RFQ ion beam cooler and buncher (RFCB)

For ISOLDE radioactive ion beams

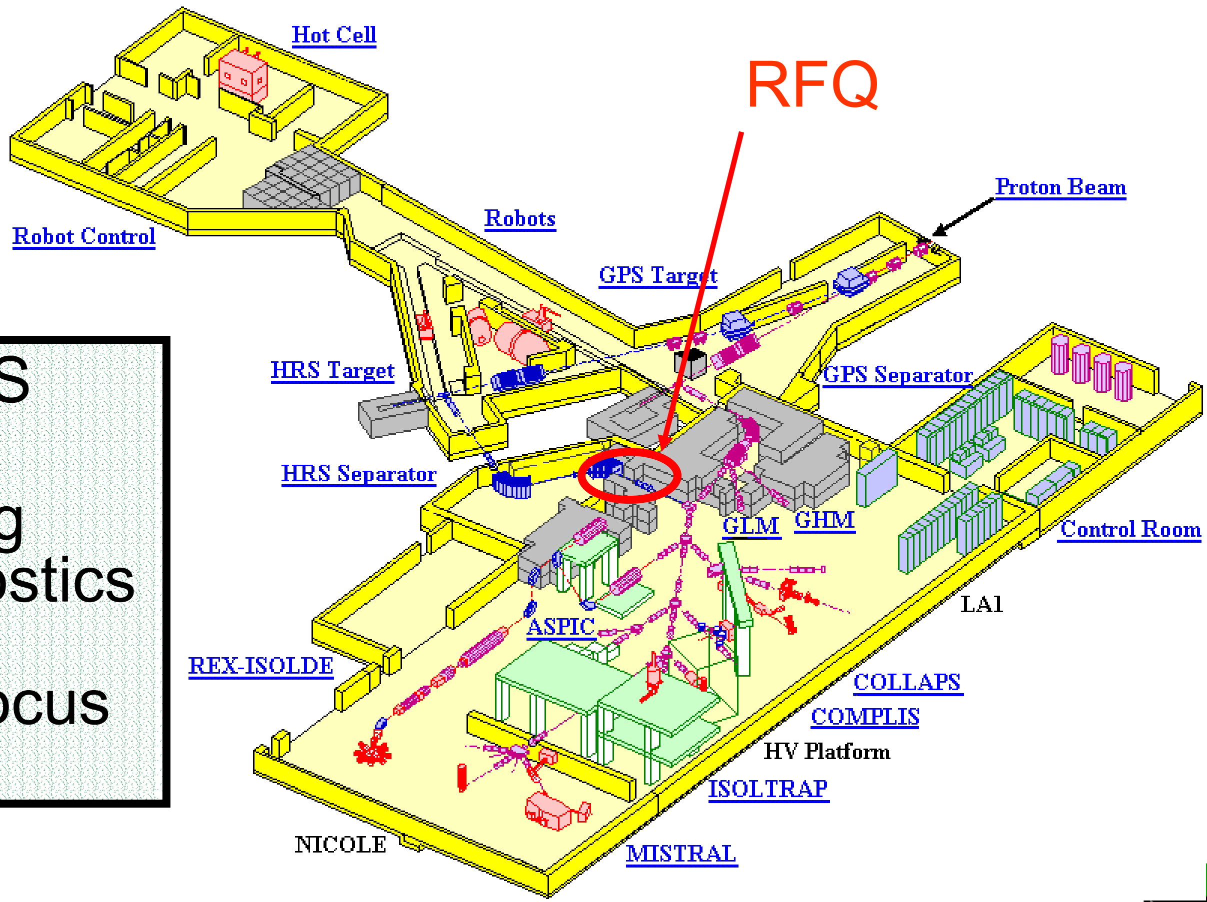
August 28, 2003
Ari. Jokinen@cern.ch
Ivan.Podadera@cern.ch
CERN AB/OP-ISO

http://www.cern.ch/ab-div-op-iso-rfqcb/

Summary

- Introduction
- Status of the project
- Mechanical engineering
- Cost estimation

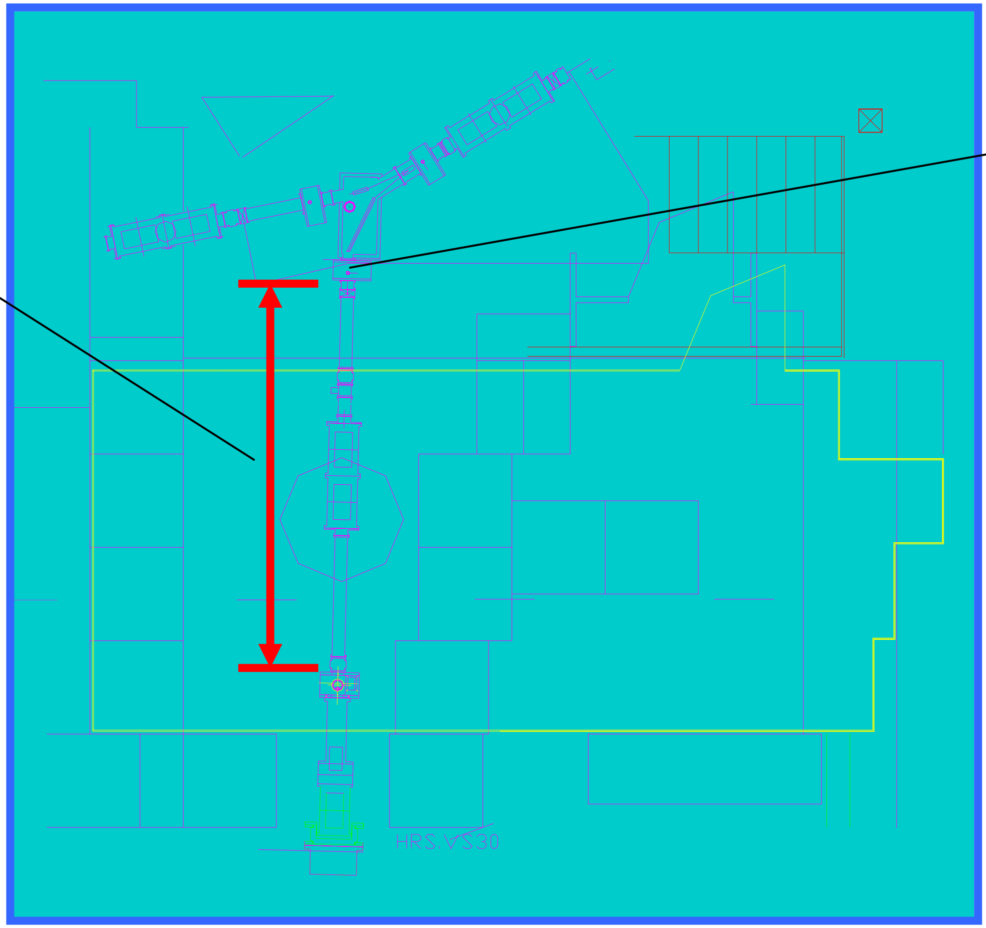
Location beam section at ISOLDE layout



- After the HRS final focus
- Up to existing beam diagnostics box after the beam gate focus

Beam line section to remove

One has to remove the existing quadrupole, the beam pipe and the beam gate

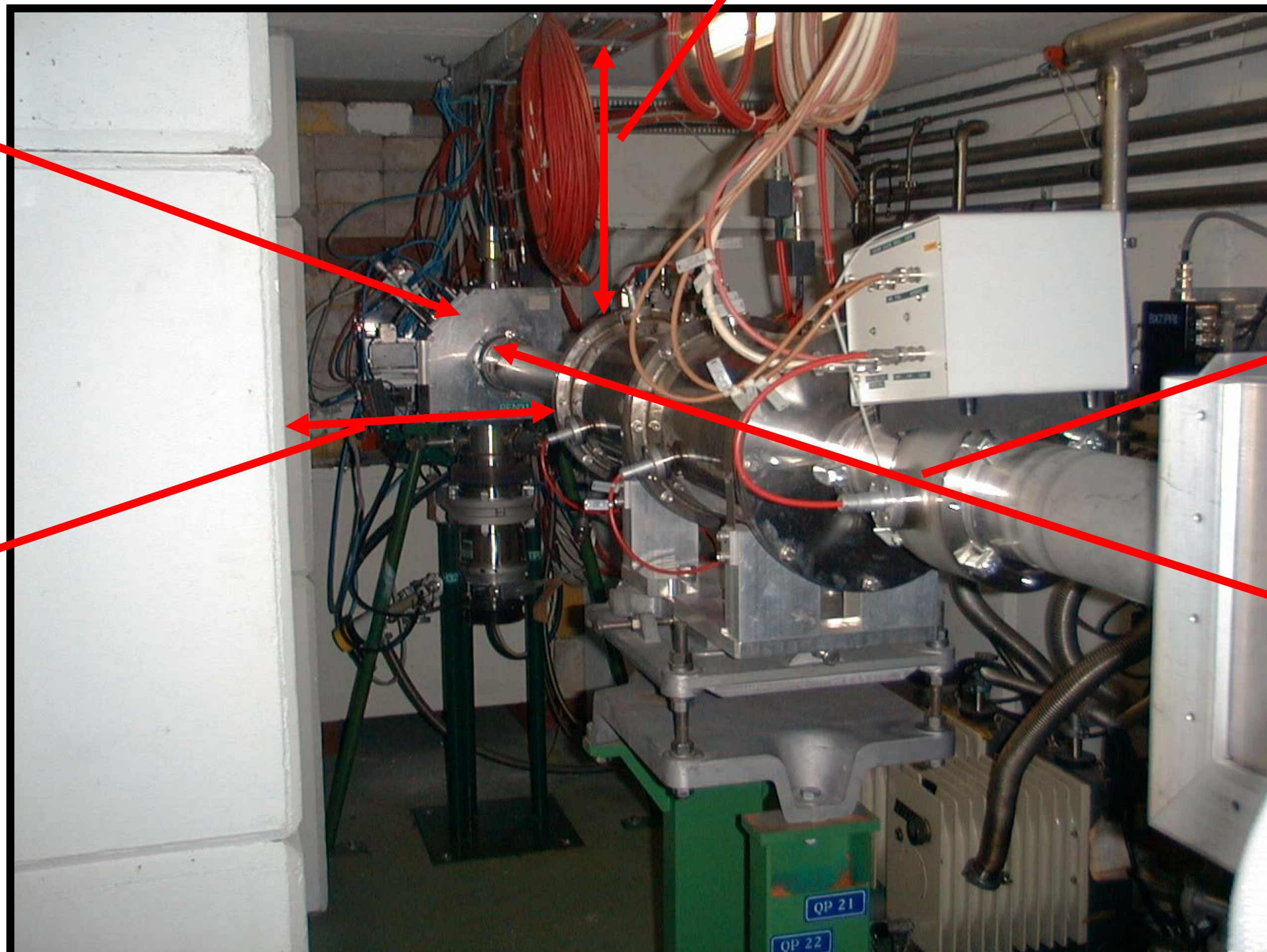


The diagnostics box, the valve and the bellow between them could be kept

Existing beam line section

High constraint (~500mm)

Diagnostics box at focal point after HRS (begin of the new section)



Length constraint

(~3300mm)

Width constraint

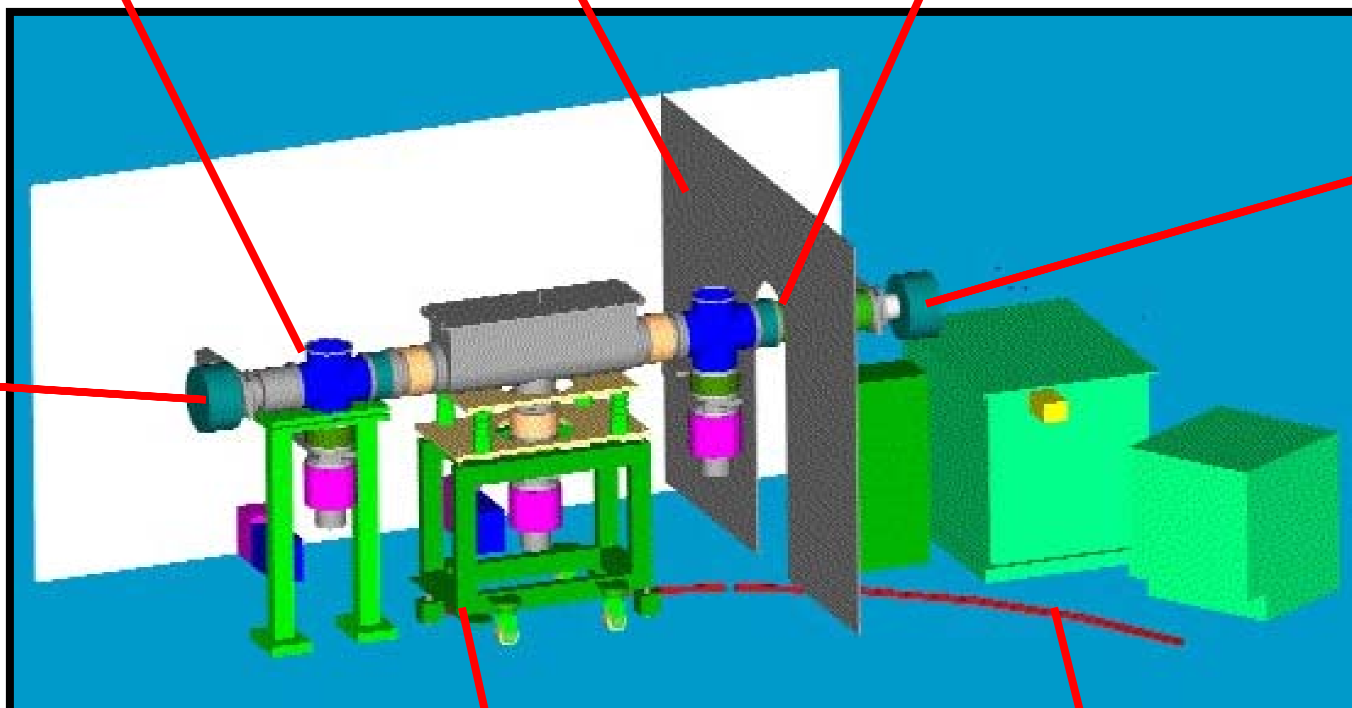
(~400-500mm)

ISOLDE
CERN

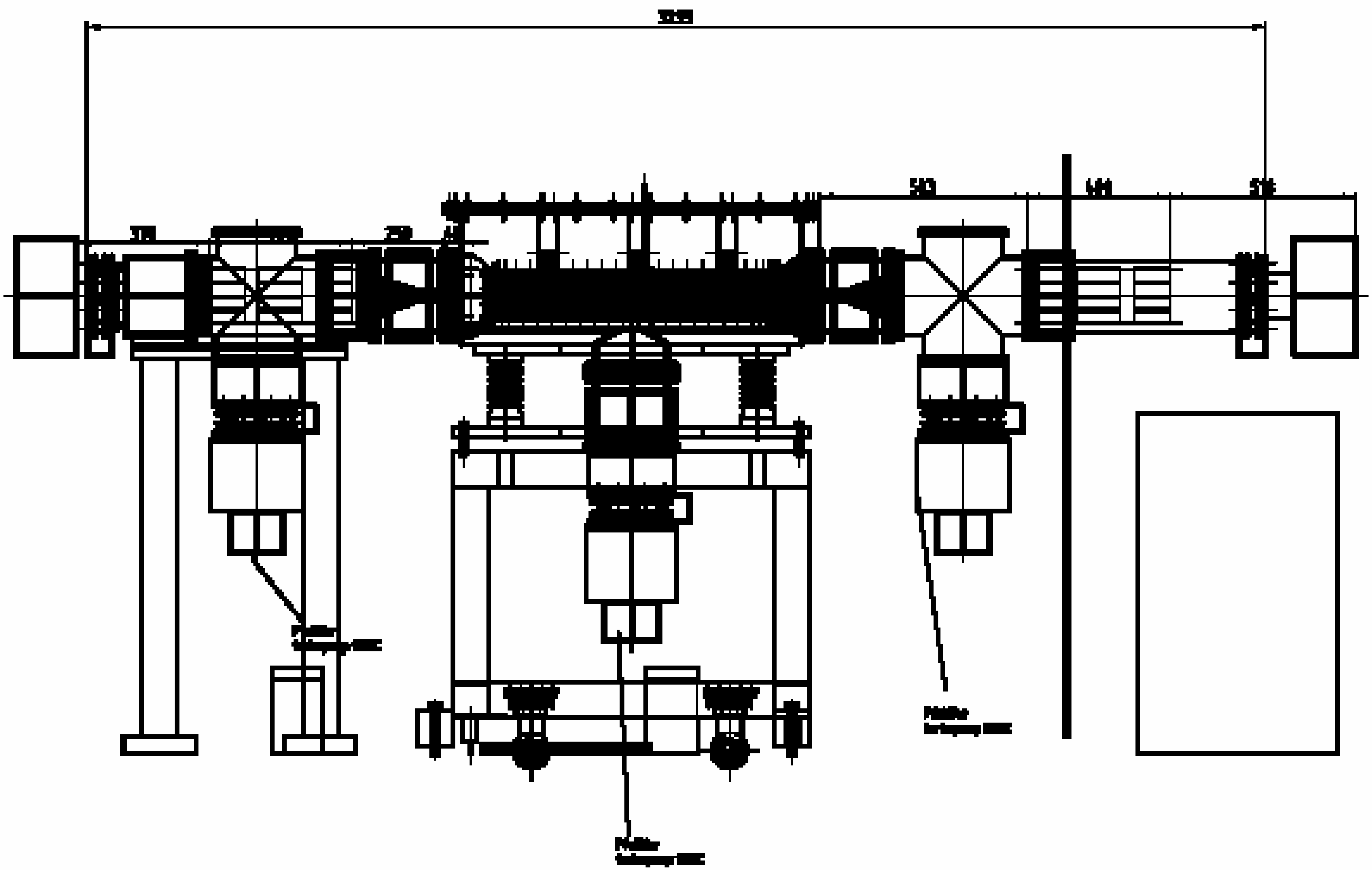
Existing beam line section

Diagnostics box at the end of our section

New beam line section layout



Beam line section layout



RFQ cooler main parameters

Before RFQ

- mass ion beams between 10÷300
- beam intensity <10^{10} ions/s
- ions energy: 60 keV ± 5 eV
- emittance around 20π mm·mrad

RFQ cooler

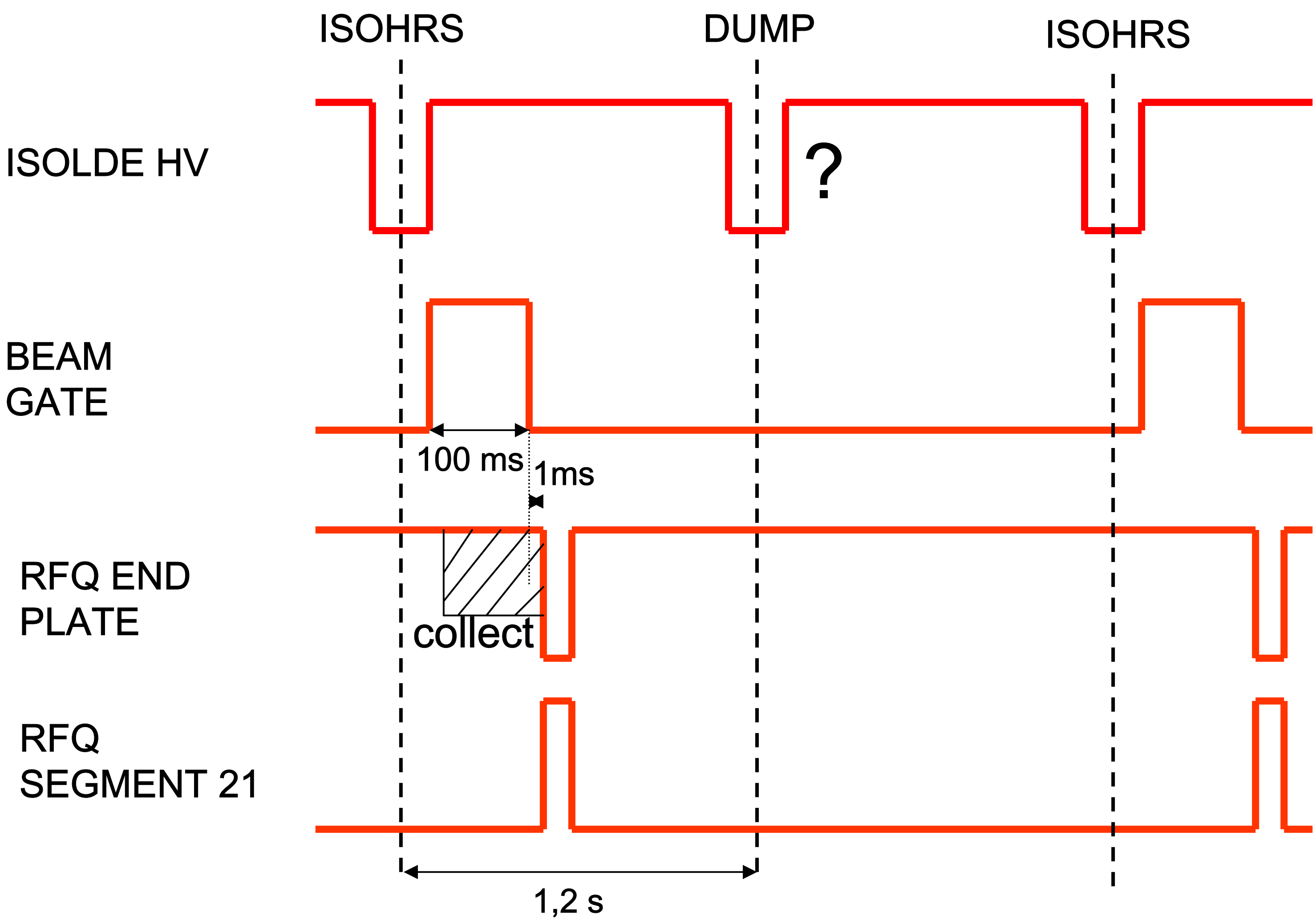
- frequency of RF field: 1÷5 MHz
- amplitude RF field: 200÷1000 V
- room temperature: 18 ºC +/- 2 ºC

After RFQ

- final emittance around 3π mm·mrad
- ions energy: 60 keV ± 1 eV
- efficiency (ions out/in) around 100%

ISOLDE
CERN

Time structure



Cooler and buncher parameters

Cooler

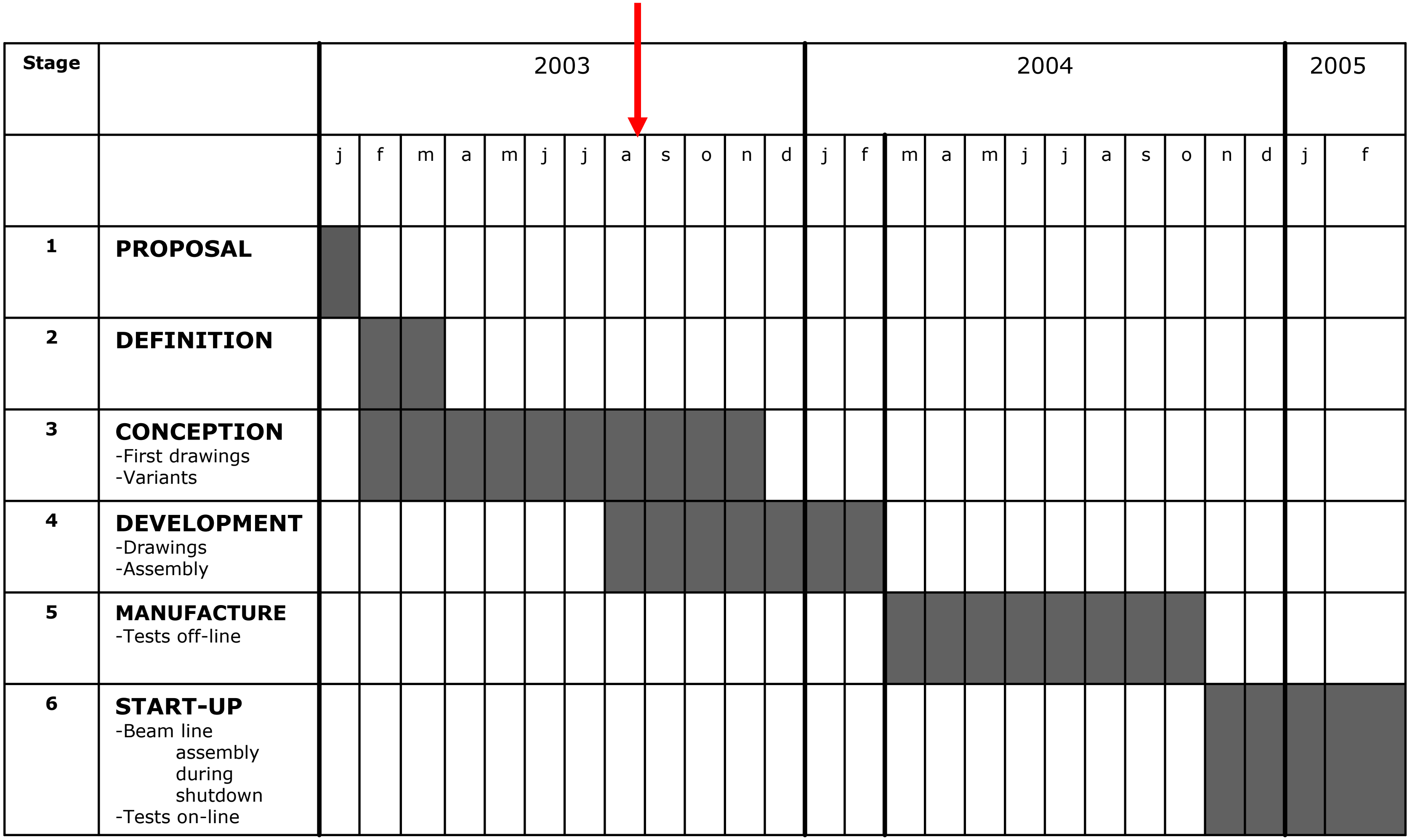
- Entry ions energy: 100 eV
- Cavity total length: 800 mm

Buncher

- Time between bunches: 1 ms – 10 ms
- Extraction with kick or just switching off the potential

Cooler and buncher sections in the same cavity or in different cavities? Use of a miniquadrupole between them?

Planning


Stage
2003
2004
2005
j f m a m j j a s o n d j f m a m j j a s o n d j f
1 PROPOSAL
2 DEFINITION
3 CONCEPTION
-First drawings
-Variants
4 DEVELOPMENT
-Drawings
-Assembly
5 MANUFACTURE
-Tests off-line
6 START-UP
-Beam line assembly during shutdown
-Tests on-line

Status of the project

In progress

- Design of beam extraction electrodes for the RFQCB
- Vacuum system
- Insulators

To be worked

- Preparation tests off-line
- Control system
- Electronics system
- Balloons to store helium gas

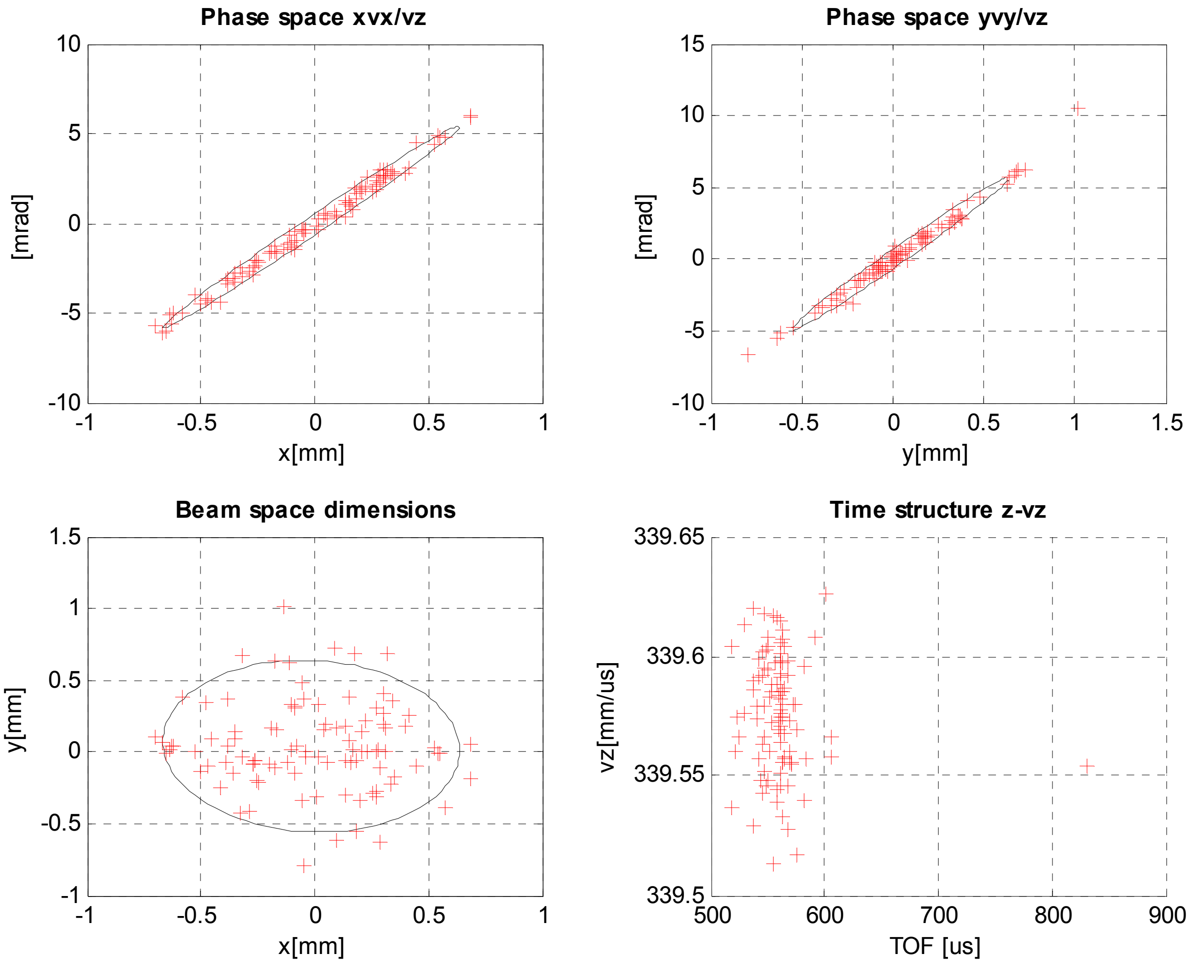
Designed

Beam line optics (quadrupoles)

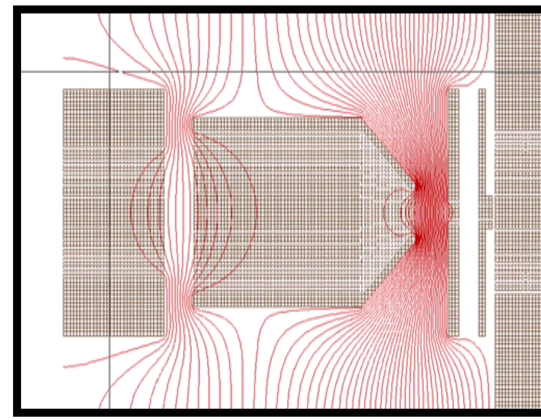
Waiting

Mechanical design

Beam extraction study



Longer skimmer electrode



Voltages:

59995-15000-0

Simulation with 100 ions of 100 amu

ISOLDE CERN

AJ, IP 28-08-2003

Control system

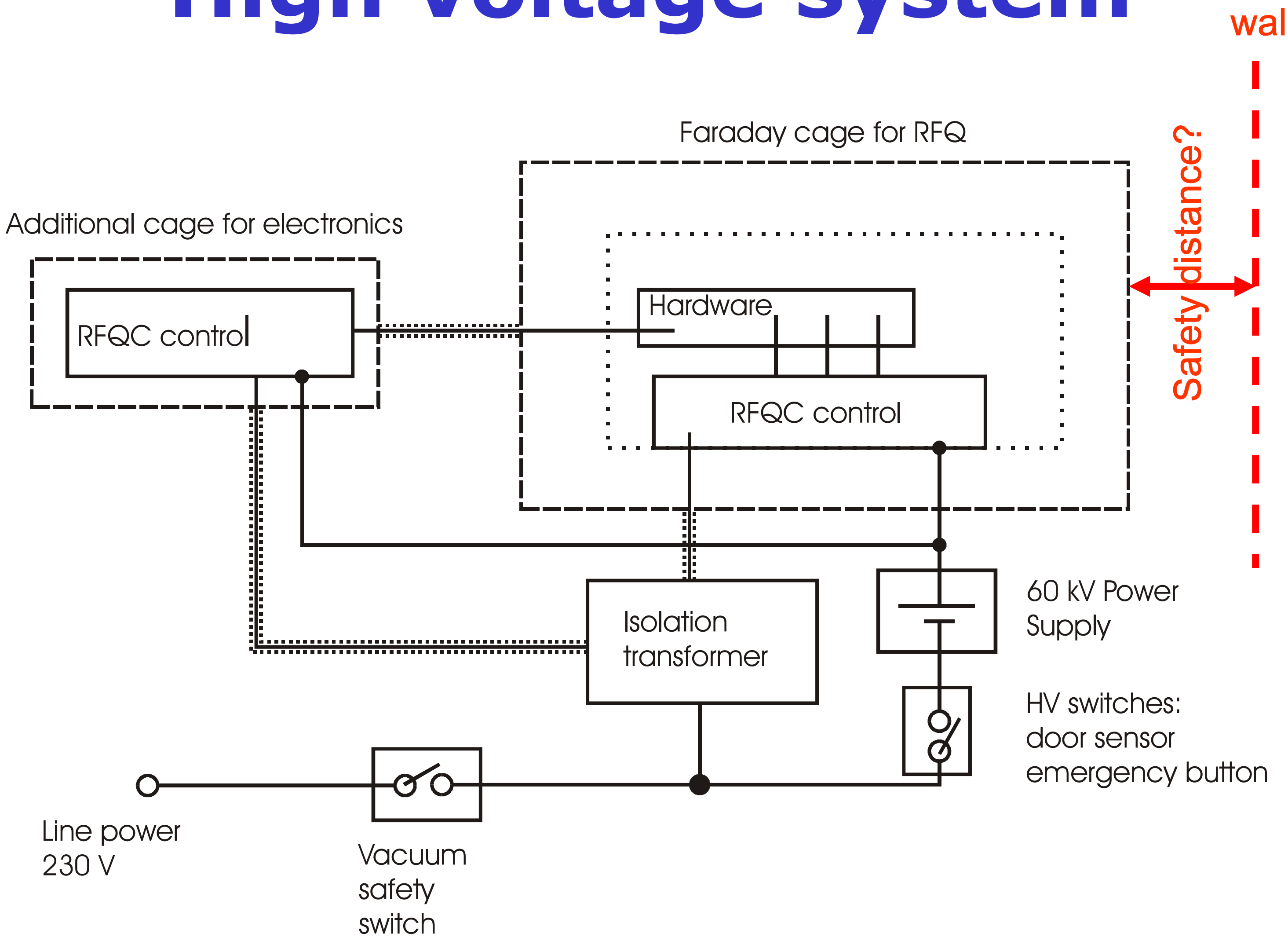
Fully integration in ISOLDE control system

Main parameters to control:

- **vacuum system** (pumping speeds, pressure inside RFQ (correcting readout of gas feeding) , gas feed, pressure at injection and ejection).
- **RF voltage** (frequency?, amplitude?).
- **DC voltages**.
- **diagnostics** (emittance, beam X-Y correction,...).

ISOLDE CERN

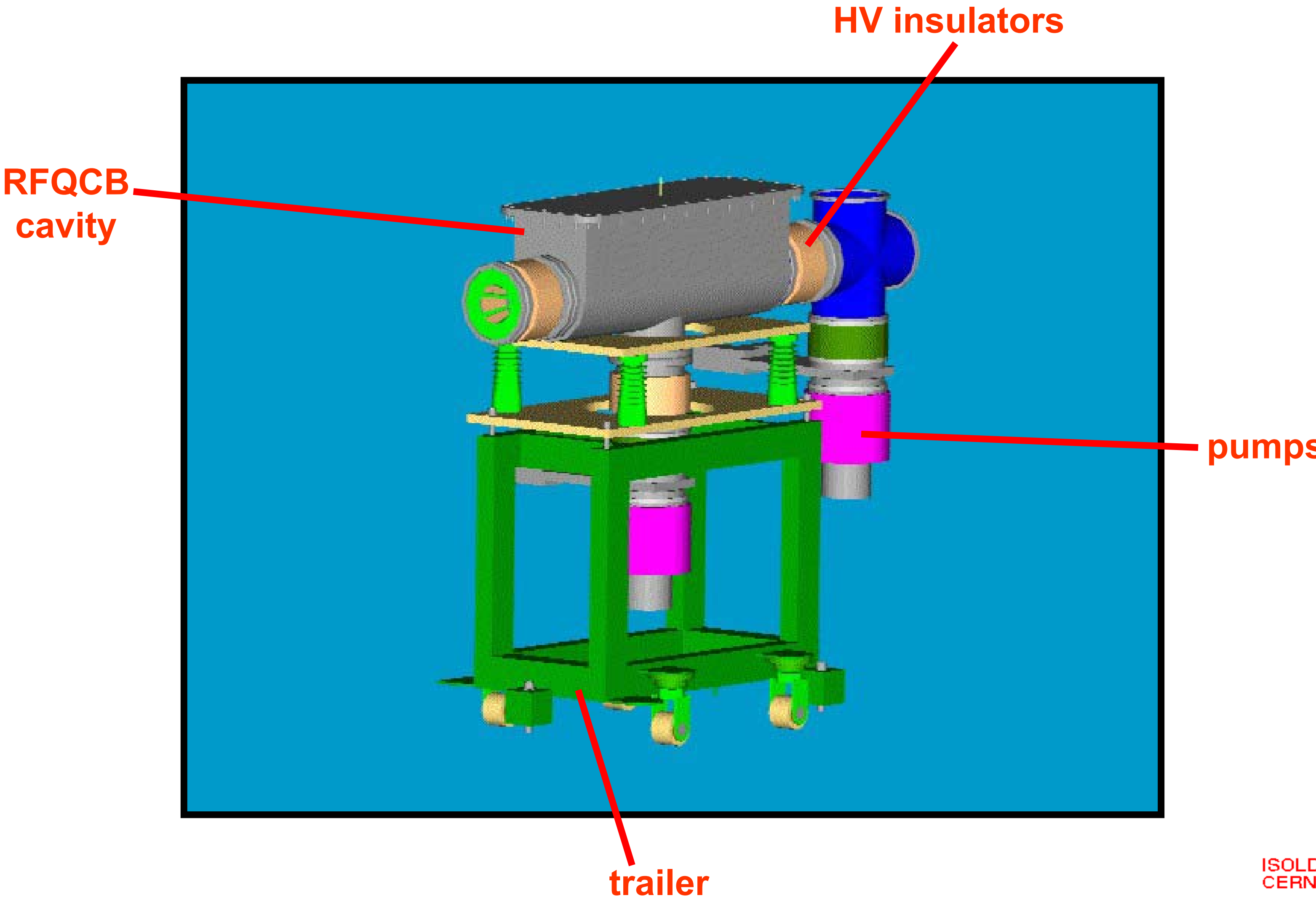
High voltage system



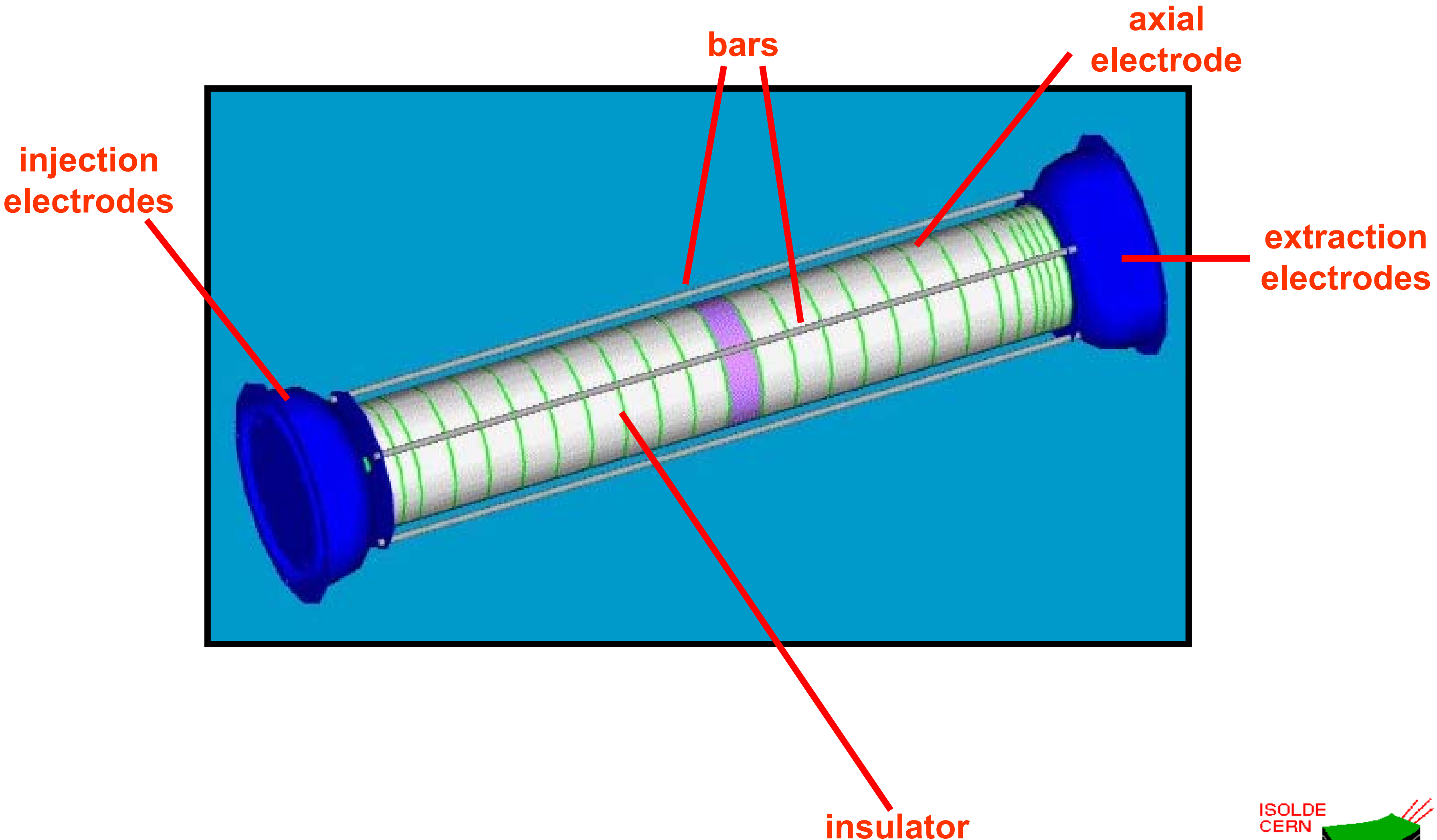
Electronics system

- power supply:
  - operational voltage >60 kV.
  - stability: 10-5·60 kV=0,6 V.
- line power 220/230 V.
- isolation transformer:
  - voltage: 220/230 V.
  - low power.
  - voltage rate: 60 kV.
- 60 kV fast switch.
- RF field provided by a function generator:
  - amplitude: $0\div1$ kV (0 to peak).
  - frequency: 100 kHz$\div$ 5 MHz.
- 25 DC power supplies $0\div200$ V.

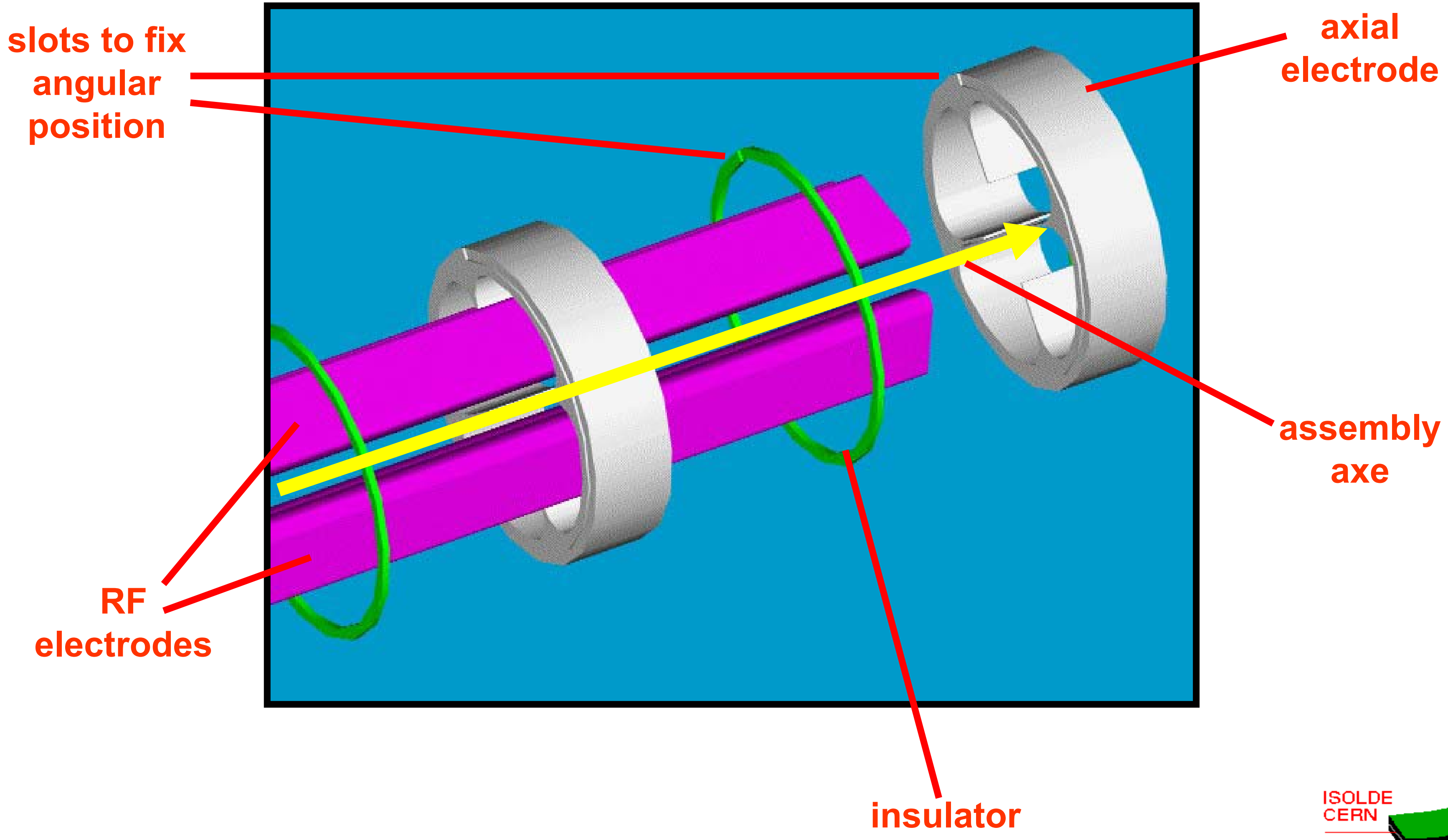
Trailer system



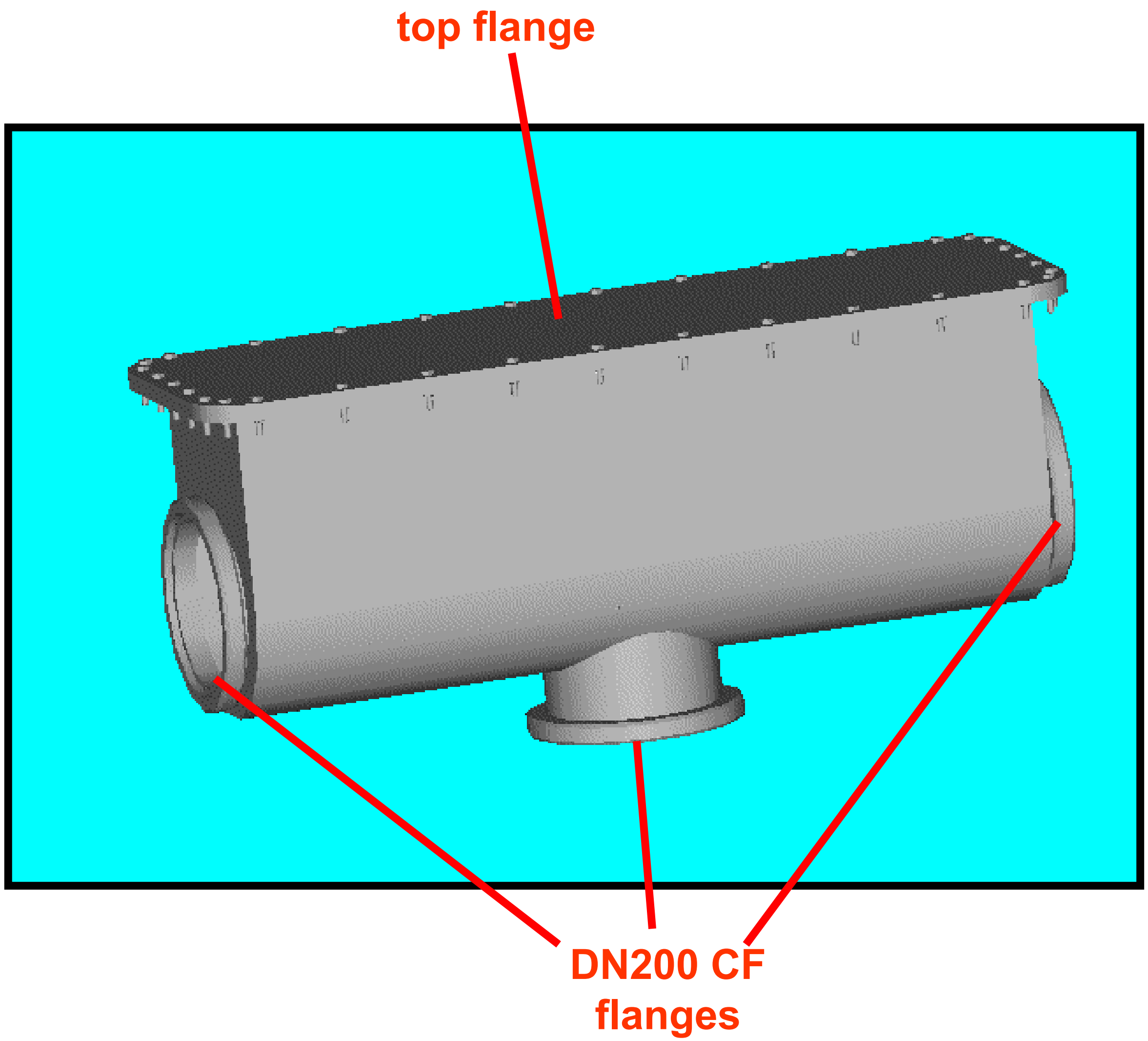
RFQCB package



Axial electrodes system



RFQCB cavity

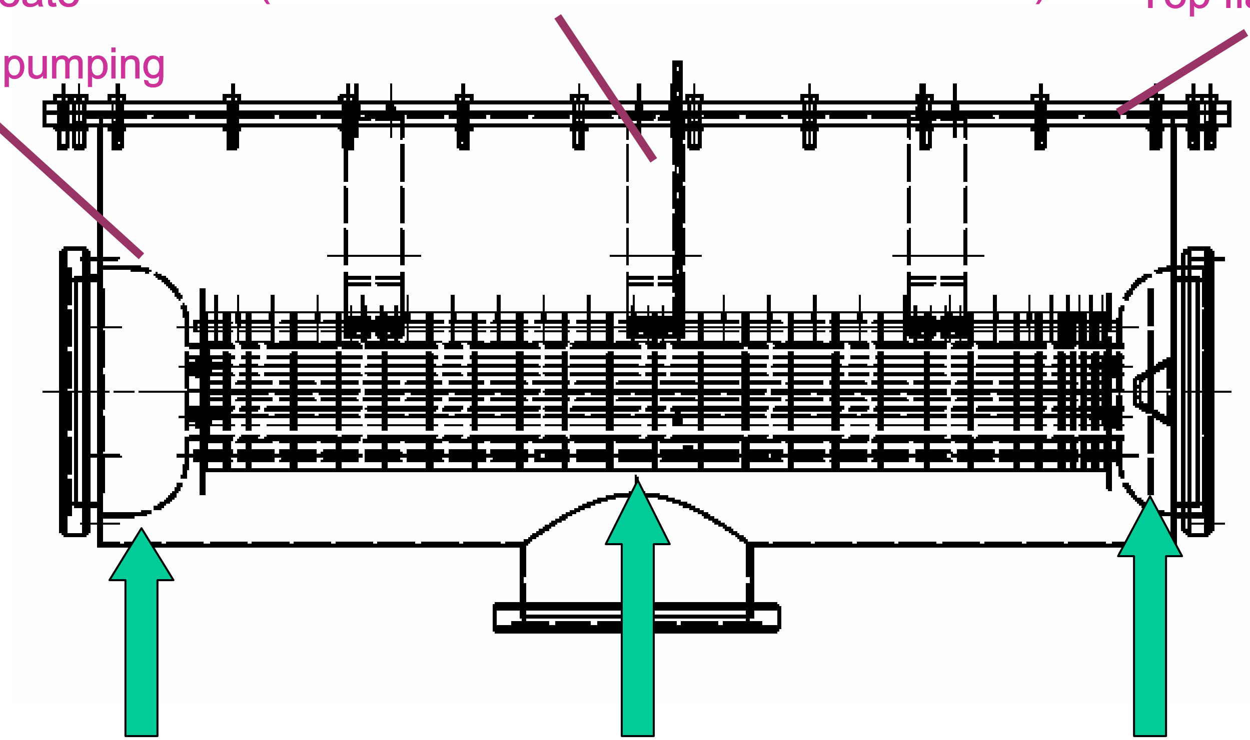


RFQCB cavity

Electrode close the cavity to create differential pumping

Piece to support it from the top flange (simulation of the deformation of the bars)

Top flange

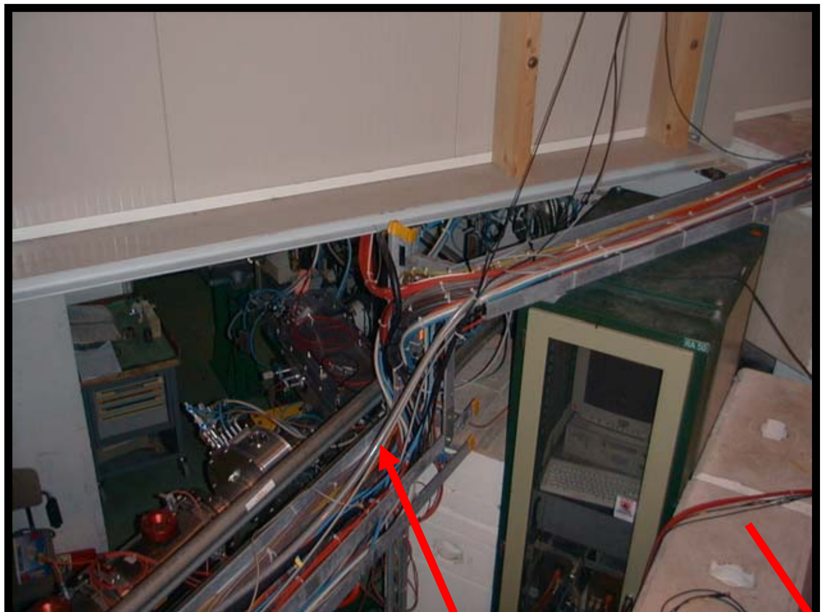


Injection electrodes

RFQCB package

Extraction electrodes

Beam line alignment



direction of beam alignment

Need to move blocks to align

point to align

Partial project cost estimation

Fabrication (CHF)	300000
Vacuum system cost (CHF)	150000
Total (CHF)	**450000**
Unexpected costs	**+10%**
Total (CHF)	**500000**

The fabrication cost includes the designing, manufacturing and assembly of all the components of our beam line section.

It is an estimation starting from the fabrication cost of the new ISOLDE front-end.

ISOLDE
CERN

Vacuum system cost estimation

Object	Quantity	Price(CHF)/unit	Price(CHF)	Price(€)/unit	Price(€)
TMH 1001	2	26424.3	52848.6	0.187780933	0.375562
TMH 1601	1	30708.3	30708.3	0.218224635	0.218225
Alcatel Pascal 2015H1	2	6000.93	12001.86	3846.75	0.08529
VAT Series 10 DN200 with position indicator	4	8150	32600	0.05791694	0.231668
VAT Series 10 DN250 with position indicator	1	12560	12560	0.089256045	0.089256

CHF/€	1.56
Total (CHF)	**140718.8**
Total (€)	90204.33

Gauges and vacuum control not included

ISOLDE CERN

Insulators cost estimation

Object	Quantity	Price(CHF)/unit	Price(CHF)	Price(€)/unit	Price(€)
Ceramaseal DN 20075 kV CF	3	5600	16800	3589.74359	10769.23

CHF/€	1.56
Total (CHF)	**16800**
Total (€)	10769.23

Insulators for the front-end => 14000 CHF

Others cost

- Control system
- Power supplies

…