RFQcb Model and Simulation for CERN-ISOLDE at Offline 2

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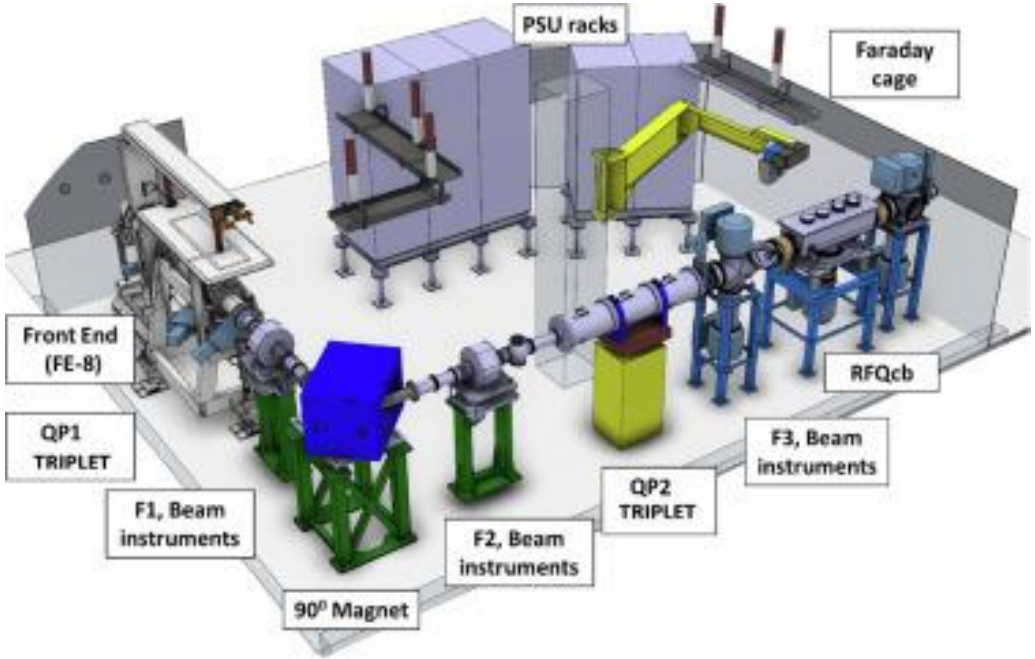
Offline 2



- Off-line ion testing facility for ISOLDE
- Equivalent testing environment specifically for Frontend and RFQcb to test targets and hardware
- Non-radioactive

RFQcb at Offline 2

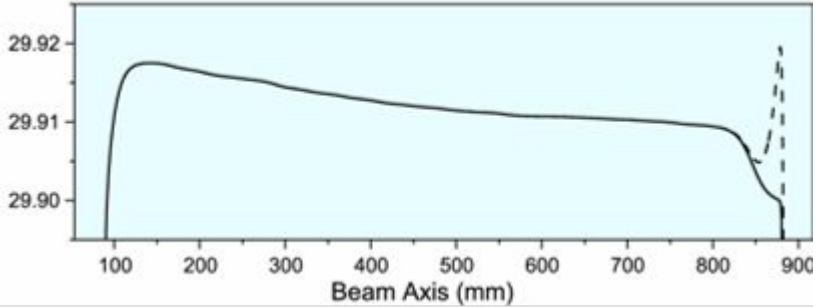
- Replica of ISCOOL at ISOLDE
- Cools and bunches the ion beam using a He buffer gas, an RF field to transversally focus the ions, and a longitudinal gradient to store, and later extract, bunches of ions

Additional features at RFQcb at Offline 2:

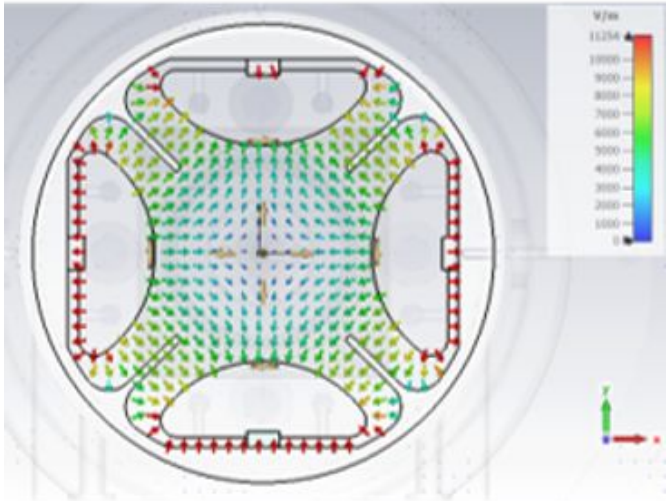
- Double pumping capacity and dynamic range of operational pressures of buffer gas
- 10x greater RF system power and greater frequency range
- Same beam energies (30-60 keV) with upgraded controls for the axial electrodes and RF controls

Longitudinal DC Potential Ramp and RF Field

By adding a buffer gas, the ions are further transversally cooled.
By adding a longitudinal potential, the ions can be stored, gathered and bunched at the end of the RFQ.



Longitudinal ramped DC potential (kV) along the RFQcb beam axis in transmission mode (solid) and bunching mode (dashed)



Cross-section of the electric fields in the transversal XY-plane showing the alternating quadrupole electric RF fields that keep the ions confined and focused transversally

Motivation for New Model and Simulations in SIMION

Ion in RF and gas collisions simulated separately

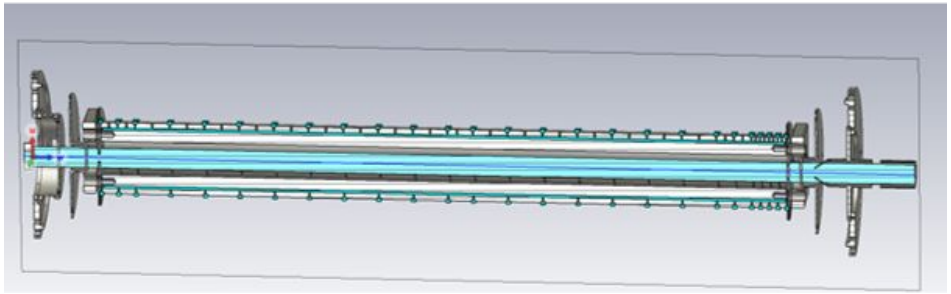
Need different software to simulate together

Build new model in SIMION

Predict effects of gas pressure

Optimizing timing for extractions

Optimize potentials



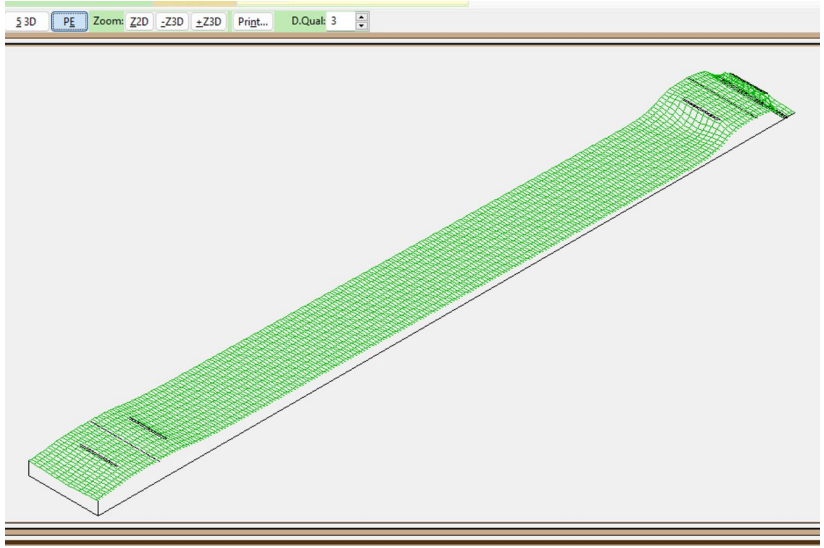
RFQcb as modelled in CST Microwave Studio

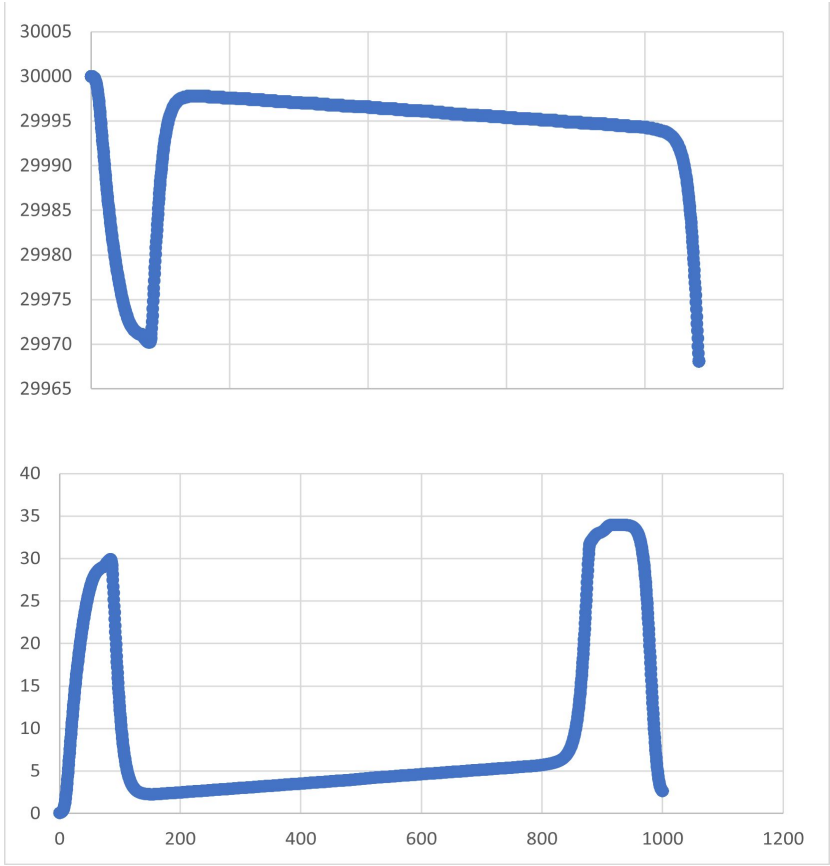
The Model in SIMION

3D view of the RFQcb modelled in SIMION. The different colors refer to different potentials.

Cross-sections of the injection (left) and extraction (right) electrodes in the YZ-plane of SIMION. The injection electrodes are used as an Einzel lens to focus the beam into the RF region. The beam is stopped from the full beam energy of 30 kV to 60 kV to approx. 100 eV. The ions then drift through the RF quadrupole region filled with the buffer gas. At the end of the RF channel, the ions can be completely stopped, stored and further cooled. By the extraction electrodes, the ions are subsequently re-accelerated to their previous energy.

The Simulation in SIMION





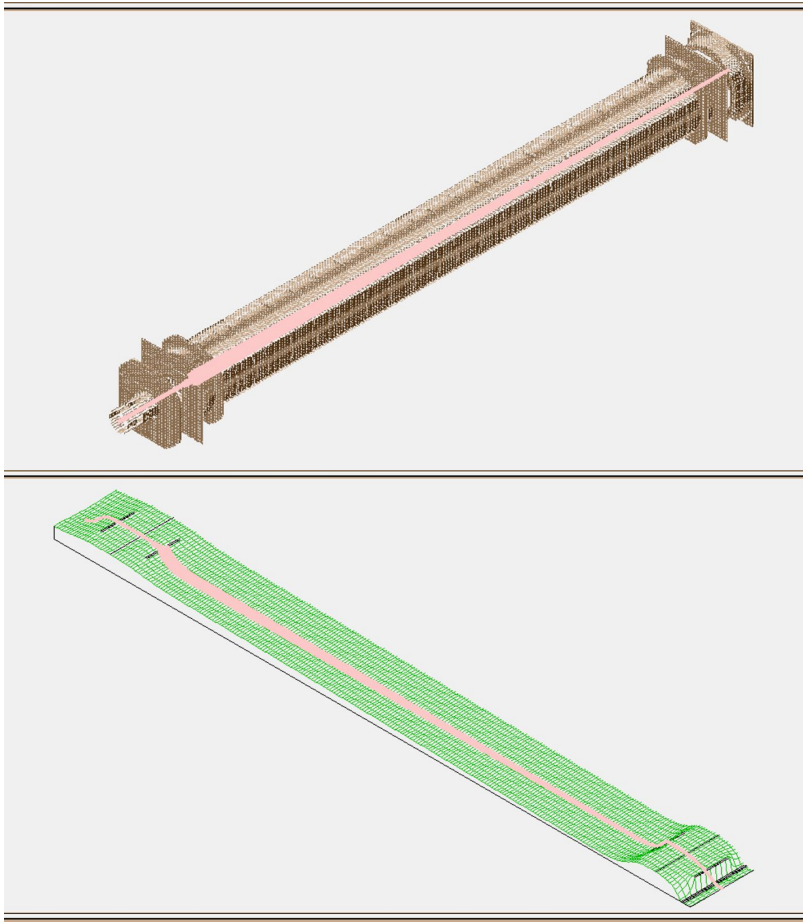
The Simulation in SIMION

ON) Grouped (.FLY2) Old Grouped (.FLY) Edit as Text Work Bench's Origin (mm)

Selected particle group:

Use: Electron Proton Default

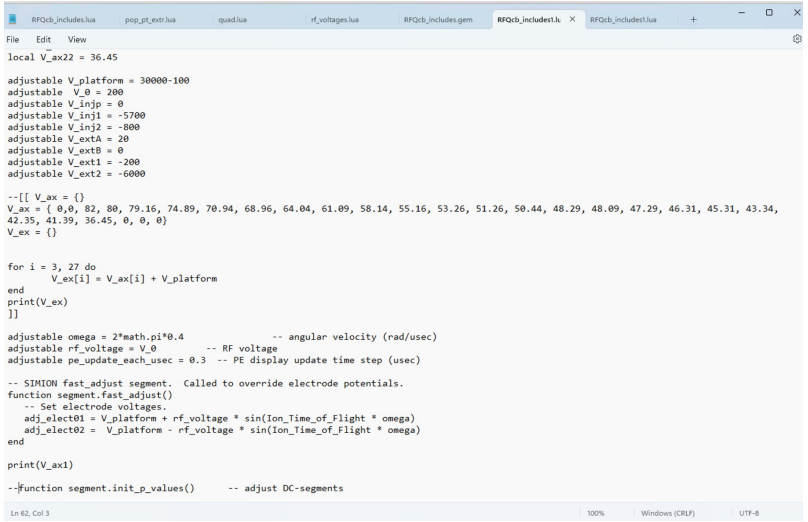
Num particles:	20		
Mass:	single value	40	u
Charge:	single value	1	e
Source position:	single vector	{ x: 50 y: 50 z: 0 }	mm or gu
Velocity format:	direction+KE		
Direction:	cone direction distribution	Axis vector: { x: 0 y: 0 z: 1 }	unitless
		Half angle (deg): 0.5 Fill	
KE:	single value	30000	eV
TOB:	single value	200	usec
CWF:	single value	1	unitless
Color:	single value	7	index



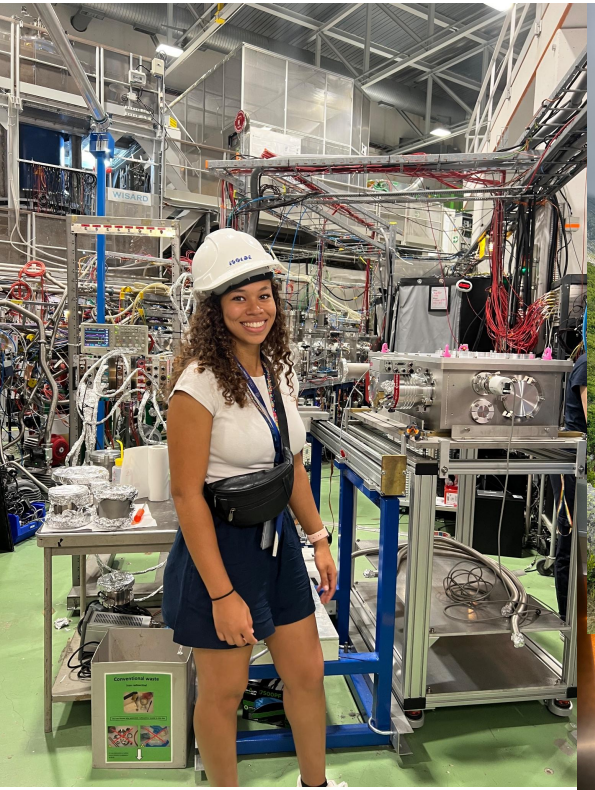
Conclusion and Outlook

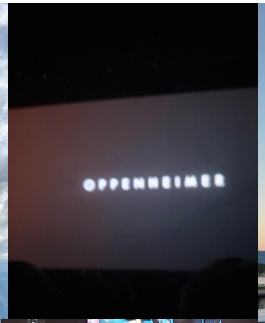
Next stage:

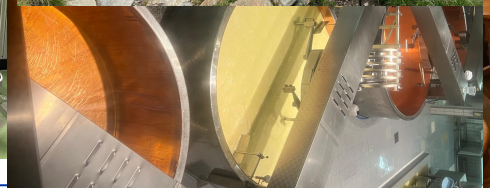
Correct potentials and collision cross-section values in SIMION and simulate different gas pressures



What has Jara been up to?







Thank you

Thank you to my supervisor, Maximilian Schuett, the UM-CERN REU, and the entire CERN Summer Student Programme.