Ion Sources at MIBL

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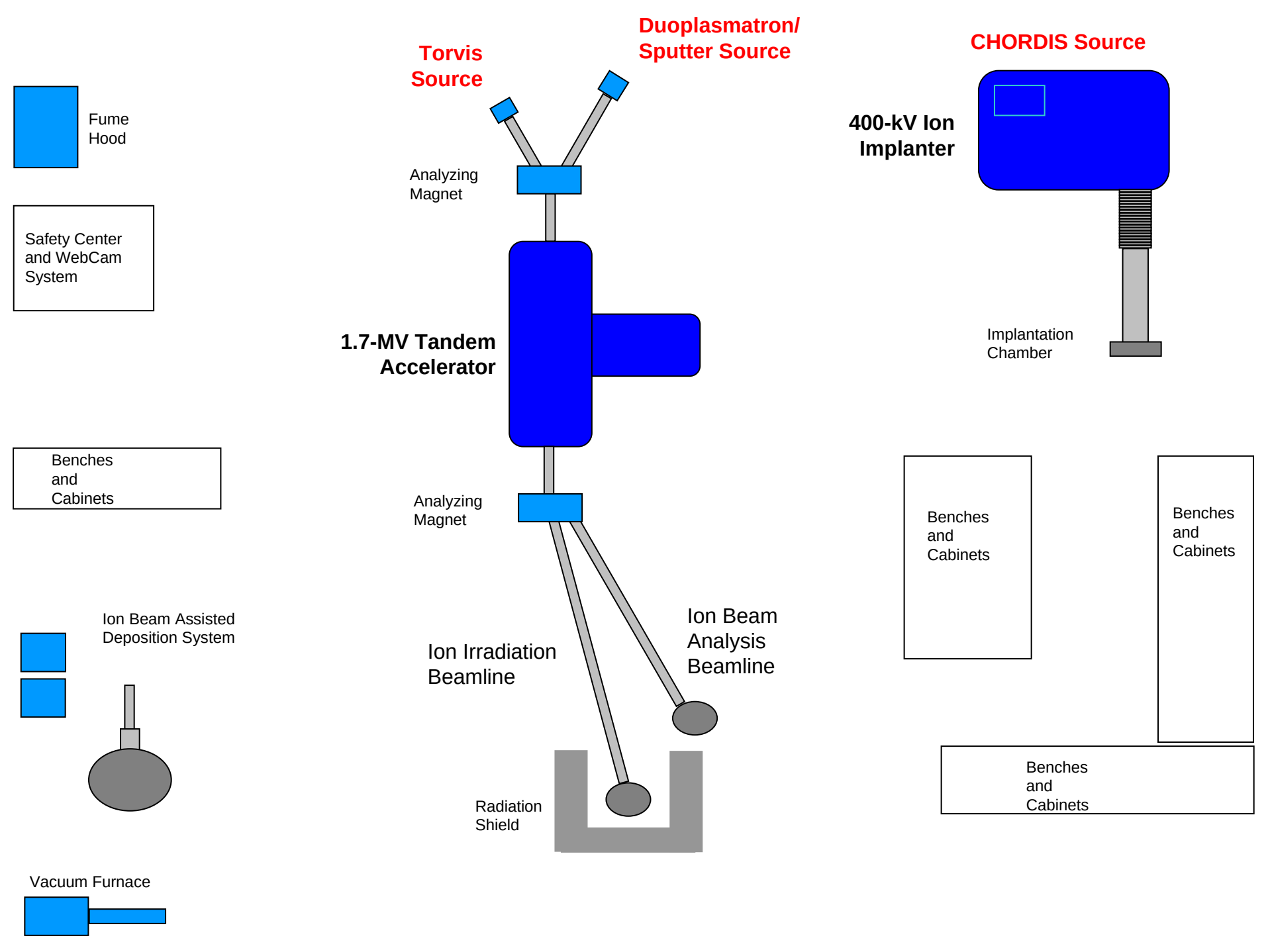
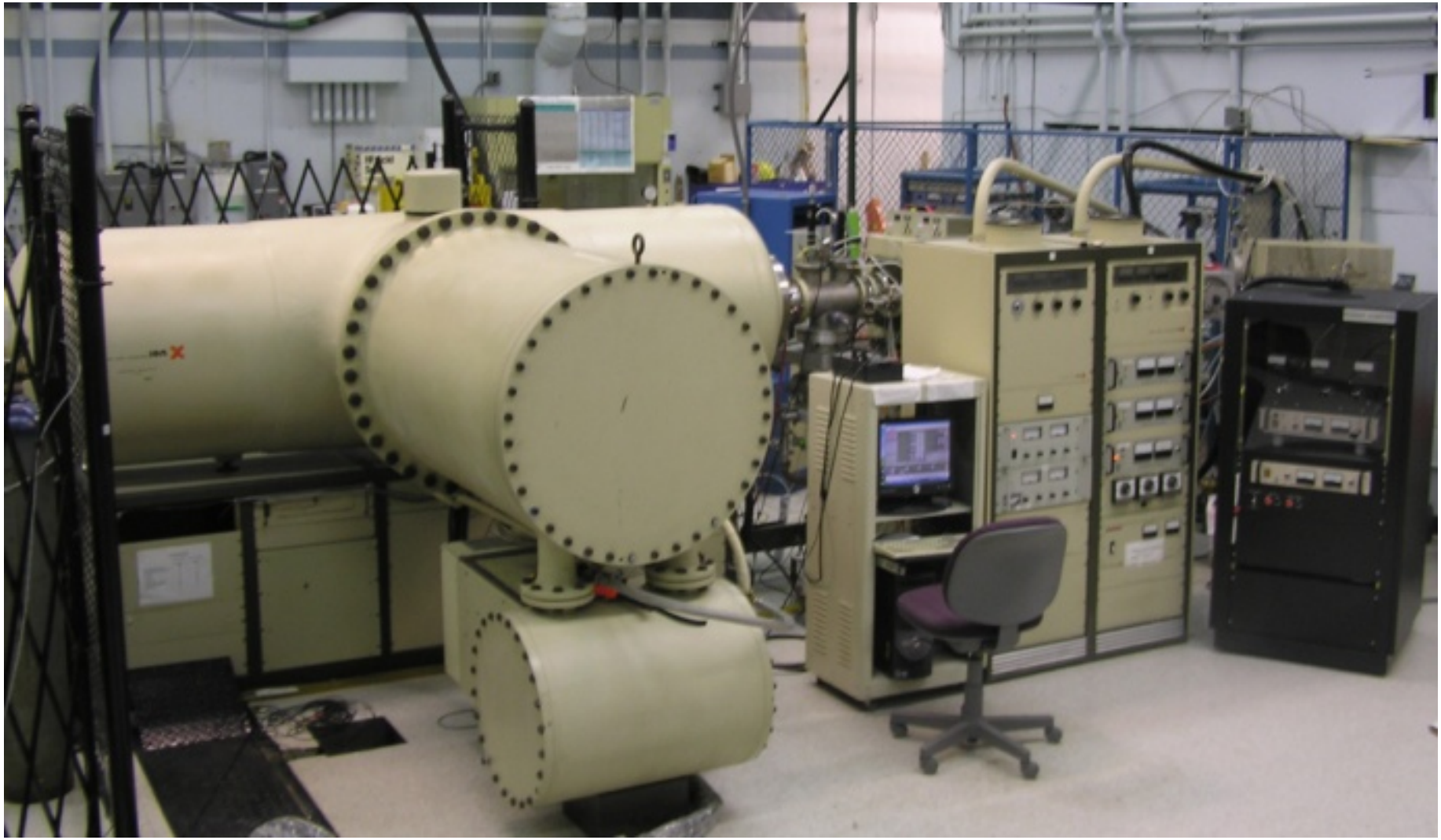
Outline

- Lab layout
- Sources:
  - Duoplamatron
  - Sputter
  - Torvis
  - Chordis

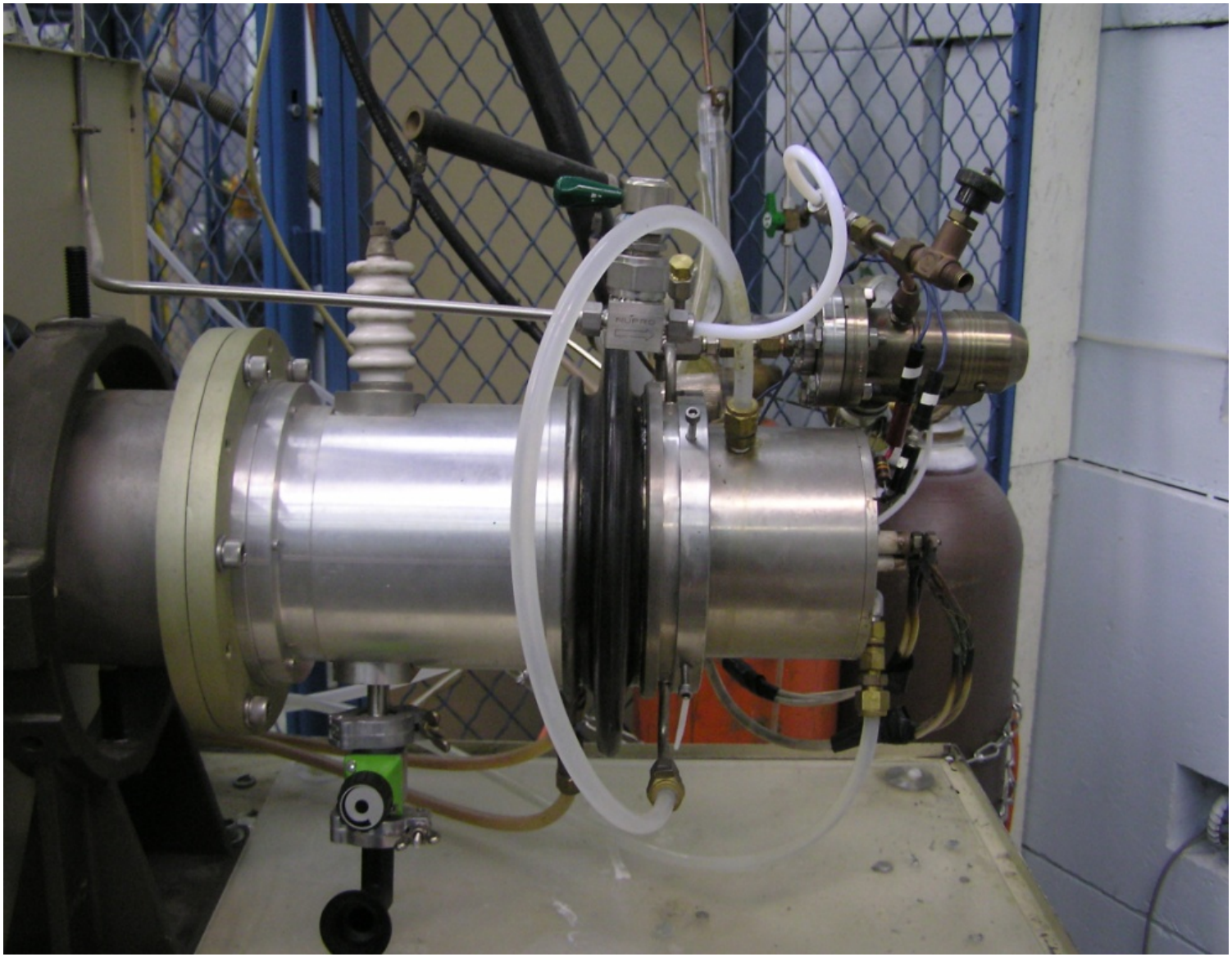
- Principle of operation
- Performance
- Applications


Fume Hood
Safety Center and WebCam System
Benches and Cabinets
Ion Beam Assisted Deposition System
Vacuum Furnace
Torvis Source
Duoplasmatron/ Sputter Source
Analyzing Magnet
1.7-MV Tandem Accelerator
Analyzing Magnet
Ion Irradiation Beamline
Ion Beam Analysis Beamline
Radiation Shield
CHORDIS Source
400-kV Ion Implanter
Implantation Chamber
Benches and Cabinets
Benches and Cabinets
Benches and Cabinets

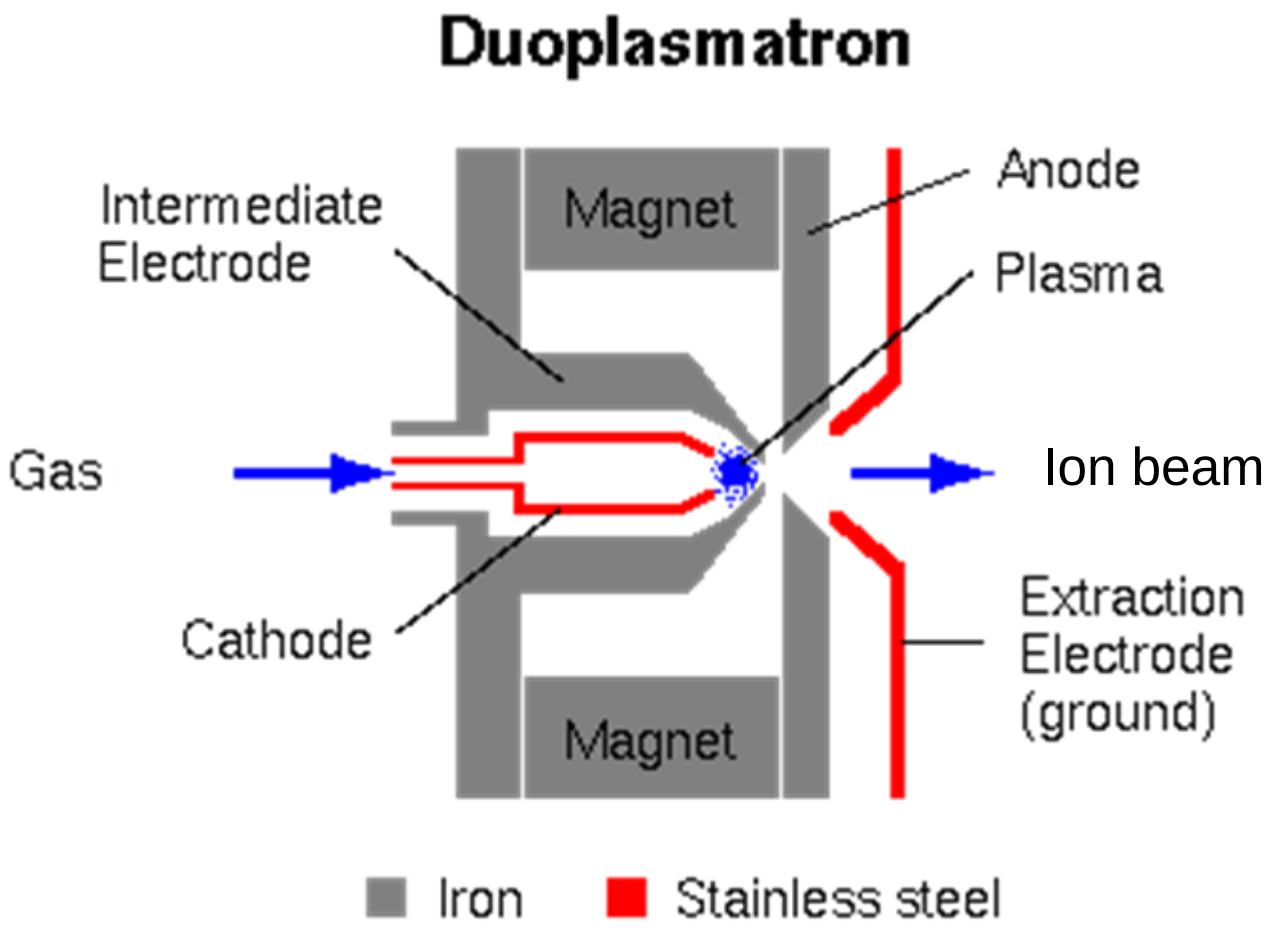
1.7-MV Tandem Accelerator



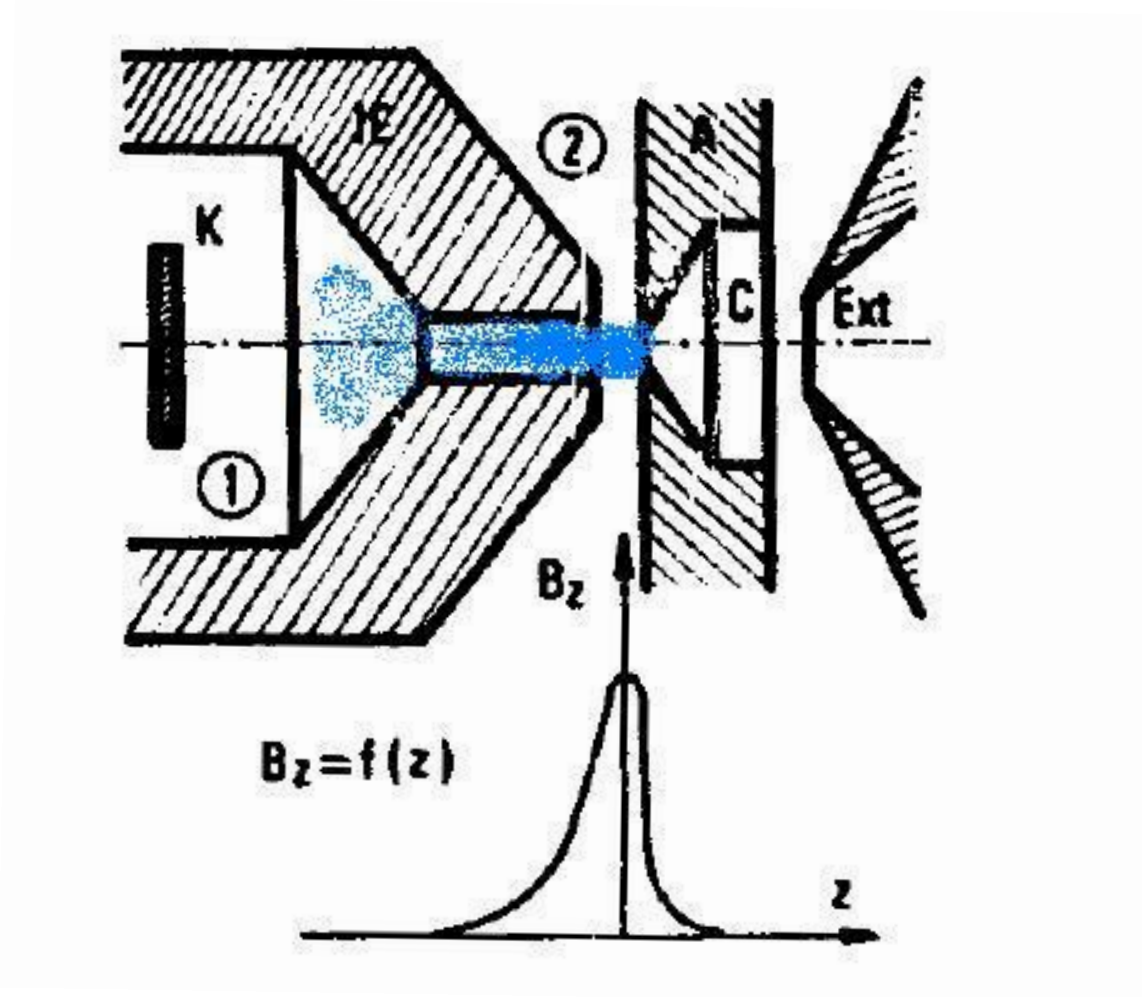
Duoplasmatron Source



Schematic


Duoplasmatron
Intermediate Electrode
Magnet
Anode
Plasma
Gas
Ion beam
Cathode
Extraction Electrode (ground)
Magnet
Iron
Stainless steel

Plasma Intensity



Applications

- Used to produce He ions to do IBA: RBS, ERDA and IC

http://www-ners.engin.umich.edu/research/Mibl/Research.html
Search for: MIBL & research

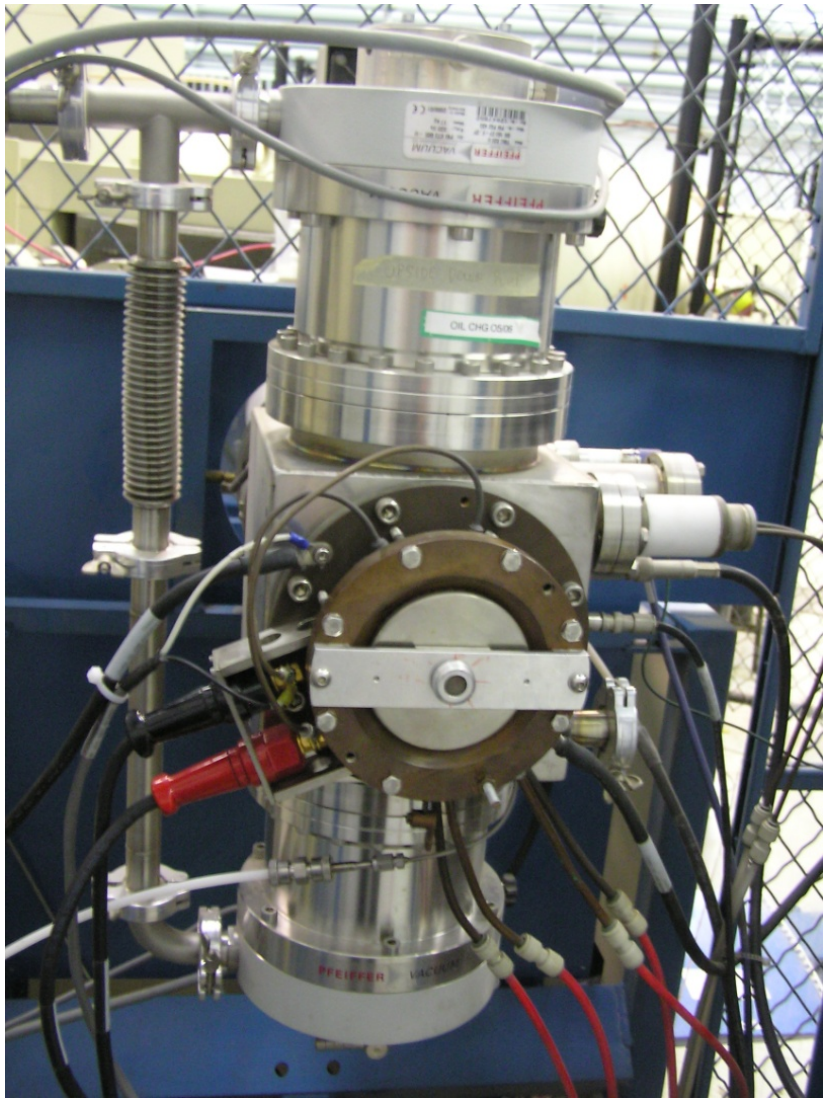
Performance

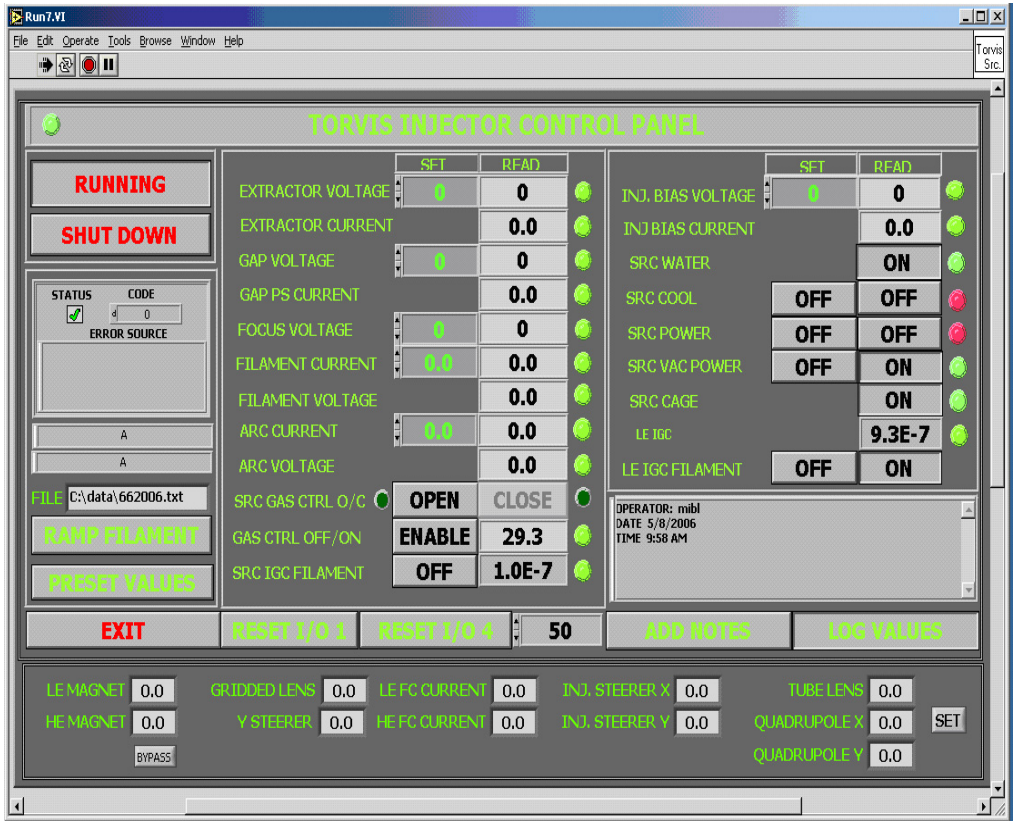
- Injected He^- current in accelerator ~300 nA
- Main maintenance: filament coating and loading sodium oven

Platinum (rhodium 10%) mesh: gauge 52, 0.1-mm diameter wire
High calcium triple carbonate spray coating (Ba-Sr-Ca CO_3)

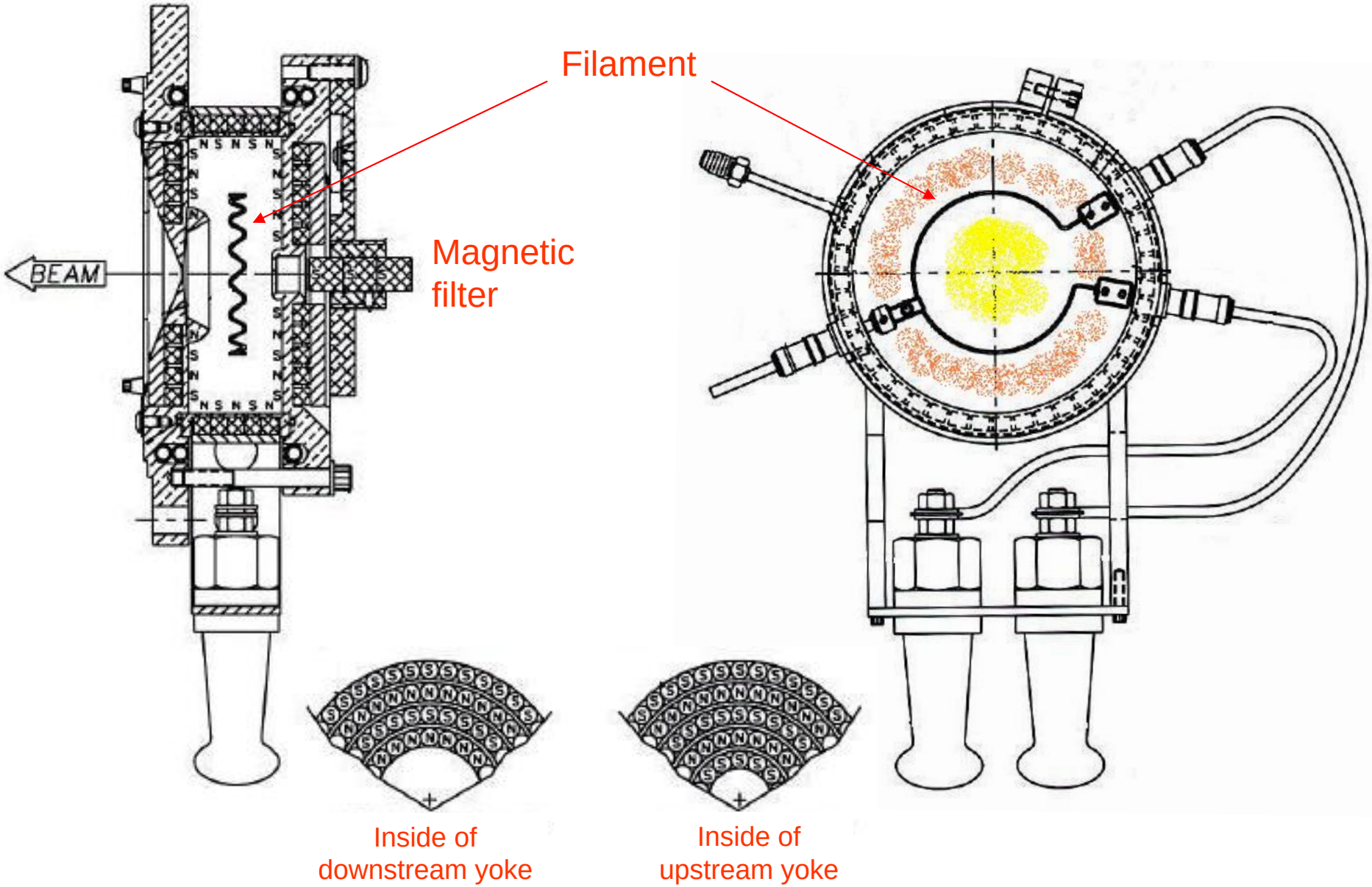
Torvis Source

(TORoidal Volume Ion Source)

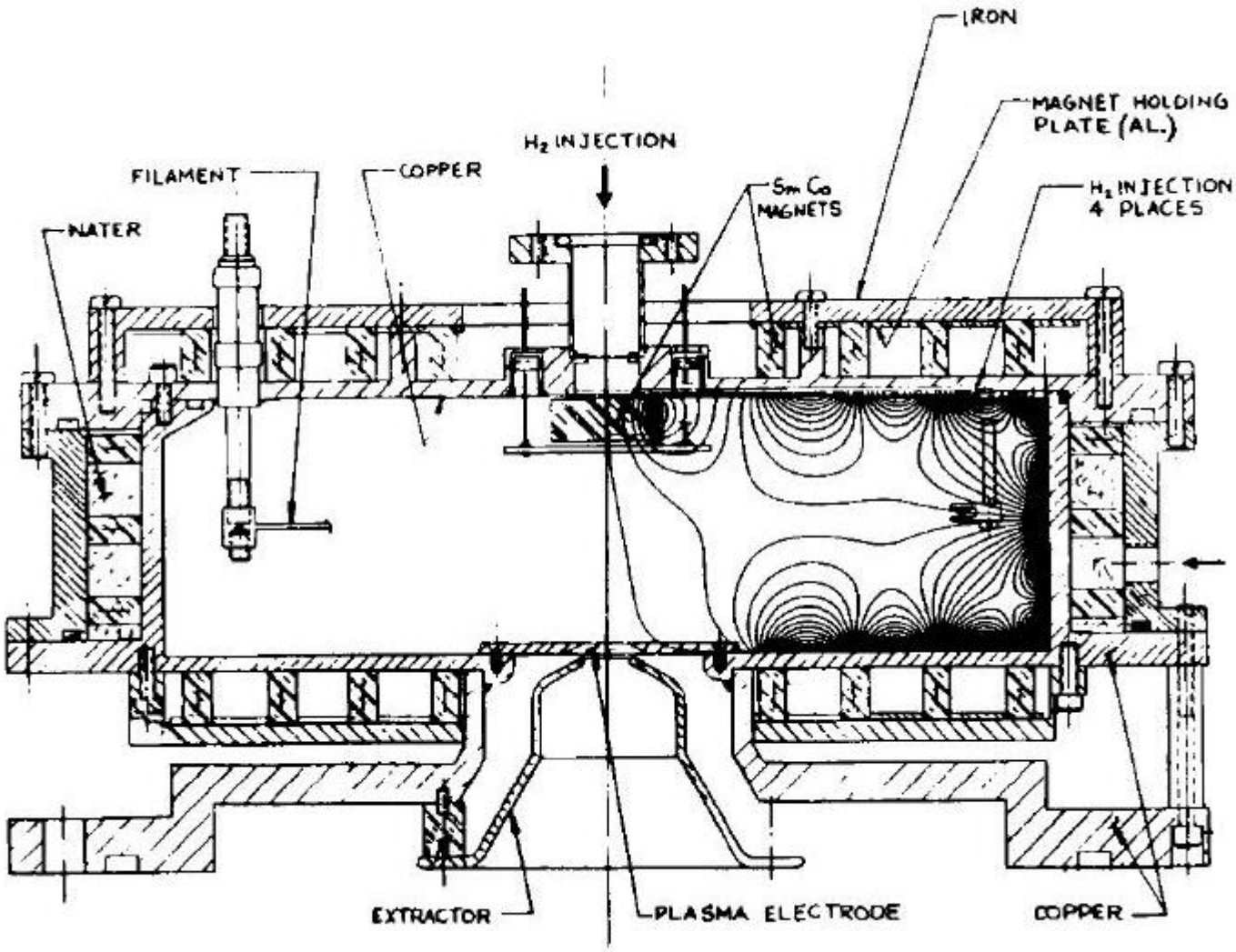




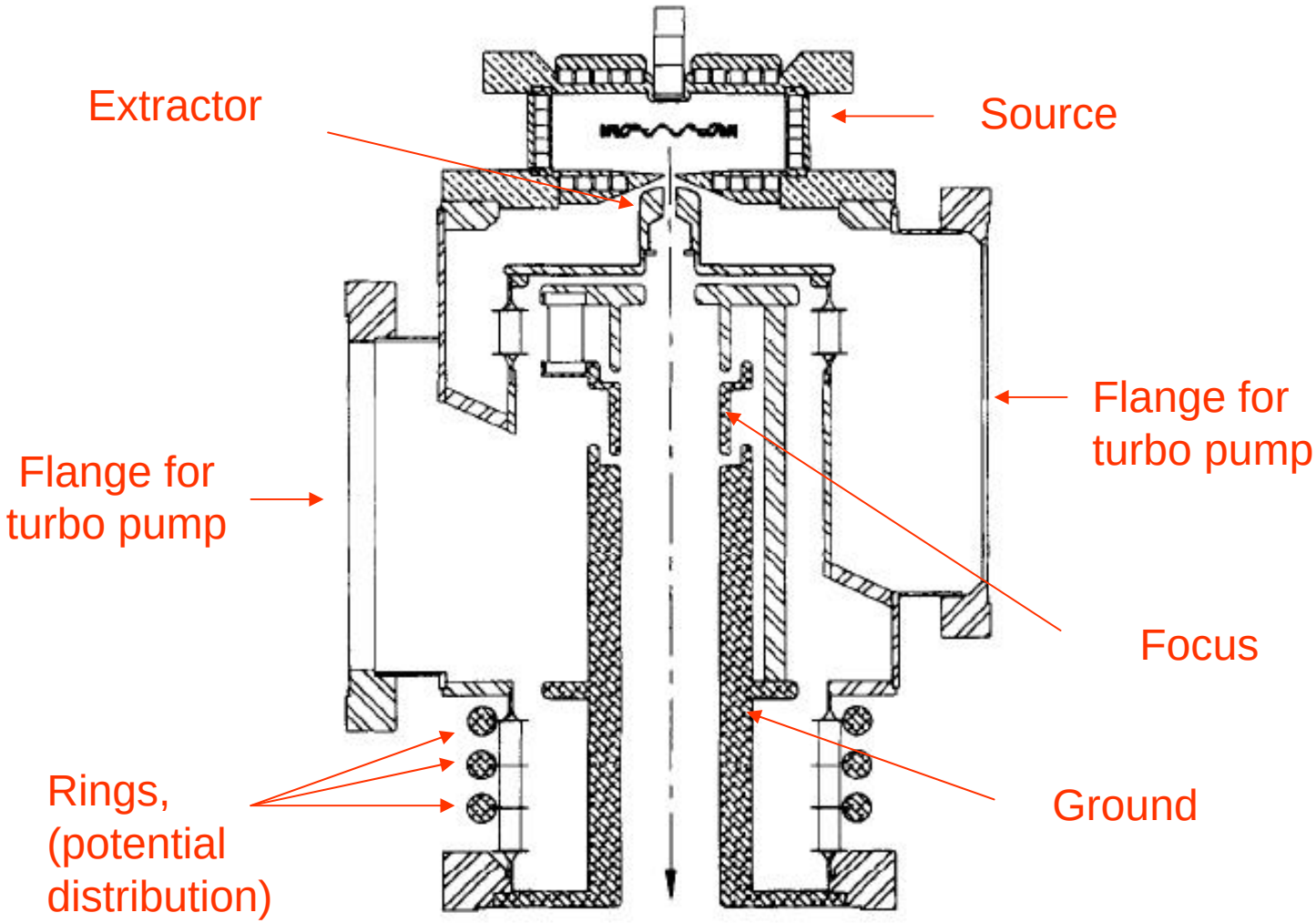
Torvis Schematics



Magnetic Fields



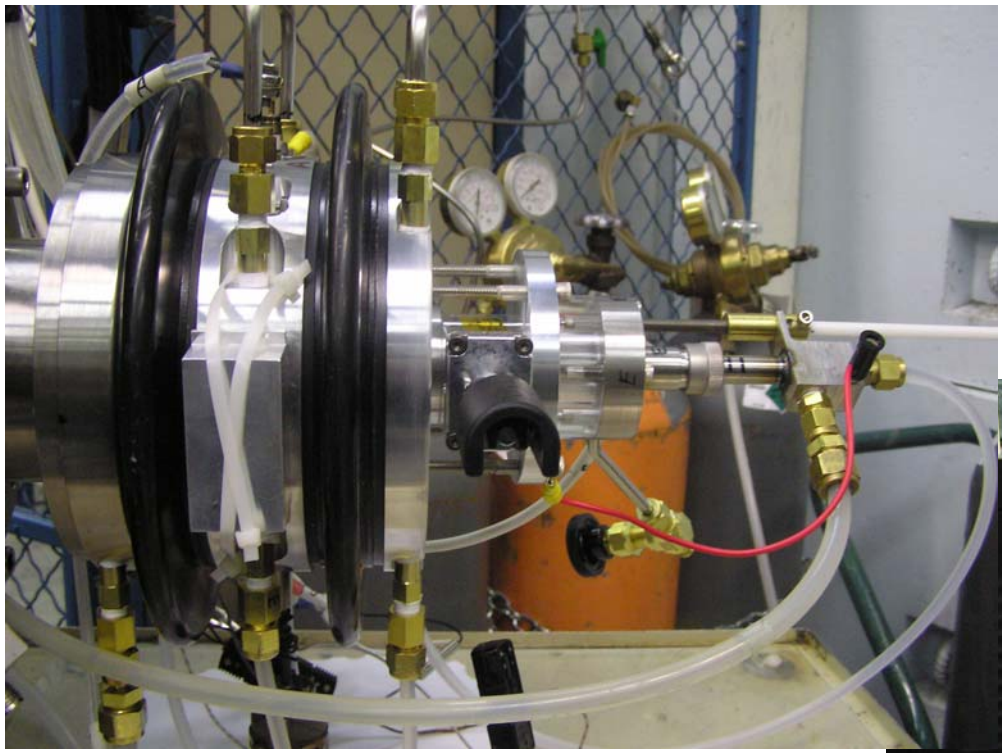
Extractor and lens assembly

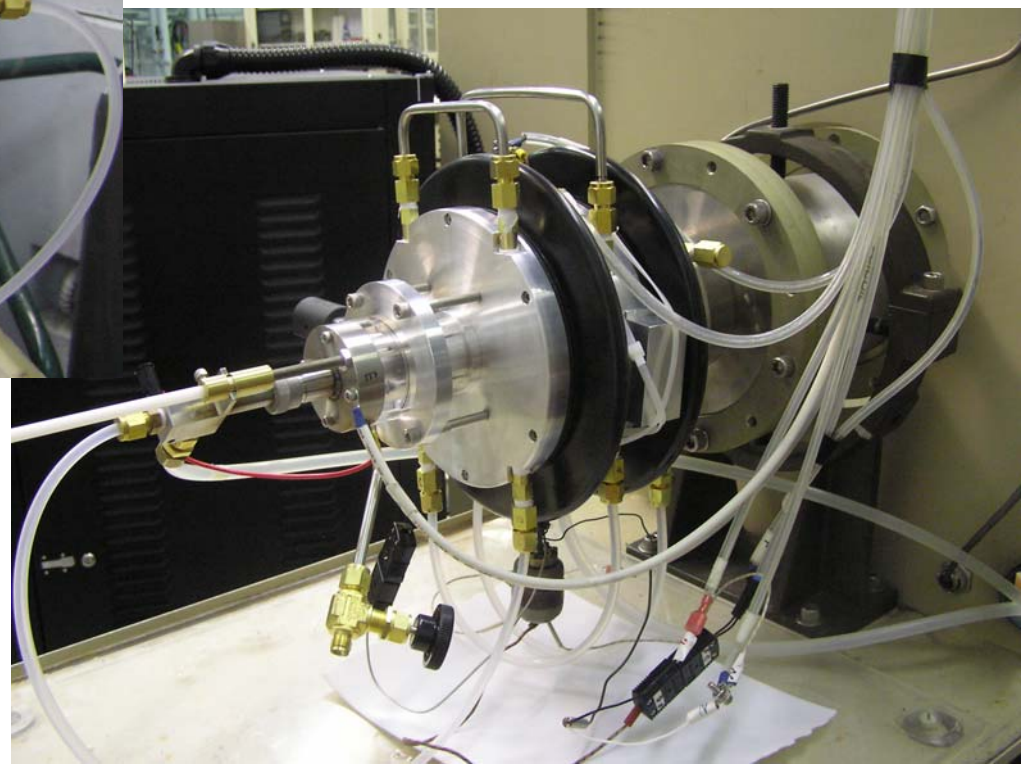


Applications and Performance

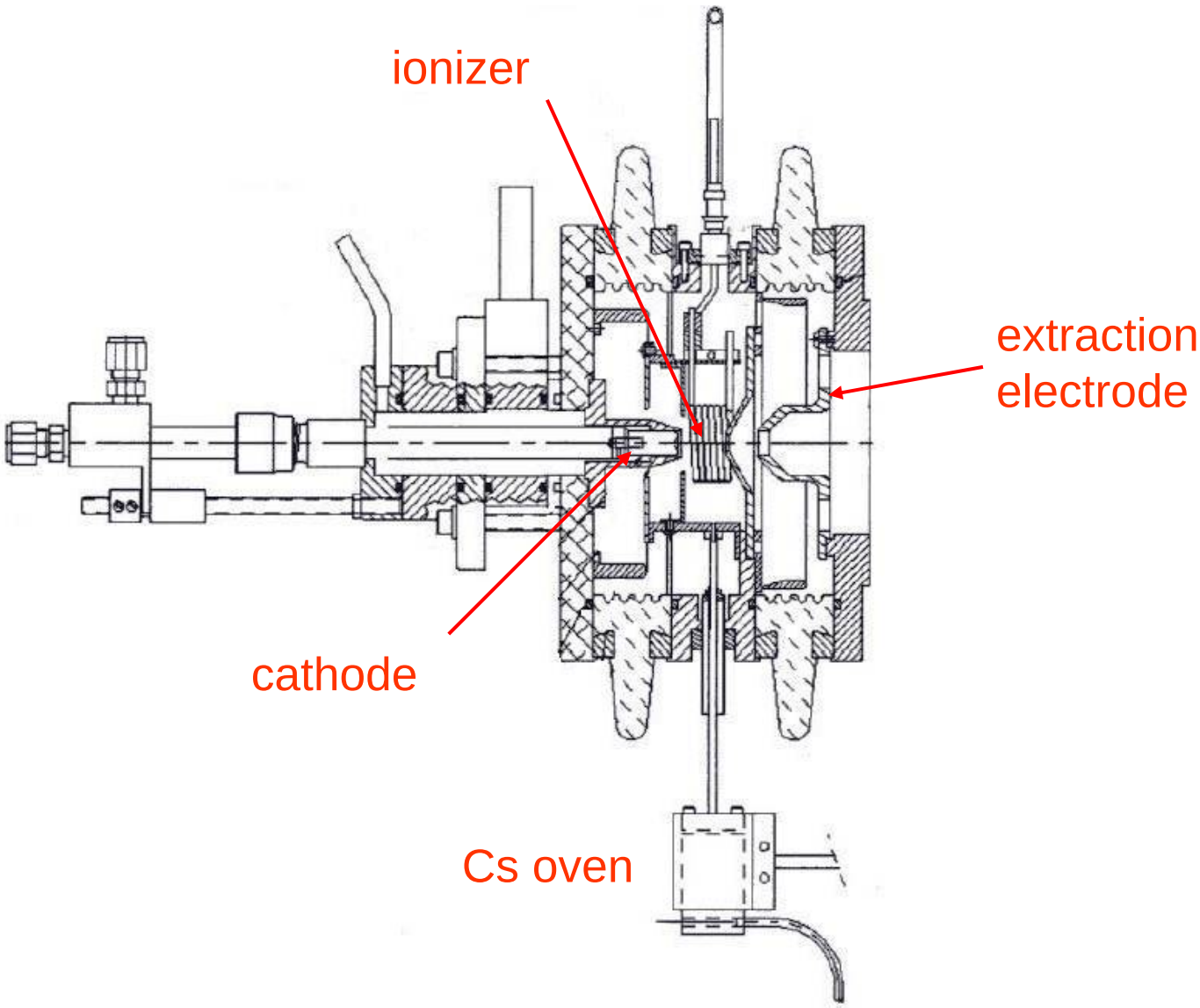
- Proton beams to induce damage in materials used in nuclear reactors: ~1 DPA per day (~60 μA)
- Used to produce D^- ions to do Nuclear Reaction Analysis (~100 nA)
- Main maintenance: change filament every ~1000 hours

Sputter Ion Source





Schematic



Applications

- Study radiation damage by heavy ions (Fe, etc.)

Fe^{++} at 5 MeV allows reaching ~100 DPA in 1 day

Performance

Maximum current injected in accelerator for Fe^- is ~20 μA and on target ~1.5 μA of Fe^{++} at 5 MeV

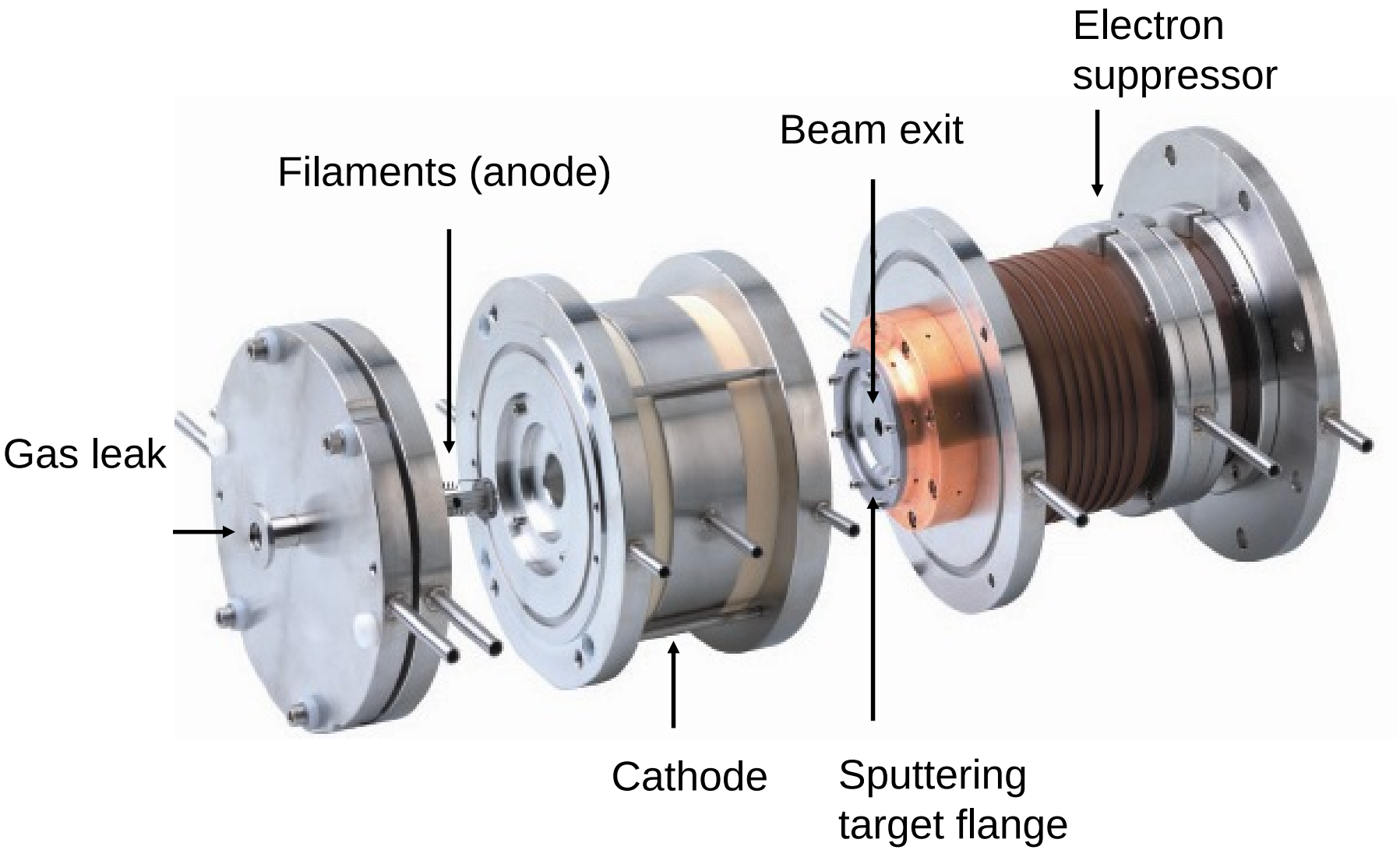
Maintenance

- Load cesium oven
- Replace cathode

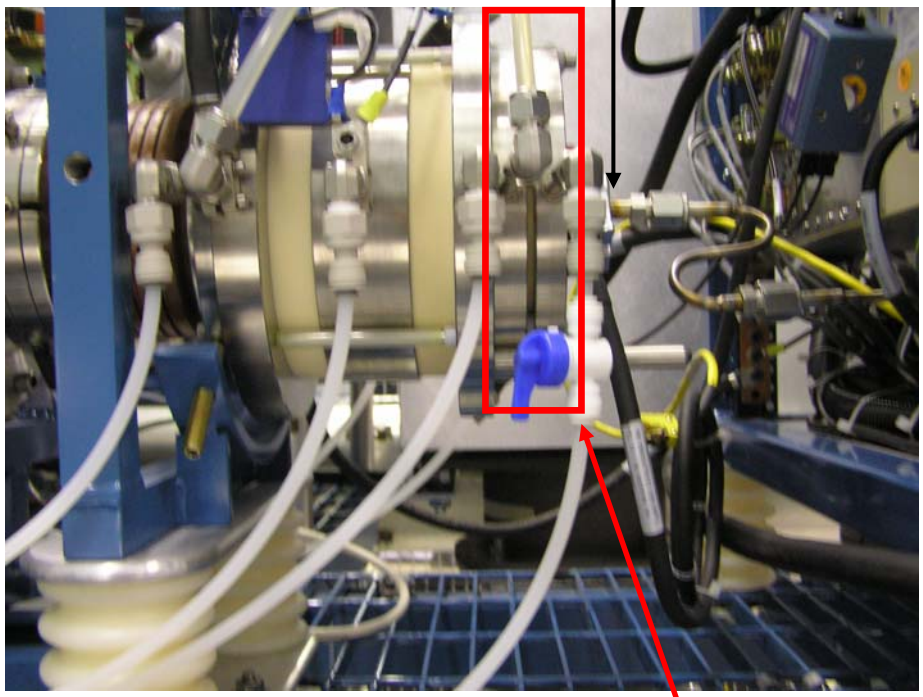
400-kV Ion Implanter

CHORDIS Source

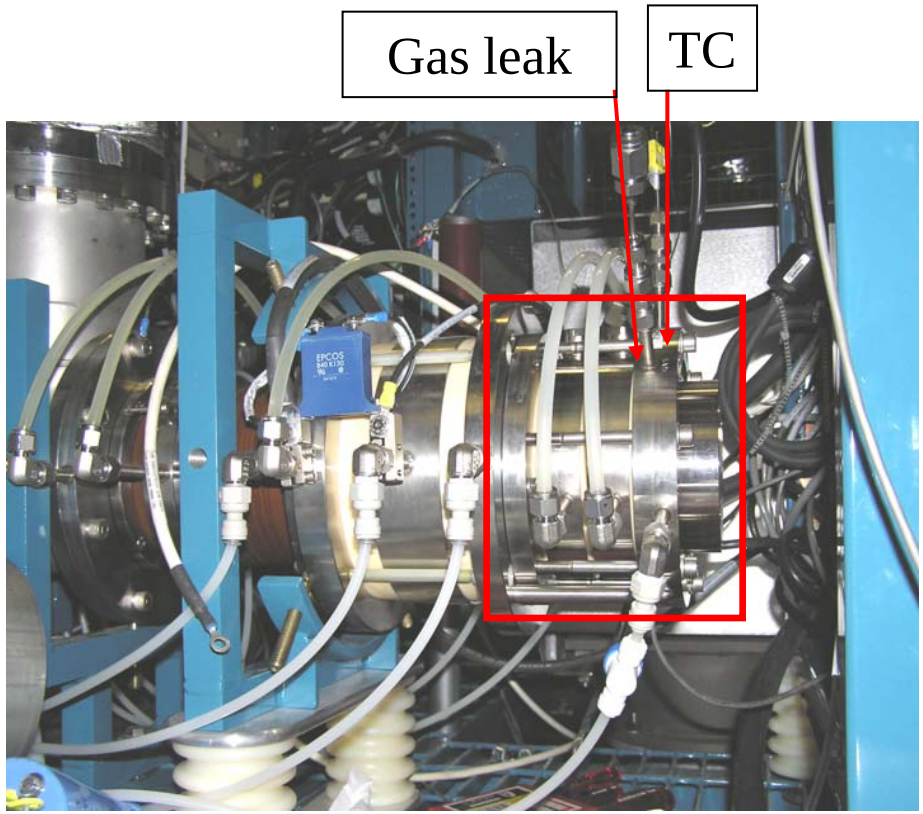
(Cold and HOt Reflex Discharge Ion Source)



Two different versions

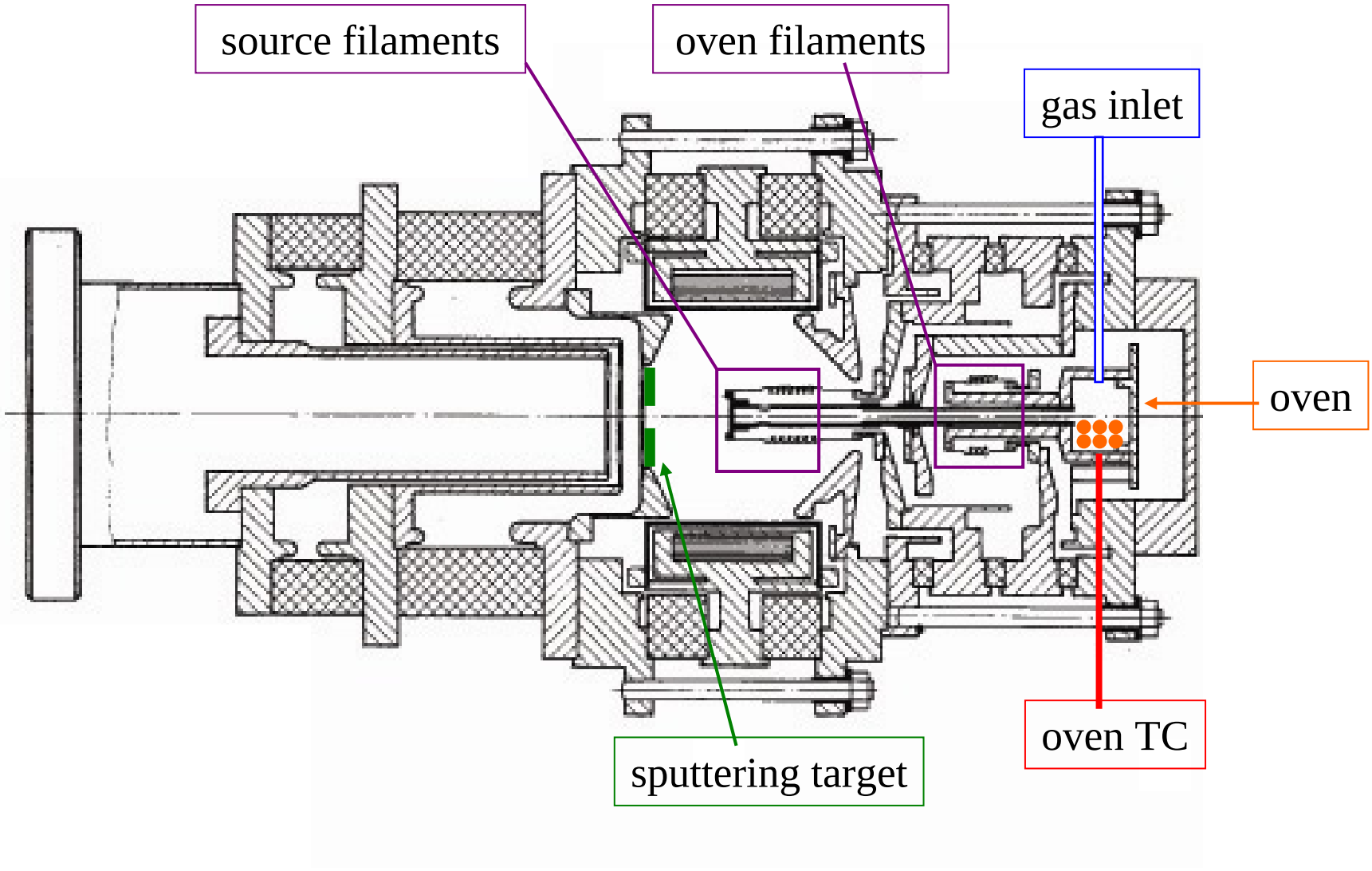


Gas/Sputter

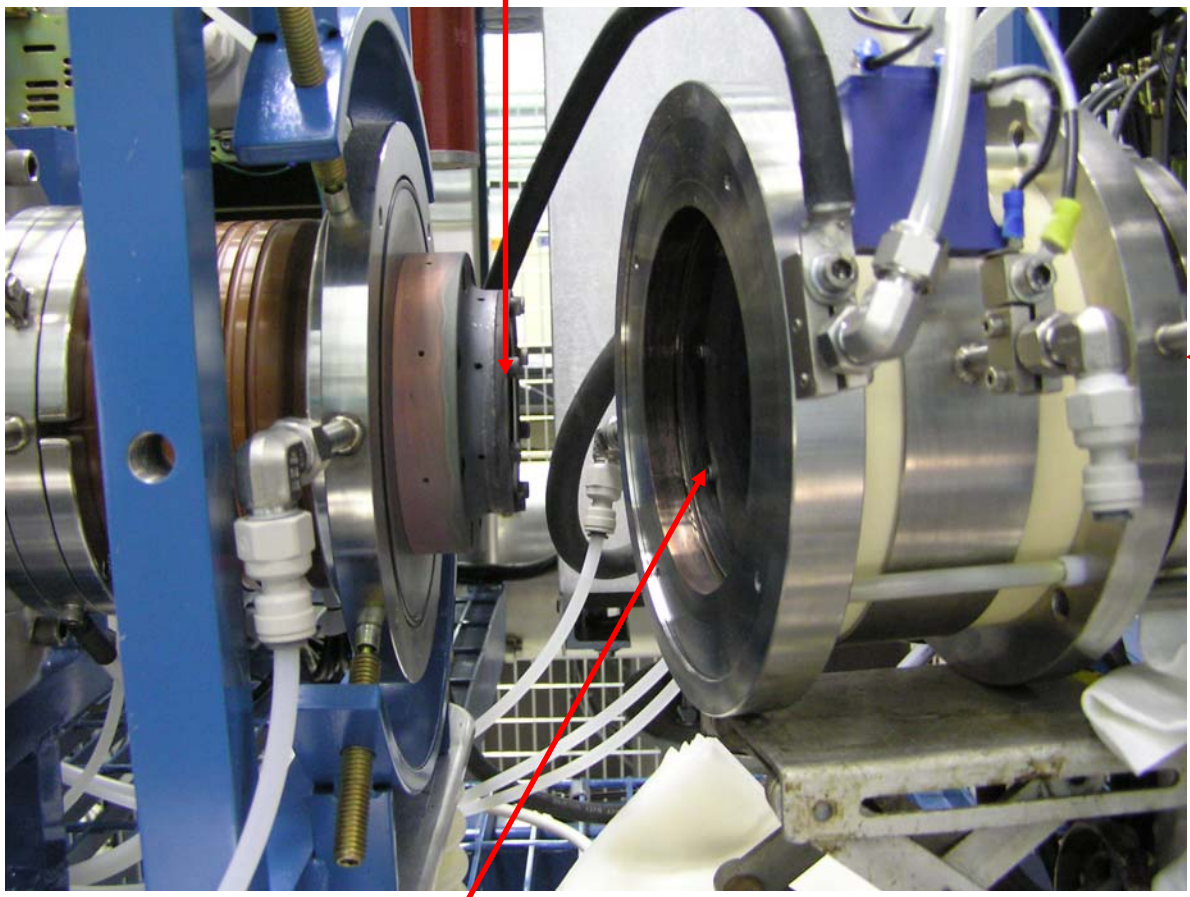


Gas/Sputter/Oven

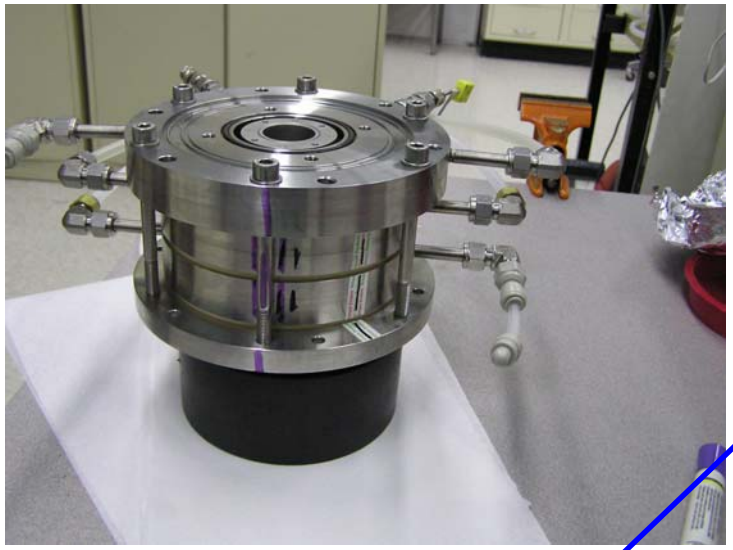
Schematic

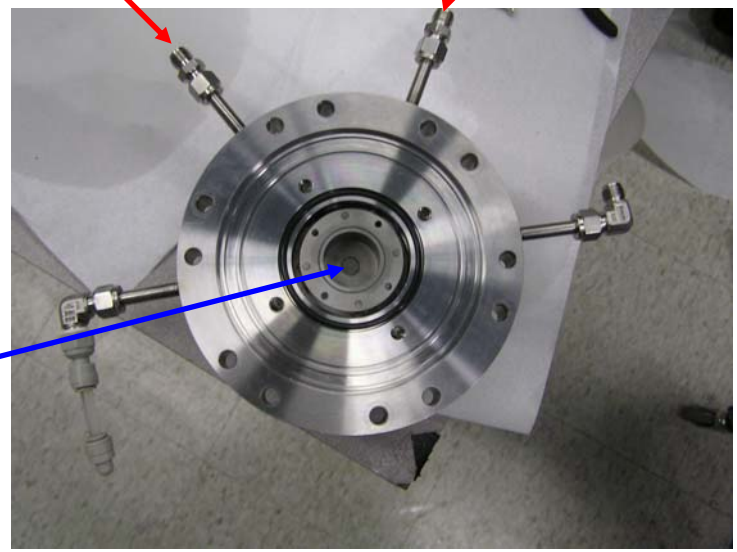

source filaments
oven filaments
gas inlet
oven
oven TC
sputtering target

Gas / Sputtering version

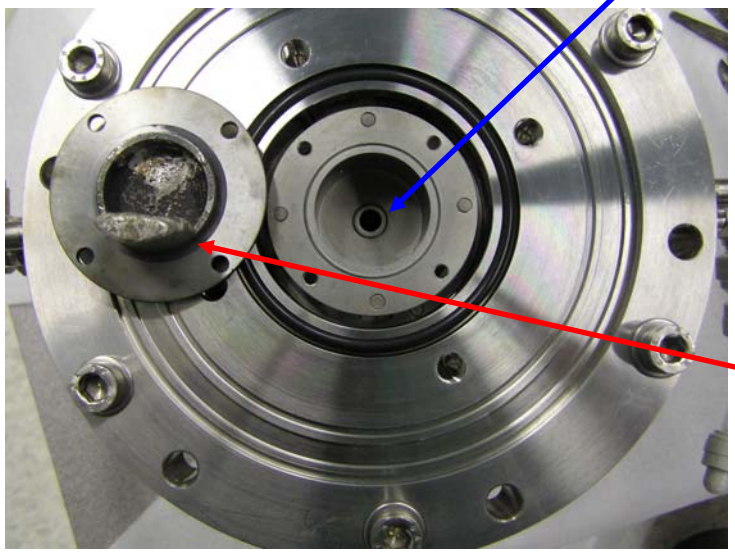


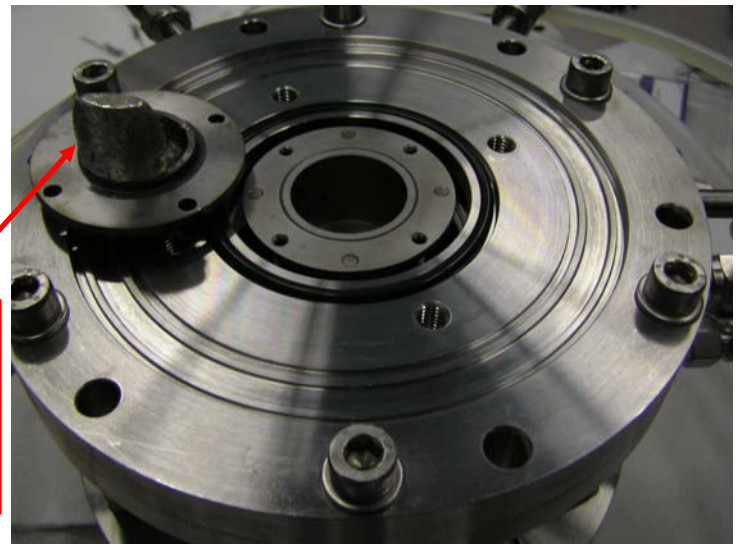
Source oven





vapor/gas inlet





melted bismuth
$T_{melting}$ = 271 °C
T_{oven} = 550 °C

Elements Implanted

Gas mode: H, He, and N.

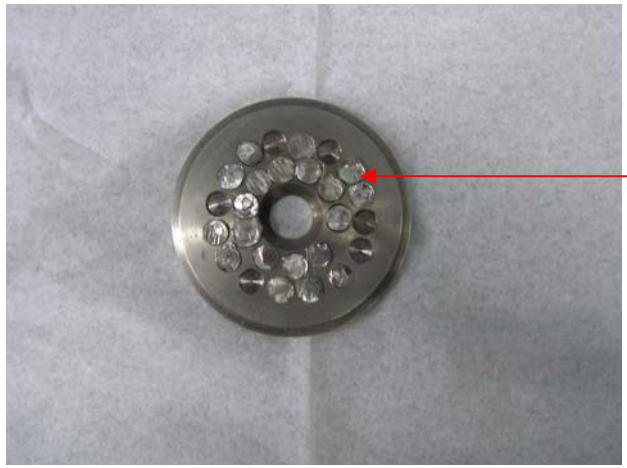
Sputter mode: B (BN, 5 μA), Si (30 μA), Cr (35 μA), Fe (30 μA), Co (20 μA), Cu (40 μA), Pd, Ag (5 μA), In (ITO, 50 μA), Ce (CeO, 5 μA), Er (5 μA), Yb (Yb_2O_3, 5 μA), Ta (5 μA), and Au (25 μA).

Oven mode: Sn (232 °C, @800 °C, 5 μA), Te (450 °C, gone at 435 °C), and Bi (271 °C, @550 °C, 5 μA).

19 elements implanted
Target temperature: LN to 600 °C
Fluences 10^{11} to 10^{19} At/cm^2
Energies from 20 to 400 keV

http://www-ners.engin.umich.edu/research/Mibl/Research.html
Search for: MIBL & research

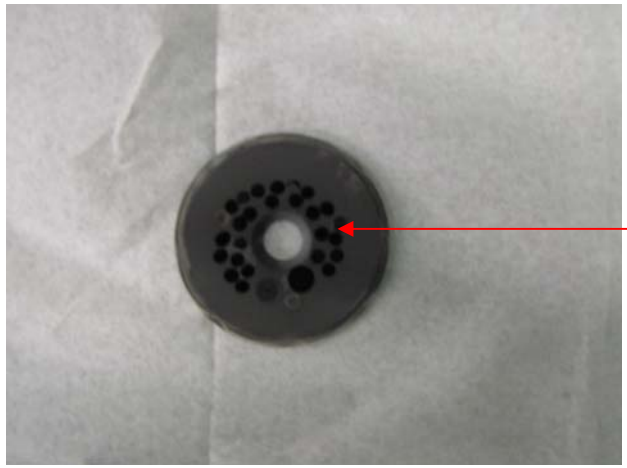
Sputtering targets (I)



Pd pellets

Cu

Sputtering targets (II)



Yb_2O_3 powder

For ceramics

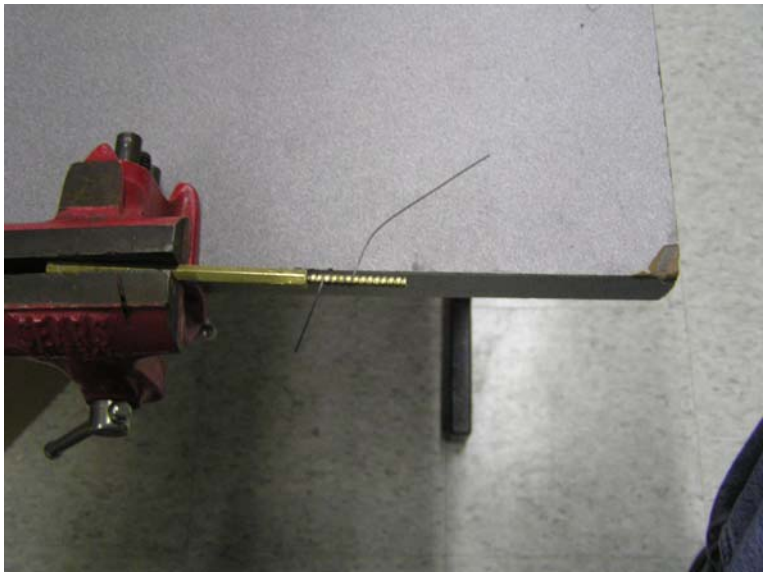
http://www-ners.engin.umich.edu/research/Mibl/Research.html

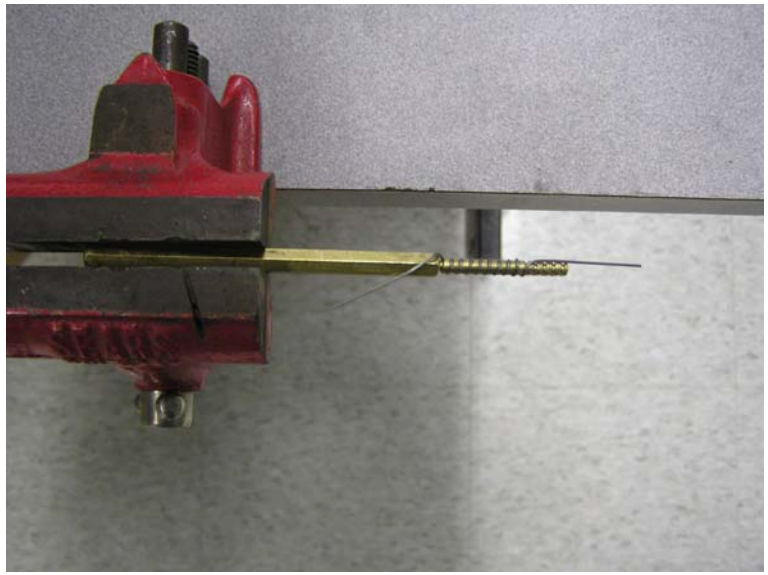
Search for: MIBL & research

THE END

Procedure to do the filaments

Doing the filaments





New and old filaments