Cold Linac NPM status

Forum diags ESS at Paris – Saclay

November 20th 2017

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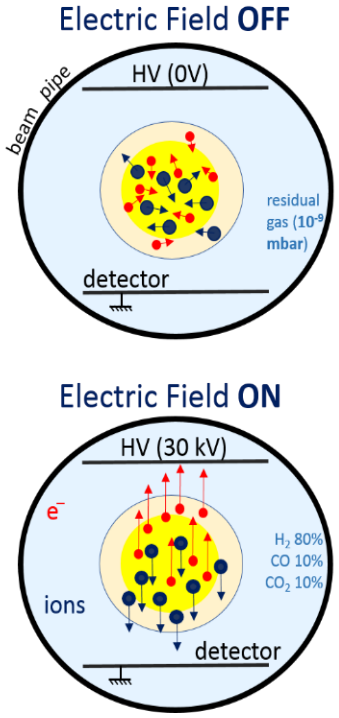
Outline

- What was foreseen
- Come back to real life
- Planning & Strategy



NPM: Non invasive Profile Monitor

What was foreseen

Test at IPHI

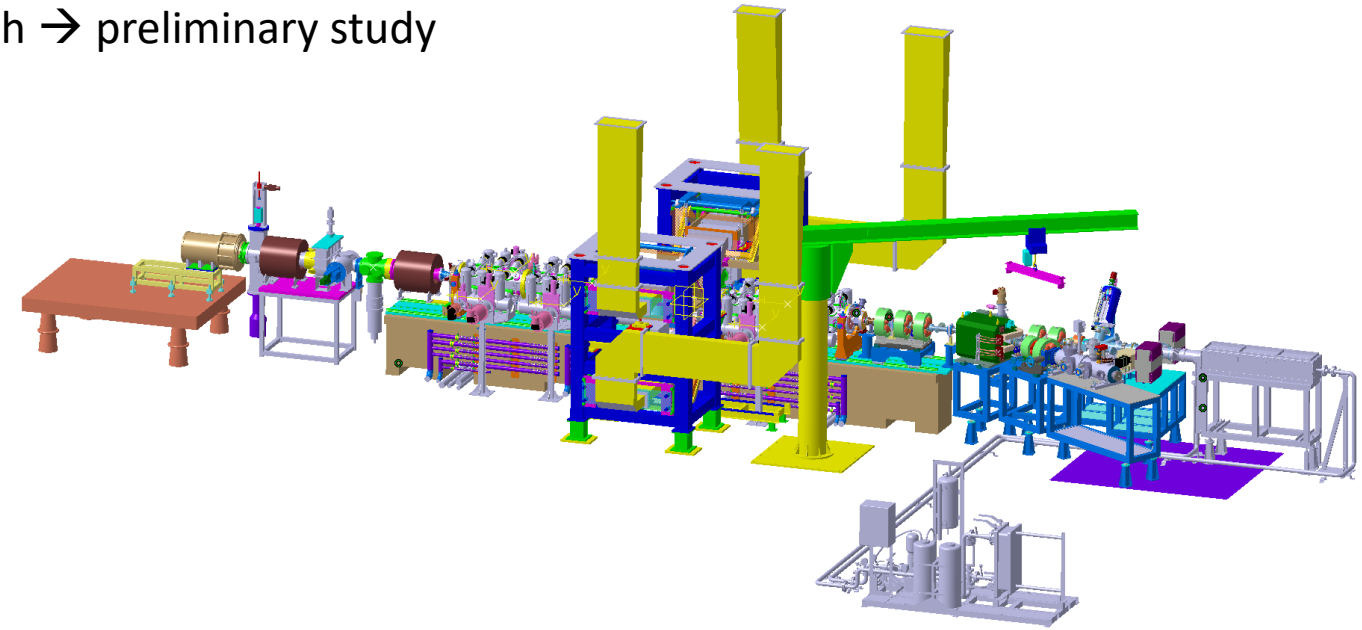
IPHI (Injecteur de Protons à Haute Intensité – Proton Injector at High Intensity)

Proton beam accelerator at CEA Saclay

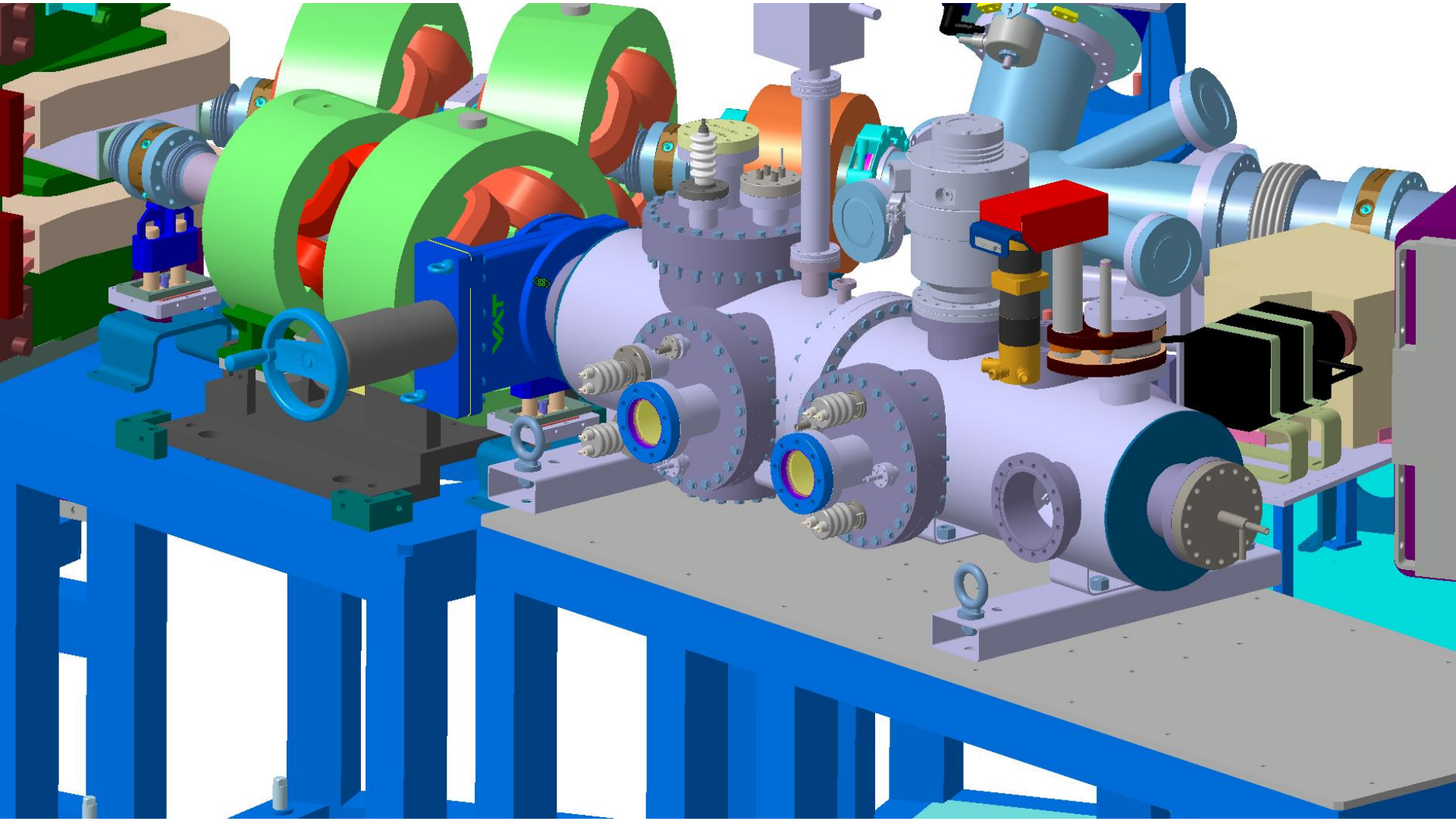
- 3 MeV - I<100 mA – up to cw
- RF = 352 MHz
- Injector: 95 keV

Far from ESS cold NPM conditions,

- but close to our colleagues → convenient for debugging, for different kinds of studies…
- Test bench → preliminary study



On deviated line



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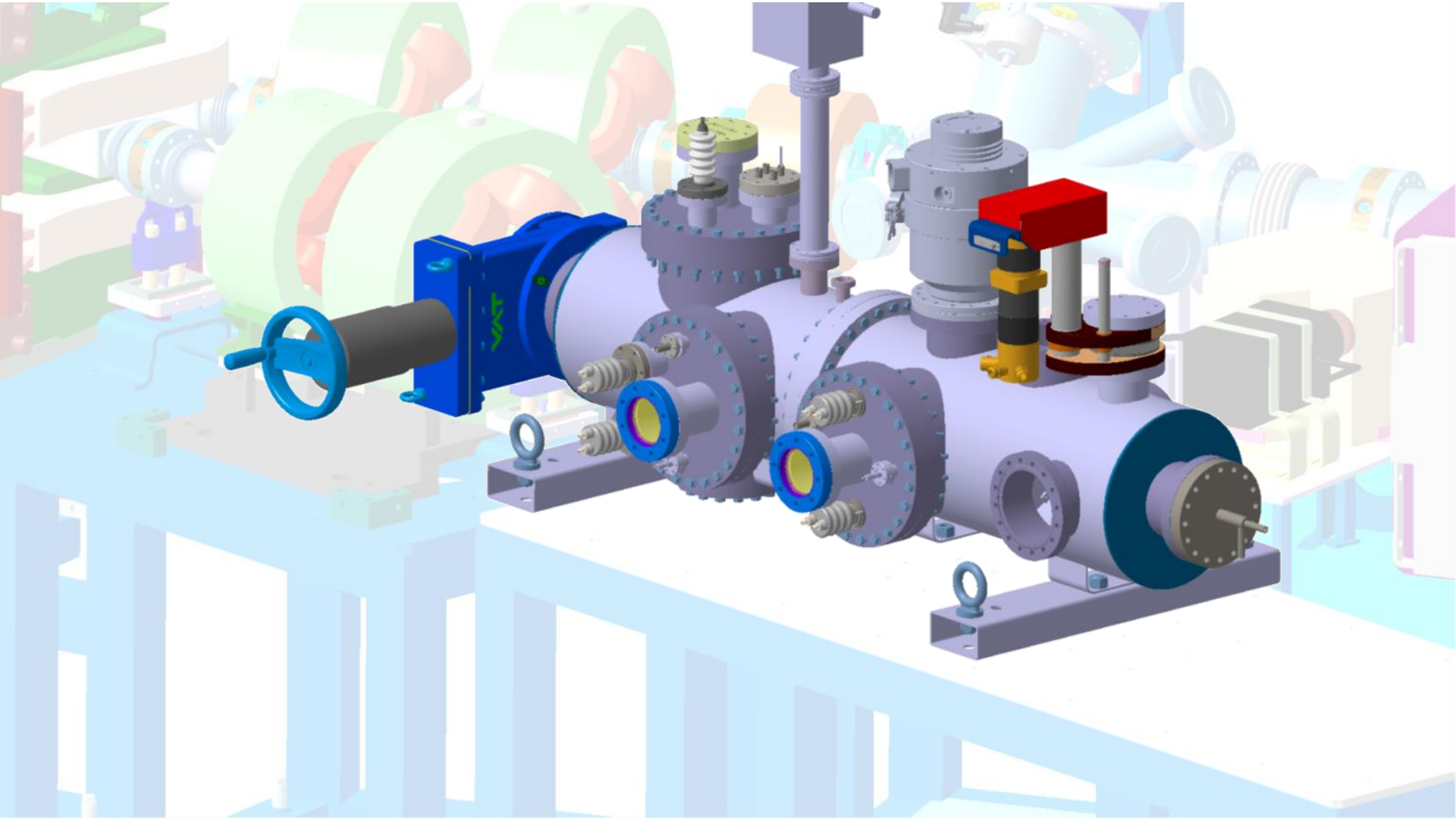
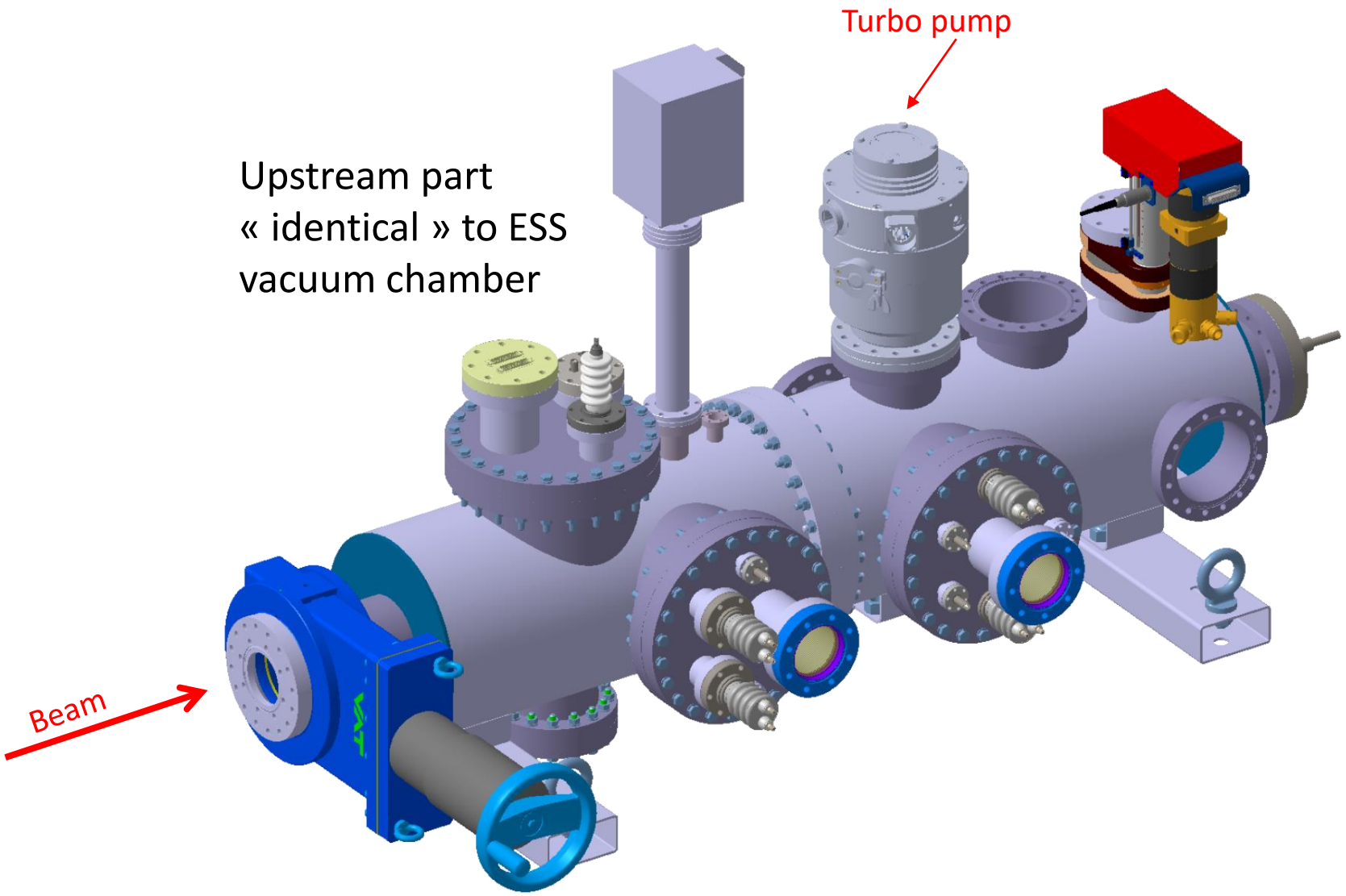


3 Read-Outs to be investigated

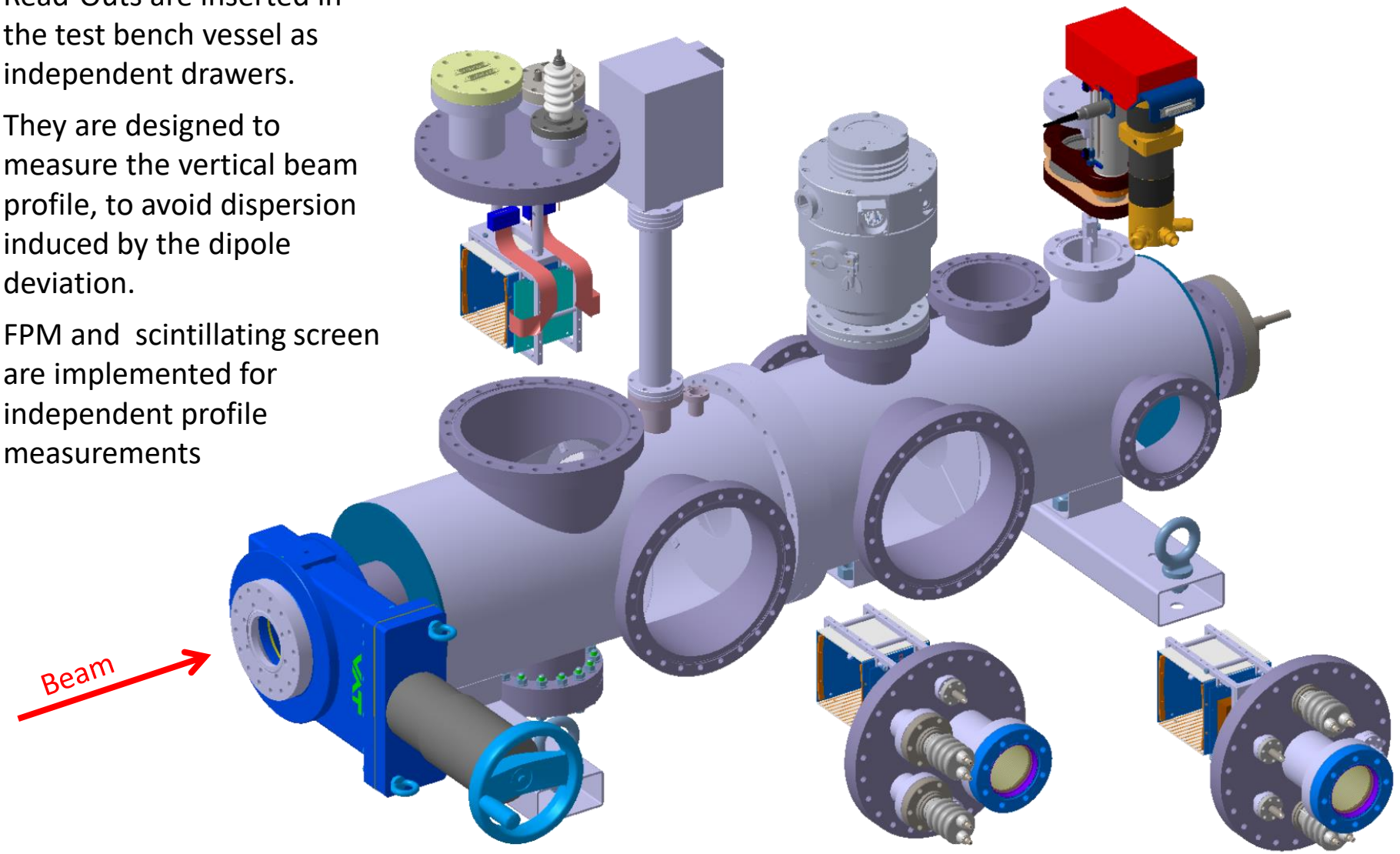


3 Read-Outs to be investigated

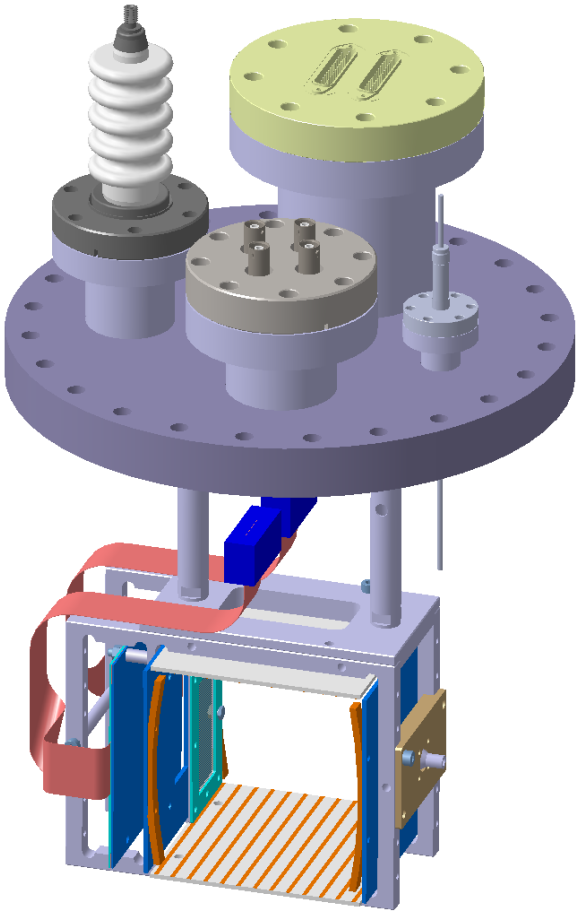
Read-Outs are inserted in the test bench vessel as independent drawers.

They are designed to measure the vertical beam profile, to avoid dispersion induced by the dipole deviation.

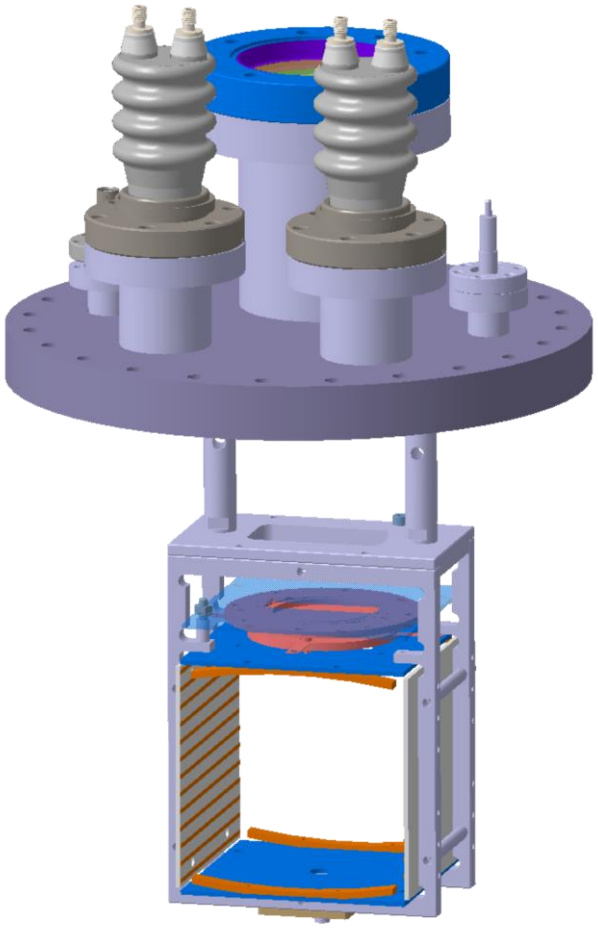
FPM and scintillating screen are implemented for independent profile measurements



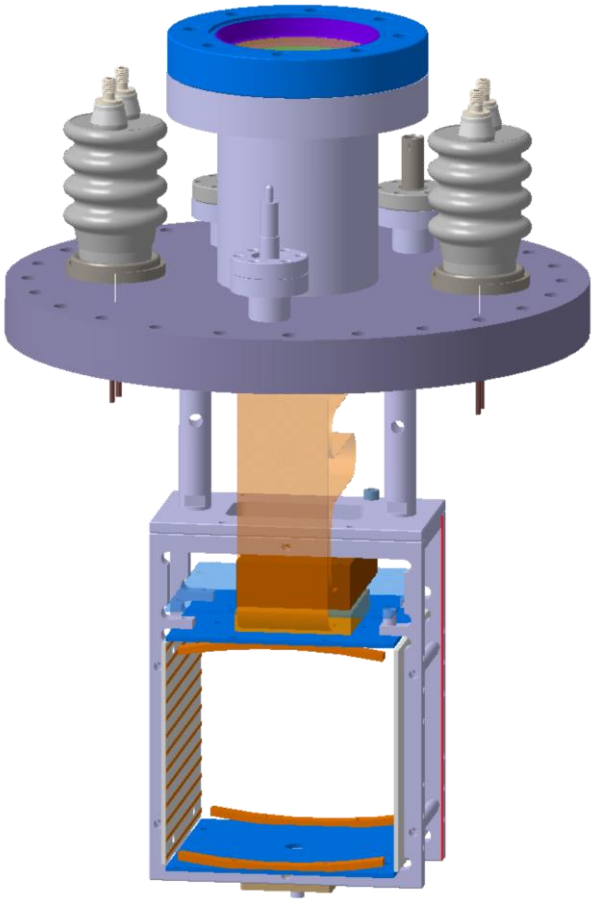
The 3 Read-Outs



RO with strips
Possibility to insert a MCP for signal amplification
Asymmetric: 0 / 30 kV



Optical
Phosphorescent MCP read by a camera
Symmetric: -15 / 15 kV



Si matrix / Optical
~~TimePix or~~ Optical
Symmetric: -15 / 15 kV

Come back to Real Life

Delays

delivery

- Vacuum chamber:
  - CFT launched by mid-June
  - Delivery foreseen beginning October
  - Delivered, after an extra cleaning process, on Nov. 13th
- HV vacuum connectors: foreseen end Oct, re-foreseen beg. December
- Mechanics, HV, MCP, Vacuum items (connectors, flanges, pumping…)

IPHI

- Refurbishing the water cooling system → good progress
- Vacuum improvement…

→ Should be ready to start beam for the 1st week of December

NPM team

- Improve SC effect study and electric field uniformity *(→ Florian's talk)*
- Develop FEE for strip reading, connection boxes for vHV
- Design mounting tools for RO, vacuum chamber for MCP storage
- Since last week (delivery of the entire test bench chamber), vacuum tests → trouble with important leakage
- Etc.

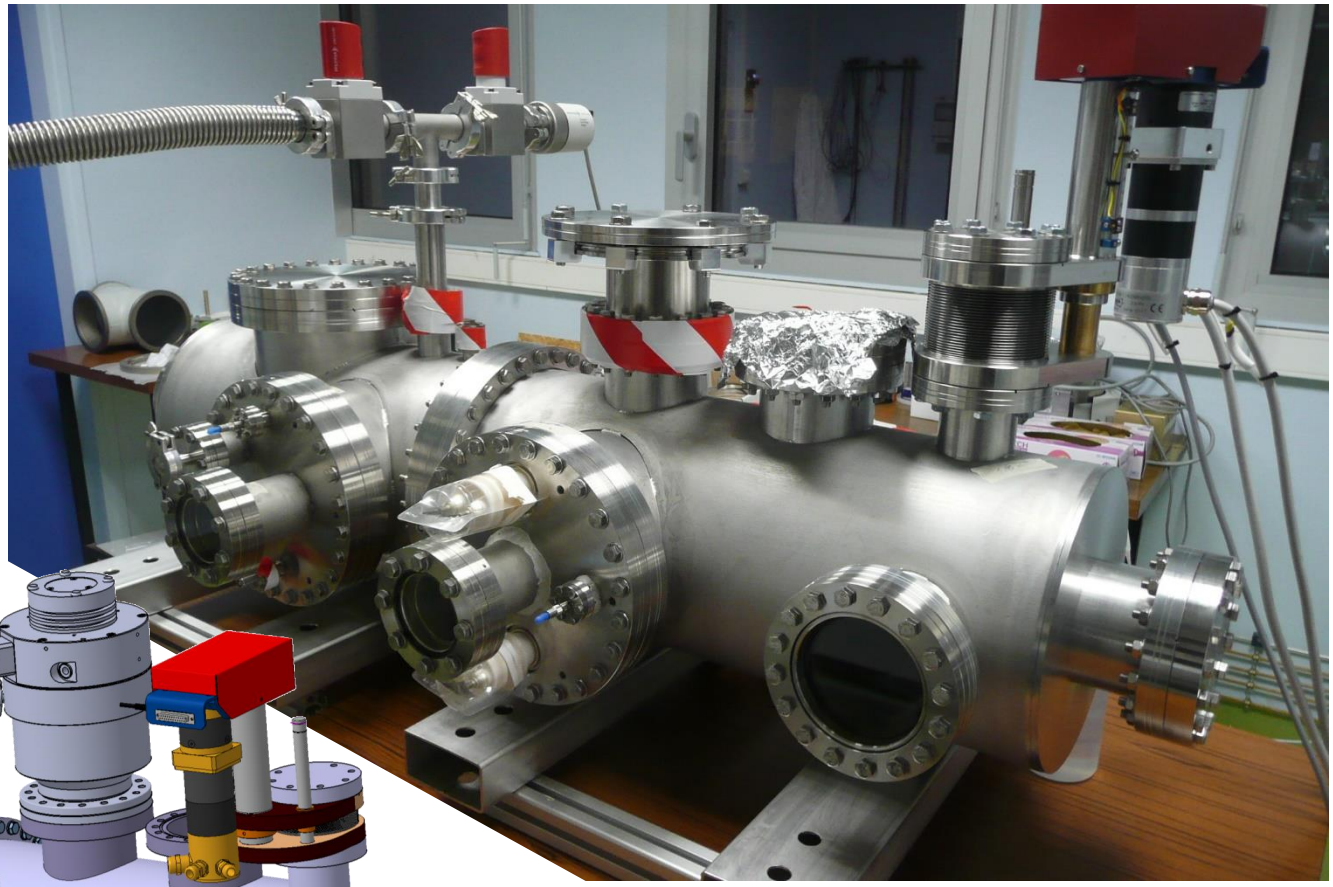
Virtual / Reality

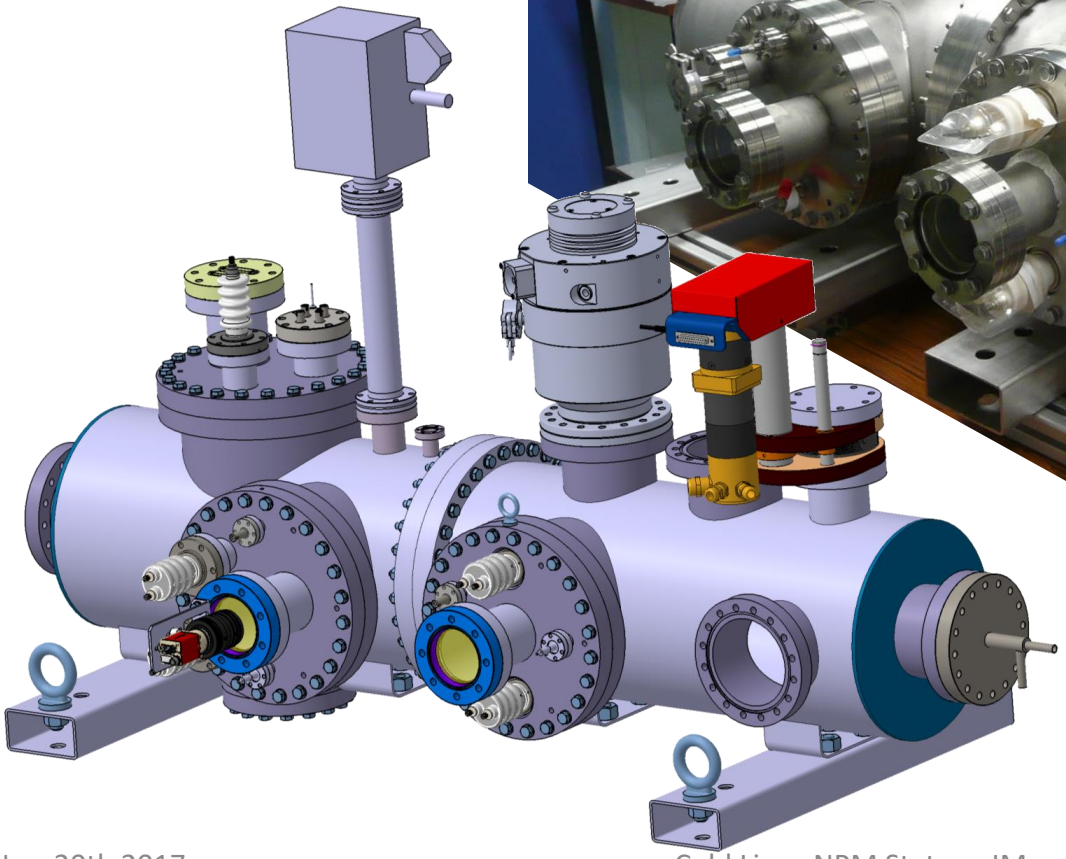
Vacuum chamber:

Leakage problems identified on view ports last Thursday.

Work is going-on!

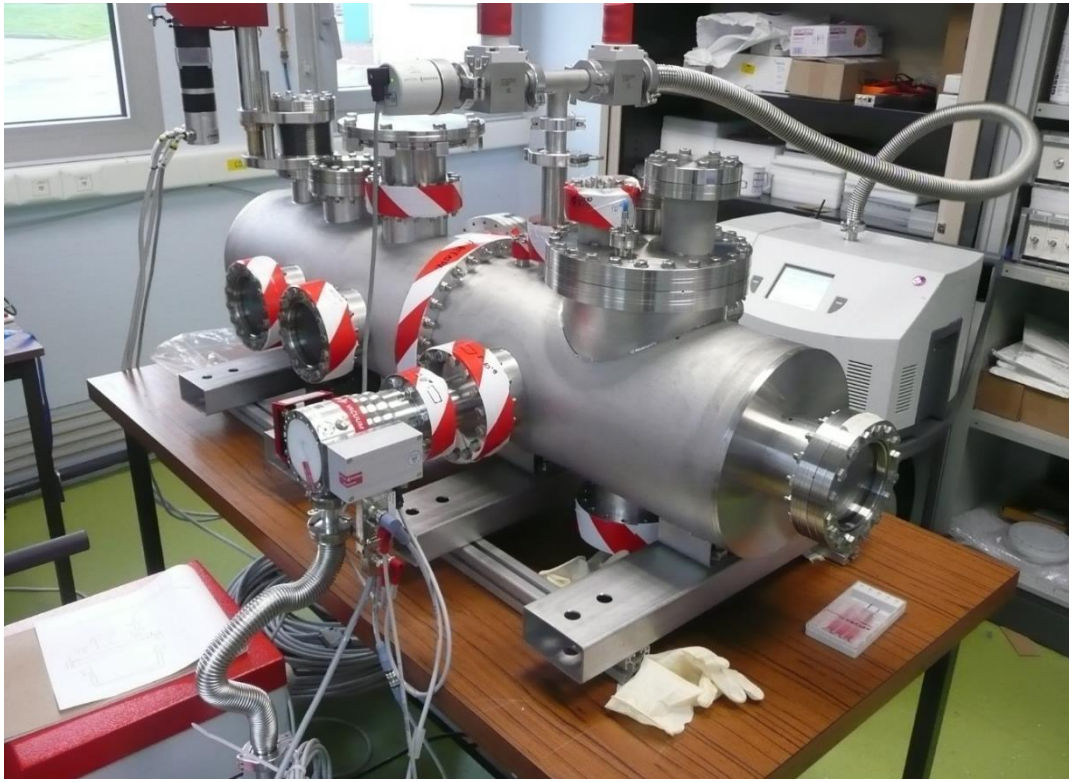
IPHI request: 10^{-7} mbar

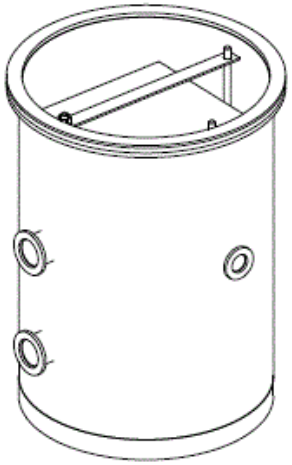


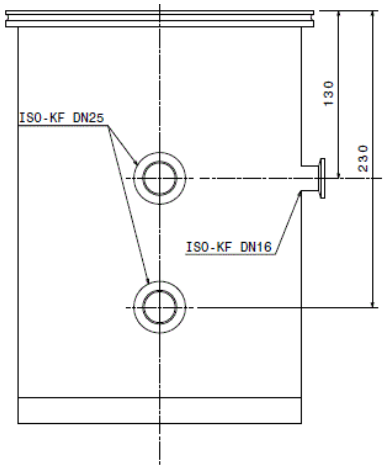


Virtual / Reality

Vacuum chamber for MCP storage



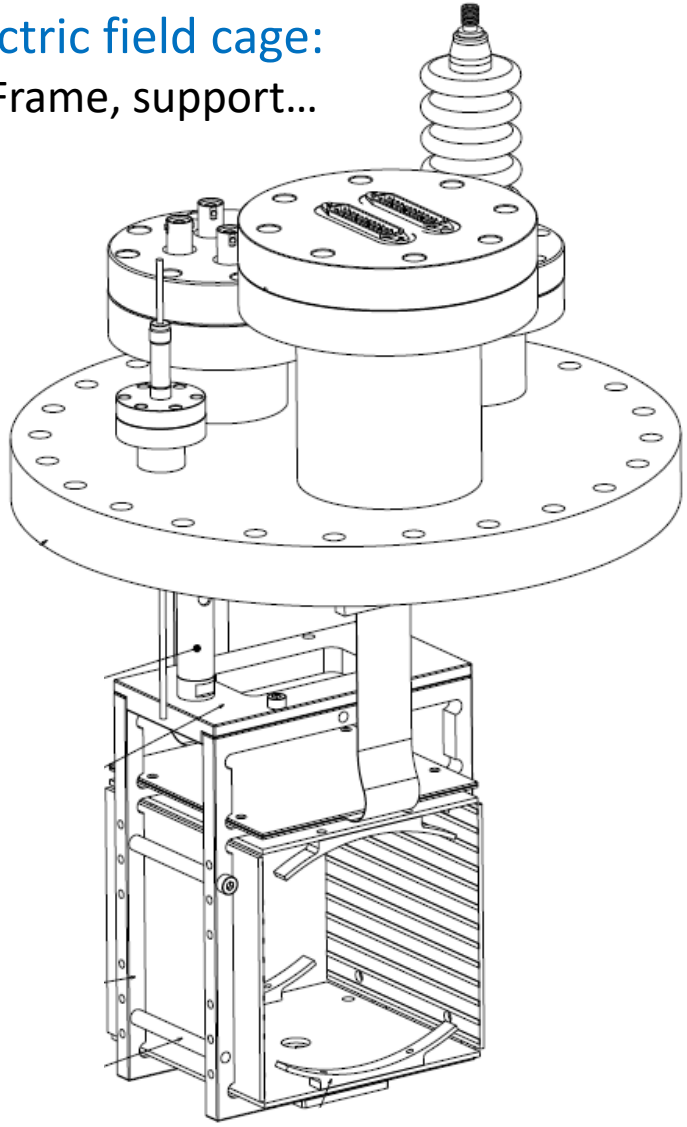


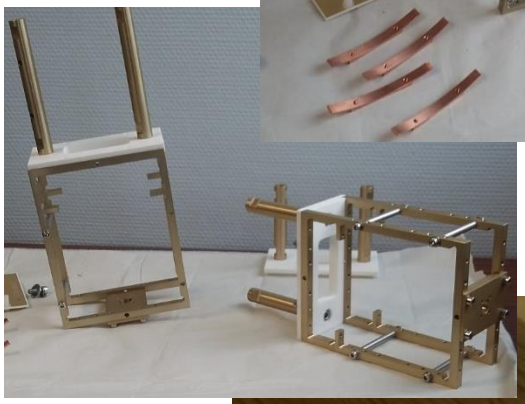


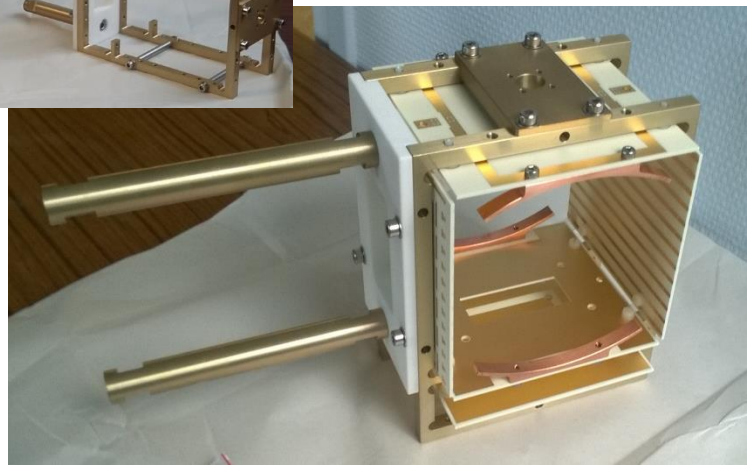
Virtual / Reality

Electric field cage:

Frame, support…

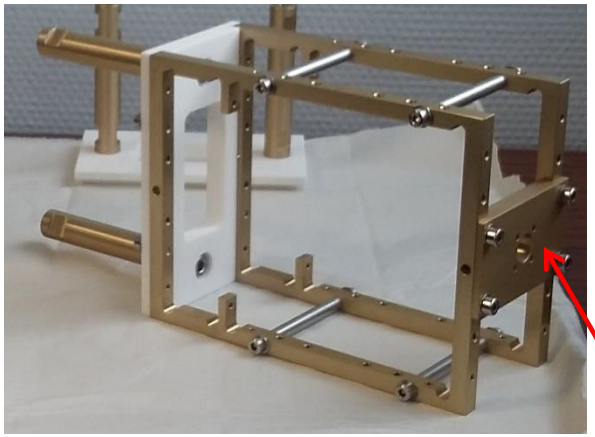






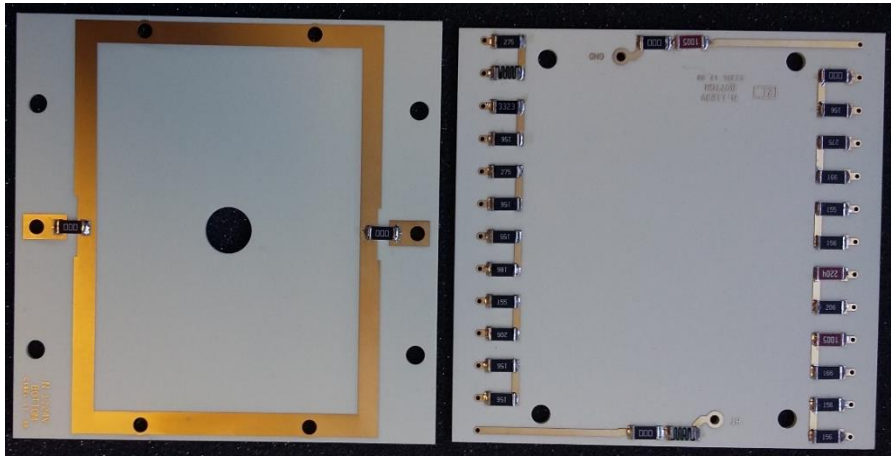
Virtual / Reality

Electric field cage:

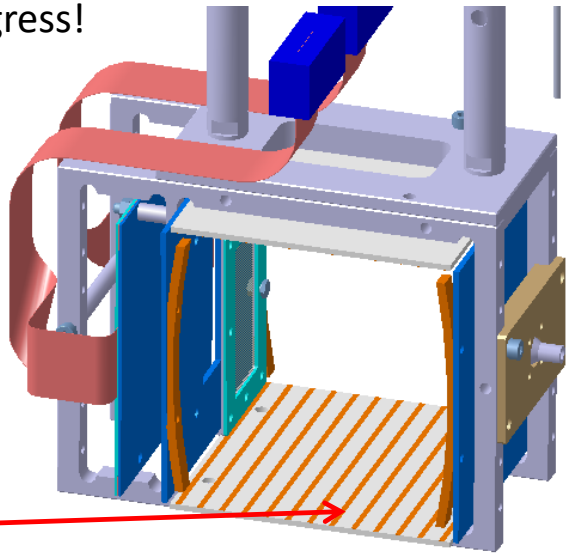


photodiode

HV electrode



Resistor soldering for the degrader: difficult task since ceramics supports, but In good progress!



degraders

DAQ, FEE & CS

Caramel and Syroco: delivered at Saclay by LPC Caen (end 8/17)

Adaptation card for signal read-out

Cameras

- NPM (2): Epics, development in progress
- FPM (1): brought by Cyrille Thomas
- Scintillating screen: Iphi

ISEG HVs: 6, 15 and 30 kV delivered

- potentiometer for MCP gain
- Connection boxes for vHV

Motor for moving scintillating screen: GeoBrick is installed and checked.

Photo-diode to monitor the ageing of the MCPs

Extra: Test on the ion implanter IRMA

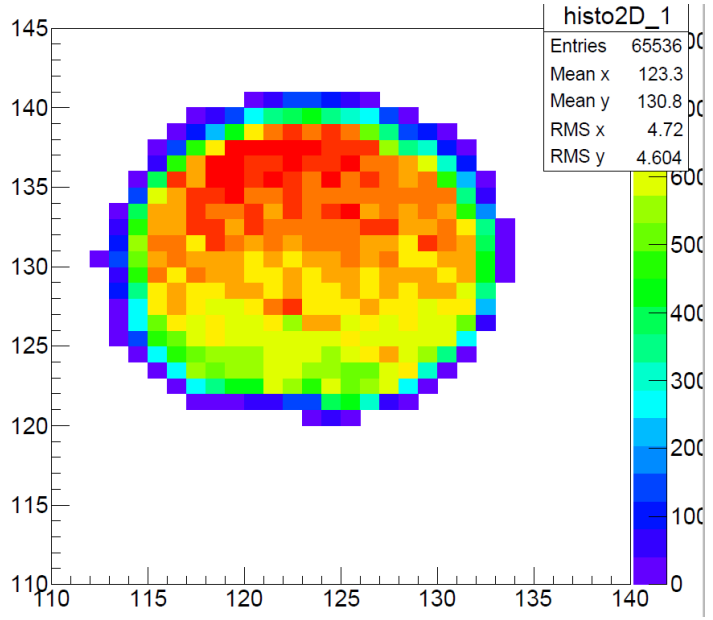
CSNSM Orsay (August 28, 2017)

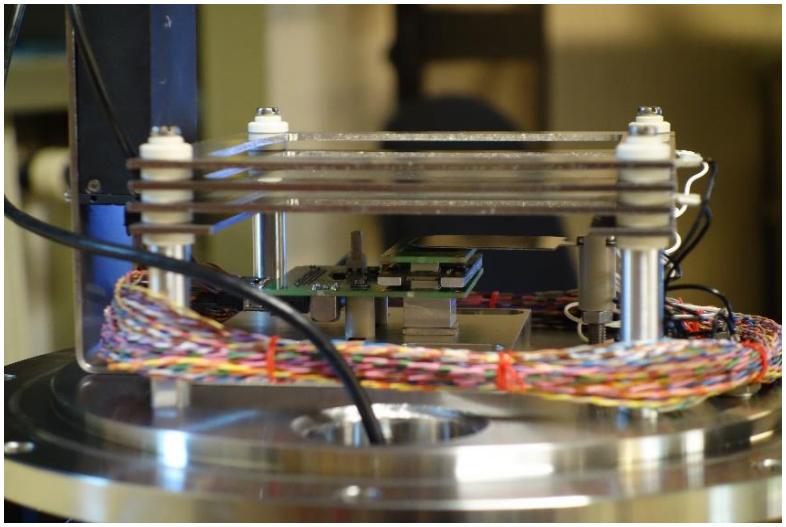
C. Bachelet & S. Renouf

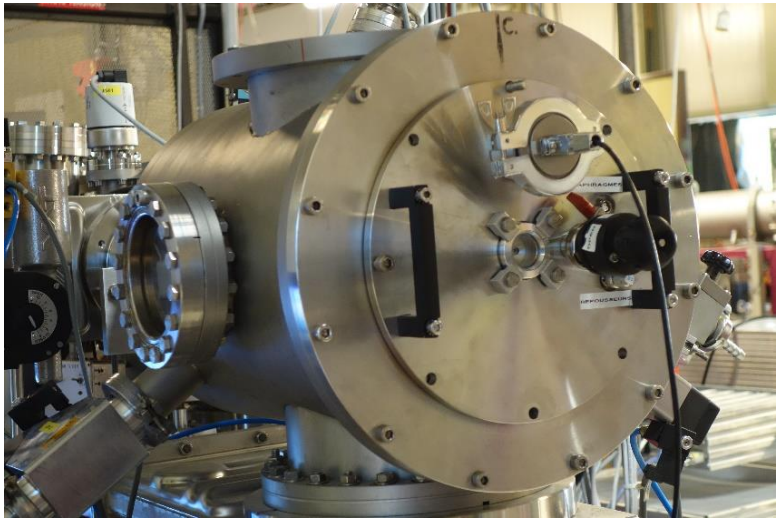
H_2^+ ions at 12, 15, 20 and 30 keV

→ difficulties to extract information, but at 15 keV we saw clear signal while 12 keV is too low

→ Plan to make new measurement, but not before Feb. – March 2018



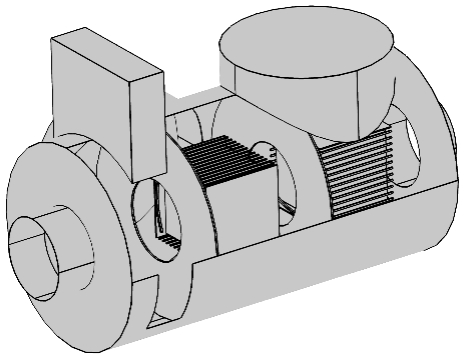




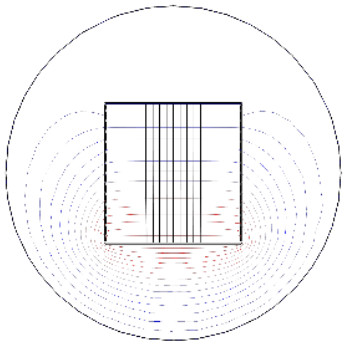
Planning & Strategy

Experimental test program (1)

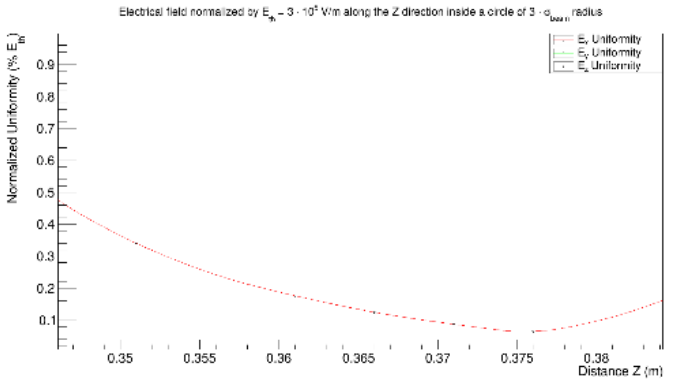
- Installation at IPHI → after integration at Dédip laboratory, checks of vacuum (10-7 mbar) and of all tuning systems
- Read-Outs:
  - Frish grid effect → beam, no IPM electric field: strip signal checking
  - counting rates:
    - Comparison between all ROs
    - Comparison between measurement and calculation
- uniformity of the electric field
  - comparison between $\vec{E}$ (3 IPM) / no $\vec{E}$ read-outs (FPM, p-screen)
  - influence of interferences between 2 IPMs



Comsol simulation for X&Y profilers



field lines

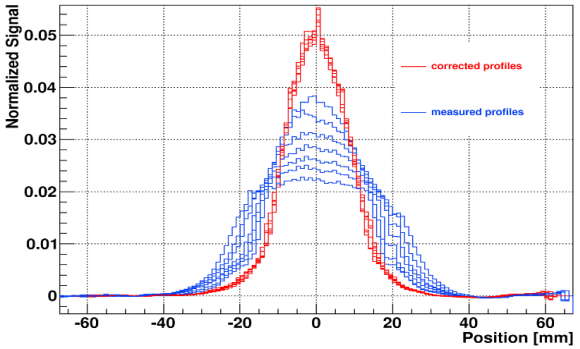


Electric field "non uniformity" in beam direction

Experimental test program (2)

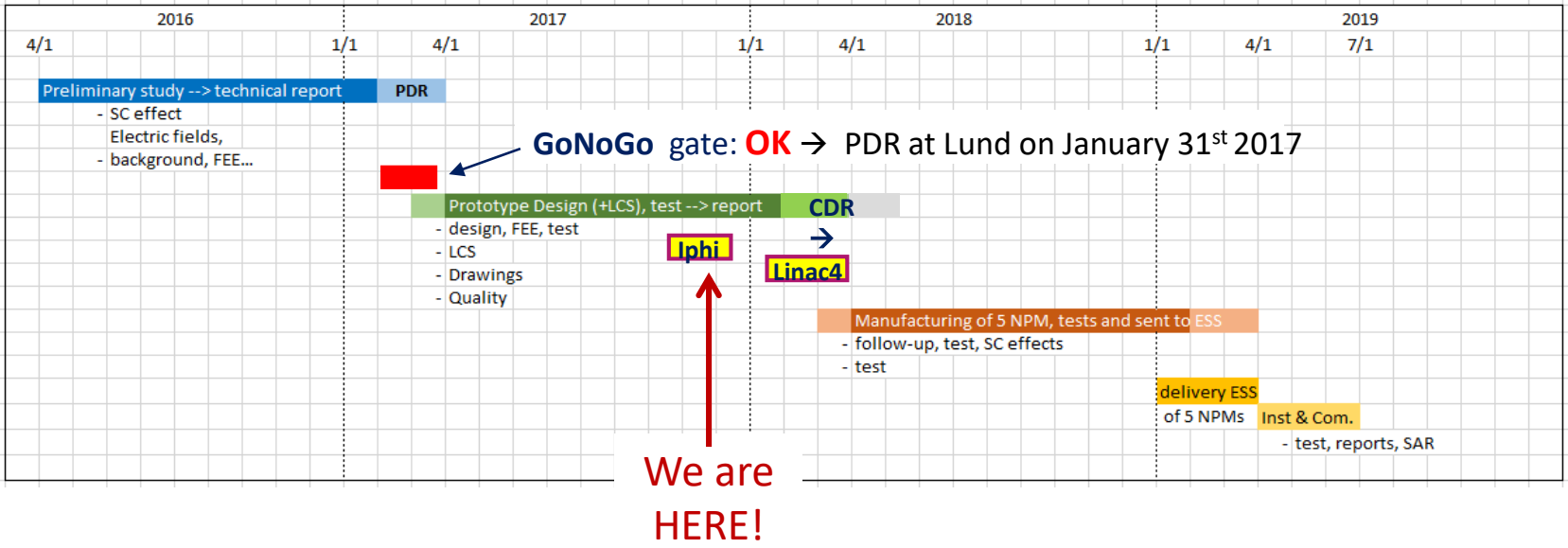
- +/- HV polarity
  - ion detection: does it work? better result?
  - MCP, TimePix3: ion / electron
- sparking effect
  - same entrance geometry VC / bench test
    → HV increasing
- Space Charge effect
  - once stabilized beam → beam parameters frozen
  - increasing and decreasing the IPM HV
    → comparison with SC calculation
- others…
  - MCP ageing effects
  - scintillating screen
  - and general improvements…

done on 01/2012, IPHI source 6 mA, E_p=90 keV



Planning

The official schedule



Delay up to now: < 1 ½ month

In the best scenario, with the vacuum leakage we have encountered on the VC, we will not be ready before beginning of December

IPHI: today they plan to put water cooling in the RFQ…

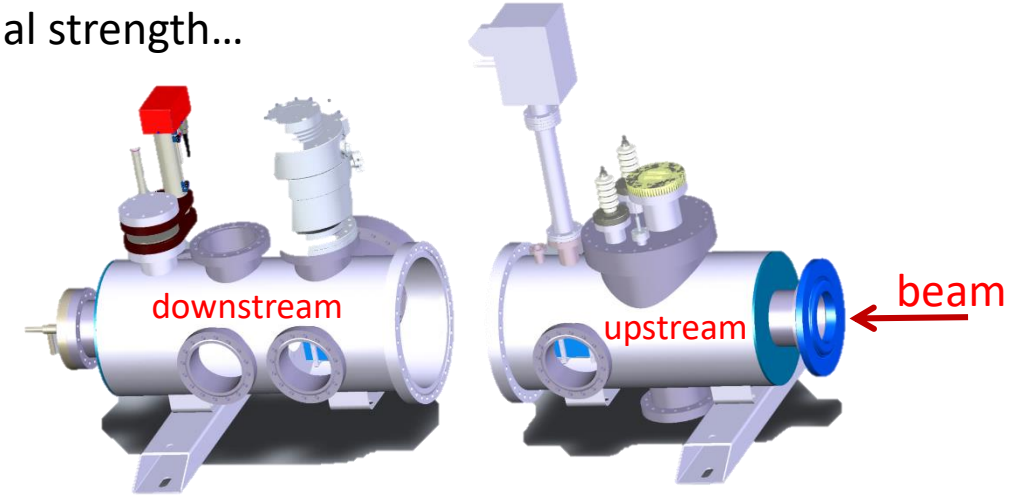
Beams for tests:

IPHI → possibility to have beam to resume December activities, in January and after (tbd)
LINAC4 → installation should be done in January, for background measurement

Strategies

Three scenarios may be foreseen for 2018

1. Keep on going on IPHI
2. “Half parts”
    - IPHI with only the downstream part of the test bench
    - LINAC4 with the upstream part (similar to ESS chamber), but only for background measurement
    - → Need more vHV, another VC for MCP…
3. “Double tests” with the entire test bench
    - IPHI: beginning 2018
    - Julich: people seems to be open, but when?
    - → Validation of the signal strength…



Summary

Material delivery

- Most of them are delivered, but with important delay

IPHI test

- Should not start before beginning of December
- Up to now, 1 ½ month of delay

Therefore, 3 scenarios may be foreseen for 2018

1. Keep on going on IPHI
2. “Half parts”
3. “Double tests” with the entire test bench

Warmly thanks to all my colleagues for the huge work done since last ESS forum (we started from scratch from PDR review – Feb. 1st 2017.)

Thank you for your attention

Extra slide

Planning IPHI + LINAC4

	M T:	Nom de la tâche	Durée	Type de contrainte
1		**NPM Project**	**190,6 sm**	**Dès Que**
2		First contact at ESS	0 jour	Début Au Plus Tôt l
3		**Preliminary design**	**32,55 sm**	**Dès Que Possible**
4		Kick-off meeting at Saclay	0 jour	Début Au Plus Tôt l
5		PDR at Lund	0 jour	Début Au Plus Tôt l
6		**Detailed design**	**61,58 sm**	**Dès Que Possible**
7		**Study for prototype design**	**40 sm**	**Dès Que Possible**
19		**IPHI whole proto test**	**5,93 sm**	**Dès Que Possible**
23		**IPHI downstream test**	**4 sm**	**Dès Que Possible**
25		**LINAC4 proto test**	**18 sm**	**Dès Que Possible**
28		write-up CDR report	8 ms	Dès Que Possible
29		CDR at Lund	0 jour	Dès Que Possible
30		**Manufacturing**	**30 sm**	**Dès Que Possible**
33		integration & test	3 ms	Dès Que Possible
34		wrapping and sending to ESS	3 sm	Dès Que Possible
35		Arrival at ESS	0 sm	Dès Que Possible