



RUHR-UNIVERSITÄT BOCHUM

Operation of the accelerators at RUBION

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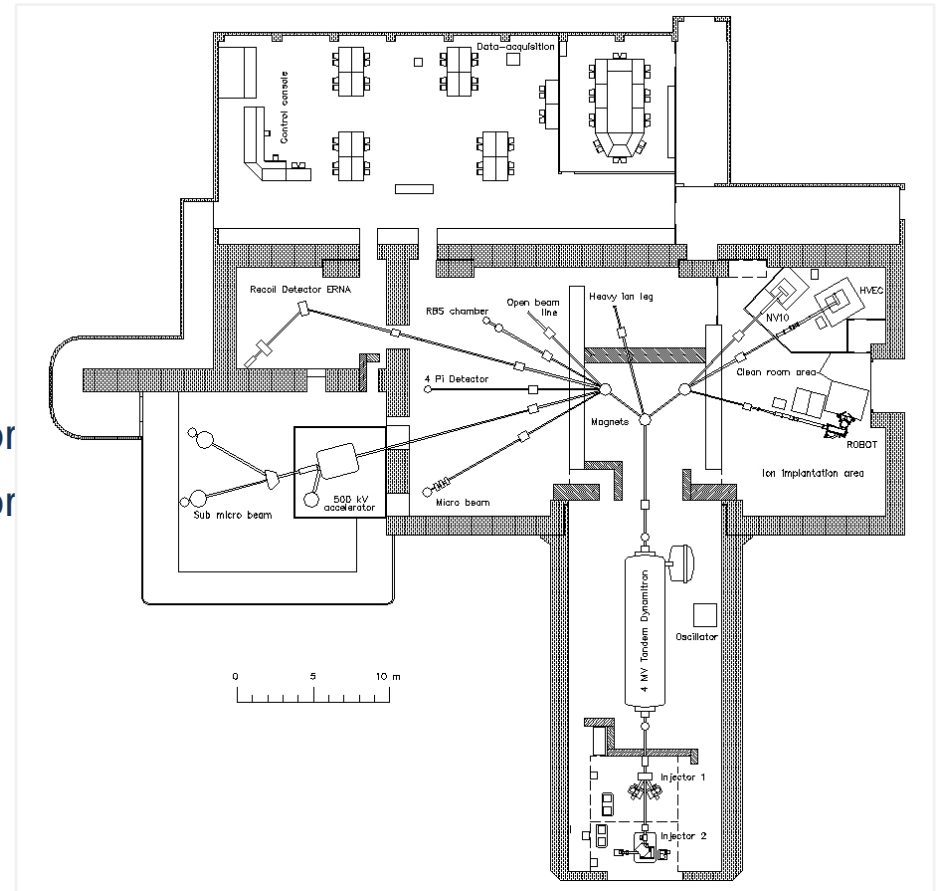
Outline

- Lab overview
- 100 kV-accelerator
- 500 kV-accelerator
- 4 MV-accelerator



Lab Overview

- RUBION is a central unit of the Ruhr-University Bochum
- Operates three accelerators:
 - 100 kV – single ended accelerator
 - 500 kV – single ended accelerator
 - 4 MV – tandem accelerator
- Radionuclid lab



100 kV - accelerator

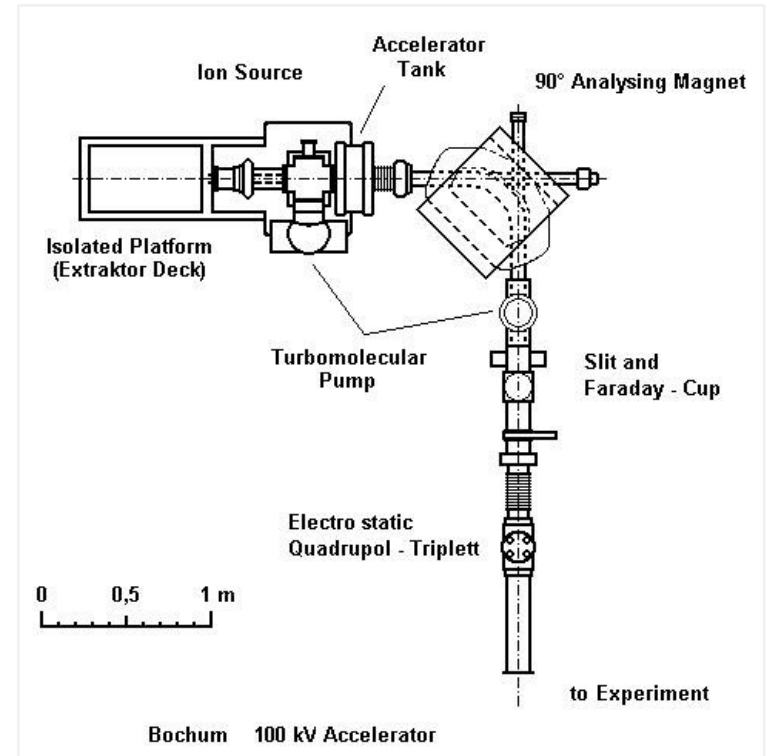
Overview

- built originally as ion source test setup
- used mainly for ion implantation
- ~ 300h operation/year



Details

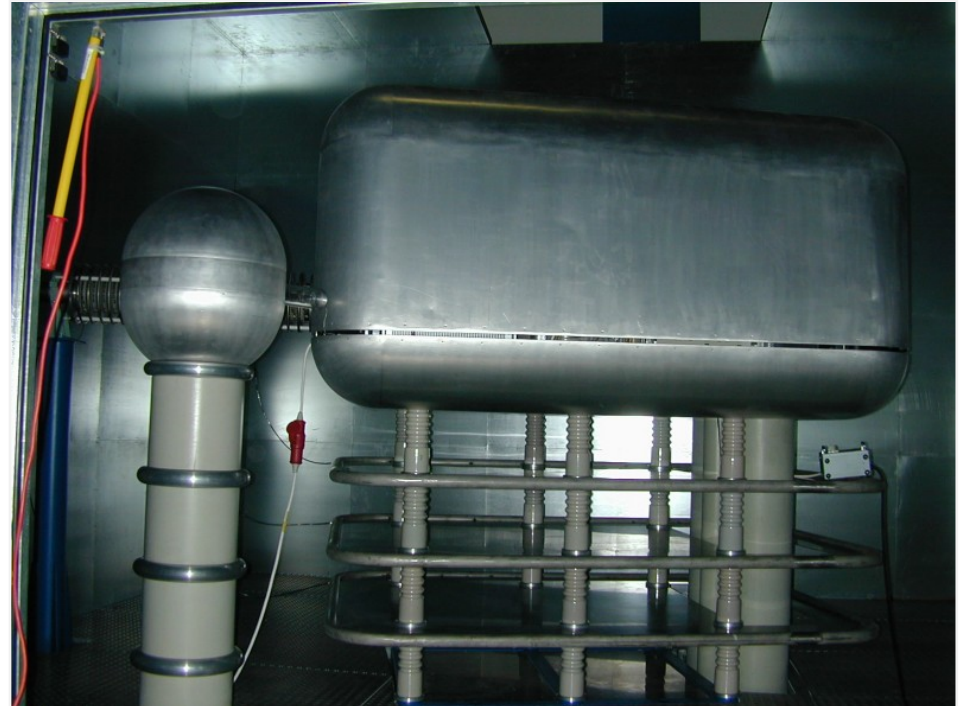
- negative high voltage up to 100 kV, 6 mA
- 90° analyzing magnet on ground, max. ~200u
- PSU manually controlled by lucite rods
- 860 type sputter source
- ion current limited by source
- setup of second ion source (development of TorVIS)



500 kV - accelerator

Overview

- built in 1990s for high energy resolution
- used for NRA, ion implantation
- ~ 200h operation/year



Details

- positive high voltage up to 450 kV, 2 mA
- stability < 50V
- 90° analyzing magnet in terminal
- PSU remote controlled by NI compact Fieldpoint / Labview
- equipped with penning source, duoplasmatron, hollow cathode source



4 MV Dynamitron tandem

Overview

- built by Radiation Dynamic Inc. and installed at Bochum in 1973
- used for ion implantation, ion beam analysis (RBS, NRA, PIXE, DIGE, ...), materials science, nuclear physics
- ~ 3500h operation/year
- limited to stable ions, but including C14



Accelerator

- up to 3.5 MV in daily operation within some minutes, 4 MV possible with conditioning
- high current (several mA), beam current limited by ion source
- tank filled with pure SF₆, ~ 6 bar,
- two gas stripper (mechanical/electrical)
- HV controlled by slit-feedback-system
- 52.5° analyzing magnet with NMR probe (energy calibrated yearly)
- good energy stability and resolution

Accelerator / Early improvements

- solid state rectifiers in oscillator PSU
- solid state rectifiers in accelerator
- cryo pumps in terminal / larger stripper canal
- optical monitor with photomultiplier tubes
- magnetically suppressed beam tubes
- gas handling system to reduce service downtime (<6h turnaround time)
- second injector for heavy ions

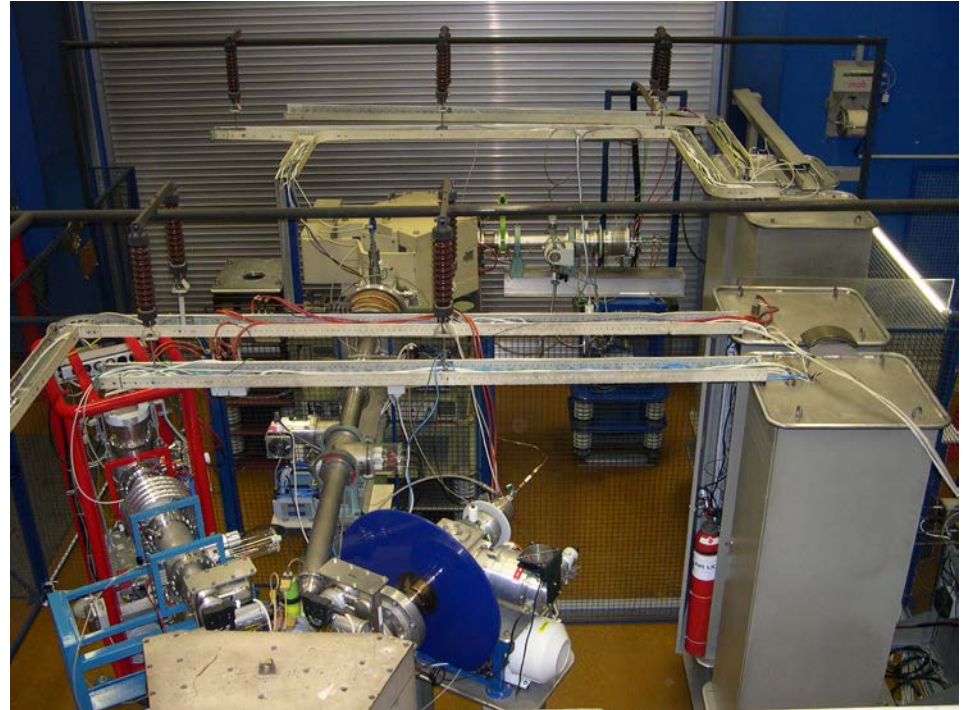
- computer controlled vacuum interlock system

Accelerator / Recent improvements

- 2011: reworked optical monitoring system (PM tubes outside, new electronics)
- 2012: new terminal control system – fiber optics
- 2014: new beamline vacuum pumps (turbo & fore pumps)
- 2015: new high voltage regulation & interlock system
- 2015: electronic log book

Injectors

- two independently operated system
- injection energy ~ 100 keV
- PSU interchangeable between both injectors
- controlled by NI compact FieldPoint / LabView

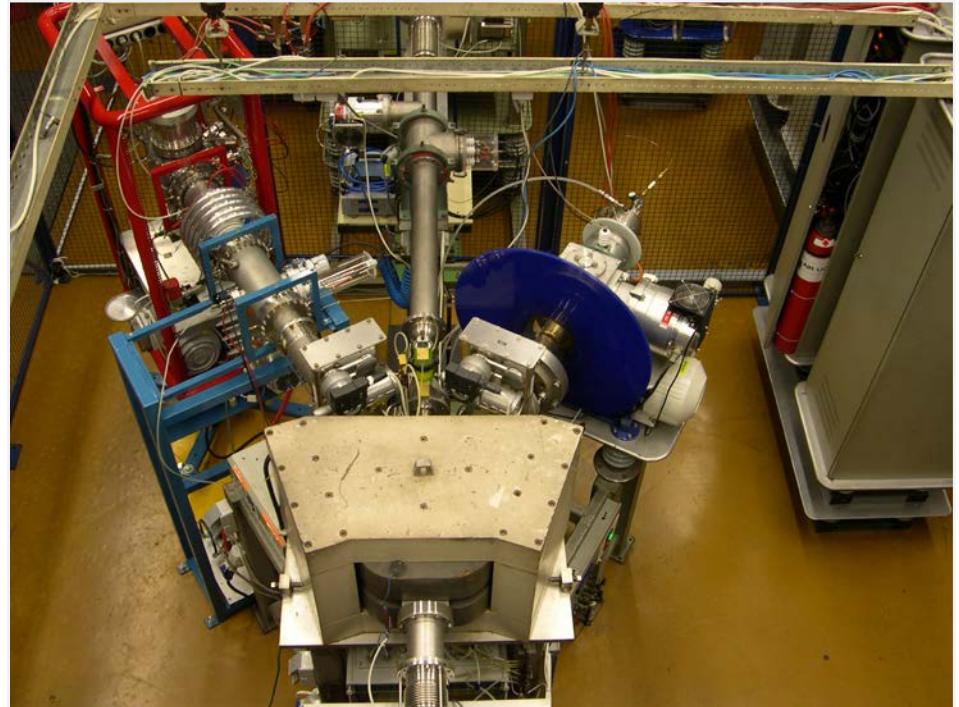


Ortec Injector

- two sources
- 30° magnet
- “quick change” system (<20 min.)

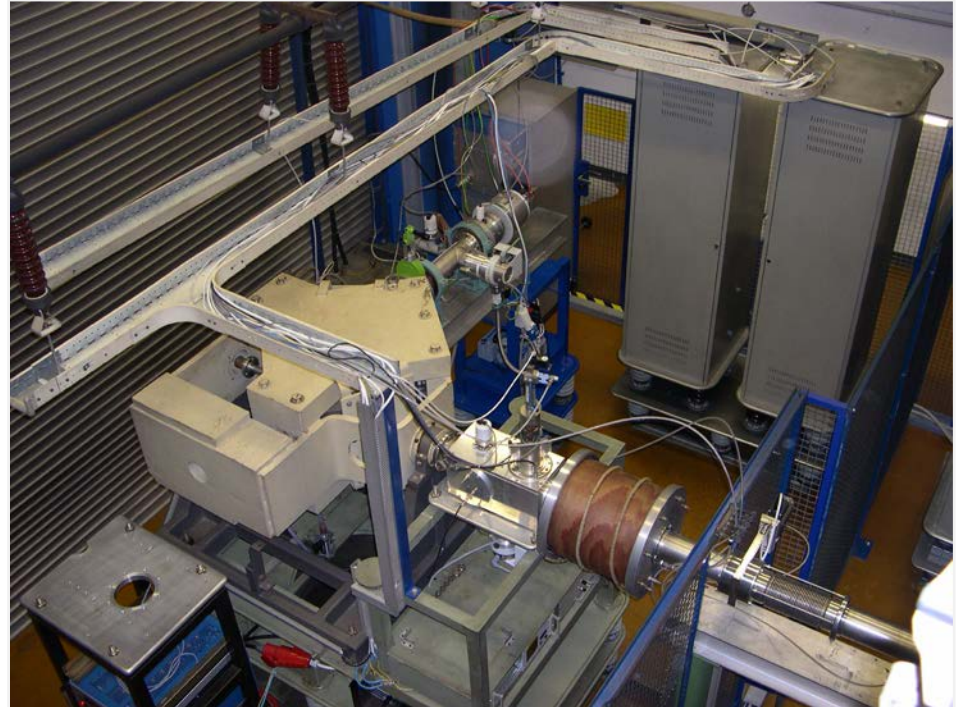
- NEC TorVIS (since 2005)
 - up to 10 $\mu\text{A He}^-$

- Duoplasmatron
 - up to 100 $\mu\text{A H}^-, \text{D}^-$
 - up to 50 $\mu\text{A C}^-, \text{O}^-$
 - up to 5 $\mu\text{A N}^-$



Heavy ion injector

- single cathode Cs sputter source
- 90° magnet
- up to 60 $\mu\text{A H}^-$
- up to 100 $\mu\text{A C}^-$
- nearly whole periodic system

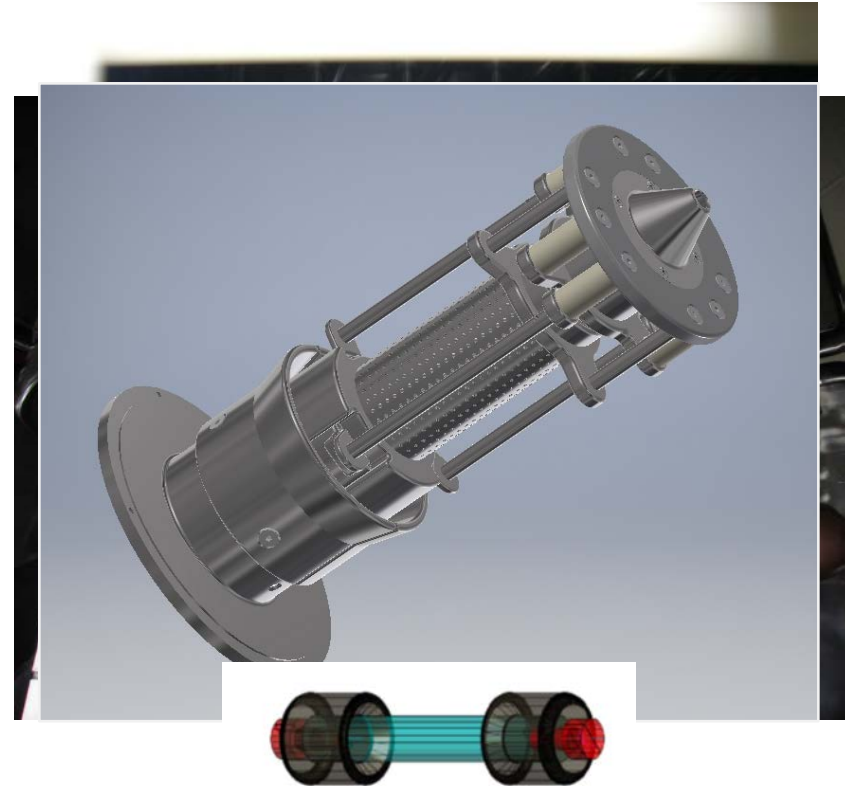


Major faults

- defective terminal electronics
 - failed tank coolers w/ burned electrical tank feedthrough
 - failed HV resistors
 - acceleration tube leak
-
- long recovery time after cleaning of TorVIS

Planned improvements

- replacement of terminal cryo pumps
- new resistors along acceleration tube
- re-design of TorVIS focusing elements



Thank you.

Accelerator team at RUBION:

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