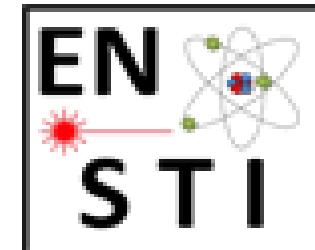




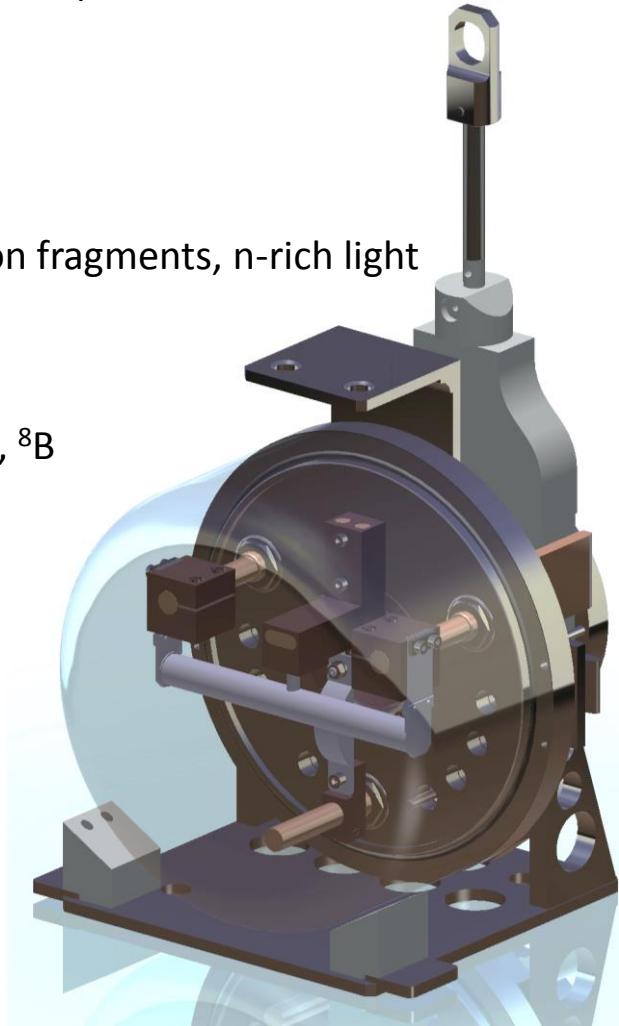
Status of Target and Ion Source Group Developments 2013

Christoph Seiffert
on behalf of TISD

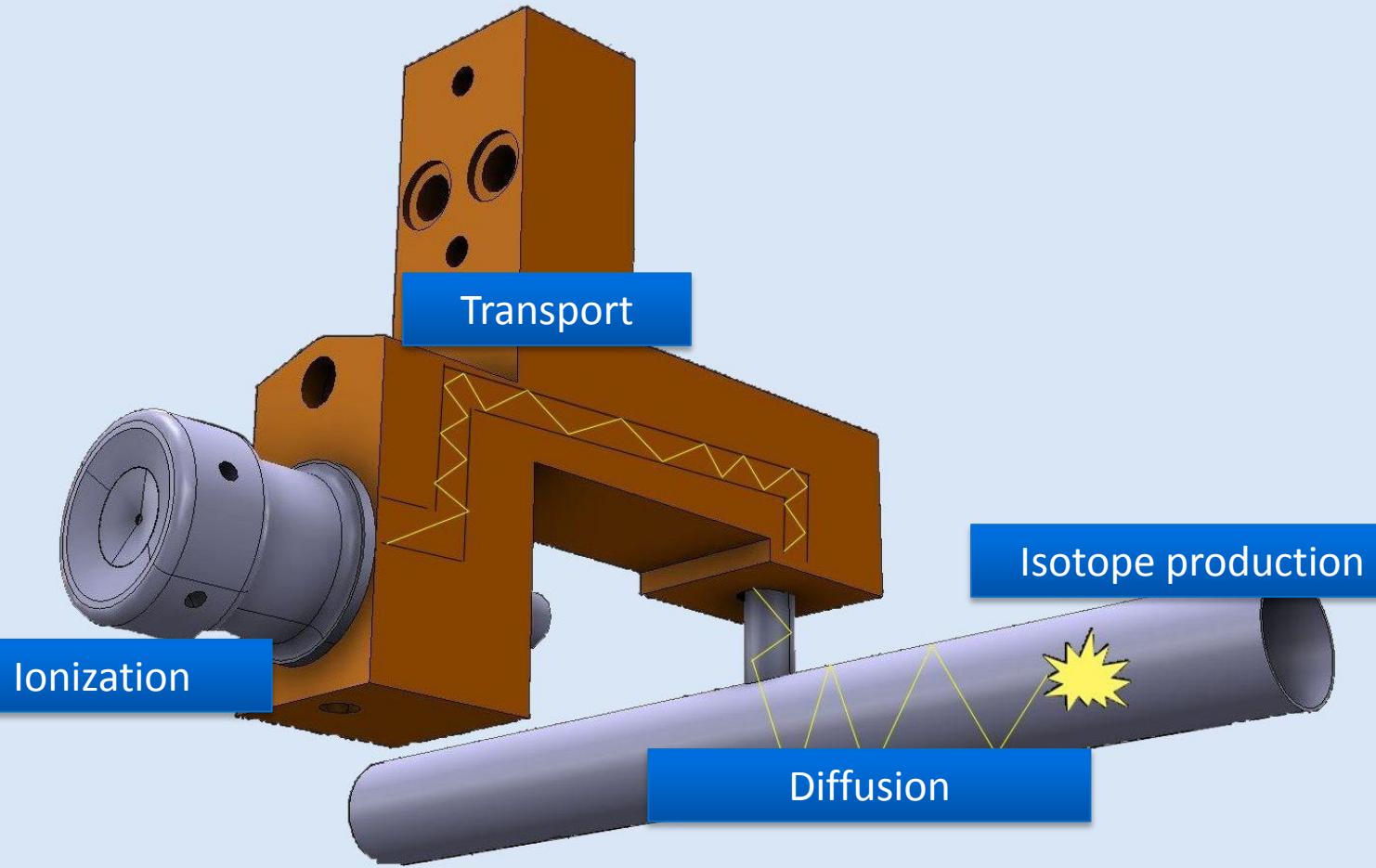


Overview

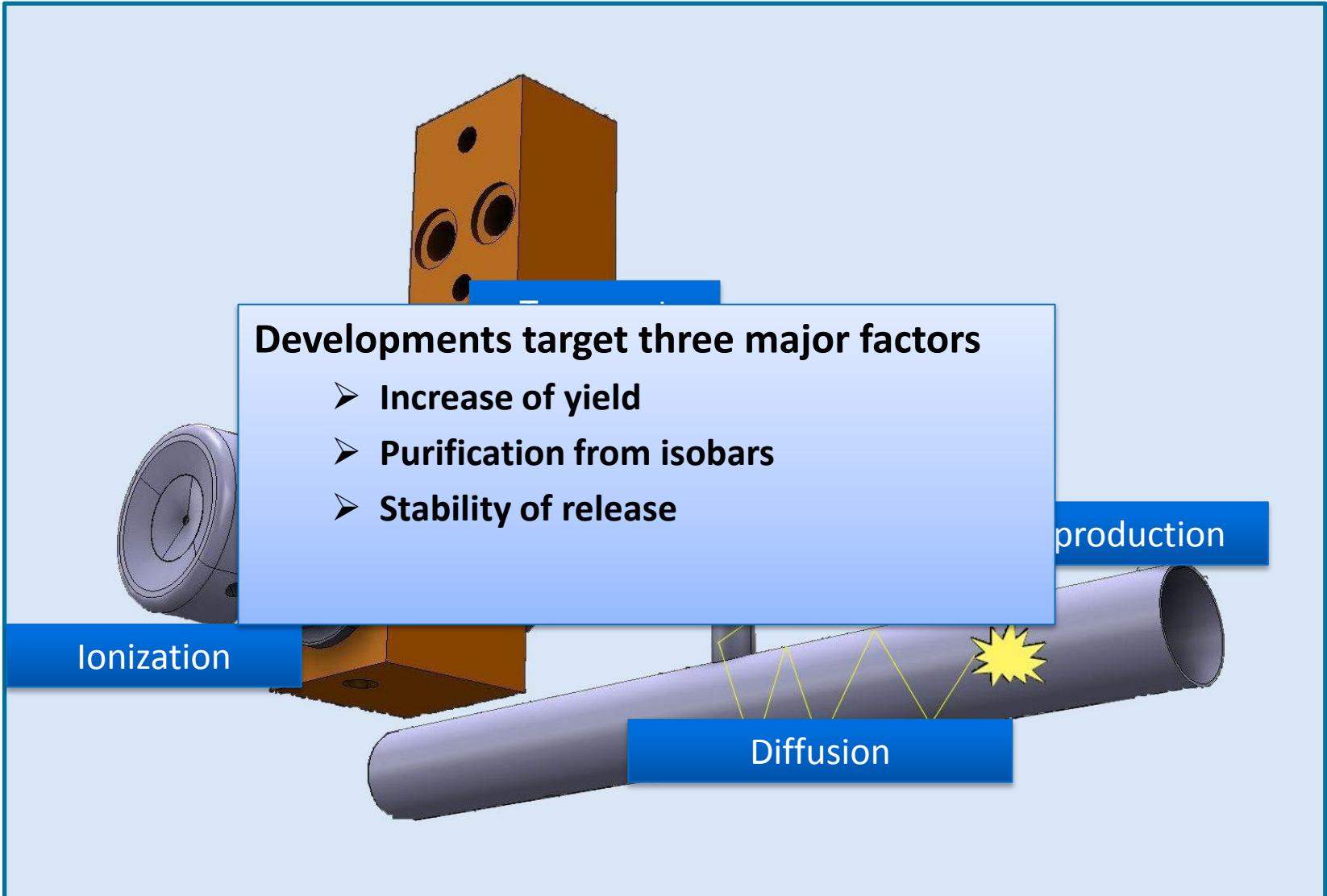
- Neutron converter:
 - SiC, Al₂O₃:
 - Titanium Carbide:
 - Diffusion of Boron:
 - Nano sized UC_x:
 - Molten Salt/Metal:
 - Molecular beams:
- purification of neutron rich isotopes
low Z elements
³⁷K, ³⁵Ca
⁸B
increase of intensity of fission fragments, n-rich light nuclei, heavy elements
¹⁸⁷Hg, ¹¹C
short lived Carbon (⁹C, ¹⁷C,..), ⁸B



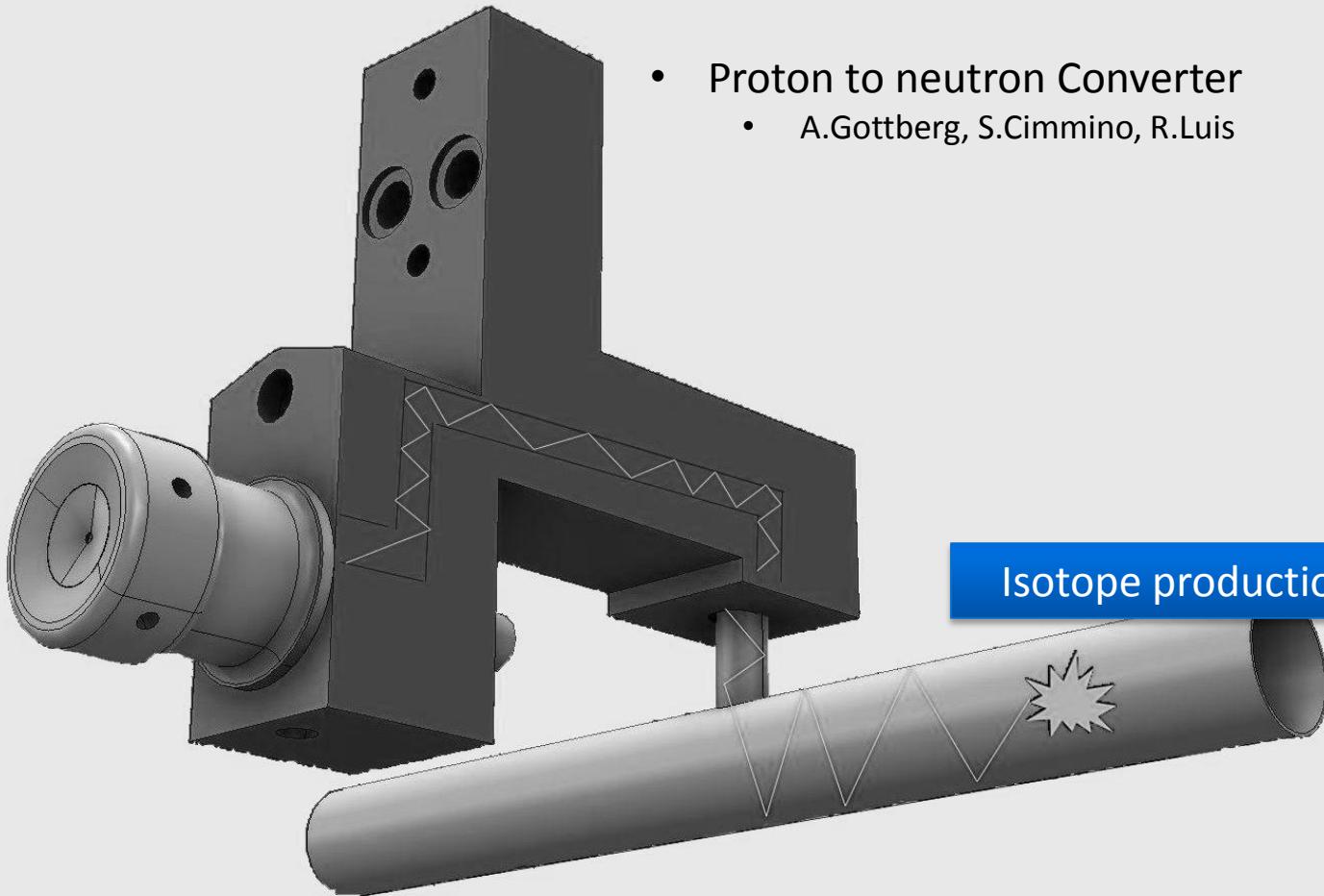
RIB production



RIB production

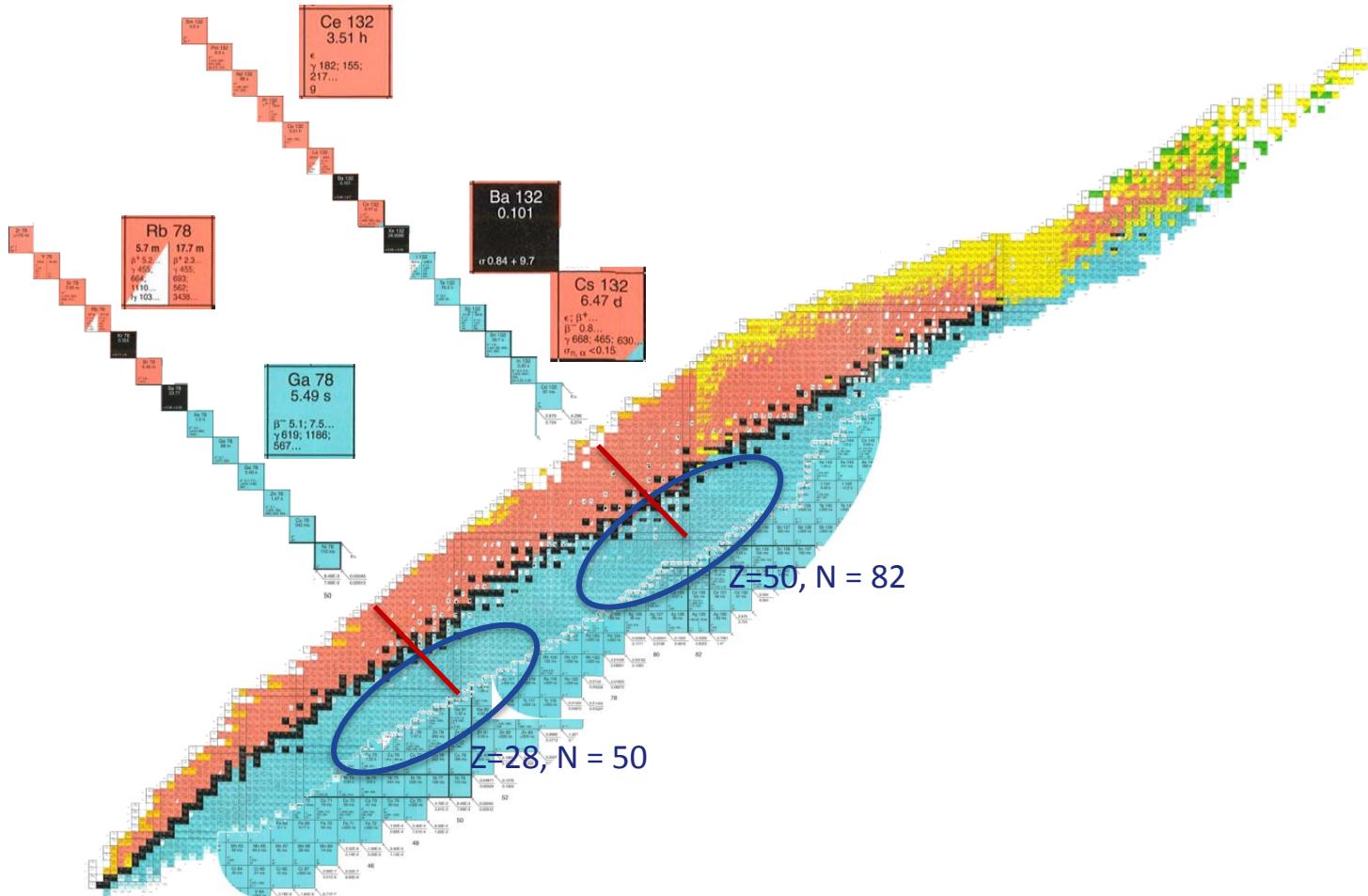


Proton to Neutron converter



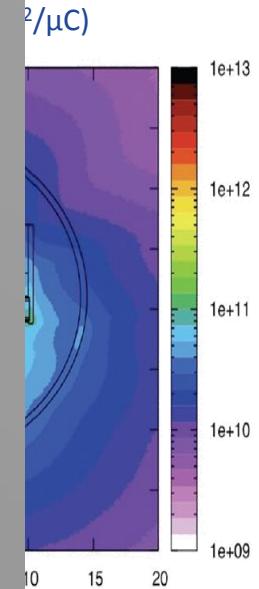
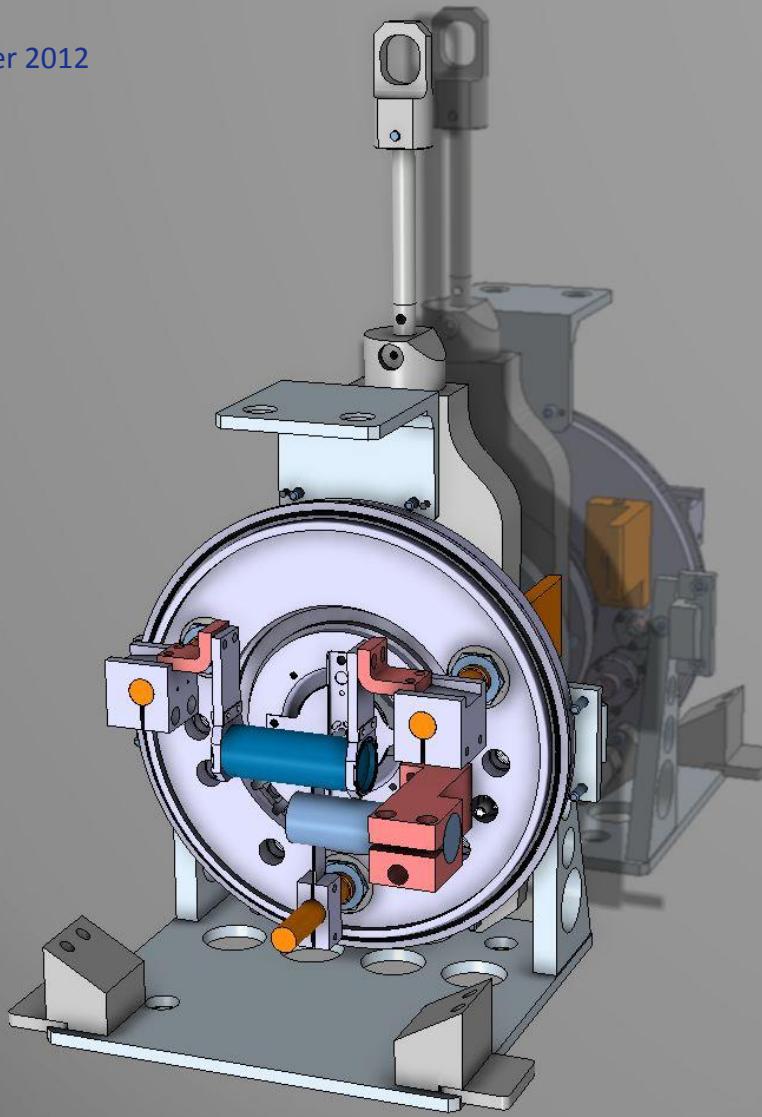
Proton to Neutron converter

- Purification of exotic neutron rich beams



Proton-to-Neutron Converter

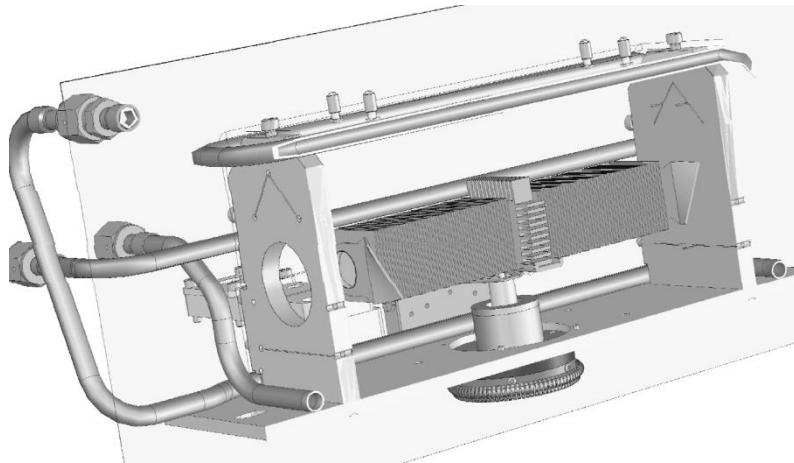
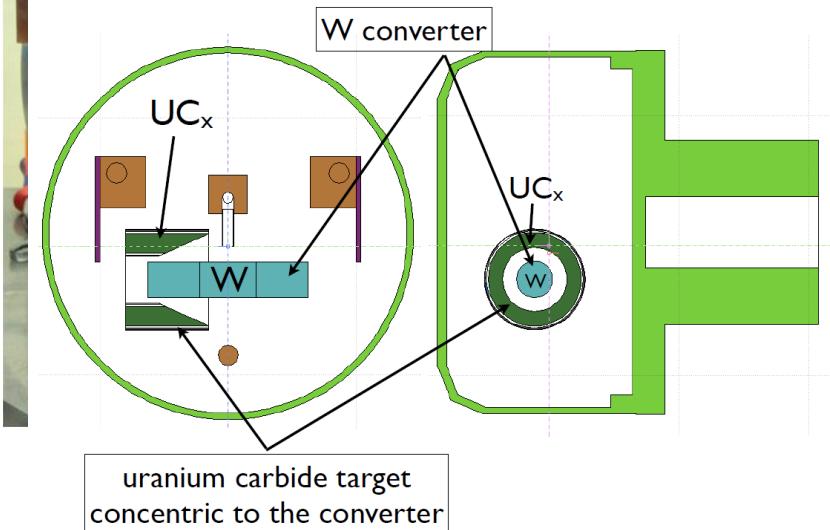
Operated in October 2012



Proton-to-Neutron Converter



Development of next consequent step of enhancement in collaboration with TRIUMF



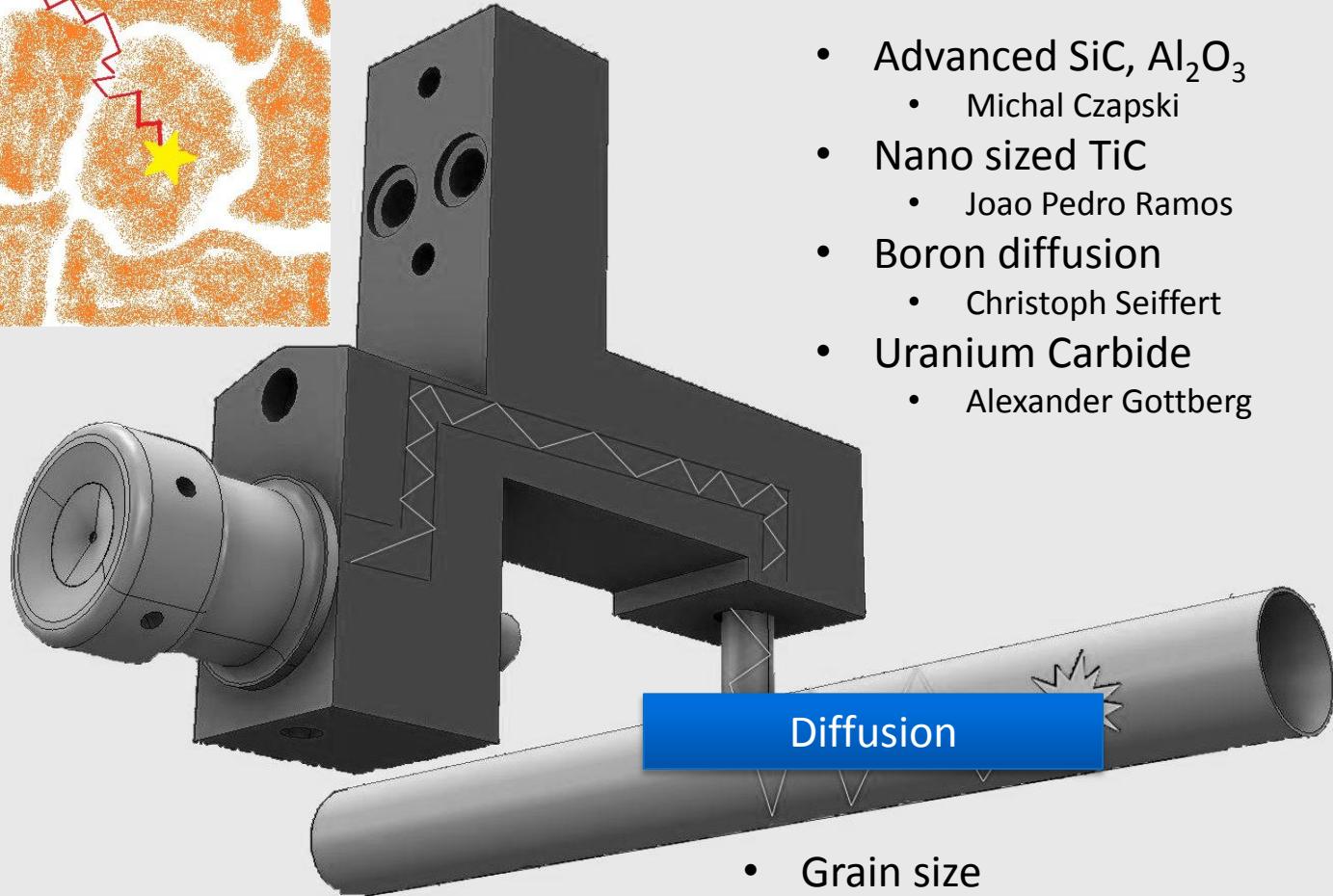
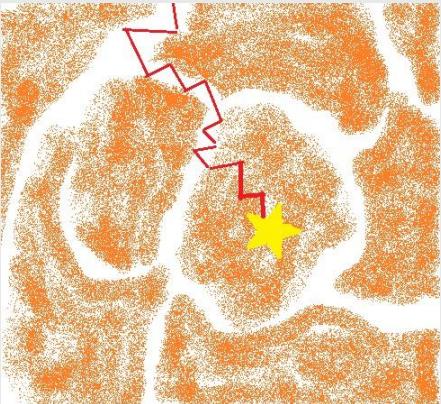
S. Cimmino et al., Intern. Workshop on Radioactive Ion Beam production and High-Power Target Station, Poster

Measured improved yield/impurities of x200 on $^{80}\text{Zn}/^{80}\text{Rb}$ compared to conventional converter

A. Gottberg et al., to be submitted to NIM B

Presentation: Serena Cimmino, Fri 9h30, Globe

RIB production



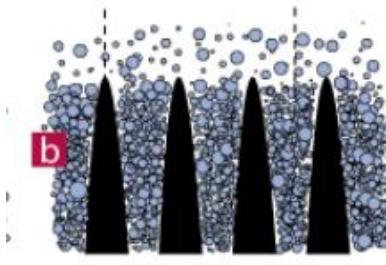
SiC, Al₂O₃ Development

Michał Czapski, S. Fernandes, et al.

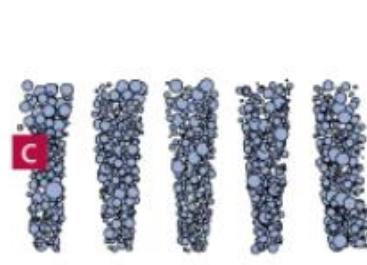
ICE-TEMPLATING METHOD (CNRS/SG CREE* patent)



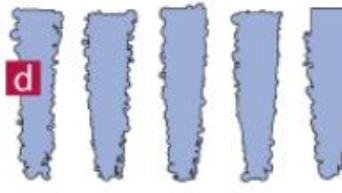
growing ice crystals concentrated colloids



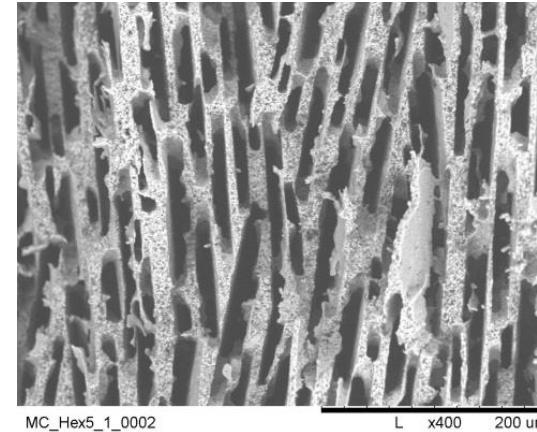
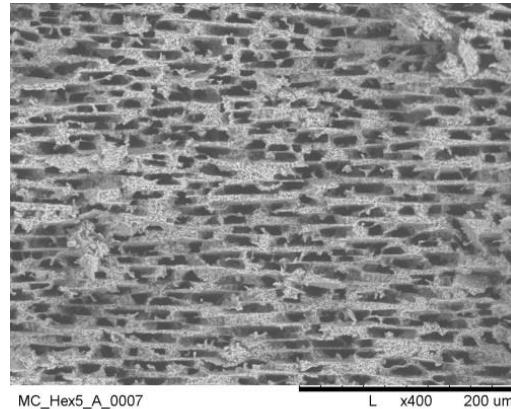
Freezing



Sublimation



Densification



Open porosity 30 – 70 %

*European R&D center of the market leader in SiC production

10

SiC, Al₂O₃ Development

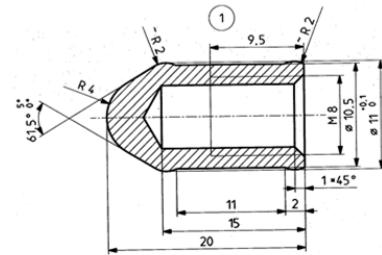
Ageing, Post-Irradiation Studies (M. Czapski, et al.)

SiC samples:

RaBIT setup

(Rapid p-beam Irradiation Transport) shuttles sent pneumatically in front of HRS front-end)

beam: NORMGPS – 1.4 GeV, 3.2×10^{13} /pulse (2.4 μ s/1.2s, 3-4 bunches), $\sigma = 2.3$

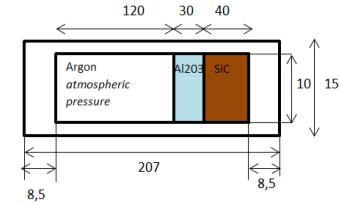
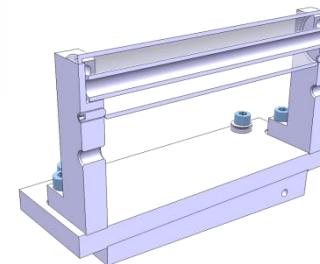


SiC + Al₂O₃ samples:

beam: SPS – 450 GeV, 1.7×10^{11} /pulse (7.2 μ s/18s, 3-4 bunches), $\sigma = 2.0$

Max. cycles = 100 (desirable 10x more)

Setup - 8 samples in a row



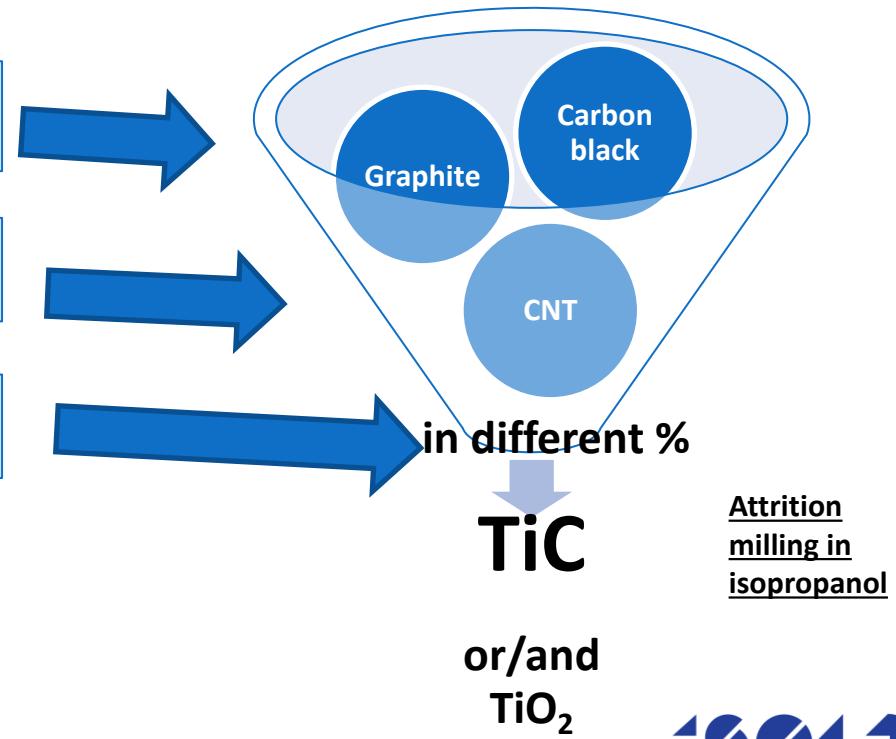
Development of Ti based refractory target nano-material for ISOLDE

- PhD project of Joao Pedro Ramos
- Beams of Potassium (37-K, 1.22s) and Calcium(35-Ca, 25ms) desired
- Ti foils and TiO_2 commonly used as material
 - Release too slow or material sinters → yield drop
- Thermally stable nano sized material needed for fast and constant release

Mixed carbon with micrometric TiC showed improved release.

CNT mix with UO_2 shows promising results.

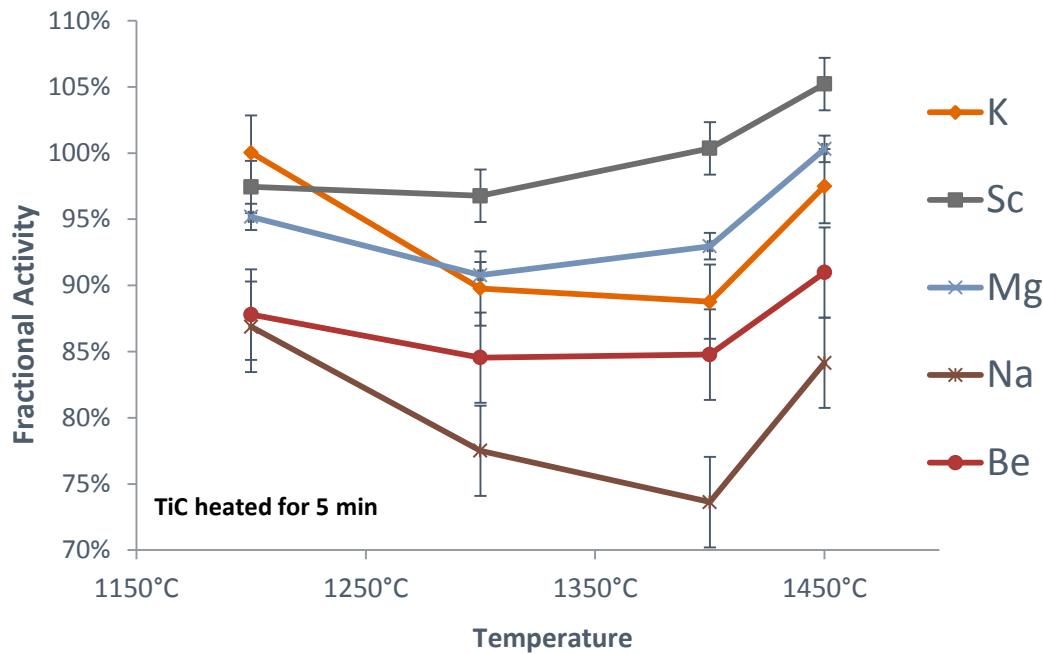
Carbon can act strongly against sintering



Development of Ti based refractory target nano-material for ISOLDE

- TiC and TiO_2 sintering studies done.
- Production and radioactive dose simulations were done.

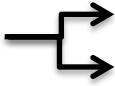
1. Irradiation
2. Heat Treatment (5, 10, 20 min at T)
3. Gamma spectroscopy
4. Reheat of sample and re-measurement

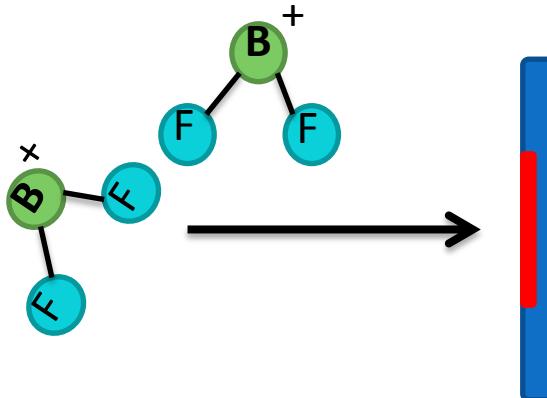


- TiO_2 shows little or no release.
- TiC little release at 10 and 20 min (re-heated samples) => radiation enhanced diffusion
- TiC samples after 5 min show fractional release down to 75% until 1400 °C.

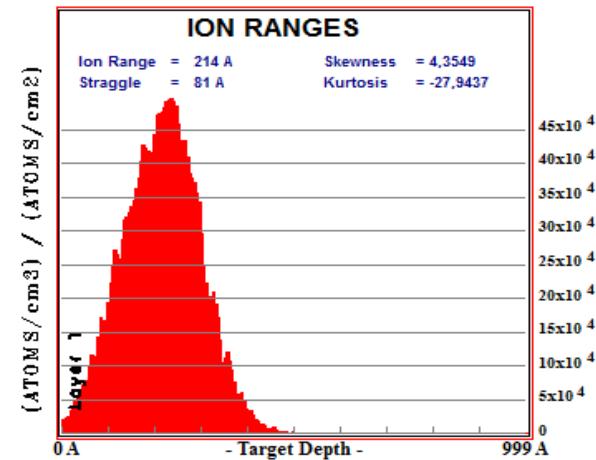
Diffusion properties of Boron

- Phd project Christoph Seiffert
- Diffusion studies of Boron in possible target materials [1]

- $\sigma_{[10-\text{B}(n,\alpha)7-\text{Li}]} = 3840 \text{ barn}$
- $10\text{-B} + 1\text{n}$ 

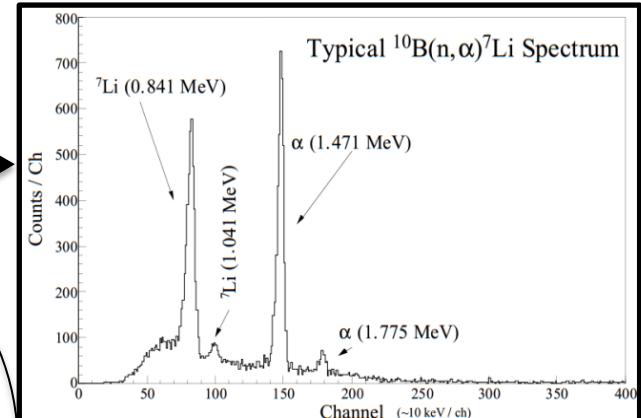
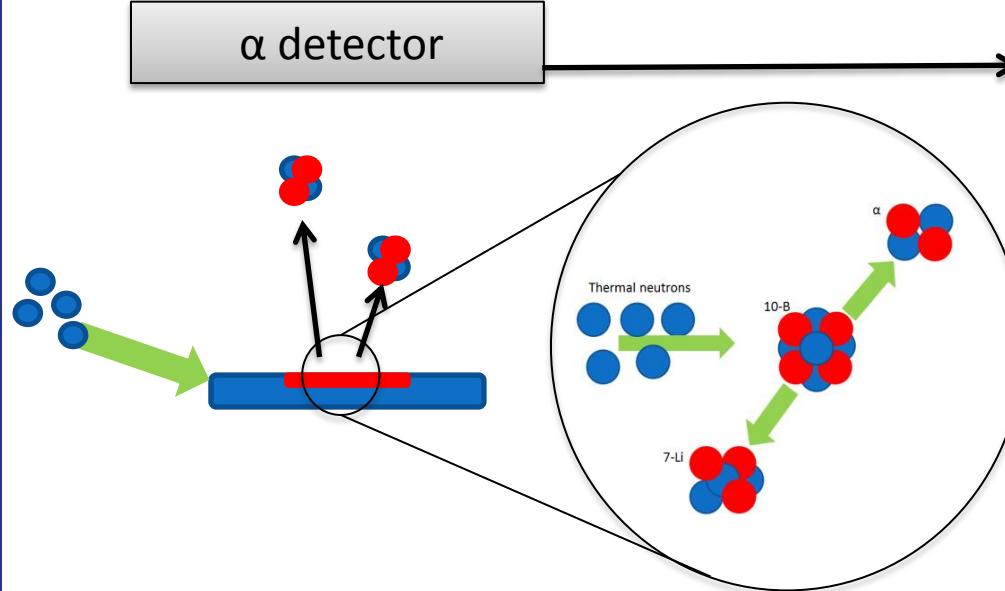


12.5 keV 10-B in carbon foil



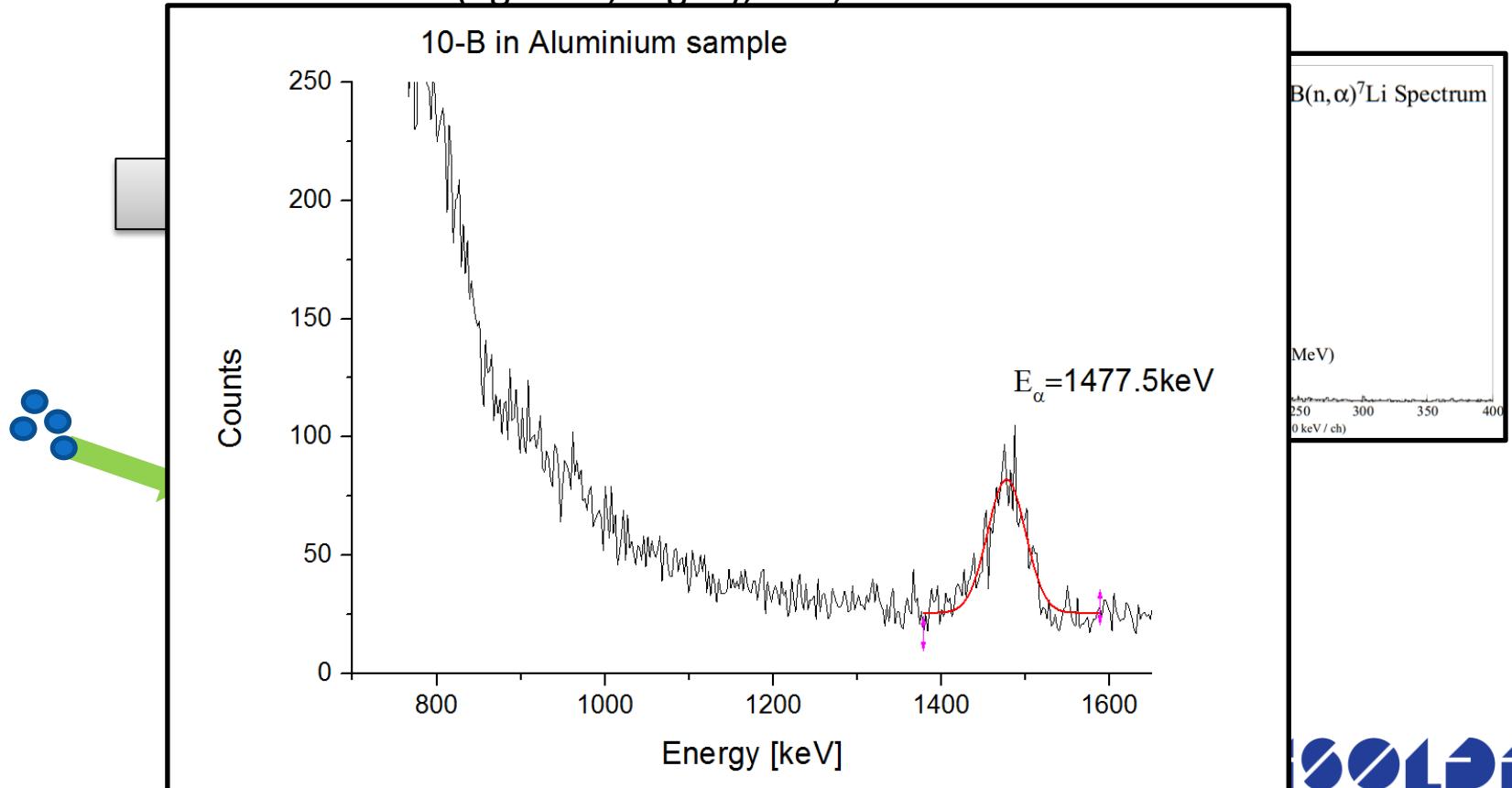
Diffusion properties of Boron

- Irradiation with thermal neutrons- measure distribution
 - Pu-Be Source 1.1×10^8 n/s @ 4π
- Heating of sample
- Materials: fluorides (eg CaF_2 , MgF_2), CNT, Al_2O_3

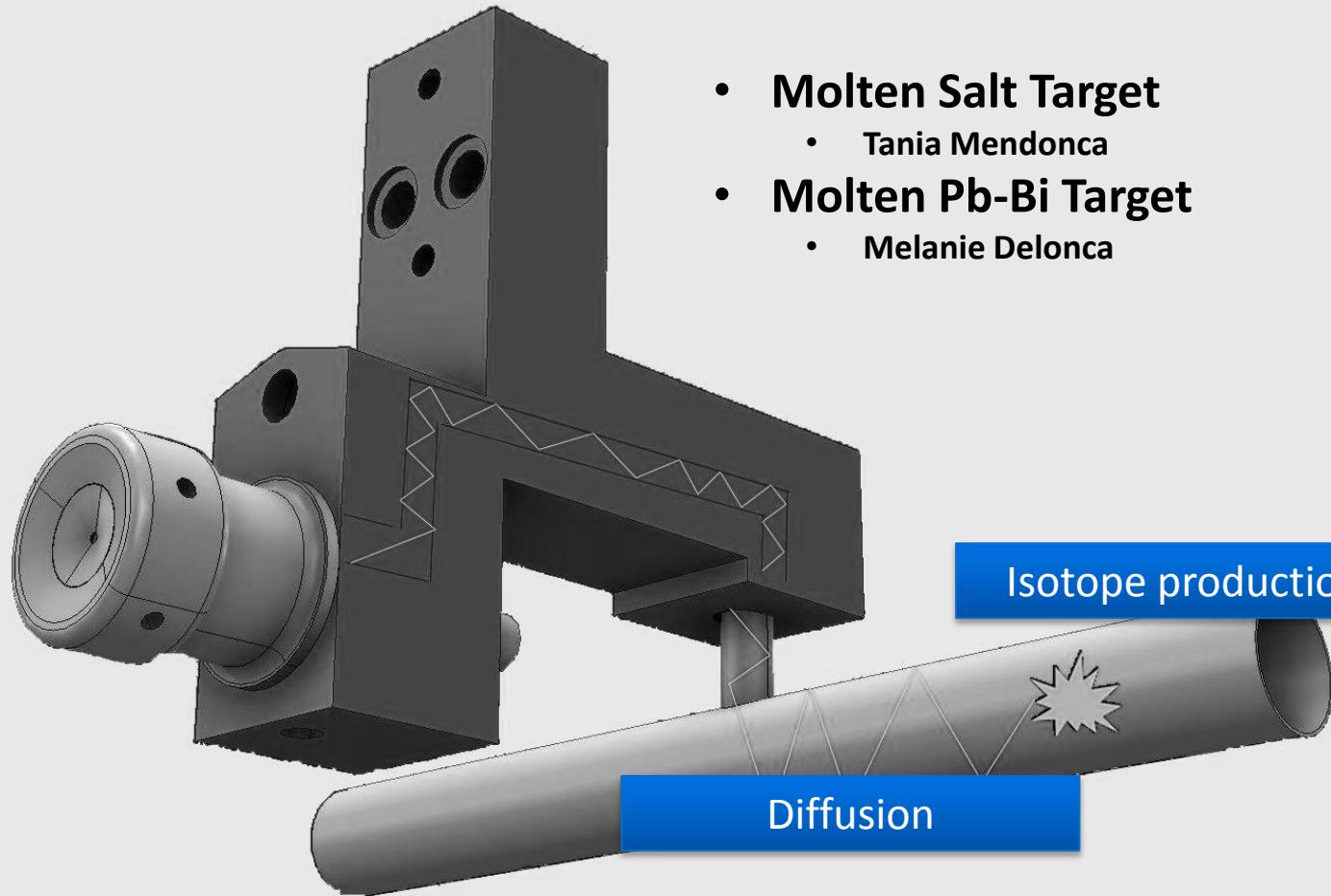


Diffusion properties of Boron

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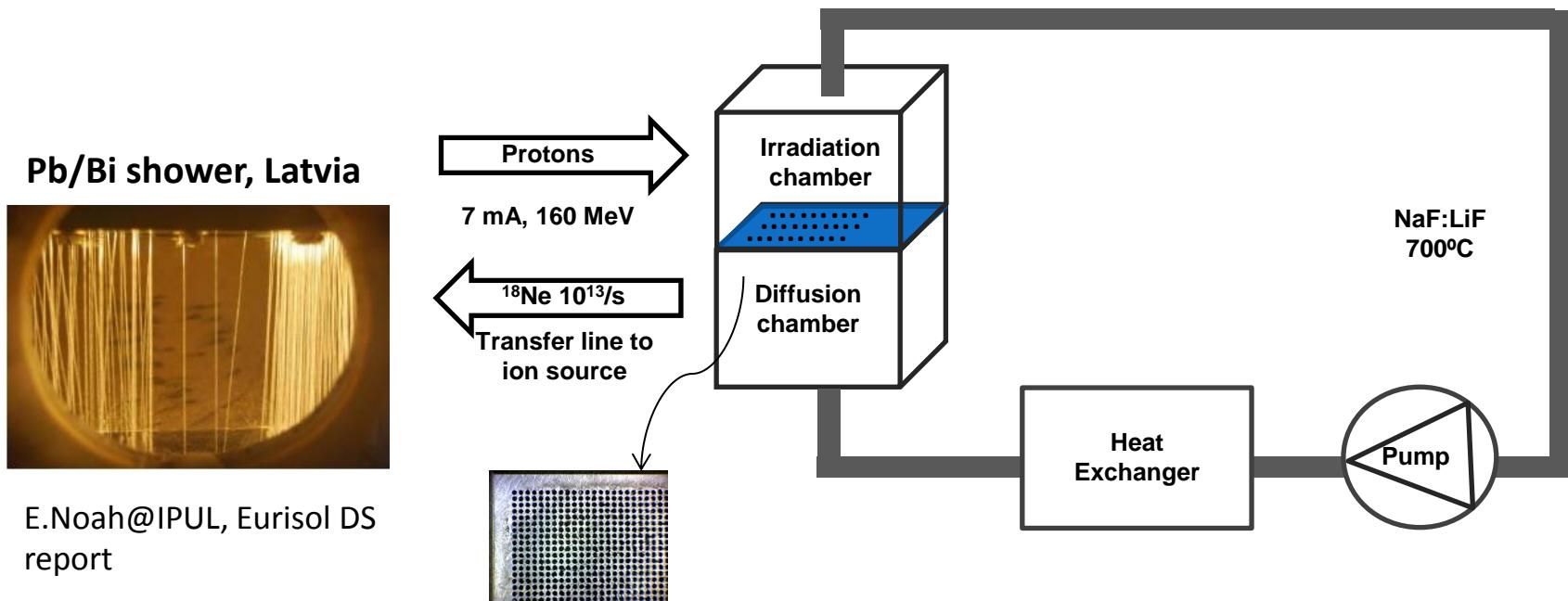


RIB production



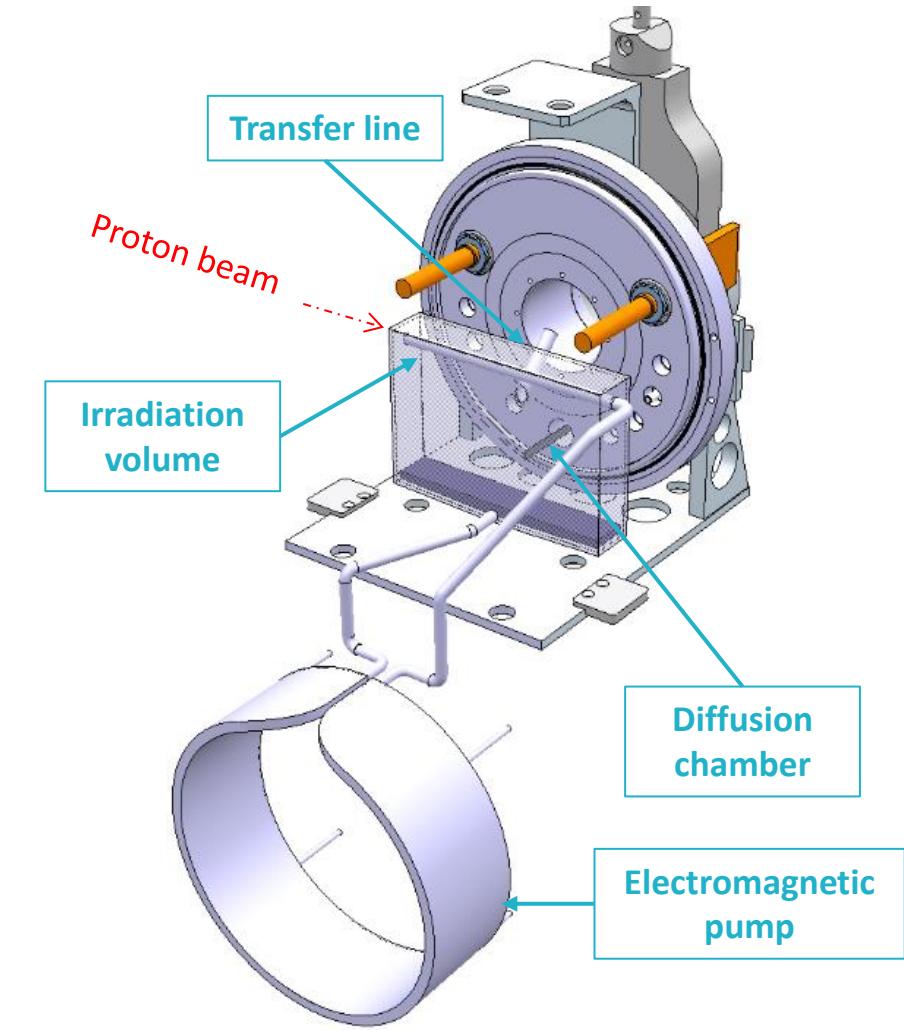
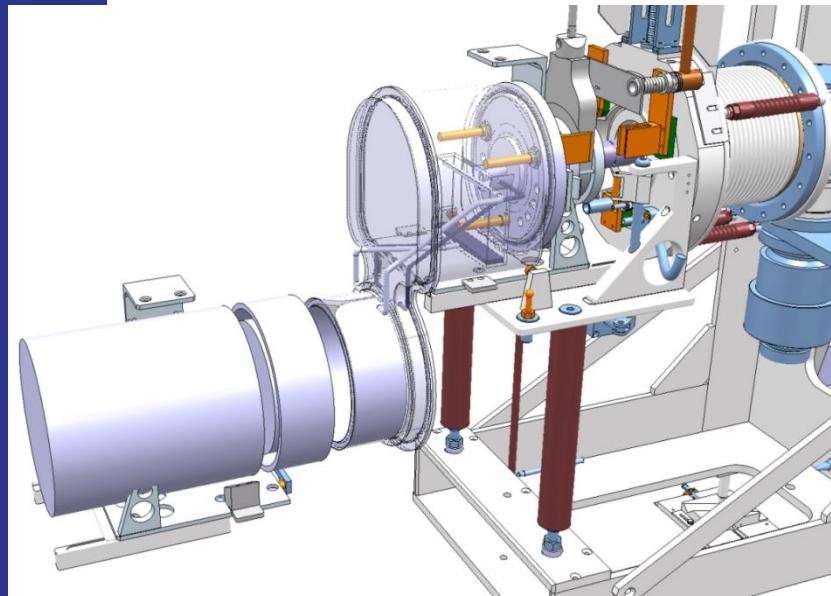
Molten Salt Target Loop for the Beta Beams

- Tania Mendonca
- Inspired from ^{18}F production for PET imaging:
 $\text{NaF target loop } (^{23}\text{Na}(\text{p},\text{X}), ^{19}\text{F}(\text{p},2\text{n})^{18}\text{Ne})$
- Rates of $10^{13} \text{ }^{18}\text{Ne}/\text{s}$ are predicted exploiting 1MW, 160 MeV proton beam



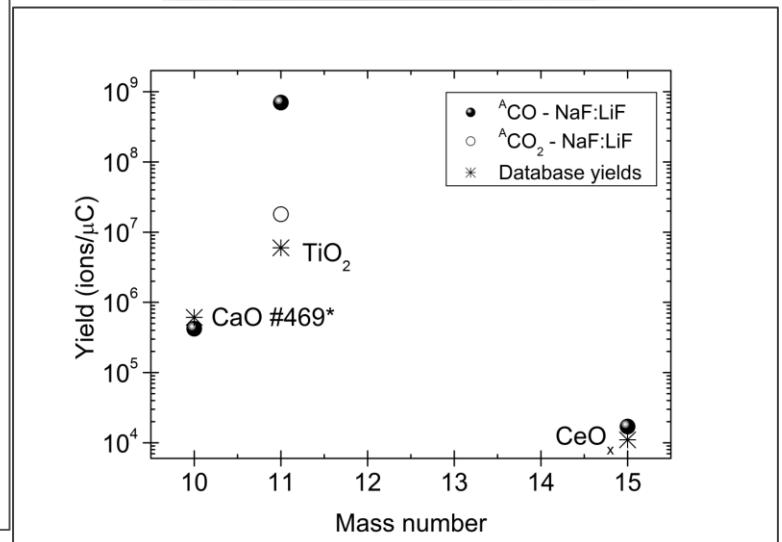
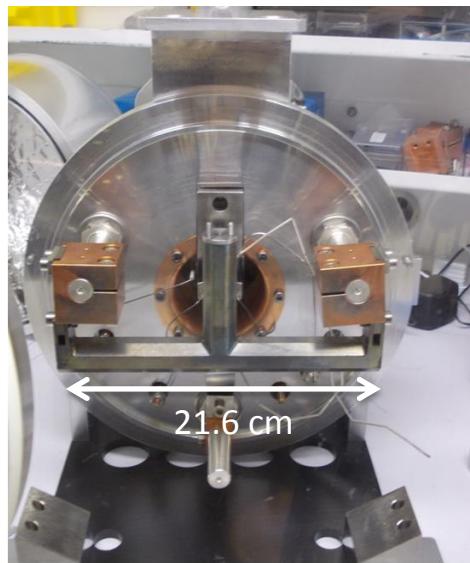
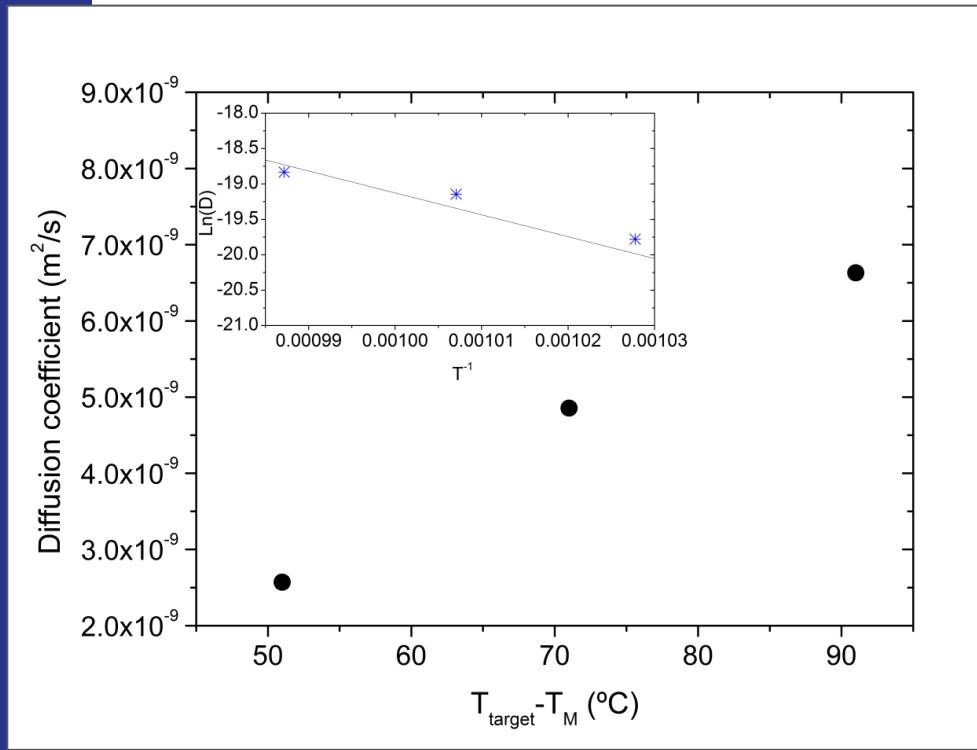
Liquid eutectic Pb/Bi loop for EURISOL LIEBE project

- PhD project of M. Delonca
- Online test in 2015

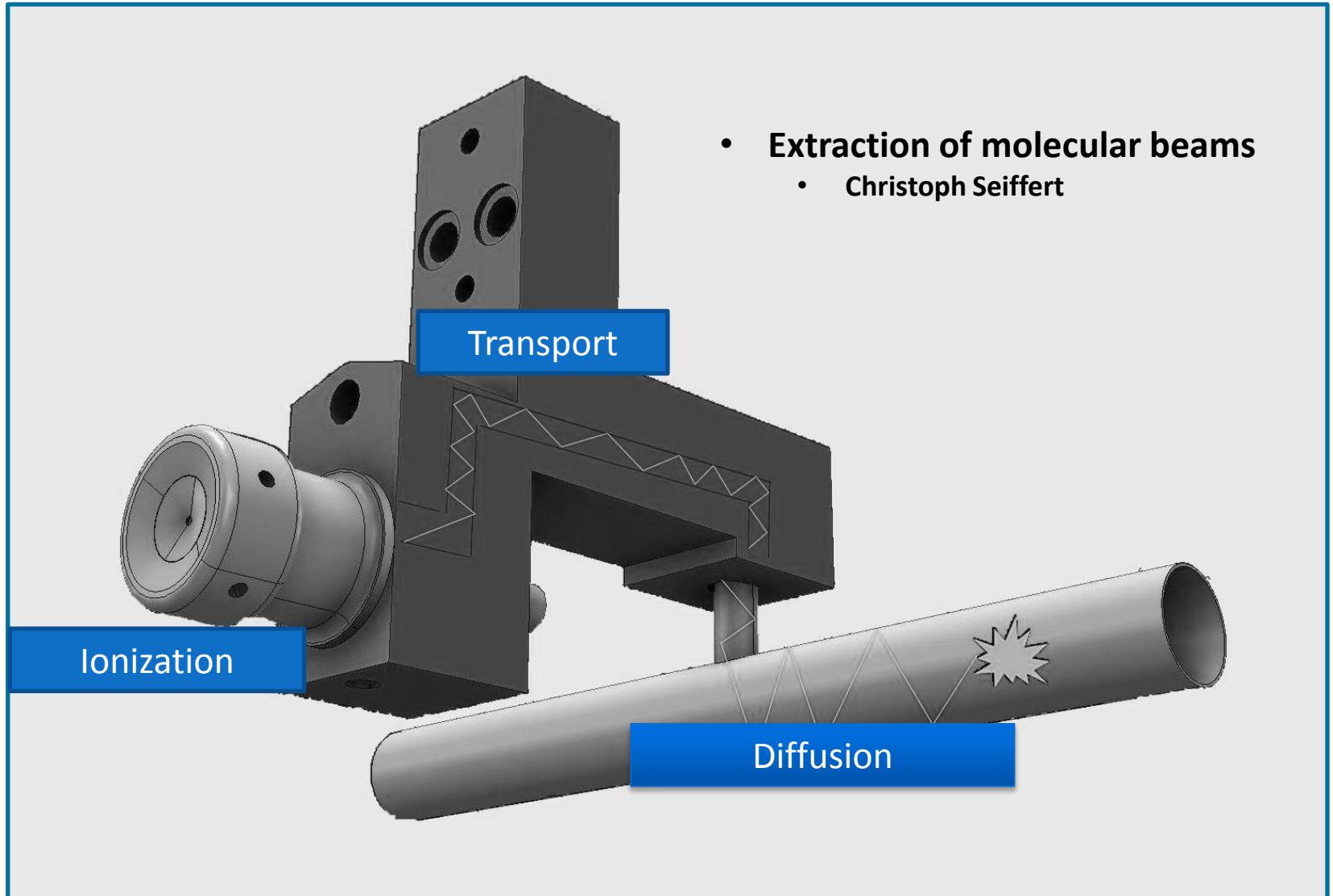


Production and release of low-Z isotopes

- Online test June 2012
- 100x ^{11}CO than database
- Diffusion coefficient of Ne in NaF:LiF
 - Dimensioning of shower

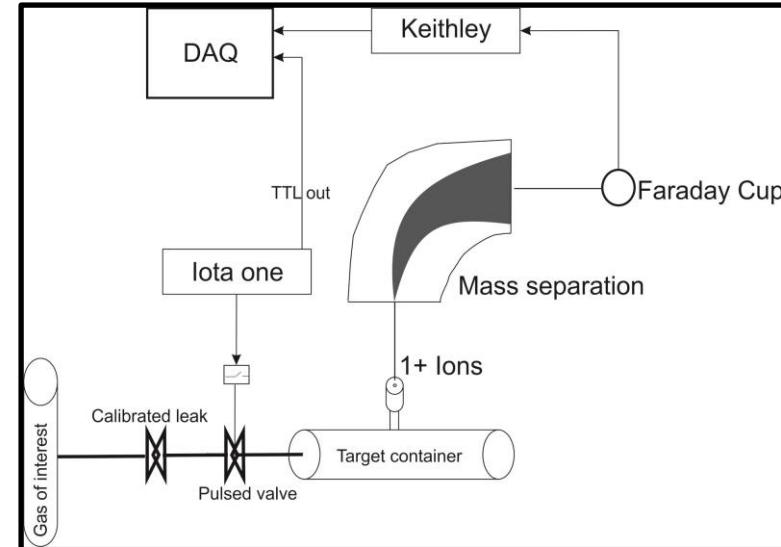
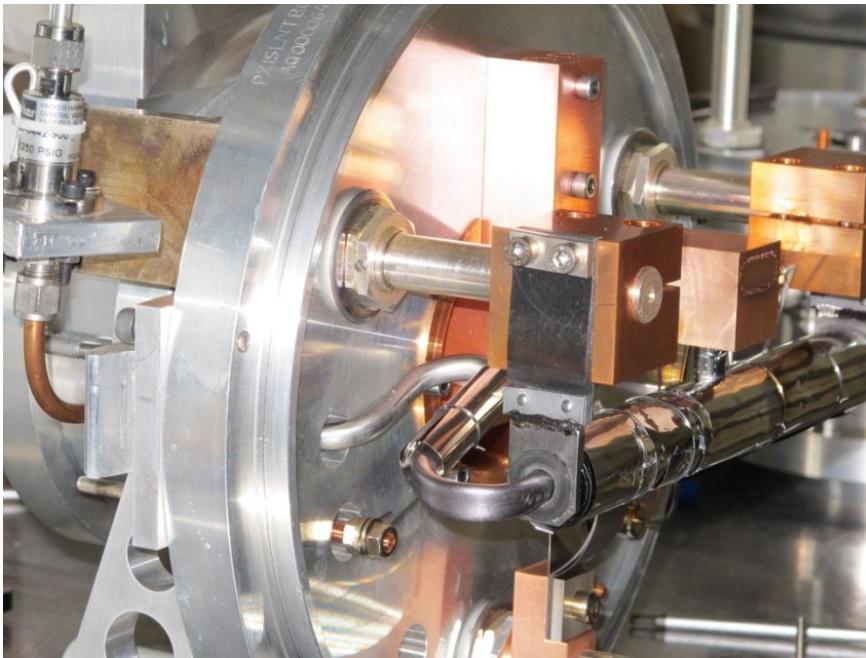


RIB production



Production of molecular beams

- PhD project Christoph Seiffert
- Goal: Beams of 9-C as CO^+ and 8-B as BF_n^+
- Material studies at Off-line mass separator:
 - Chemical interaction
 - Adsorption on Surfaces
 - Ionization



Summary

- Developments aim to improve yield, purity and stability of release
- Further improvement of Neutron converter –S. Cimono, T.Mendonca, R.Augusto
- Different projects of development and improvement of material properties
 - SiC, Al₂O₃ – M. Czapski
 - TiC – J. P. Ramos
 - Diffusion of Boron – C. Seiffert
 - Uranium Carbide – A. Gottberg
- Molten salt and Pb/Bi targets – T. Mendoca, M. Delonca
- Material studies for the extraction of molecular beams – C. Seiffert
- Beam developments: <http://isolde-upgrade.web.cern.ch/isolde-upgrade>
 - ISOLDE webpage -> projects

Thank you

