Cryocatcher Prototype at GSI

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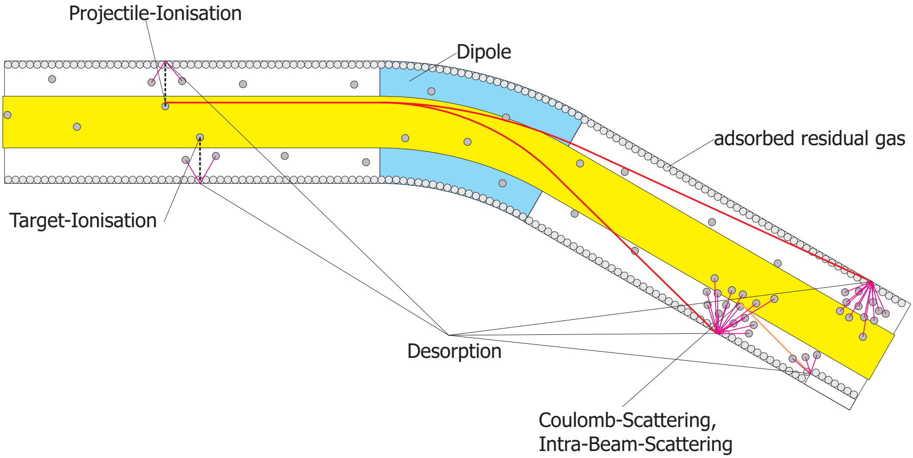
GSI Helmholtzzentrum für Schwerionenforschung

Meeting on Interface 11 T – Cold Collimation
CERN, 5th October 2011

Charge Exchange Beam Loss



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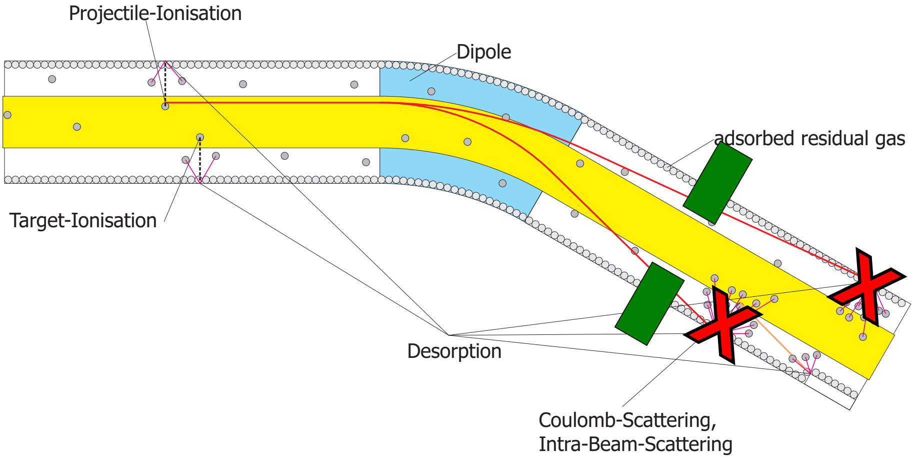

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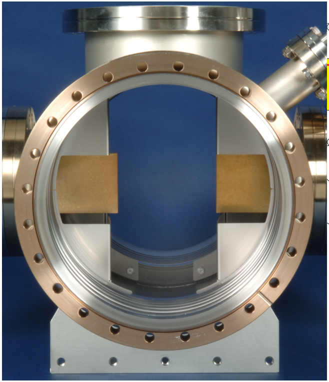

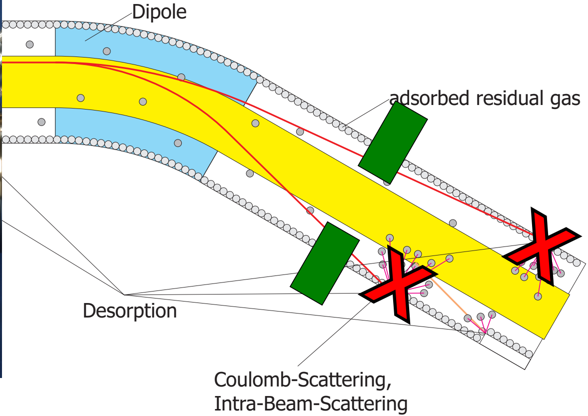

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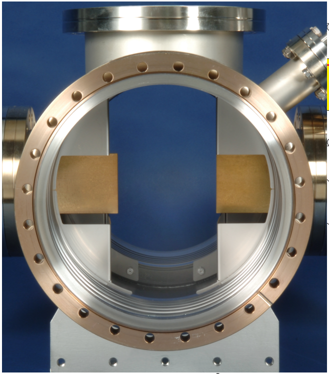
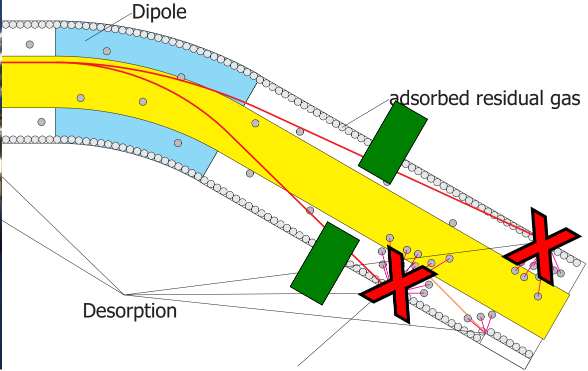
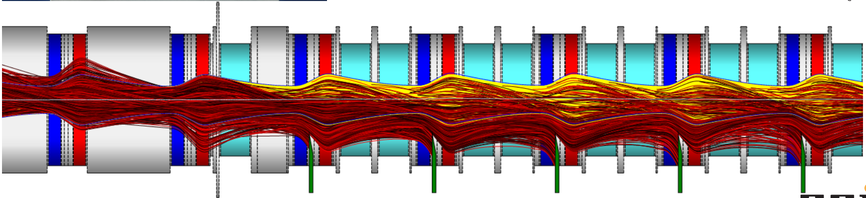


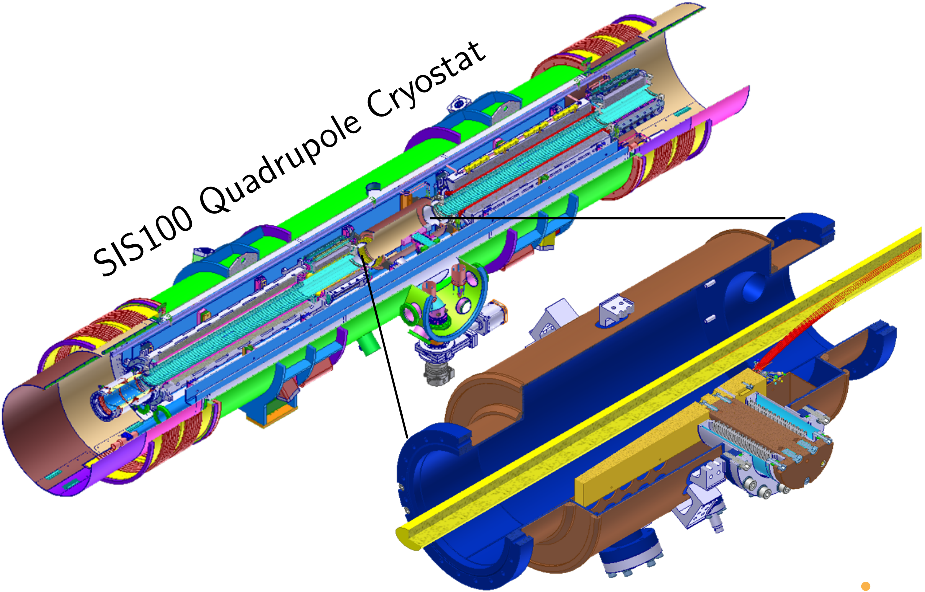


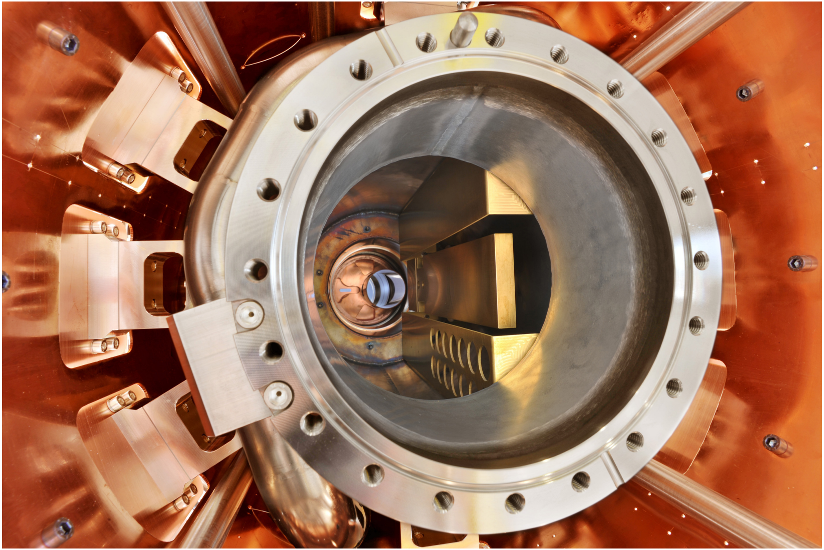


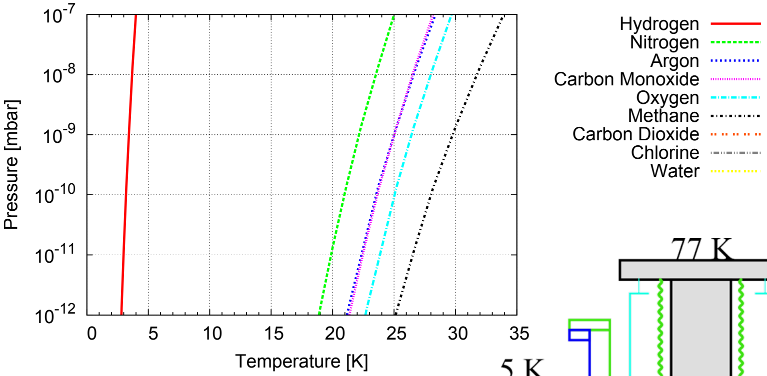
Cryocatcher Requirements

- Controlled catching of charge exchanged ions on low desorption surfaces
- Surrounding cold chamber acts as a cryopump
  - Low static pressure
  - High pumping speed
- Thermal load onto LHe-cooling has to be kept low
- Cryocatcher has to be kept at a higher temperature to prevent gases from freezing out on the surface of the catcher
- Measurement of lost ions desirable

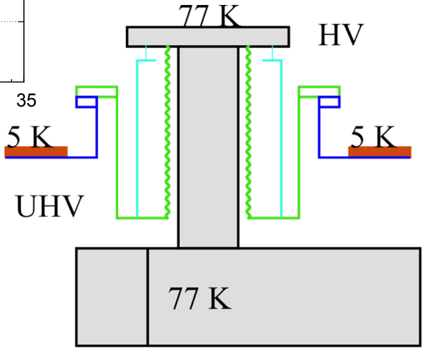
Position of the Cryocatcher



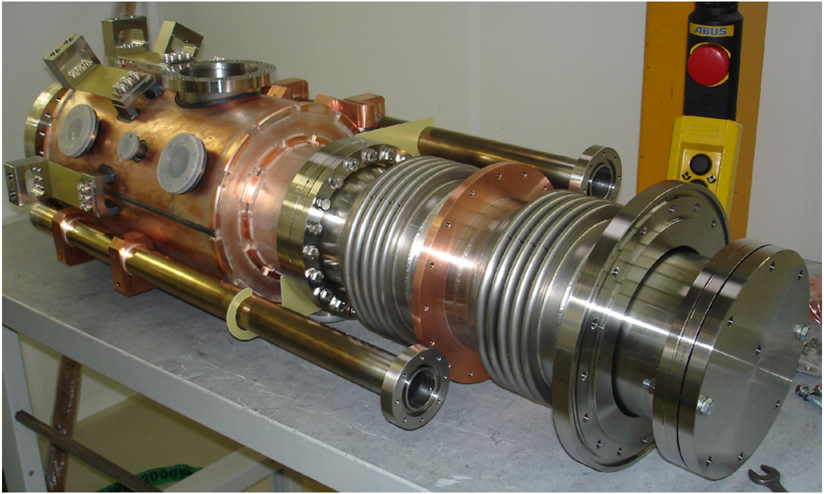


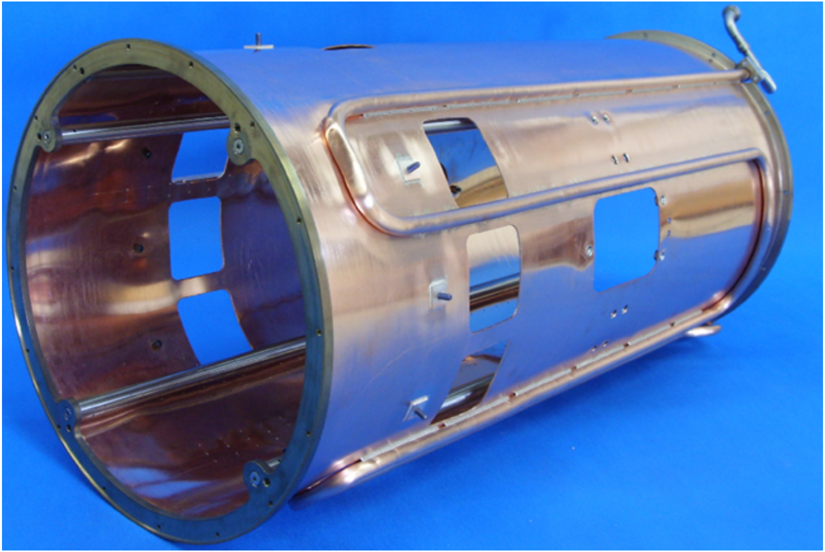


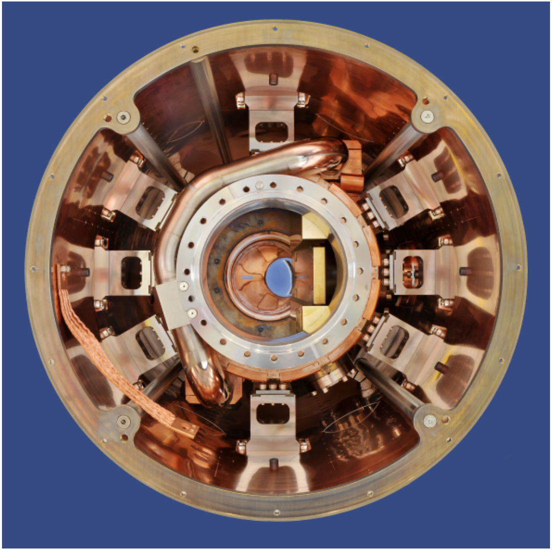
Pressure [mbar]
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{-12}
0
5
10
15
20
25
30
35
Temperature [K]
Hydrogen
Nitrogen
Argon
Carbon Monoxide
Oxygen
Methane
Carbon Dioxide
Chlorine
Water



77 K
HV
5 K
5 K
UHV
77 K

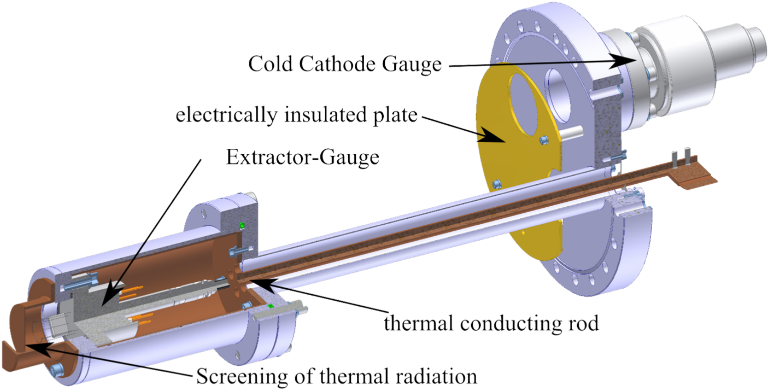

ABUS



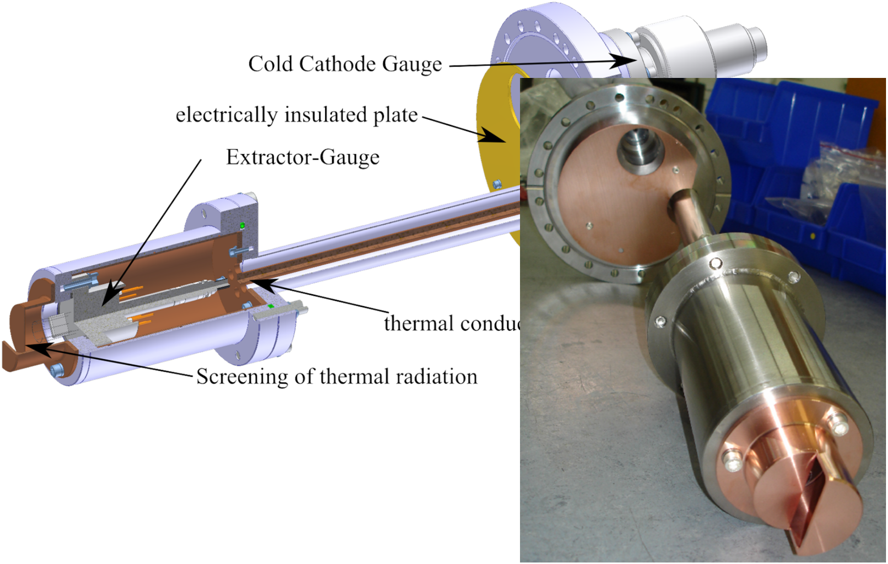


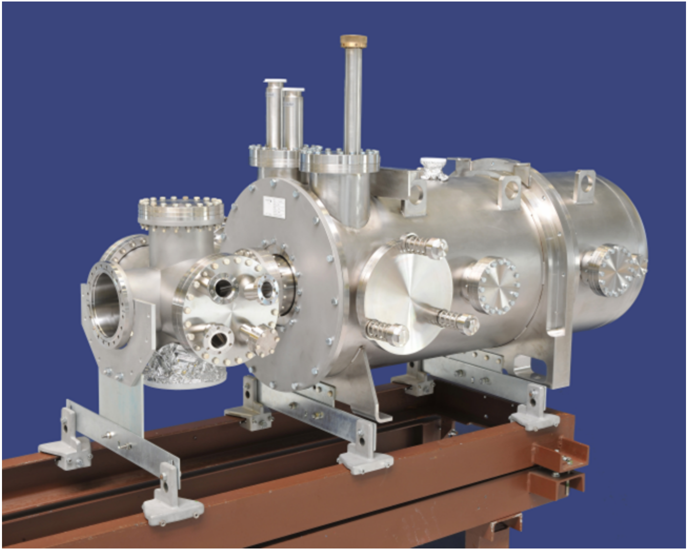
Cryocatcher Prototype

Measurement of desorbed Gases

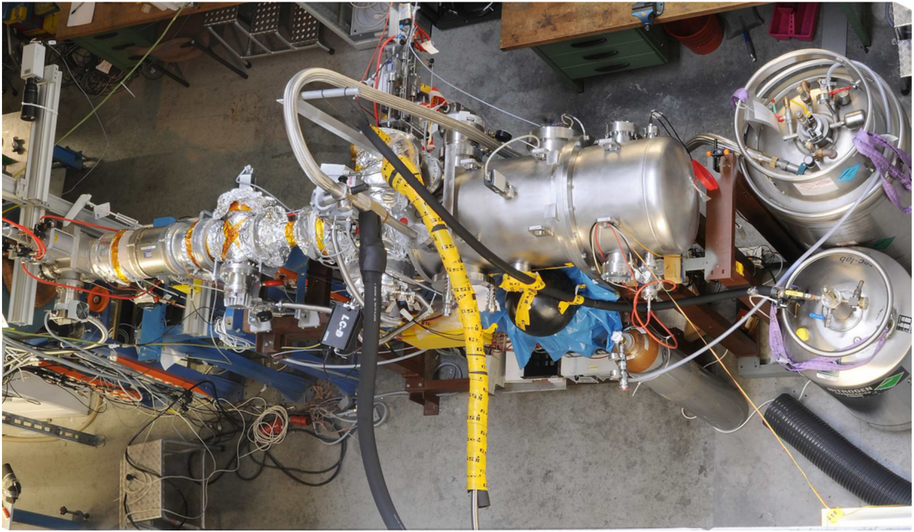


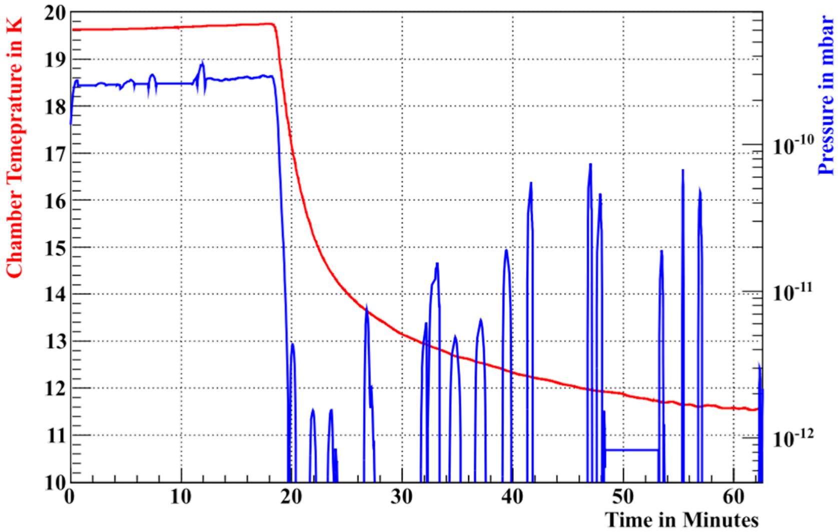
Cryocatcher Prototype
Measurement of desorbed Gases



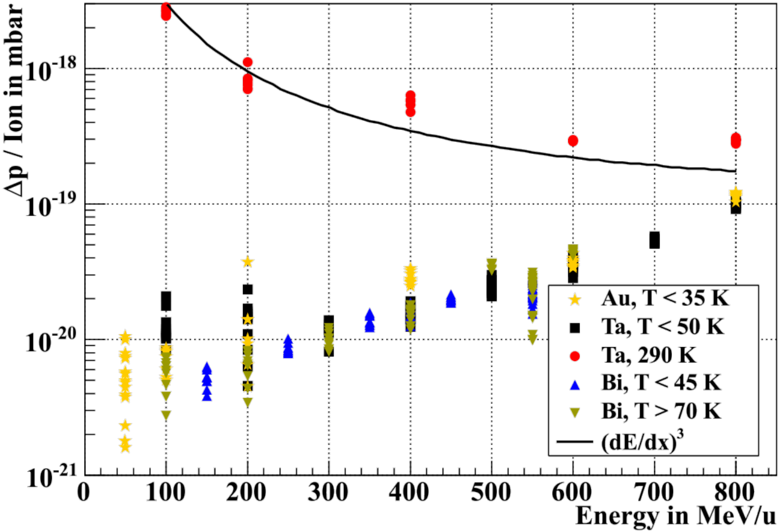


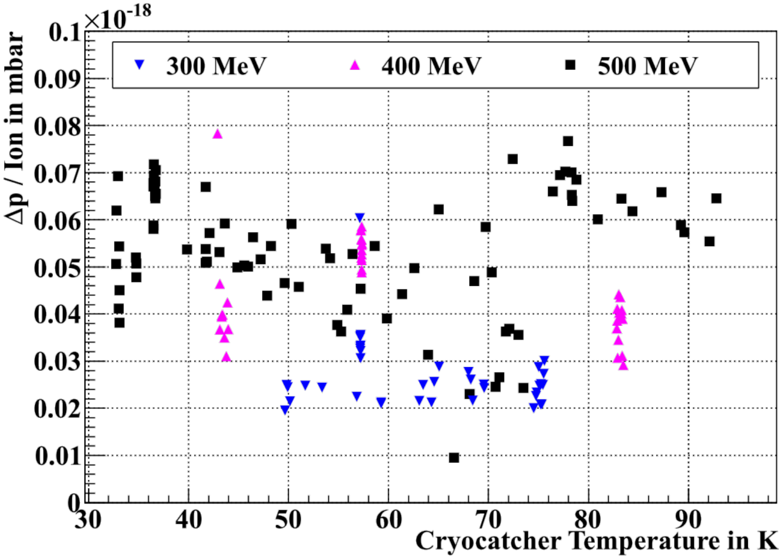
Cryocatcher Prototype
The Experiment




Chamber Temeprature in K
Pressure in mbar
20
19
18
17
16
15
14
13
12
11
10
10^{-10}
10^{-11}
10^{-12}
0
10
20
30
40
50
60
Time in Minutes

Measured Pressure Rise



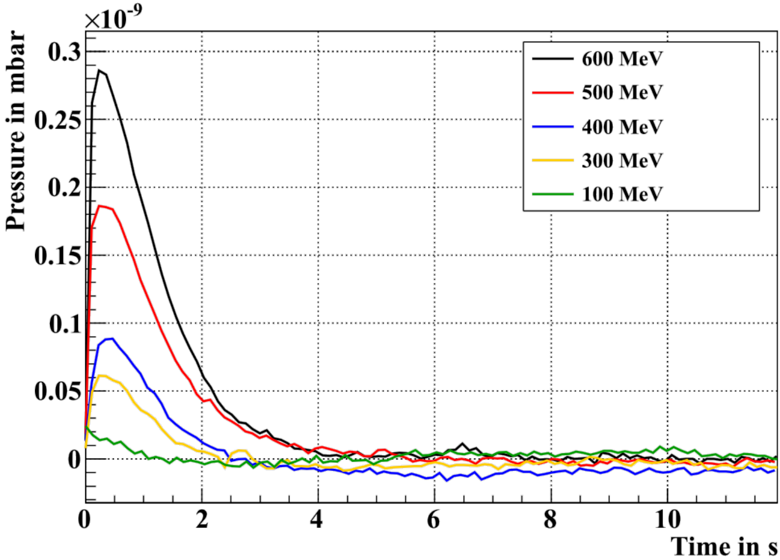


×10^-18
Δp / Ion in mbar
300 MeV
400 MeV
500 MeV
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
30
40
50
60
70
80
90
Cryocatcher Temperature in K

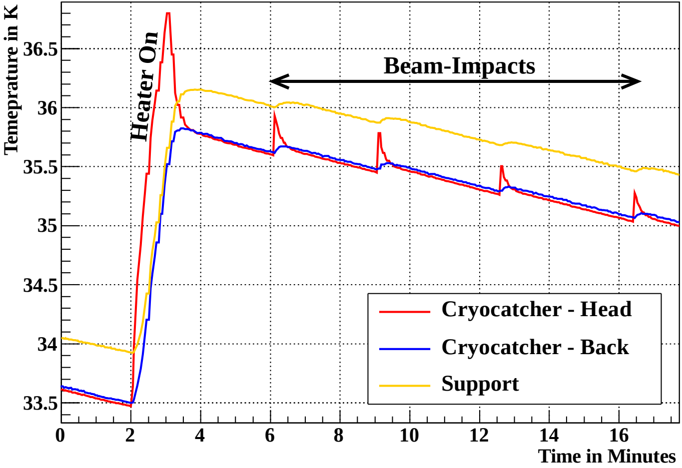
Summary

- The Cryocatcher has been tested at GSI using Au-, Ta-, and Bi-beams from SIS18 with energies ranging from 50 to 800 MeV/u.
- The cooling-concept showed the desired results in temperature and pressure.
- The measured pressure rise (i.e. desorption yields) showed an unexpected scaling with the ion energy.
- A dependence of the pressure rise (i.e. desorption yields) on the catcher temperature could not be observed ($32\,\mathrm{K} \lesssim T \lesssim 94\,\mathrm{K}$).
- The work on the specification for the final SIS100 cryocatcher is in progress.

Measured Pressure Rise for Bi

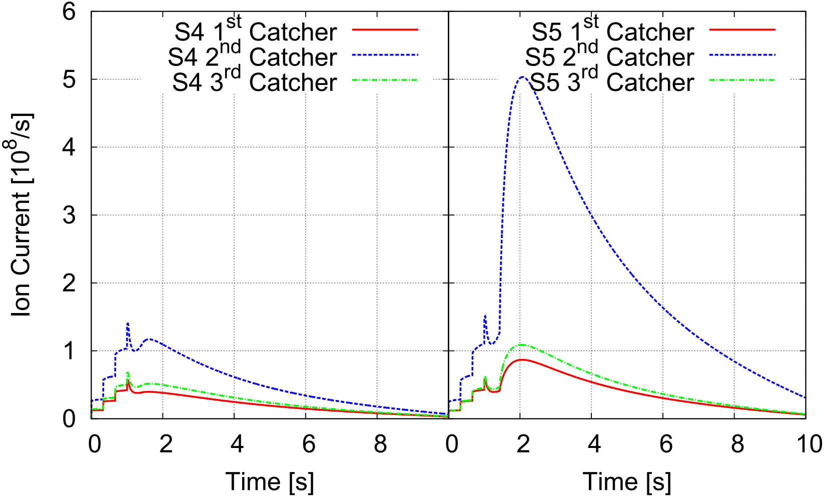


Temperature Rise during Ion Bombardment



Bombardment with Bi at 650 MeV, 2×10^9 per pulse

Simulated Currents on Cryocatchers for Slow Extraction



Predicted average beam energy deposition on the ion catchers within each sector of SIS100 for a cycle with fast (FX) and slow extraction (SX). The differing numbers for sector 5 during slow extraction are given in brackets.

Ion Catcher	**Load (FX) [W]**	**Load (SX) [W]**
1	0.5	1.5 (3.1)
2	1.4	3.8 (16.7)
3	1.1	1.9 (3.7)
4	0.6	1.2 (1.4)
5 – 10	0.6	1.2

Explosive Plating