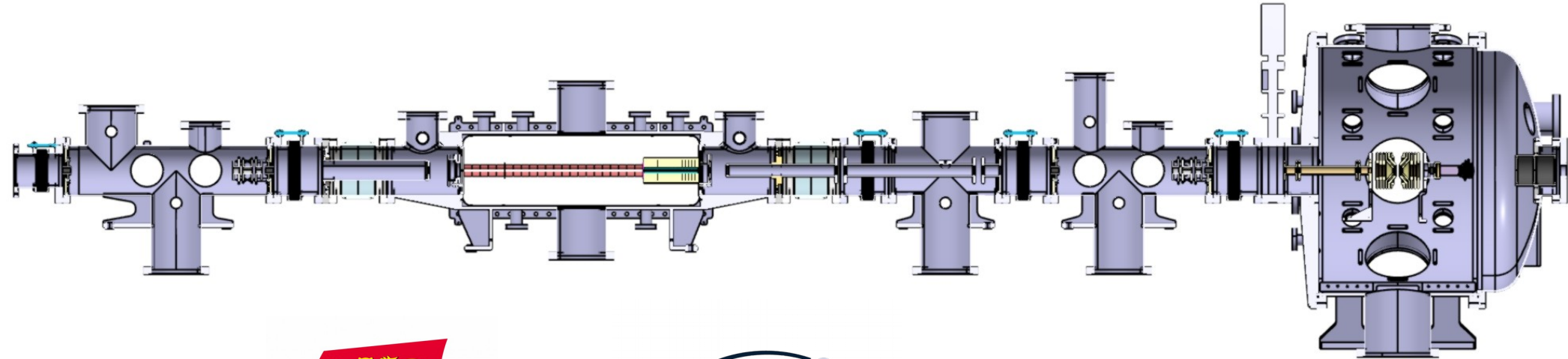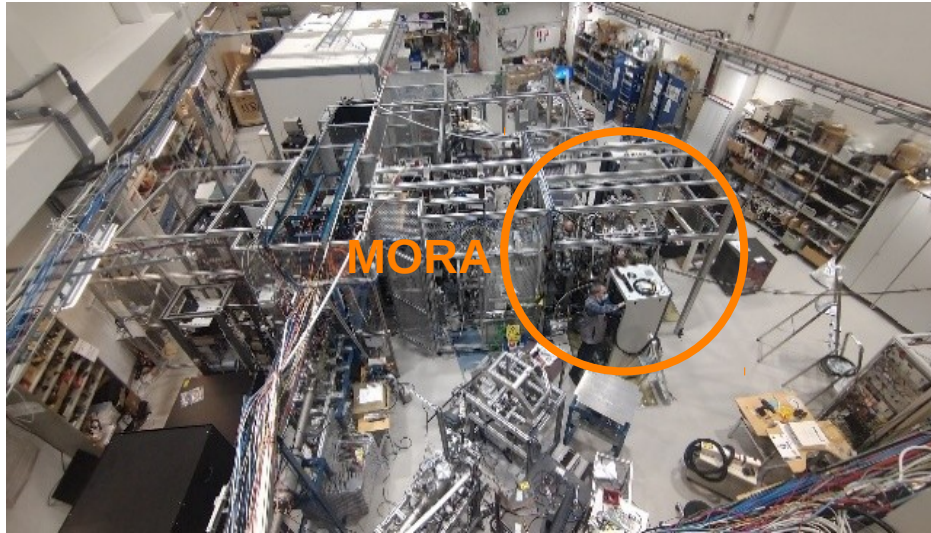# Radio Frequency Quadrupole cooler and buncher for MORA at DESIR

MORA at DESIR

Currently located at JYFL (Finland),
MORA will be moved to DESIR.

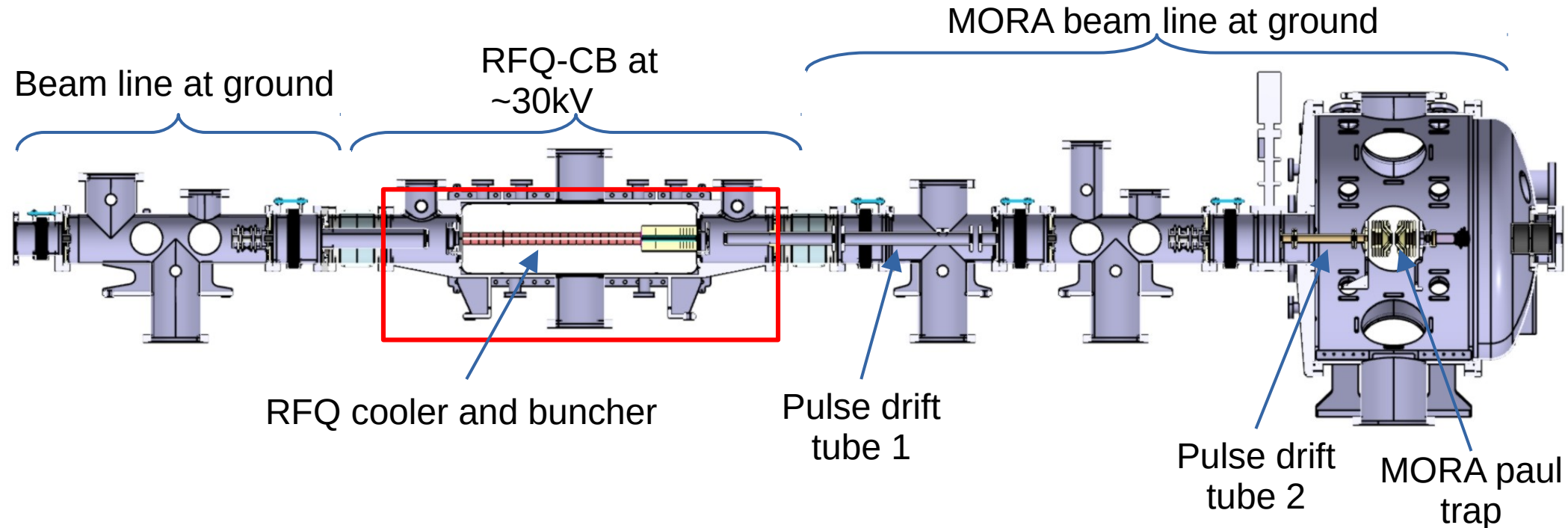

Overview of the mora experiment
at JYFL (finland)

Motivation to move to DESIR :
- Better **beam purity** thanks to HRS
- Better **beam intensity** from SPIRAL1 and S3-LEB

Why does MORA need its own RFQ-CB?
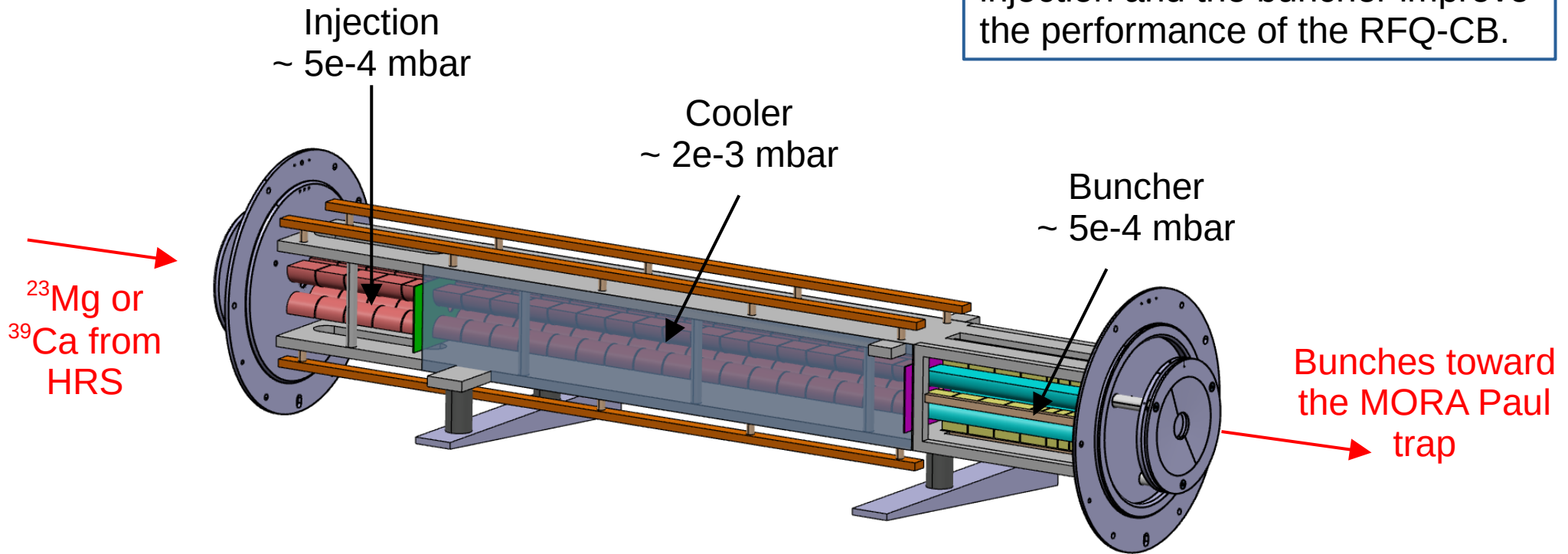- too much distance between GPIB and MORA
- We can optimise this RFQ-CB for MORA only
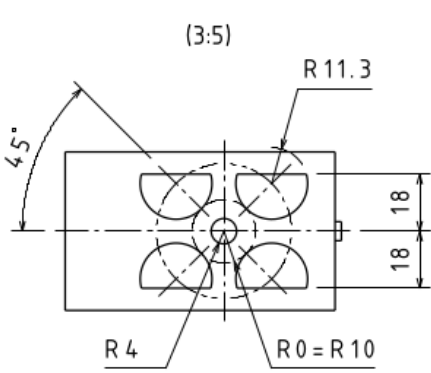- MORA RFQ-CB can be used as a rebuncher

MORA beam line at ground

Beam line at ground

RFQ-CB at ~30kV

RFQ cooler and buncher

Pulse drift tube 1

Pulse drift tube 2

MORA paul trap

Design of the RFQ cooler and buncher
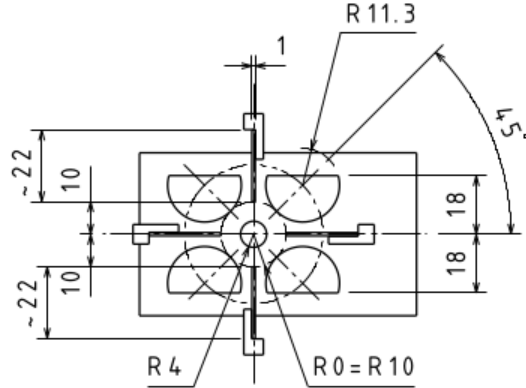
Divided in 3 sections :

Simulations have shown that having a lower pressure in the injection and the buncher improve the performance of the RFQ-CB.

Injection
~ 5e-4 mbar

Cooler
~ 2e-3 mbar

Buncher
~ 5e-4 mbar

^{23}Mg or ^{39}Ca from HRS

Bunches toward the MORA Paul trap

Injection and cooler
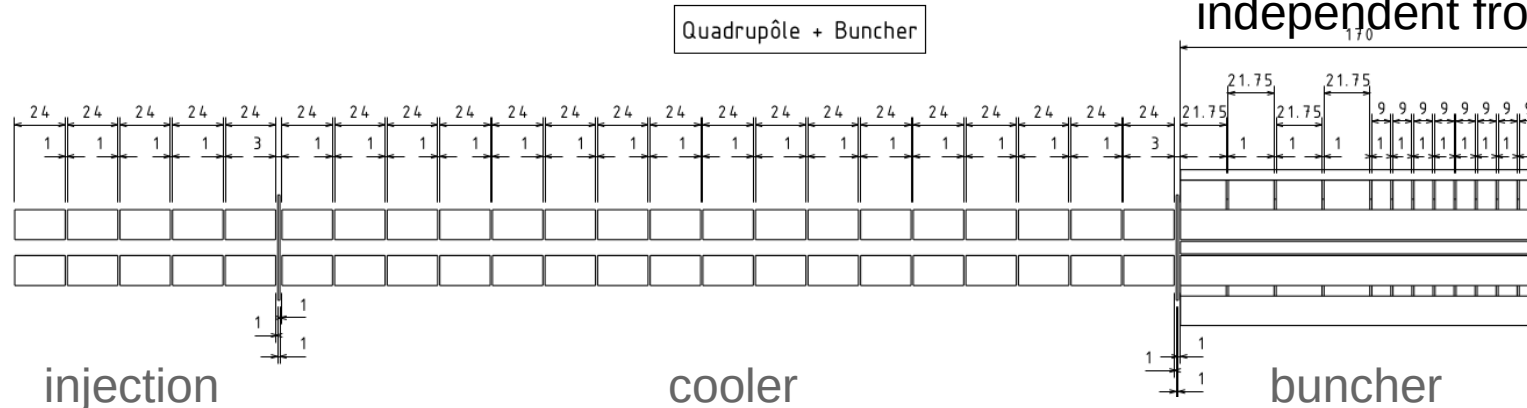
buncher

R0 = 10 mm
Peak-to-peak RF voltage = ~ 2000 V
q parameter = ~ 0.5

In the buncher, the longitudinal electric potential is set via DC electrodes, independent from the RFQ rods.

injection

cooler

buncher

Quadrupôle + Buncher

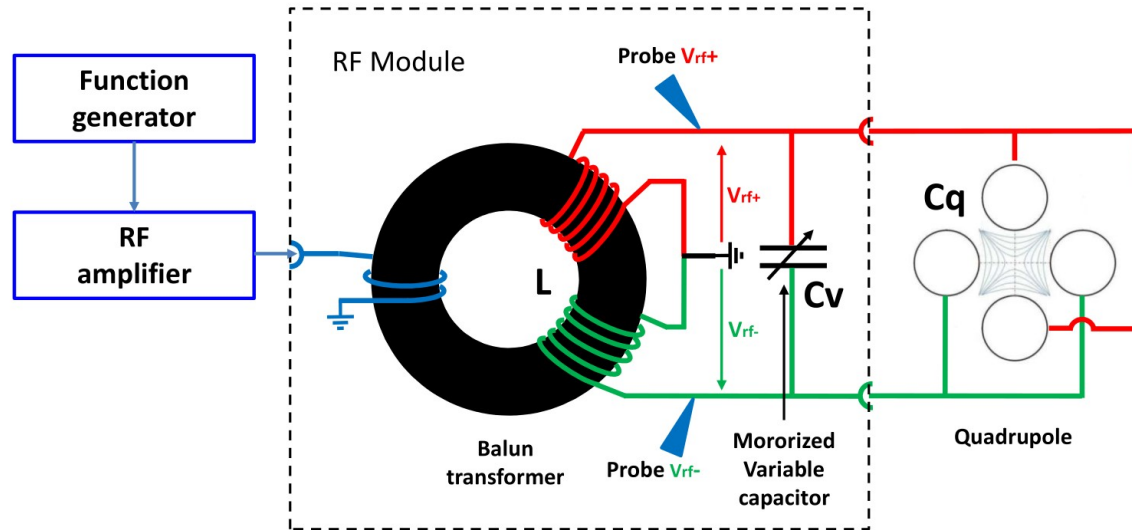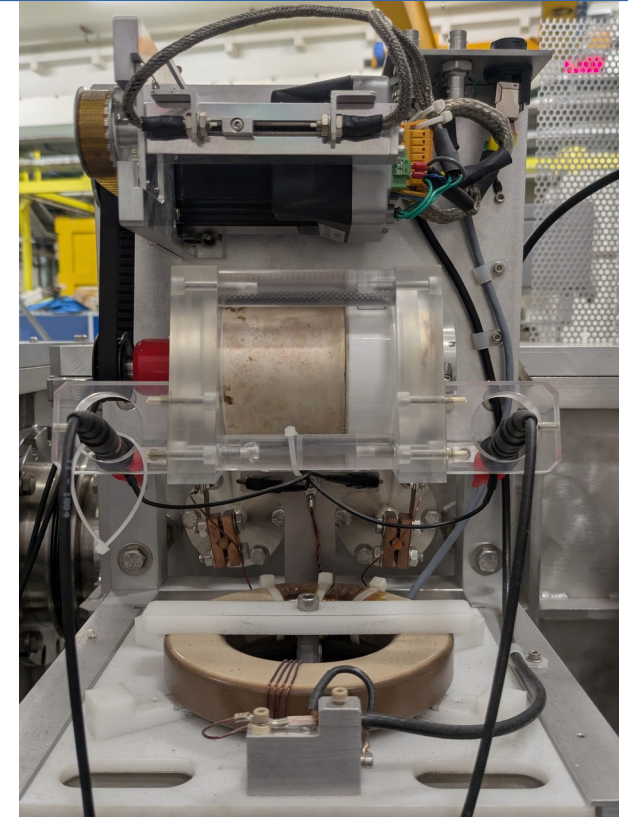Reuse the same design of the other RFQ build at LPC Caen.

Diagram of the Balun-transformer RF circuit

RF system of REGLISS (S3-LEB)
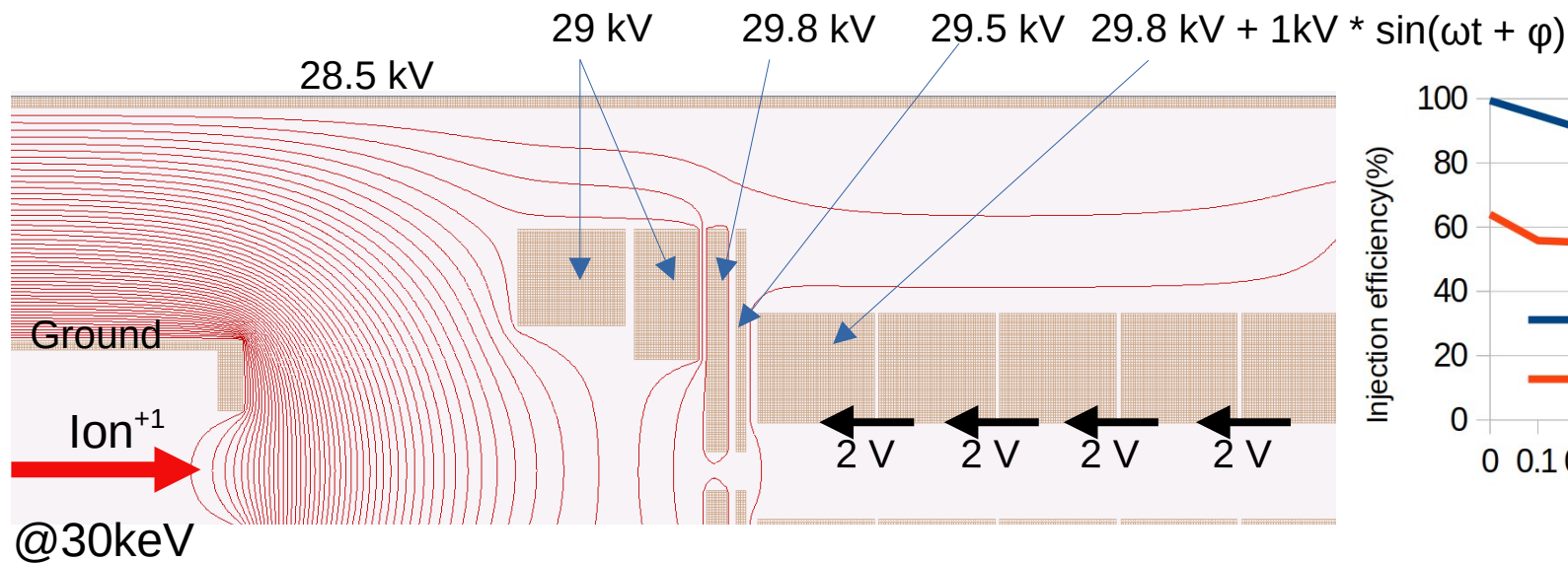
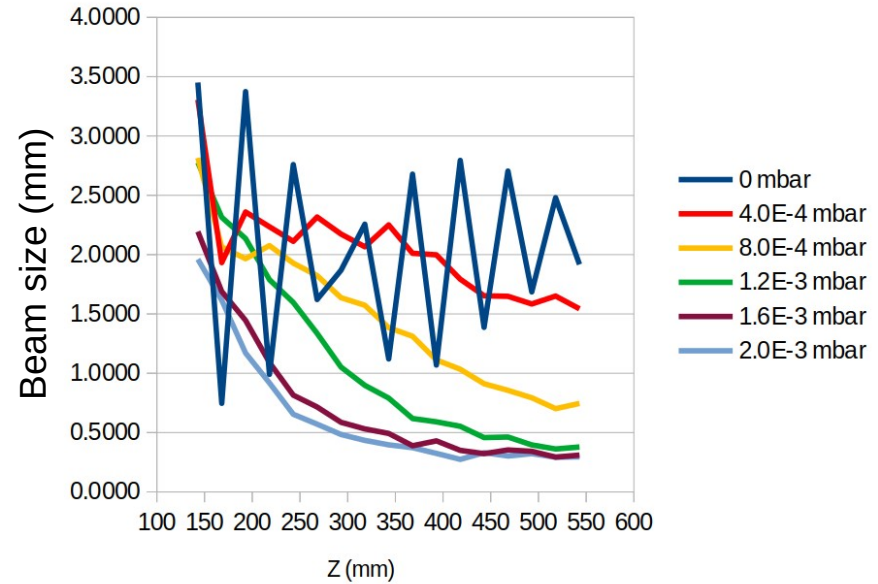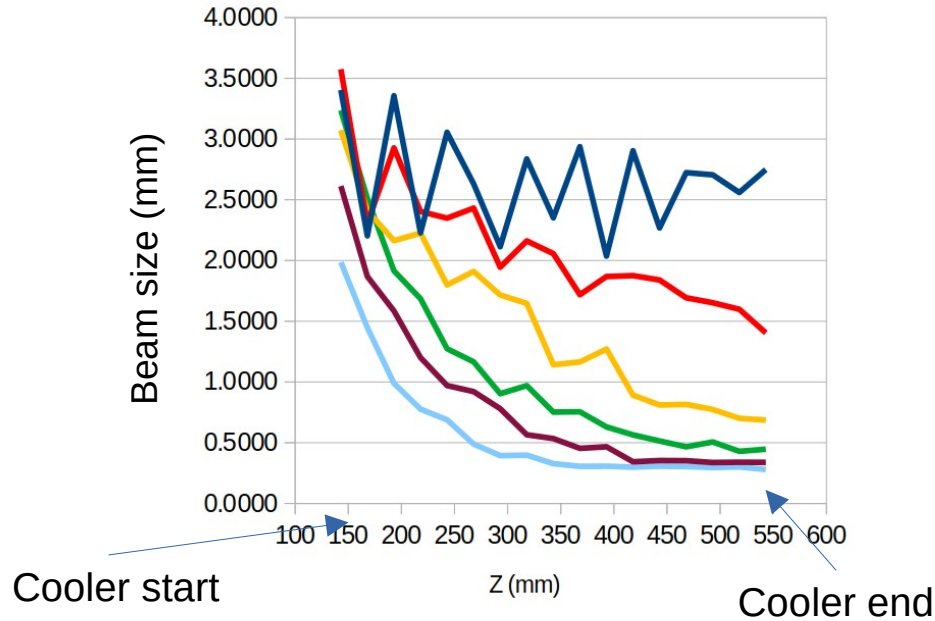Simulation have been performed from the beam injection into the RFQ up to the MORA Paul trap.

Collision model : hard sphere
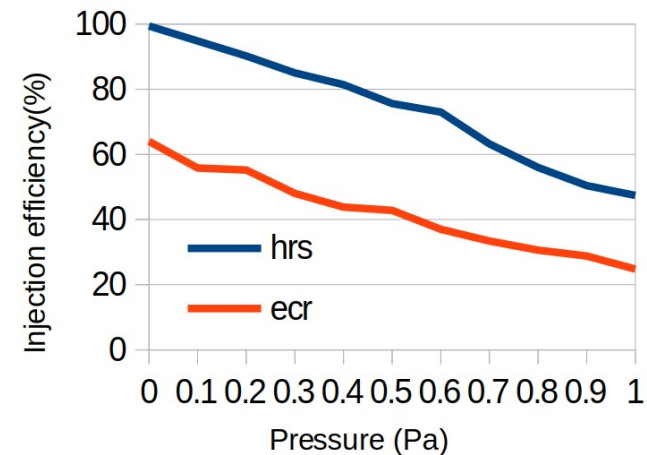
SIMION simulations : Cooling
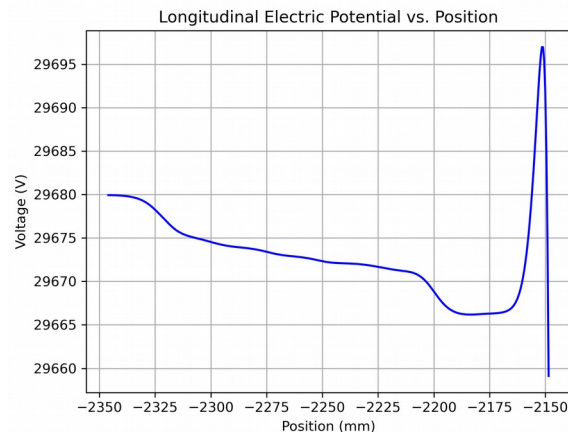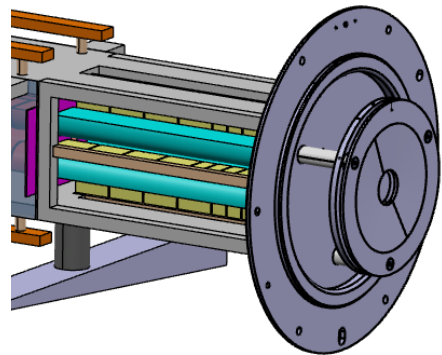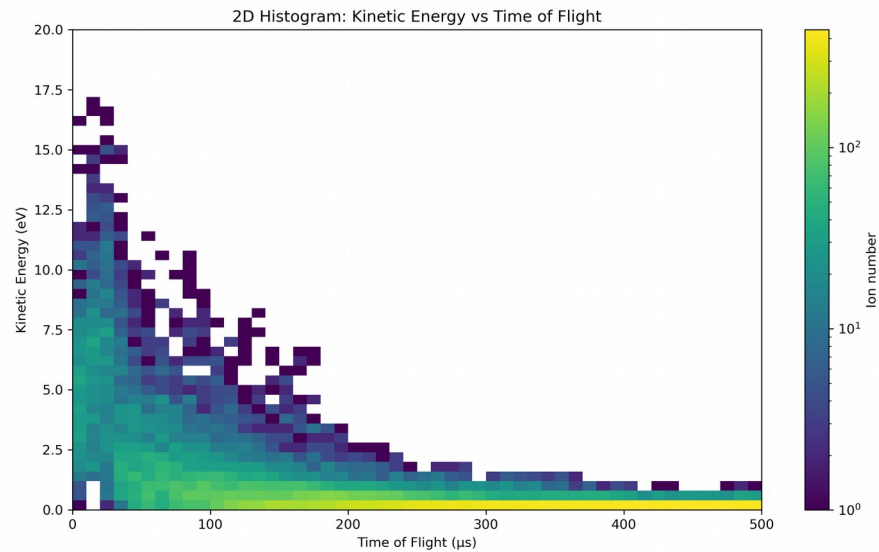

HRS beam m = 23

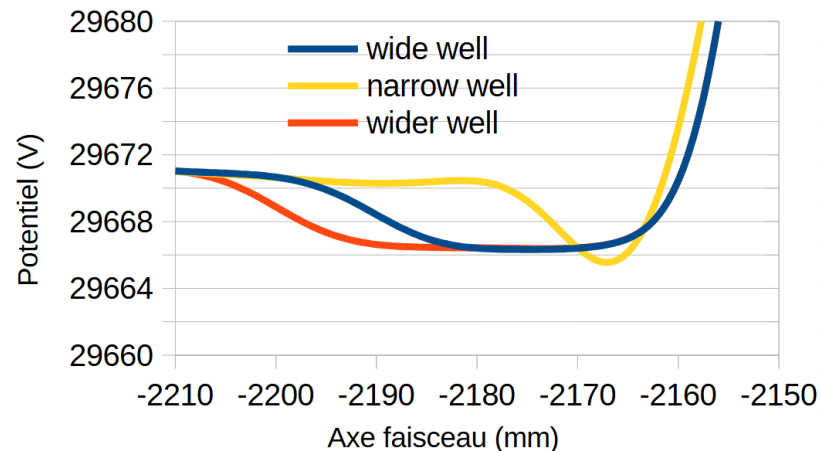ECR beam m = 23

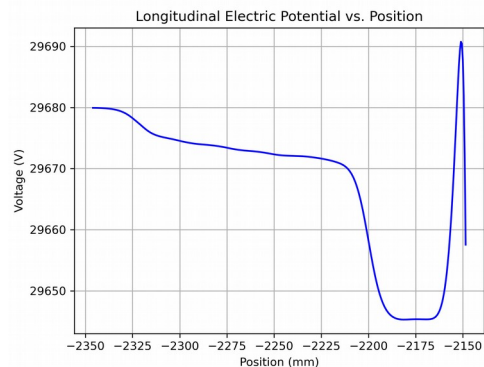The cooler could operate at 2e-3 mbar

SIMION simulations : bunching

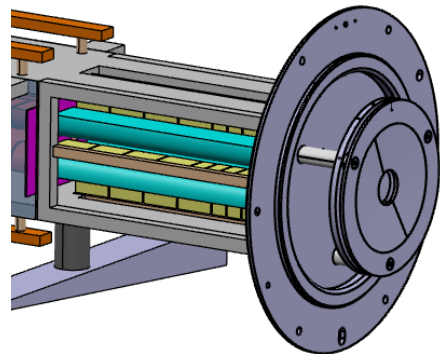Exemple of bunching potential

Fast cooling time in the buncher : under 1 ms
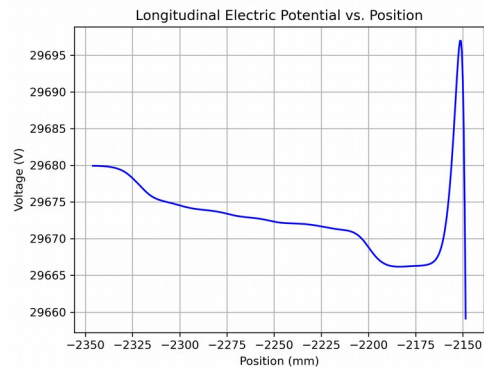
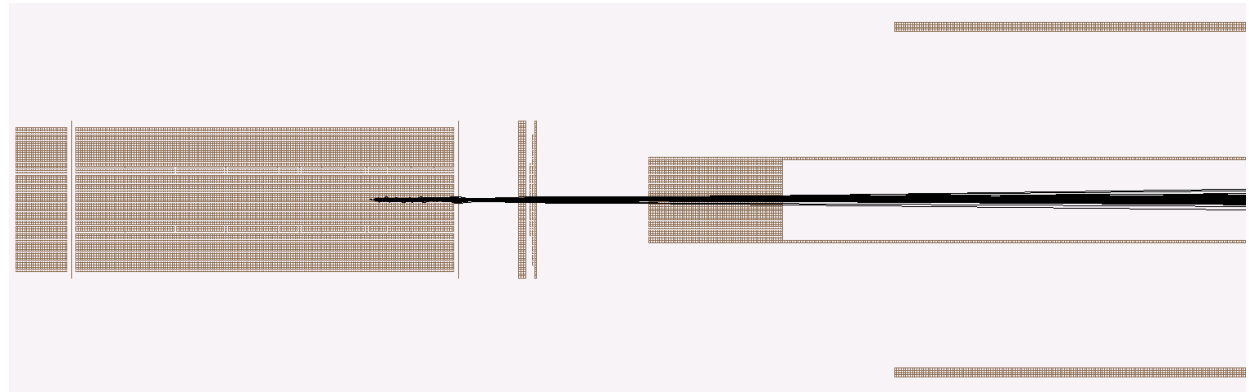Fine control over :
-width of bunching well
-depth of bunching well
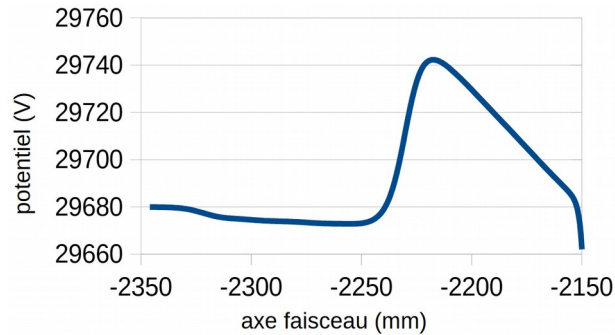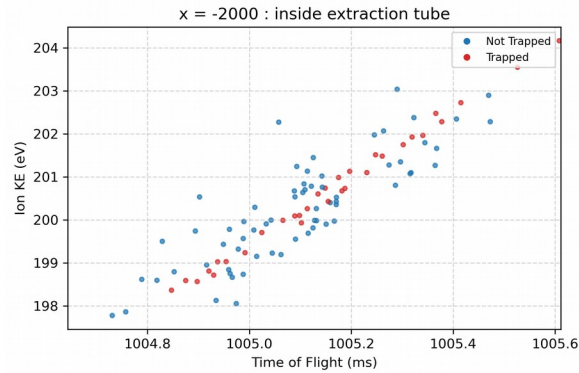
Typical extraction potential

SIMION results: ion bunch extration

The DC wedges of the buncher allow to tune finely the extraction slopes.
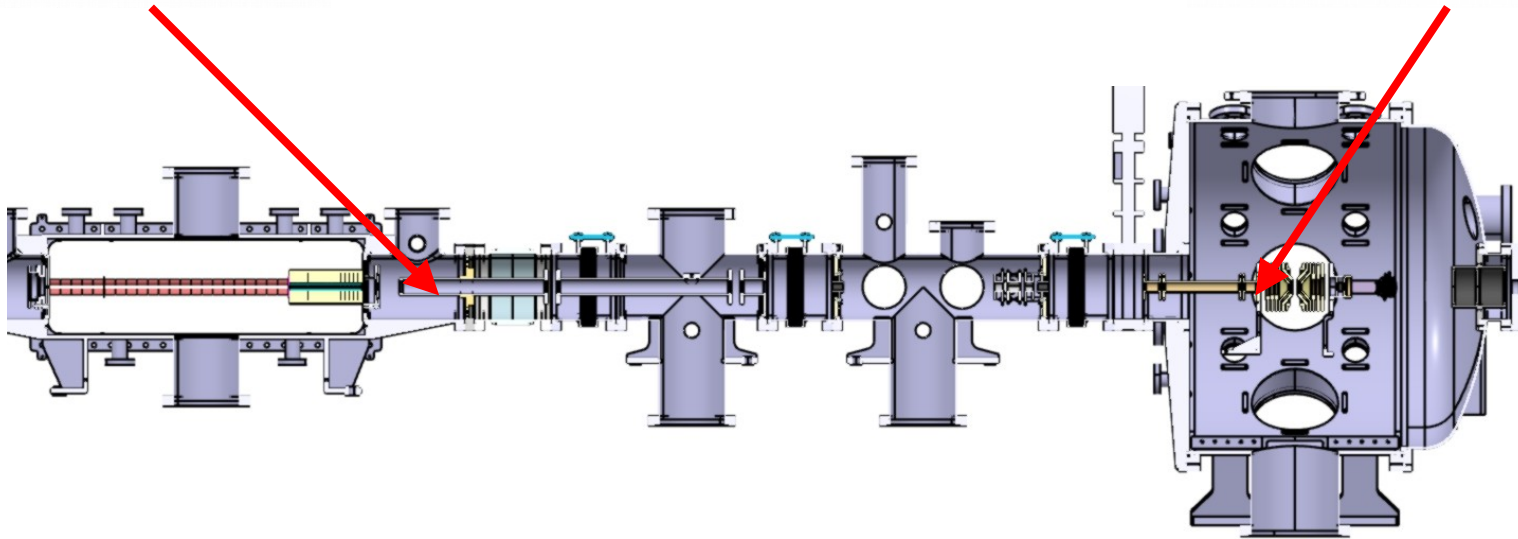
=> mastery of the ion bunch properties :
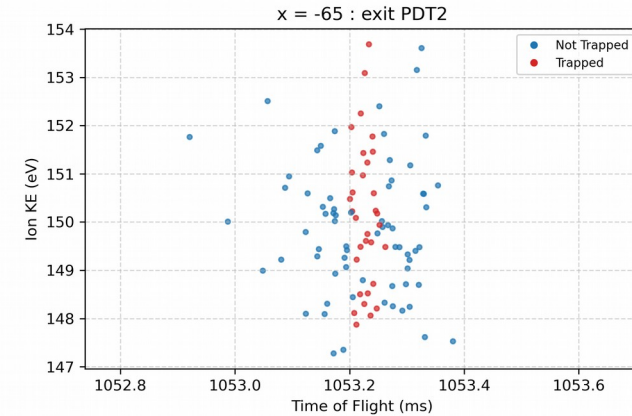   -time dispersion
    -length
    -energy spread

x = -2000 : inside extraction tube

This time-energy focalization technique allows to have large ion bunches :
-in the buncher
-in flight

=> help with space charge effect

x = -65 : exit PDT2

SIMION simulations : Conclusions

Up to 100 % trapping efficiency from buncher to Paul trap

80 % overall efficiency (some loss during injection into RFQ-CB)

Space charge effect calculation have to be caried but prove to be challenging
=> **commissioning will tell us the max bunch size possible**

Thank you