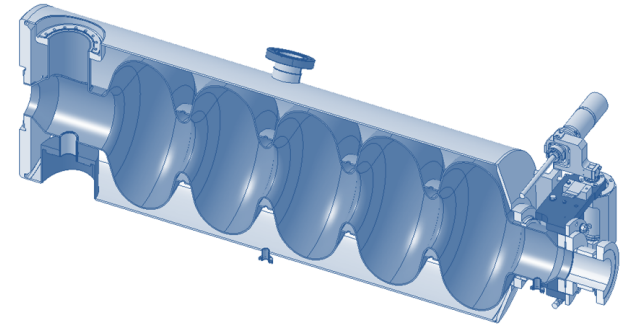


Mechanical layout and technical specification of the cavity-tuner-He-tank unit

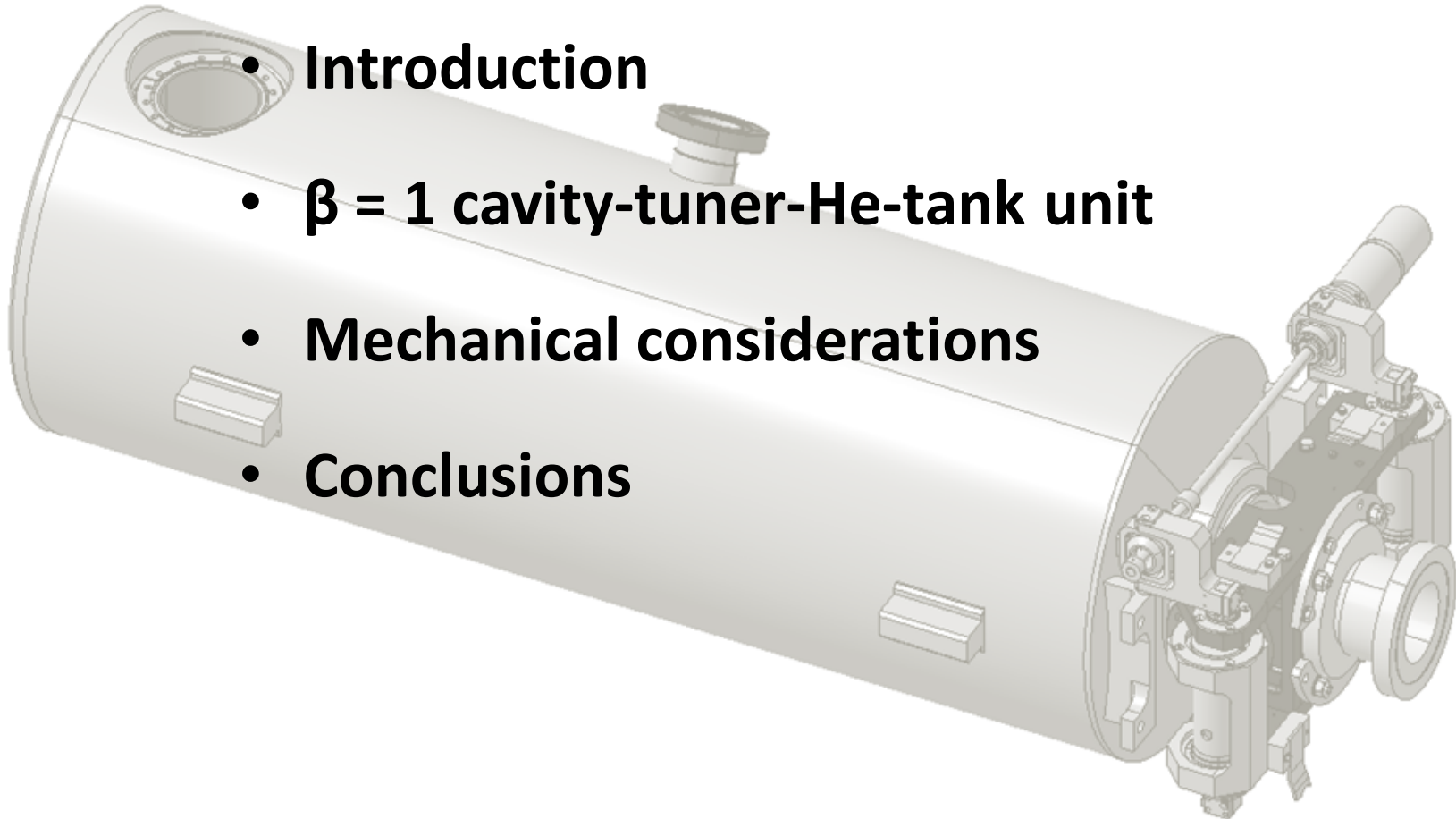
Ofelia Capatina / CERN

3rd SPL Collaboration Meeting CERN 11 – 13 Nov 2009

Overview



- **Introduction**
- **$\beta = 1$ cavity-tuner-He-tank unit**
- **Mechanical considerations**
- **Conclusions**

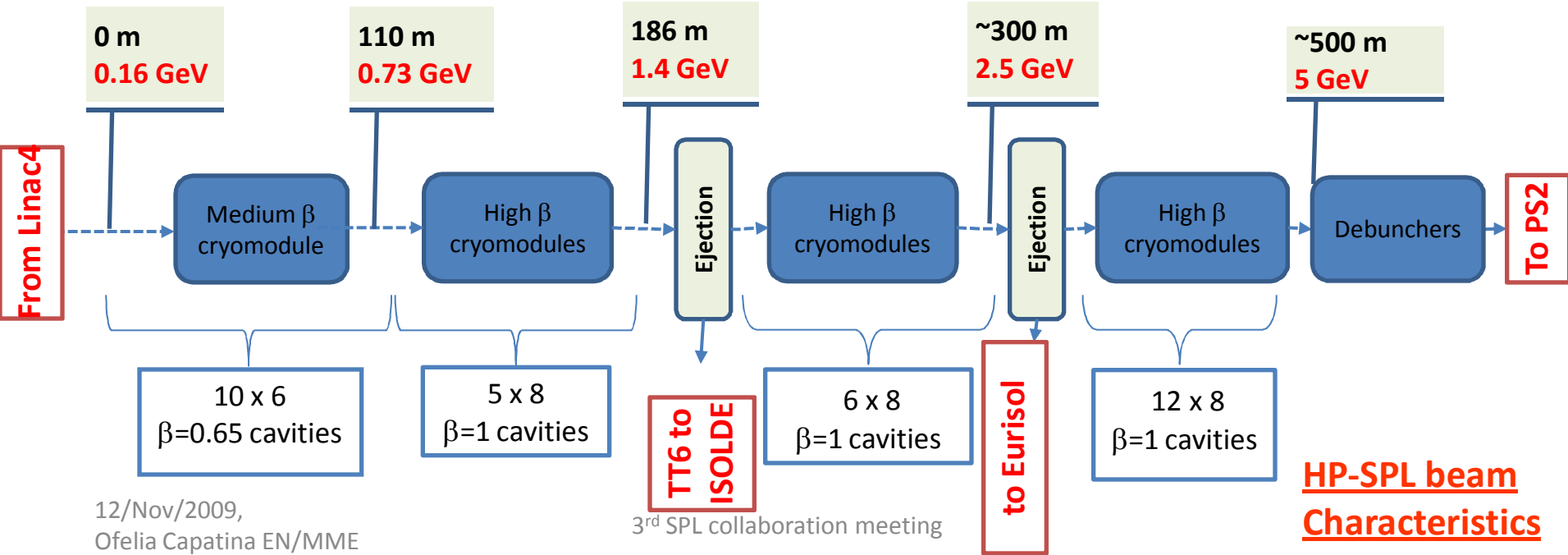
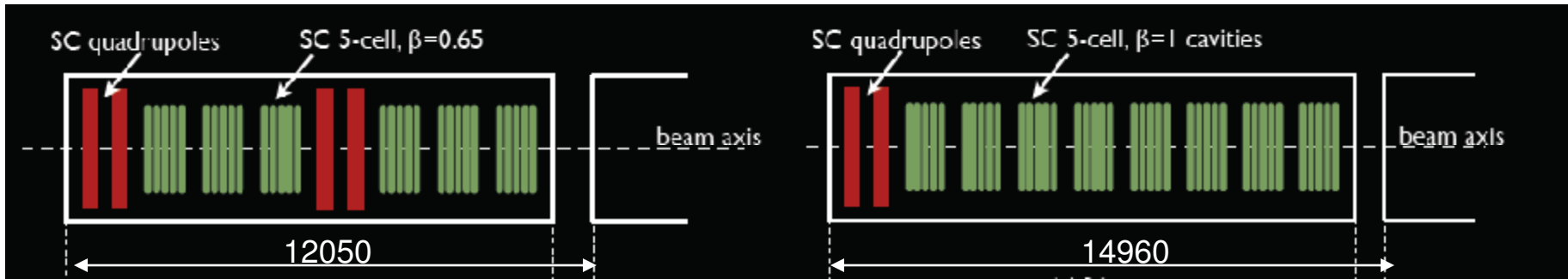




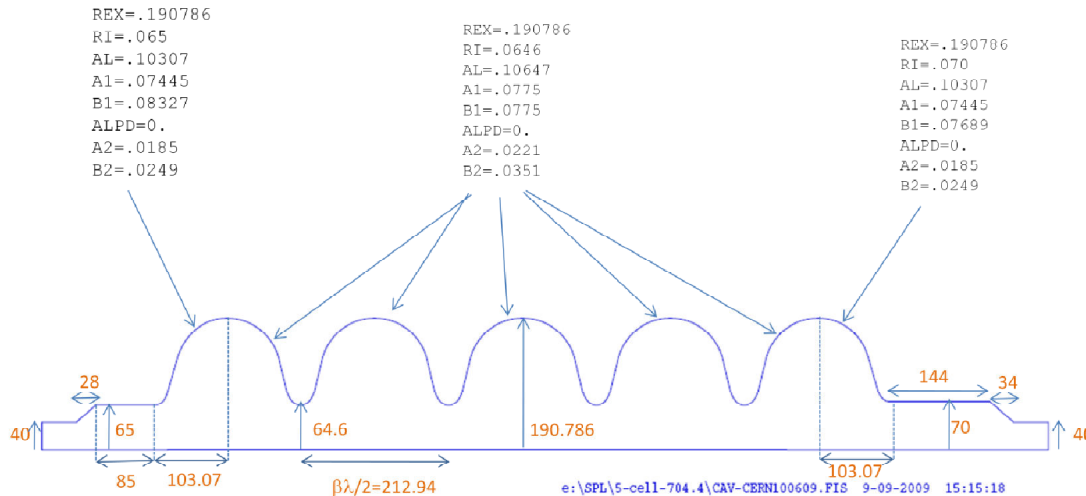
Presentation by Frank Gerigk, Yesterday

Total no. of cavities (SC 5-cell, 704MHz, 19.3/25 MV/m)

- 60 x $\beta=0.65$
- 200 x $\beta=1$



- Cavity design
 - Cavity design for $\beta = 1$ done by CEA-Saclay



Cavity beta 1 L.: 1495
beta 0.65 L.: 1127

- Cavity design for $\beta = 0.65$ done by CNRS-Orsay

$\beta = 1$ cavity design presentation by Juliette Plouin, Today 10:30

$\beta = 0.65$ cavity design presentation by Guillaume Olry, Today 10:50

- Helium tank and tuner

Mechanical issues Workshop Recommendations

<http://indico.cern.ch/conferenceDisplay.py?confId=68968>

Presentation by
Ofelia Capatina,
Today at 11:10

Therefore we recommend

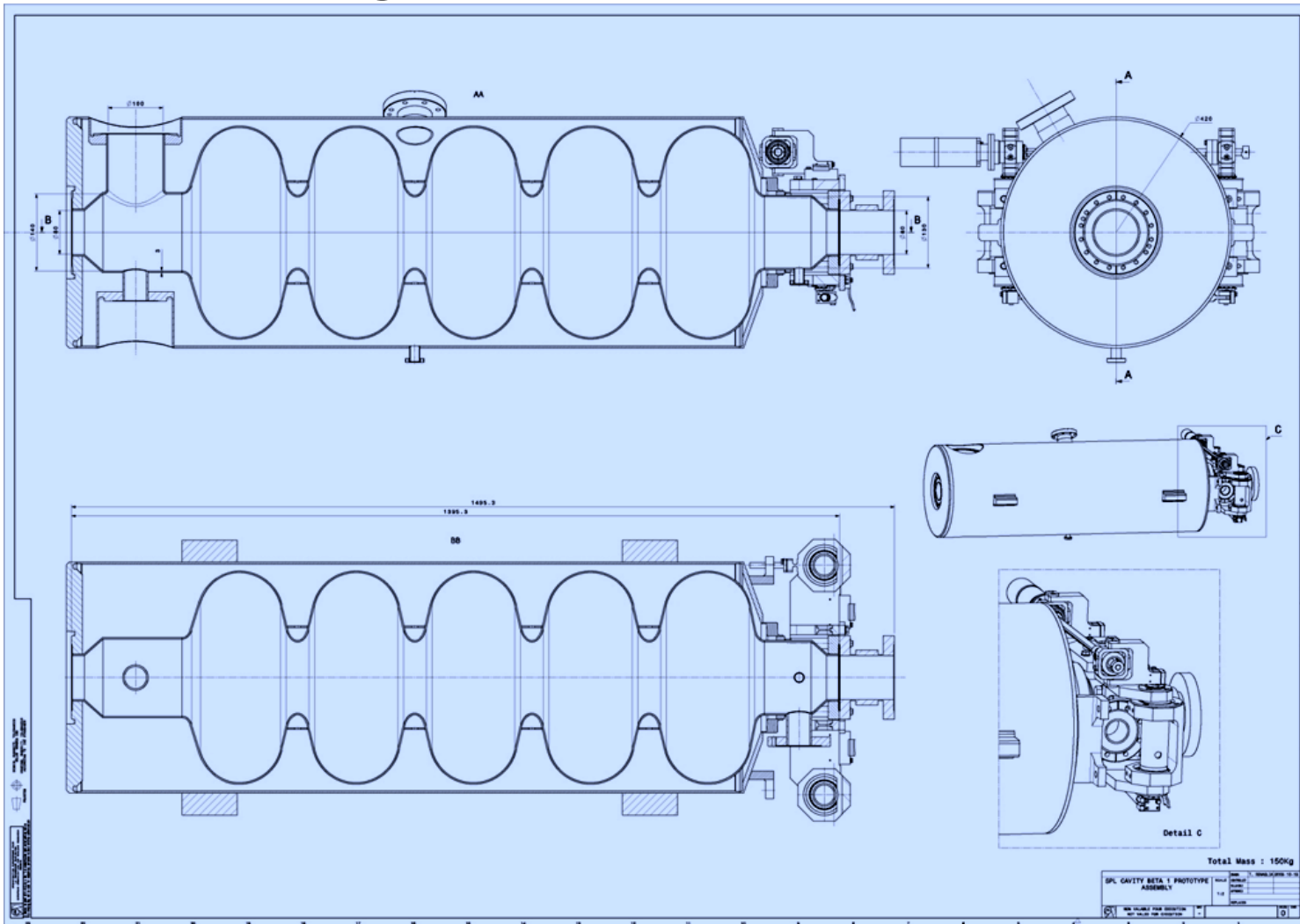
- (1) to build the demonstrator by using at maximum the existing experience, recipes and technical solutions, i.e. the CEA-Saclay/XFEL design as baseline, unless they turn out to be not adaptable to, or not needed for, the SPL project.

➡ **Titanium helium tank + CEA tuner for prototype cryo-module**

- (2) to perform a comprehensive study, in parallel to the work on the demonstrator, about all the mechanical and electrical topics which were mentioned in the preceding conclusions. The results of this study may require the manufacture of related hardware, i.e. cavity equipped with stainless steel He tank and modified tuner.

➡ **Stainless steel helium tank + adapted tuner parallel study**

- General configuration for the demonstrator

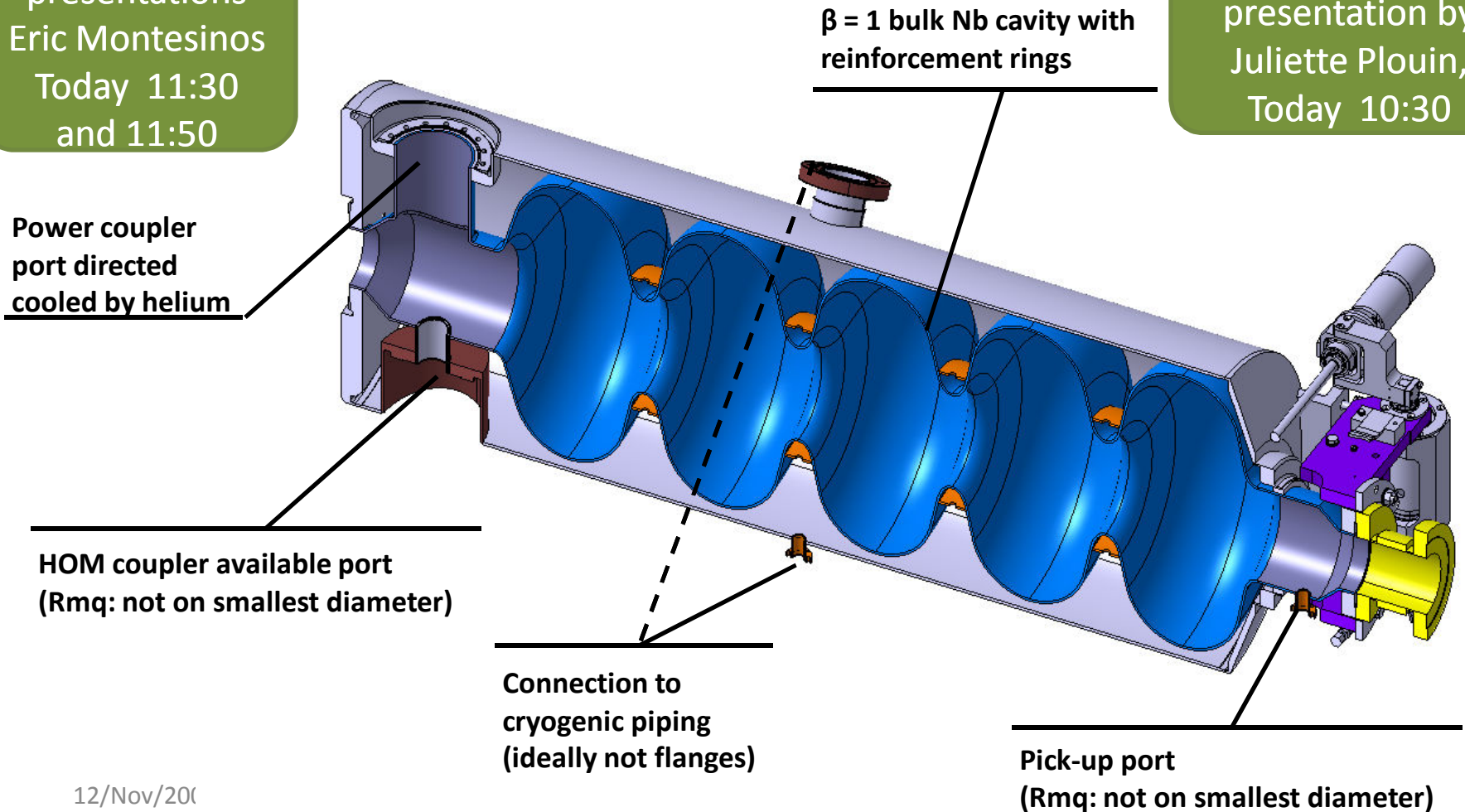


$\beta = 1$ cavity-tuner-He-tank unit

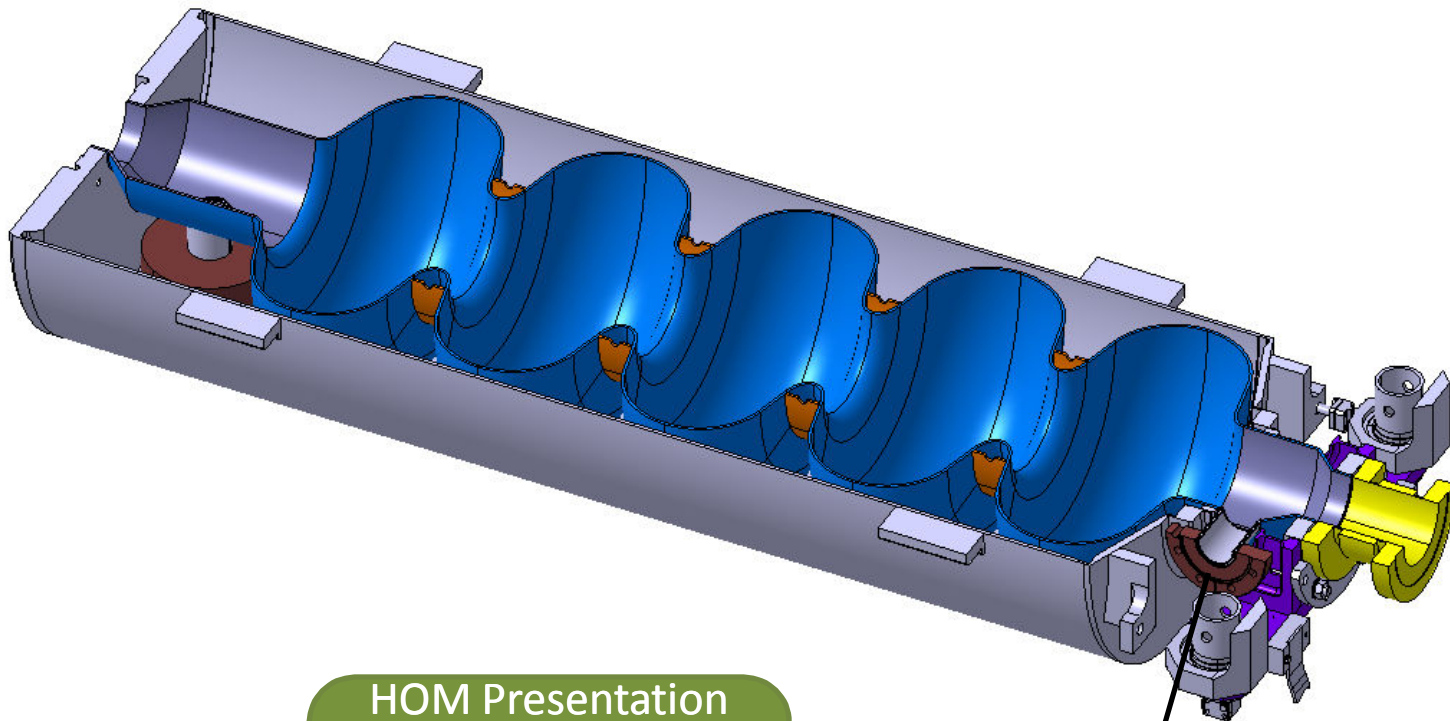
- General configuration for the demonstrator

Power coupler presentations
Eric Montesinos
Today 11:30 and 11:50

$\beta = 1$ cavity design presentation by Juliette Plouin, Today 10:30



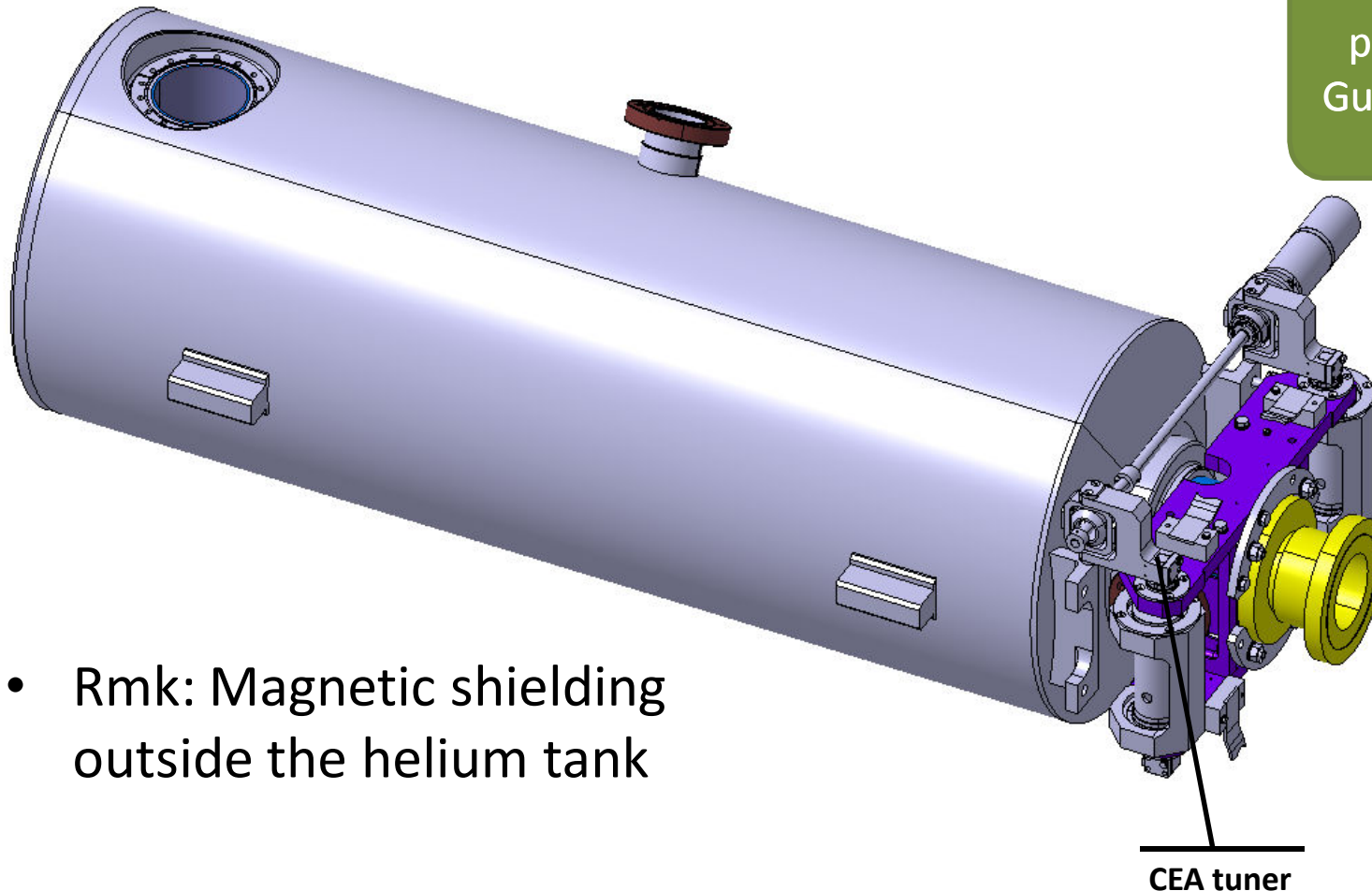
- General configuration for the demonstrator



HOM Presentation
by Alessandra
Lombardi
Yesterday 16:30
WG2 + WG4 session

2nd HOM coupler available port
(Rmq: not on smallest diameter)

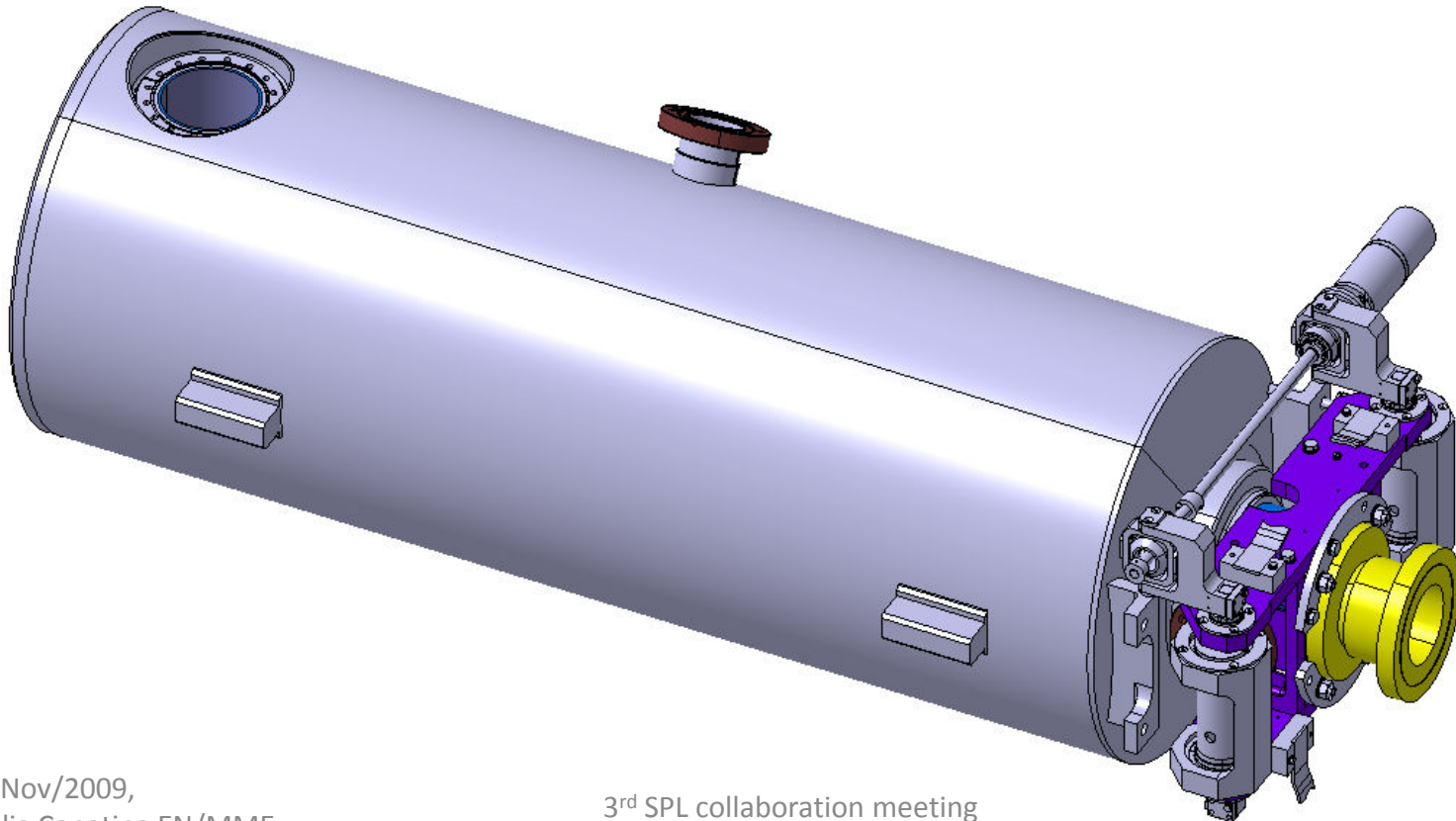
- General configuration for the demonstrator



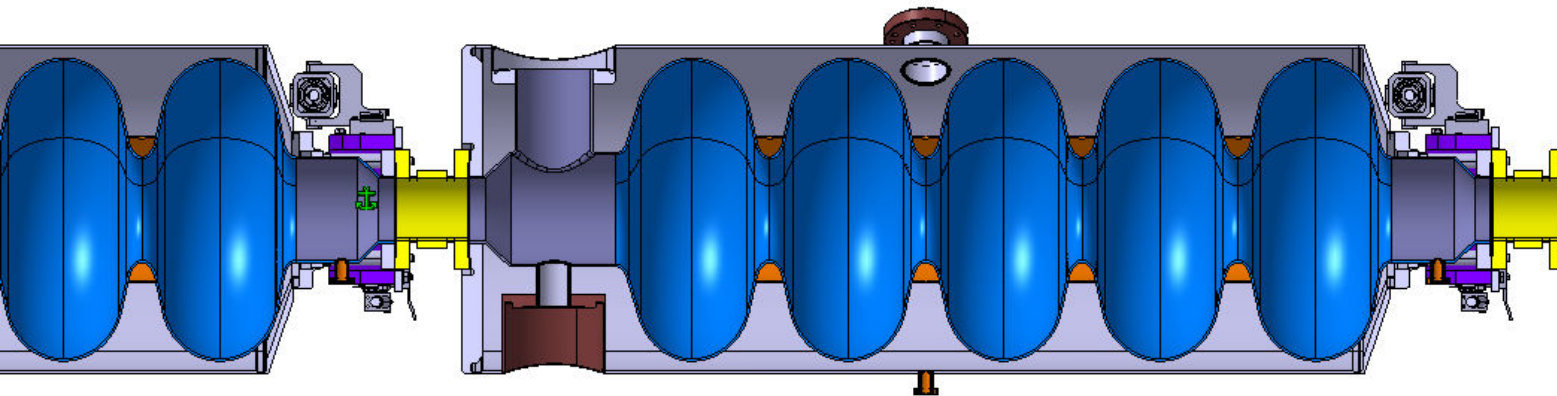
CEA tuner
presentation by
Guillaume Devanz,
Today 9:40

- Rmk: Magnetic shielding outside the helium tank

- Remarks concerning the present design
 - Helium tank design to be checked with respect to procedures of installation in the clean room (rmq by Guillaume Devanz / CEA)



- Remarks concerning the present design
 - Heat load to cryogenic bath by the copper plated stainless steel bellow in between cavities – cavity too short(?) - (rmq from WG3 cryomodules)



- The mechanical design shall consider the following aspects:
 - Maximum stress in the different components (in particular the cavity) during its complete life cycle
 - Ponderomotive effects: changes in frequency caused by the electromagnetic field (radiation pressure)
 - Dynamic Lorentz detuning (pulsed operation)
 - Microphonics: changes in frequency caused by connections to the external world
 - Vibrations
 - Pressure fluctuations

Mechanical considerations

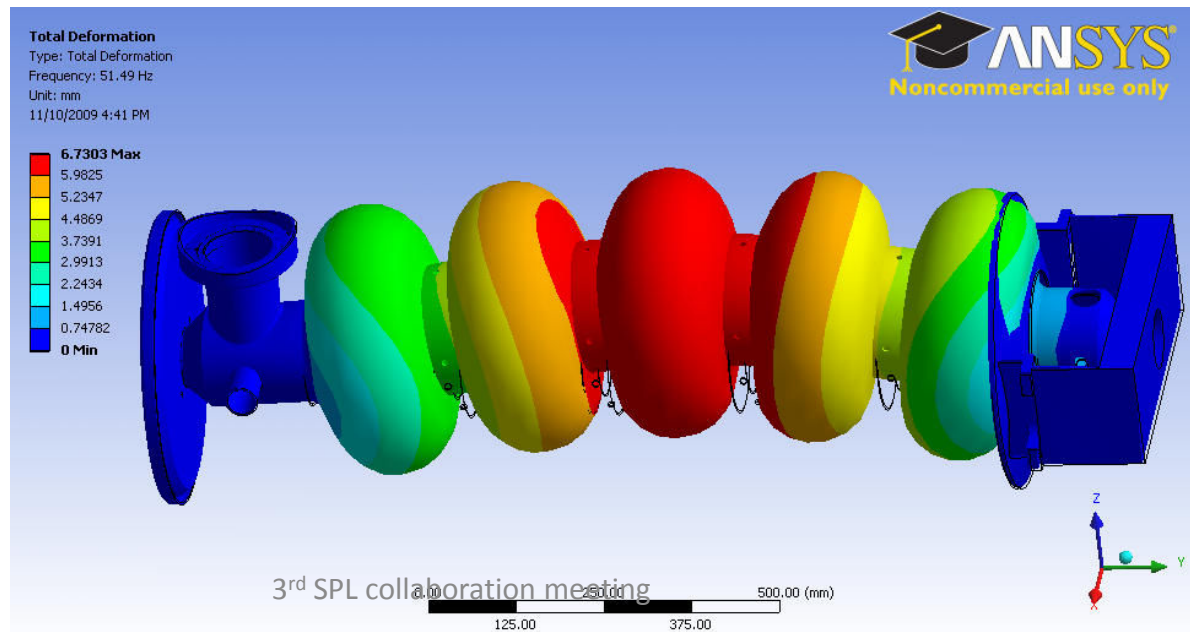
- Maximum stress in the different components (in particular the cavity) during its complete life cycle
 - The exhaustive list of different load cases for all the components (in particular the cavity) have to be analyzed:
 - Differential pressure conditions
 - Leak tests, nominal operation, design pressure, ...
 - Thermal contractions
 - Handling and transport
 - Tuning
 - ...
 - Particular attention for room temperature load cases since the Nb presents low yield strength – the yield stress increases at cold
 - At CEA, mechanical calculations for load cases during tuning have been performed (see Juliette's presentation)



- Lorentz force detuning
 - Calculations performed by CEA-Saclay and stiffening rings proposed to limit the Lorentz detuning => see Juliette's presentations

Mechanical considerations

- Vibrations
 - Avoid as much as possible external vibrations sources linked to the cavity
 - Raise the cavity mechanical frequencies so that they do not couple to the lower frequency external vibration sources
 - For the present design 1st natural mode at $\sim 50\text{Hz}$
=> design still to be reinforced ? ; tuner range an issue ?



- The baseline design for $\beta = 1$ cavity-tuner-He-tank unit to be installed in the prototype cryo-module is:
 - Titanium helium tank
 - CEA-Saclay cavity design
 - CEA-Saclay tuner
- All possible load cases have to be listed and mechanical analyses performed (some of them already done)
 - May still result in design modification
- A parallel study is carried out for an alternative solution with stainless steel helium tank and adapted tuner