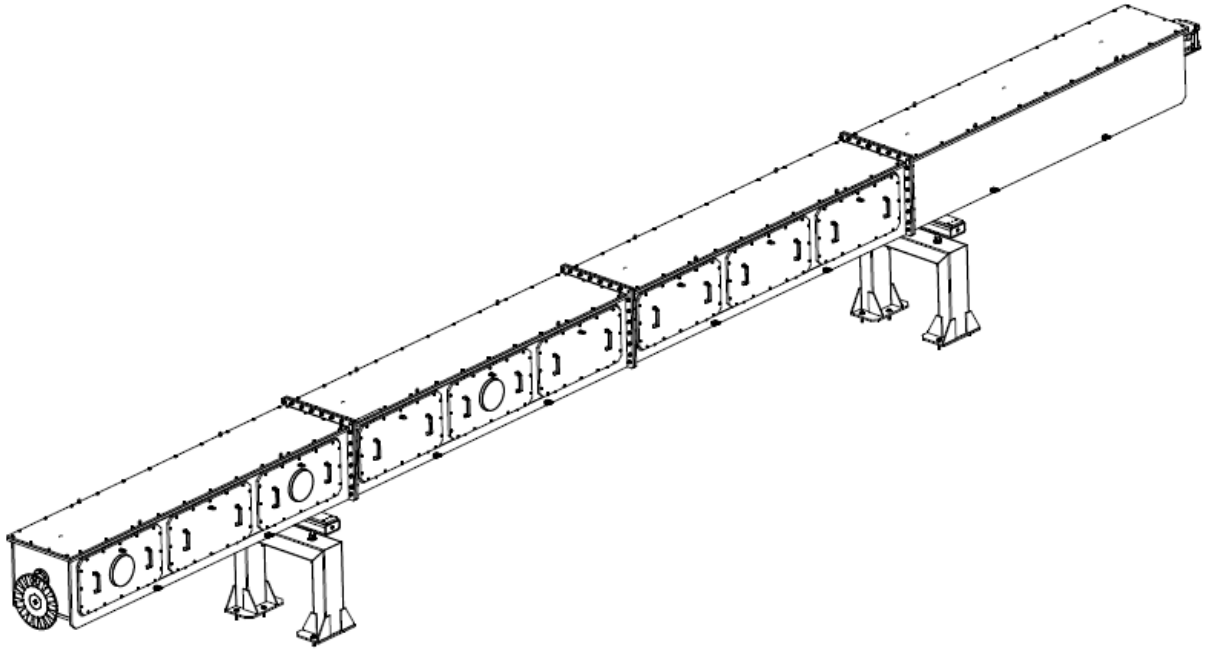
Telescopic nose & Guide field

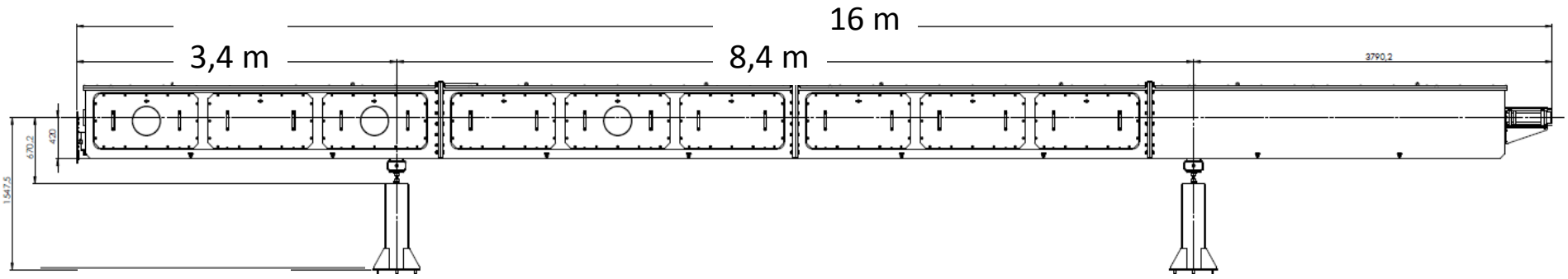


Diaphragm holder

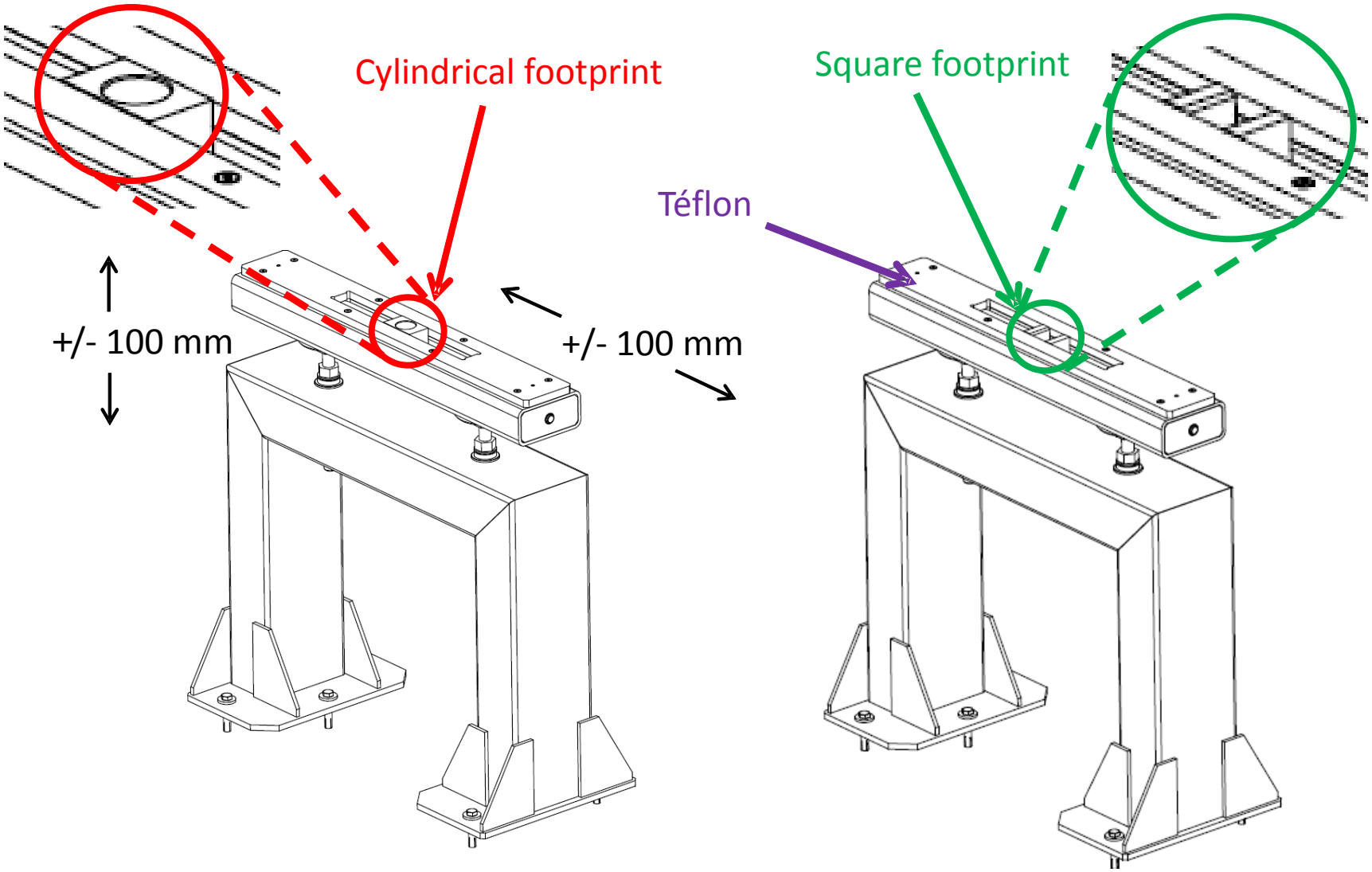


Collimator support



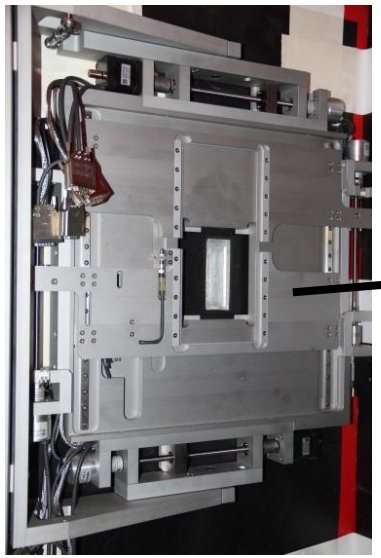


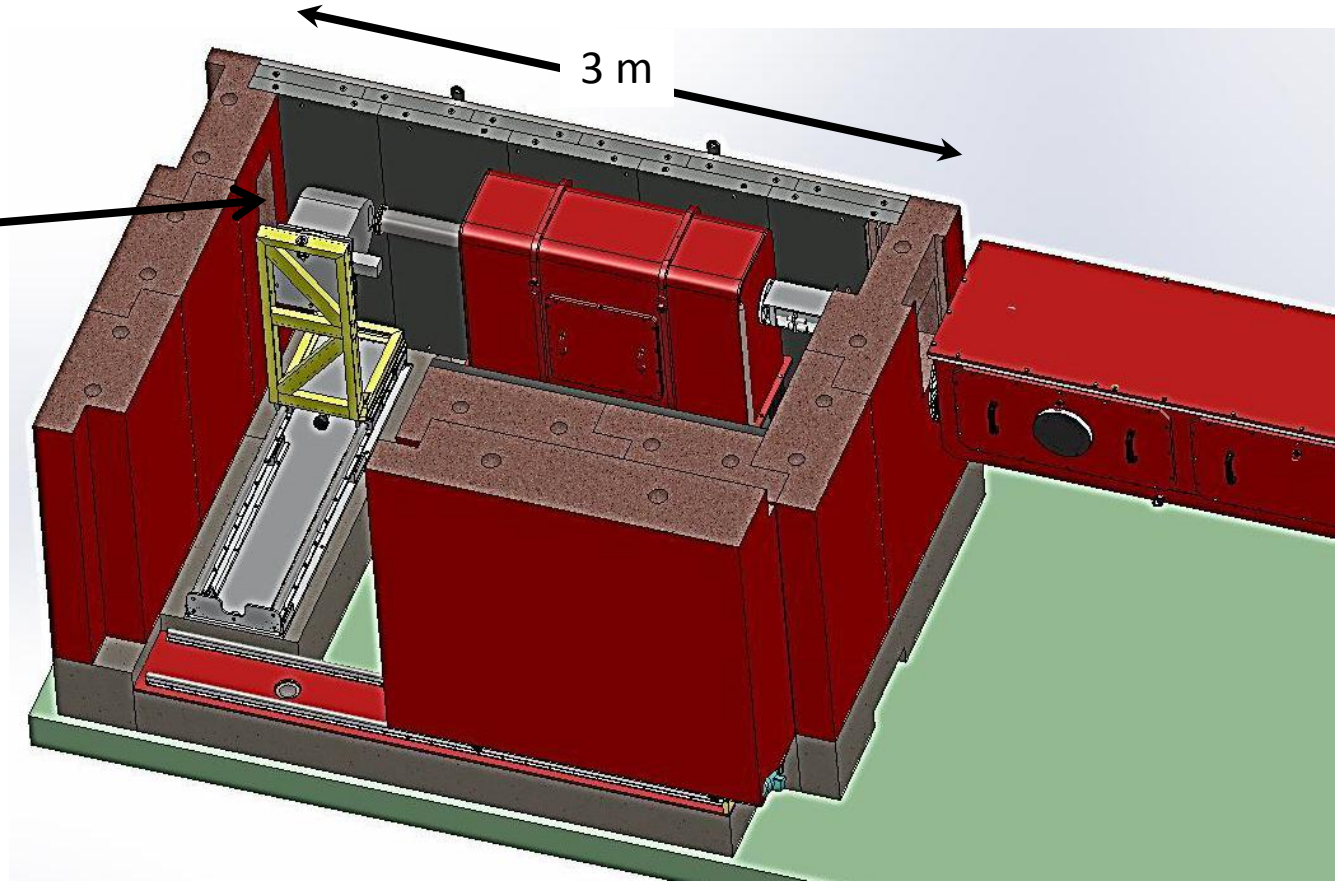
Collimator support



19 m collimation

Collimation length = Sample to detector

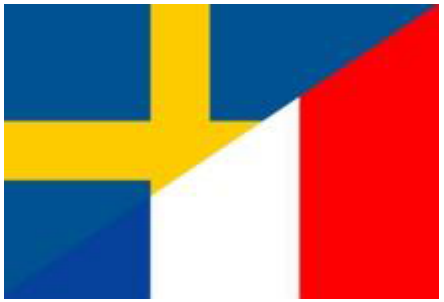




Acknowledgements

LLB Staff

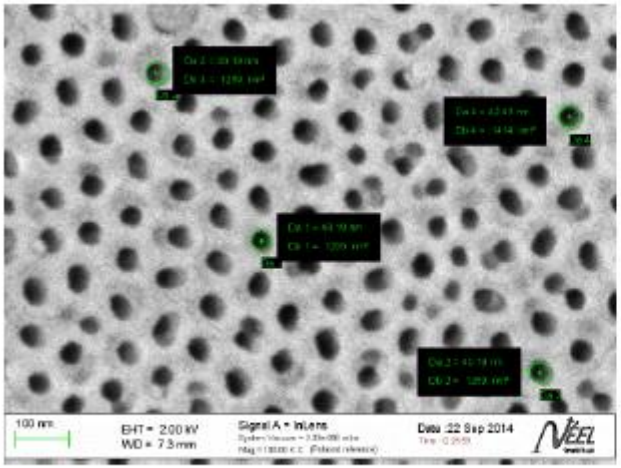
Design office	P. Permingeat P. Lavie
Polarization	S. Klimko
Motion control	F. Coneggo P. Lambert W. Josse G. Koskas
Technicians	M. Detrez A. Helary
Scientists	G. Chaboussant A. Brûlet



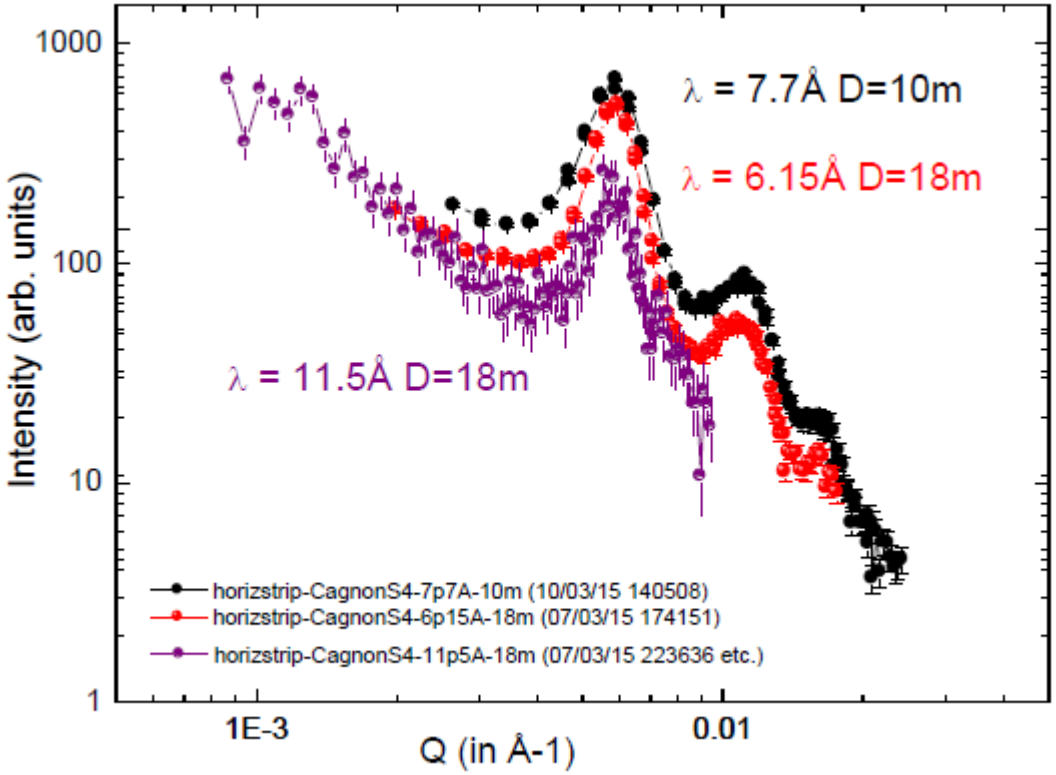
TRIANGLE DE LA PHYSIQUE

NanoSciences ILE-DE-FRANCE

First Results / SANS

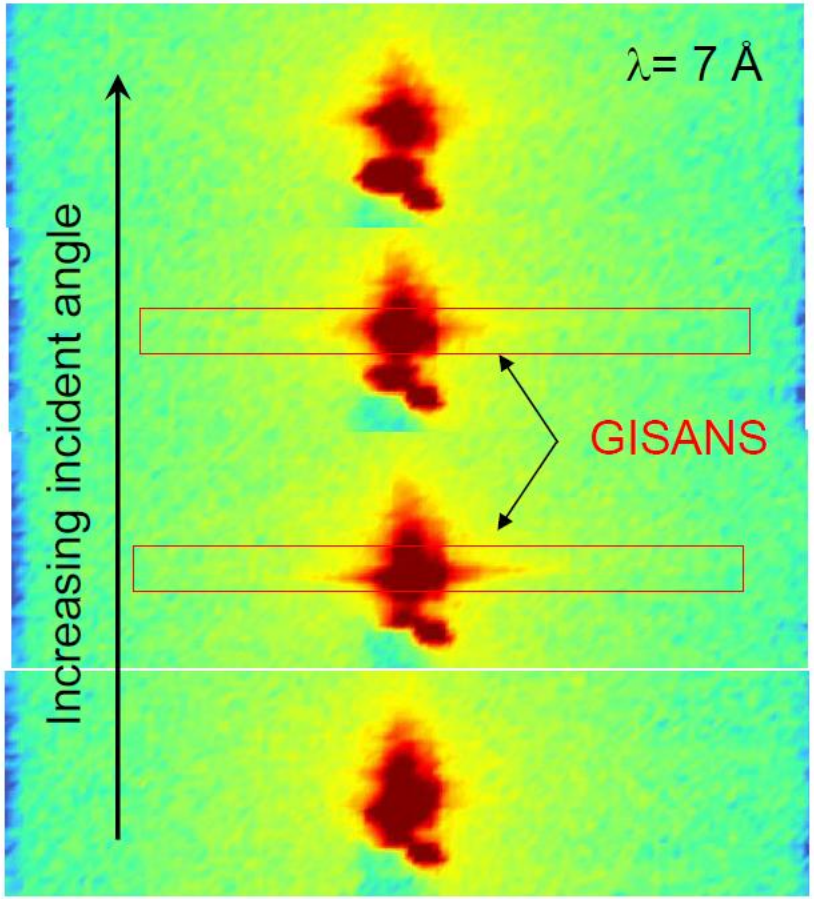


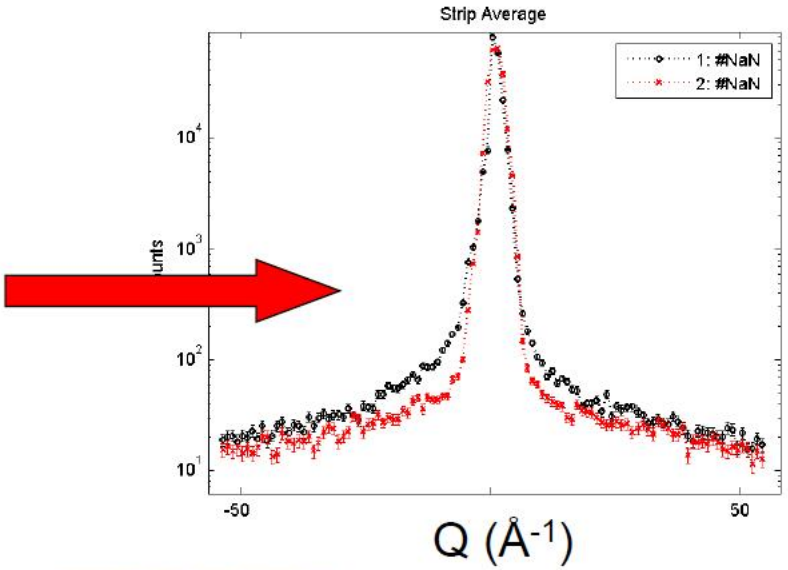
Spacing : 100 nm
Pore size : 40 nm

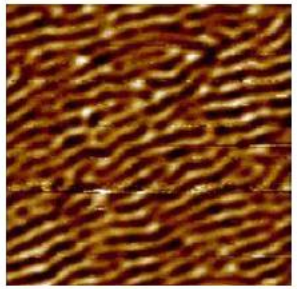


First Results / GISANS

GISANS on nanostructured $CoSiO_2$ / Si wafer

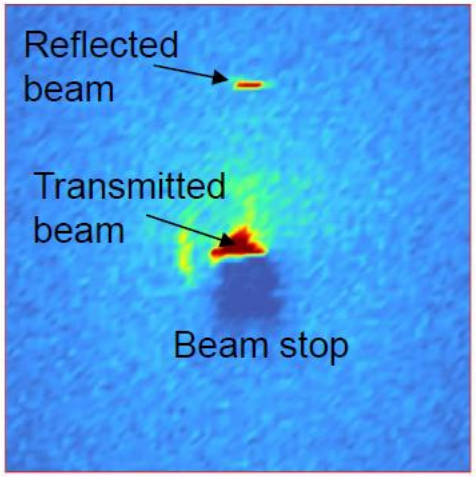


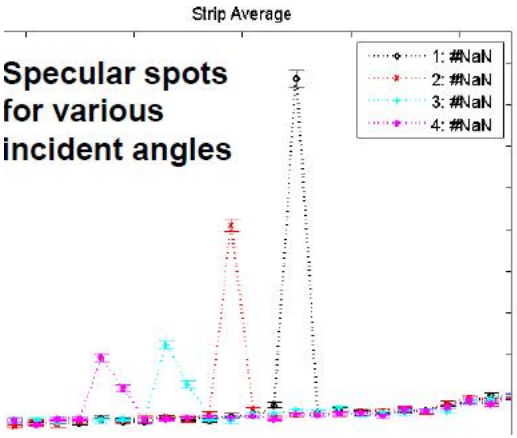




« domain » formation length scale : 125 nm

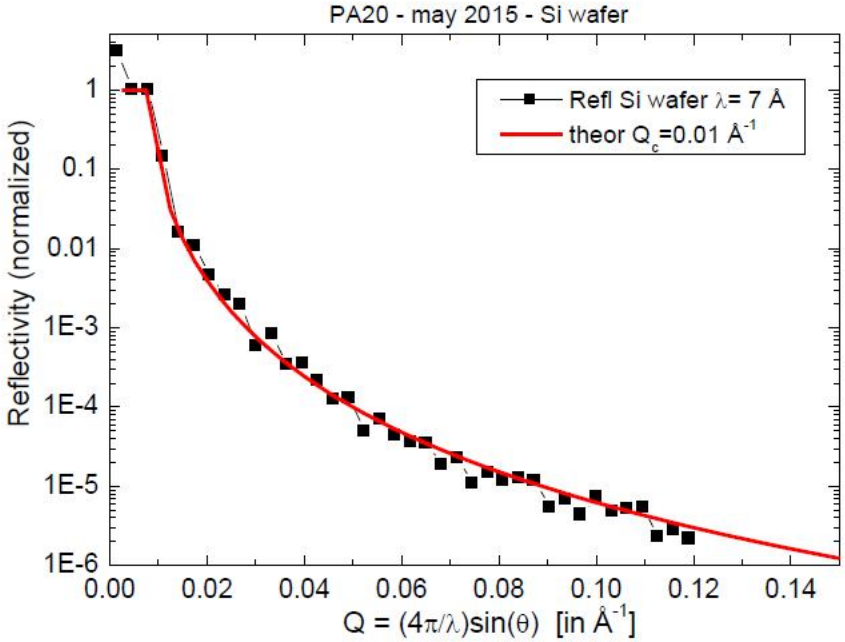
First Results / GISANS





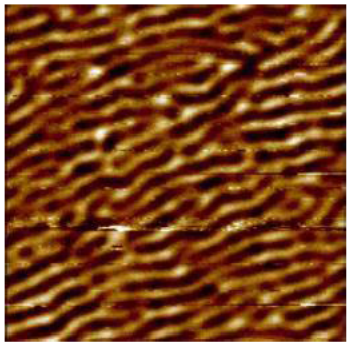
Reflectometry on a Si wafer

λ= 7 Å
Collimation : 2m
Diaphragmes : 1mm*25mm



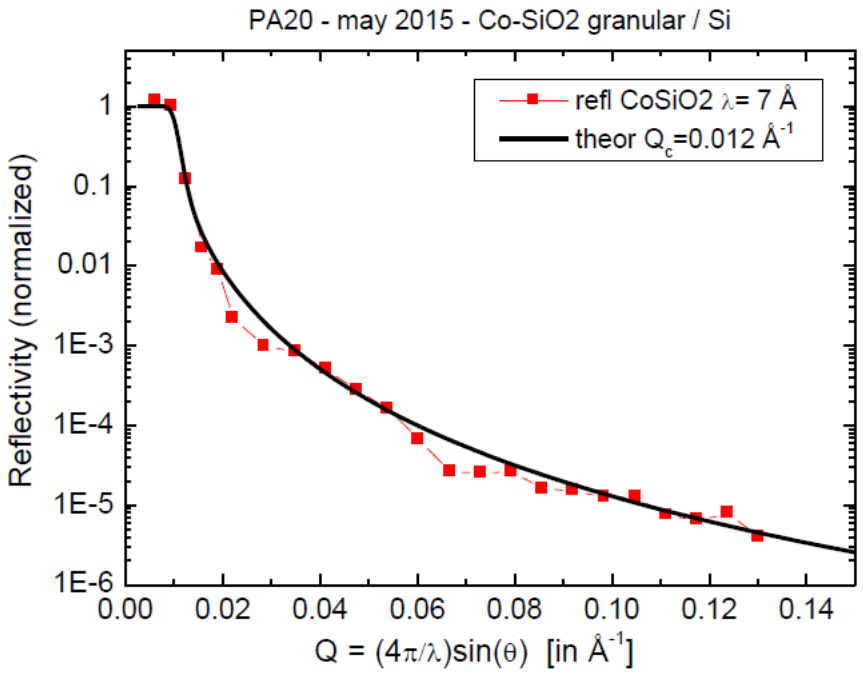
First Results / GISANS

Reflectometry on on nanostructured $CoSiO_2$ / Si wafer



presence of weak stripe domains in the superferromagnetic phase

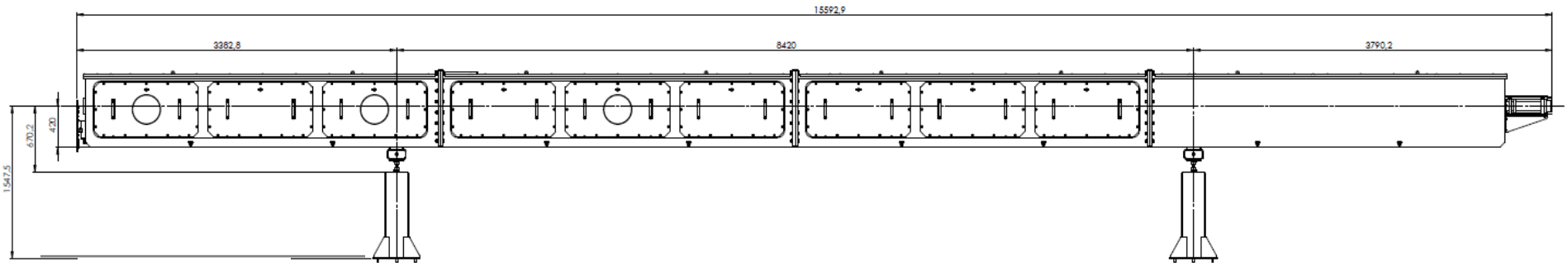
λ= 7 Å
Collimation : 2m
Diaphragmes : 1mm*25mm

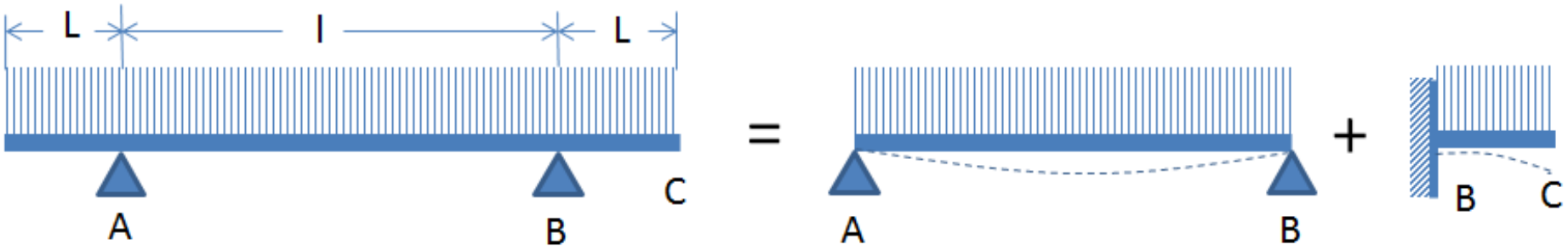


Collimator support

Only 2 supports located at 25% of the length to minimize bending

(2 temporary supports needed during assembly as collimator is made out of 4 x7.5 m pieces)





Overview

Instrument PA20

Collimator

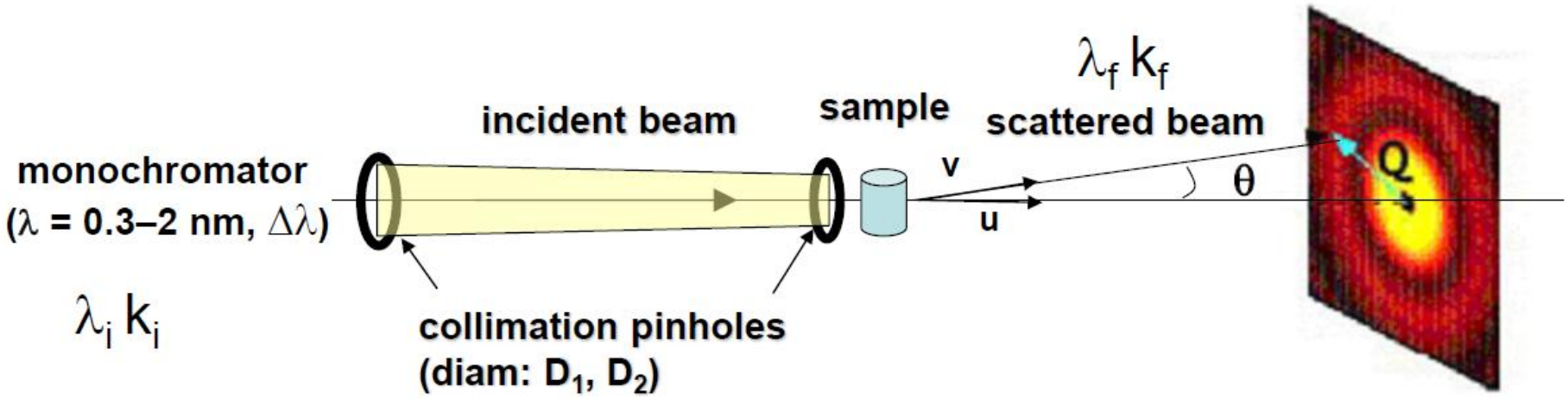
Scientific modes:

- SANS
- GISANS
- VSANS

Polarization

Technical aspects

SANS mode



Rectangular apertures with slits

6 collimation lengths : 19, 16, 12, 8, 4, 2 m

Foreseen “standard” collimation : 25x25 mm^2 entrance and 12.5x12.5 mm^2 exit
i.e. full use of beam width

Guide field calculation

Adiabatic rotation without loss of polarization:

$$\omega_L > 10.\,\omega_B$$

Larmor precession freq.

Angular magnetic field rotation freq.

$$\omega_L > 22.\,\omega_B \quad @\ \lambda = 4\ \text{Å}$$