TISD activities in 2018

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The Target and ion Source Development (TISD) team

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Providing a large choice of **intense** and **pure** radioactive beams

Constant development is required to keep ISOLDE at the forefront of RIB facilities

RILIS team in 2018

Valentin Fedosseev

Section Leader
EN-STI-LP

Shane Wilkins

CERN Fellow
October 17 onwards

Katerina Chrysalidis

Doctoral student, 2nd year
Univ. Mainz

Bruce Marsh

Staff Member
EN-STI-LP

Camilo Buitrago

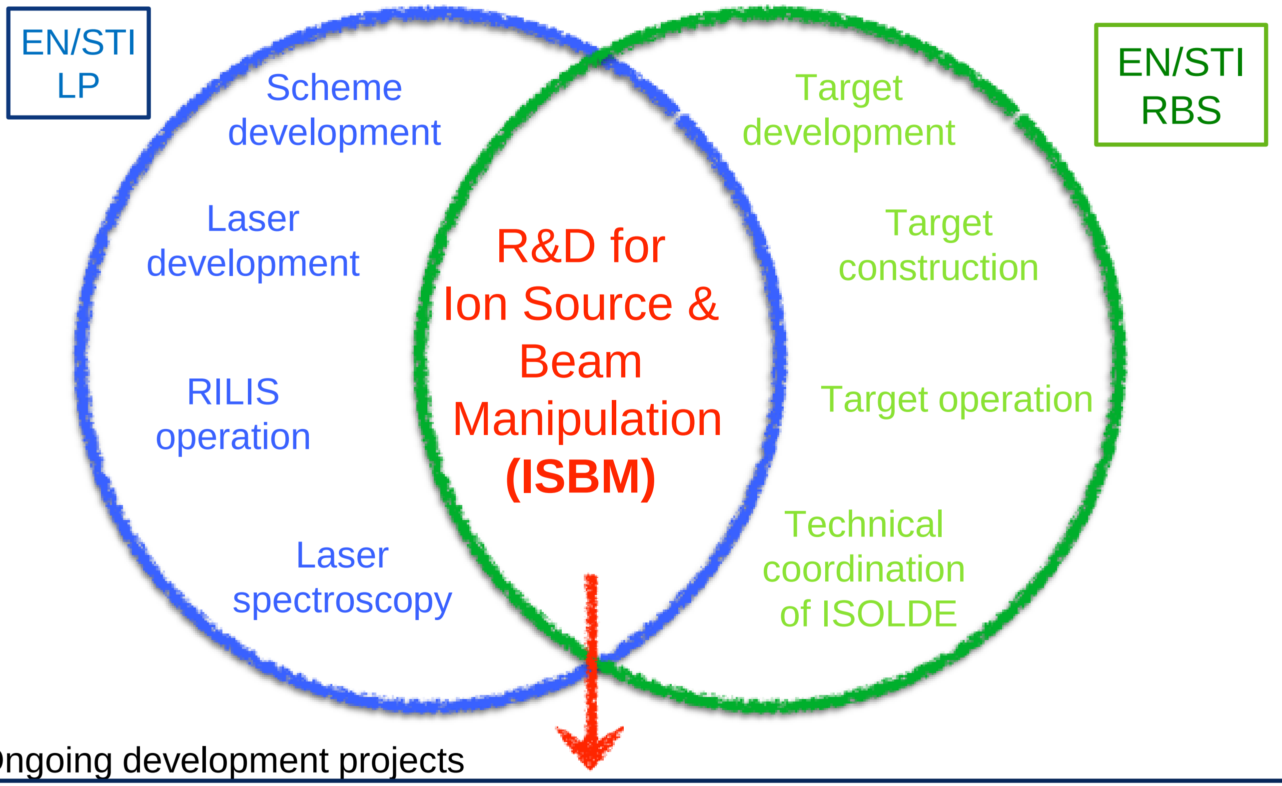
CERN Fellow
April 17 onwards

RILIS

Support from PNPI:
Dima Fedorov
Pavel Molkanov
Maxim Seliverstov

LARISSA group, Mainz:
Dominik Struder
Reinhard Heinke

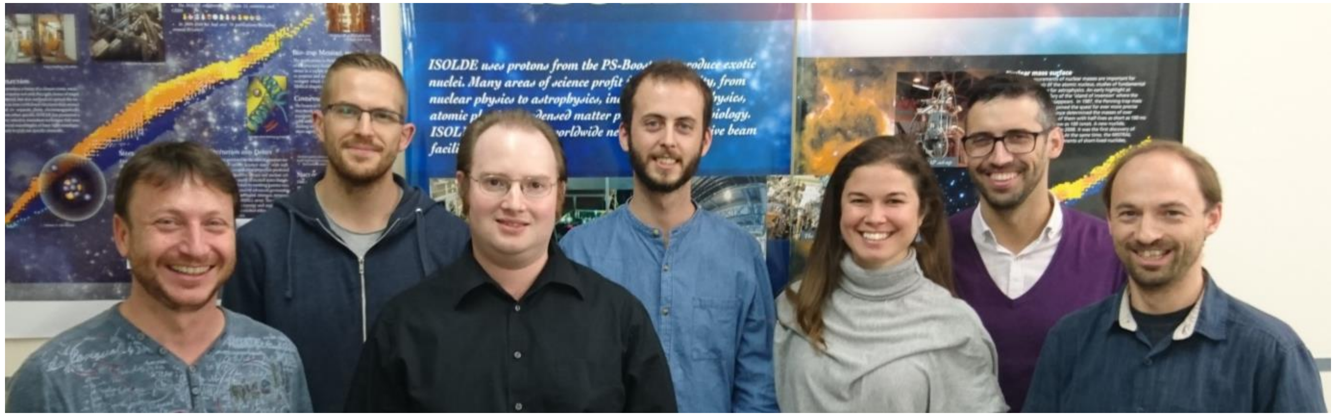
ISBM working group



Ongoing development projects

- LIST
- FEBIAD optimization
- ISCOOL upgrades
- Fast beam gating
- Development of refractory metal beams
- VADLIS
- ToFLIS
- Ion beam multiplexing
- Ion source selectivity
- Optical pumping in ISCOOL
- Negative ion beams
- HRS upgrade

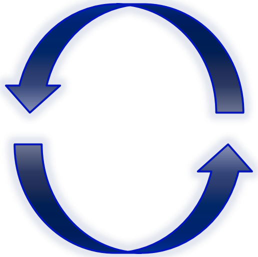
Target and ion Source Development (TISD) mandate



Providing a large choice of **intense** and **pure** radioactive beams

Constant development is required to keep ISOLDE at the forefront of RIB facilities

- target and ion source units
- target materials
- beam interactions (p2n converter)
- ion source design / mode of operation shared with ISBM group

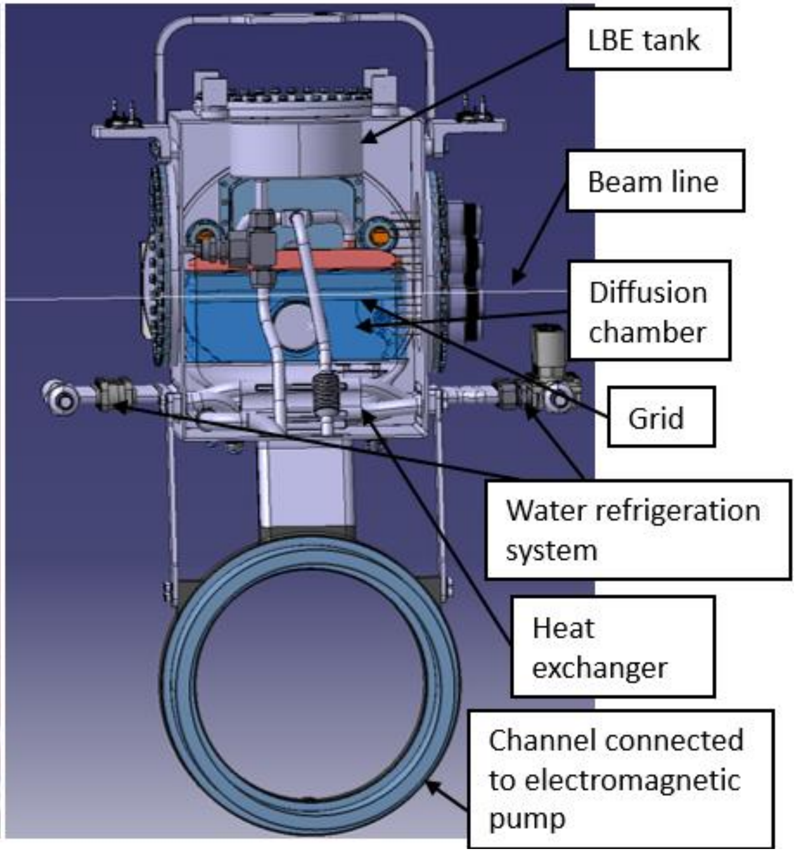


- yield & release study
- ion source efficiency measurements
- prototype tests

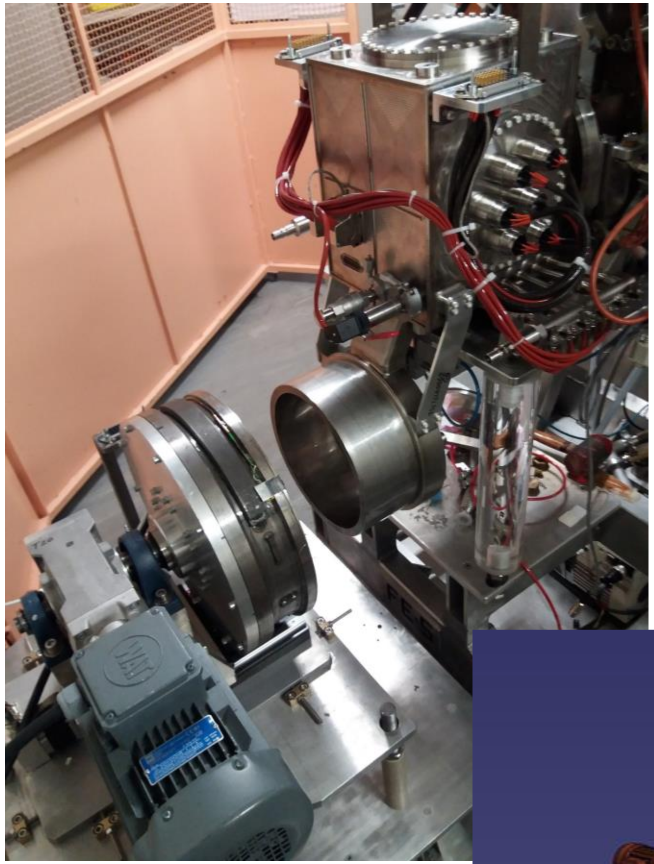
Sharing same resources as the ISOLDE physics program

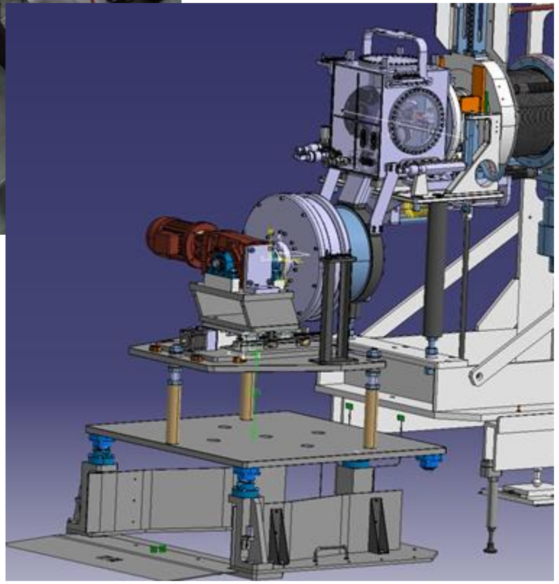
- WORKSHOP: target unit production
- OFFLINE: target quality control
- ISOLDE: beamtime

The LIEBE target – Assembled



LIEBE fully assembled and coupled to offline 1



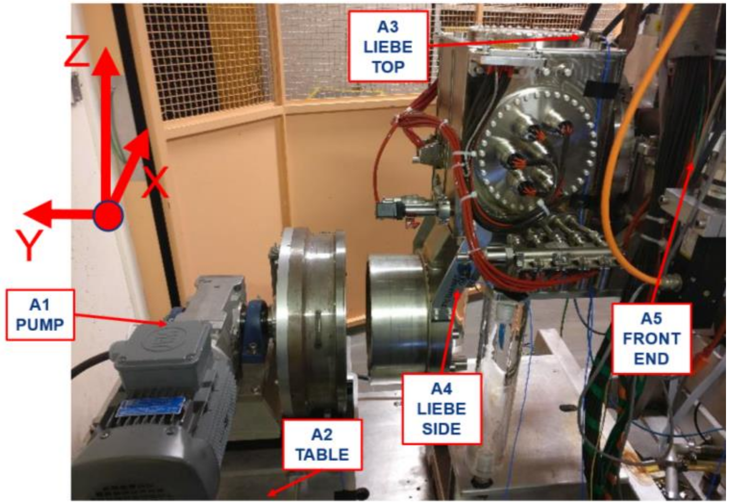


LIEBE: Offline Tests

Vibration tests:

Good stability of the pump and no direct transmission to the target

Vibration tests setup



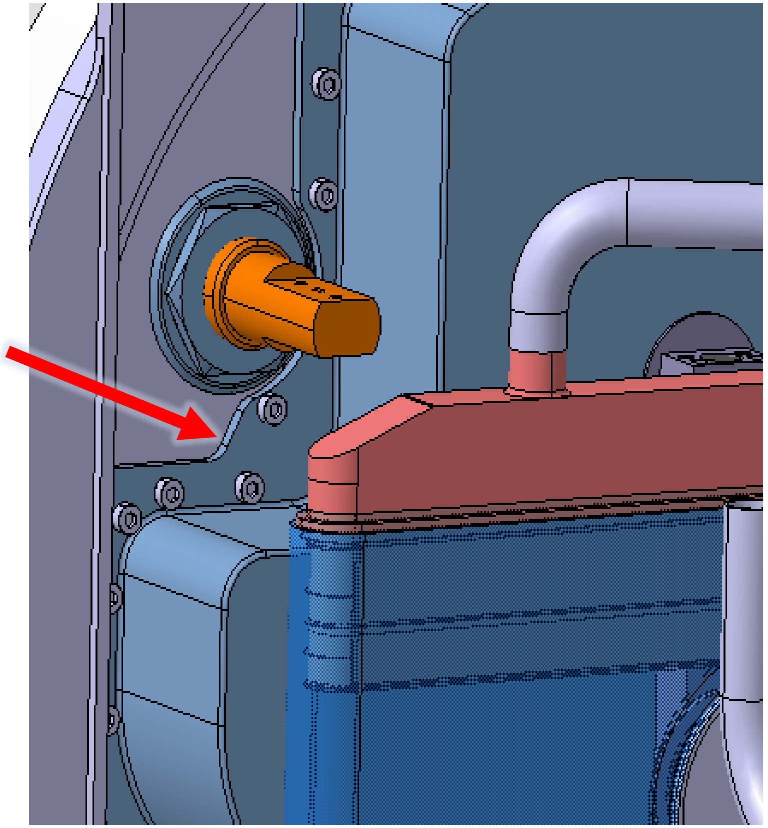
	PUMP +X	PUMP +Y	PUMP +Z	LIEBE +X	LIEBE +Y	LIEBE +Z
Baseline	0.20	0.19	0.19	0.06	0.05	0.04
10Hz	0.83	0.54	0.47	0.52	0.17	0.22
20Hz	0.54	0.39	0.64	0.24	0.85	1.27
30Hz	0.88	0.79	1.13	0.45	0.39	0.19
40Hz	1.44	0.92	1.19	0.48	0.22	0.25
50Hz	4.28	1.76	1.41	0.73	0.27	0.25

Standardized model to evaluate the stability of the setup over time.

Ion source tests:

- Leak was found when heating the ion source to 1600 °C

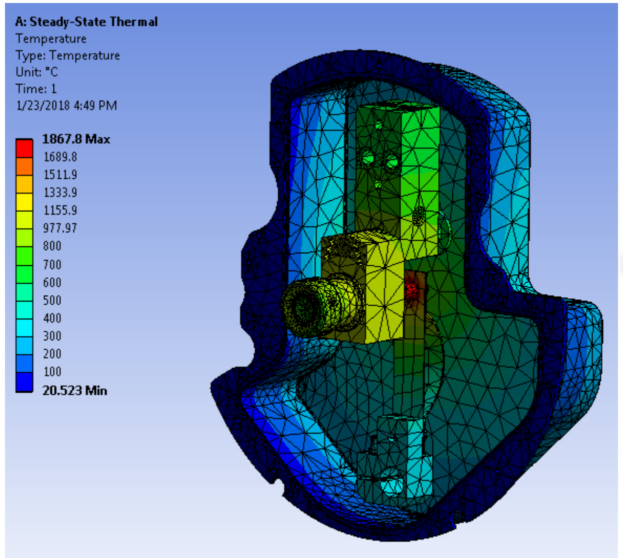
Leak on vessel containing the ion source.

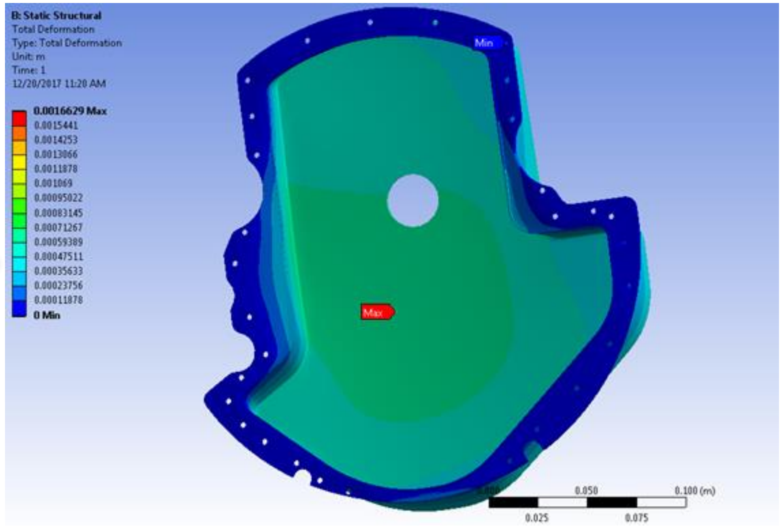


LIEBE: Offline Tests

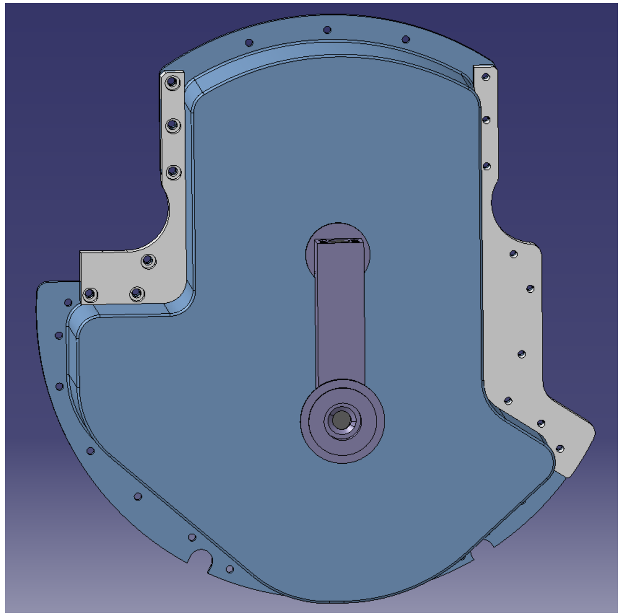
Fixing the leak:

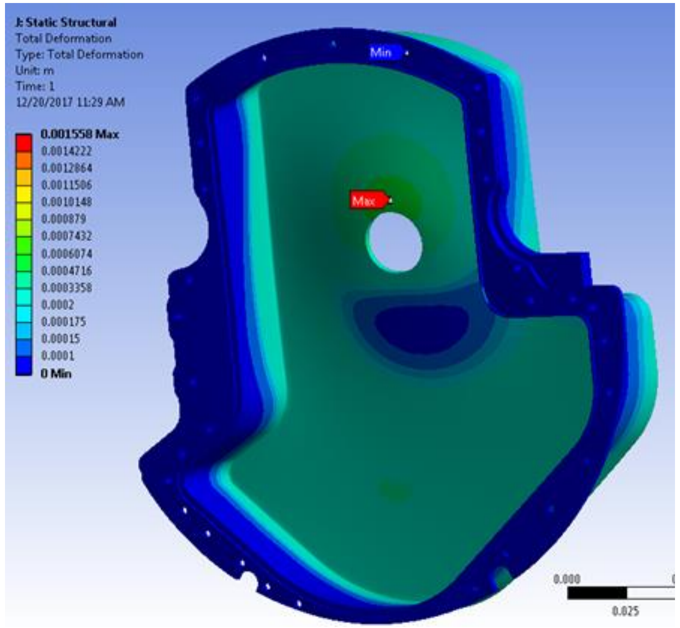
- Experimental tests and numerical analysis to understand the problem:
  - High temperature cathode inducing a thermal gradient on the vessel containing the ion source.
  - Deformation of the sealing path due to thermal dilatation.





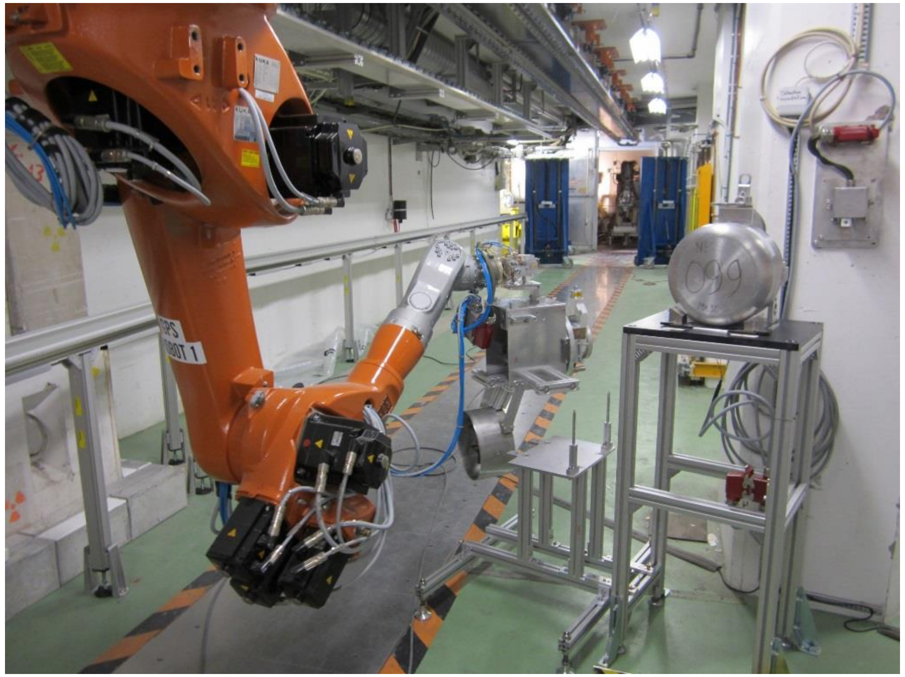
- Manufacture of dedicated pieces to increase sealing pressure:
  - Experimental tests of the new pieces to be done.



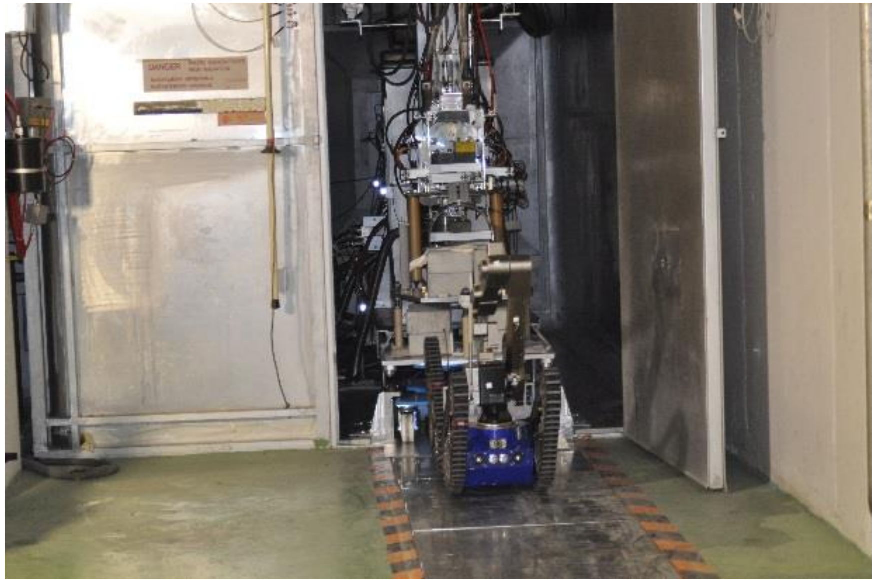


LIEBE 2018

- Offline tests delayed until the leak is fixed.
- Test of LIEBE Online intervention procedure during 2018 shutdown:
  - Installation of new power supply cables
  - Robot tests
  - Alignment tests



KUKA robot handling the LIEBE mock up target

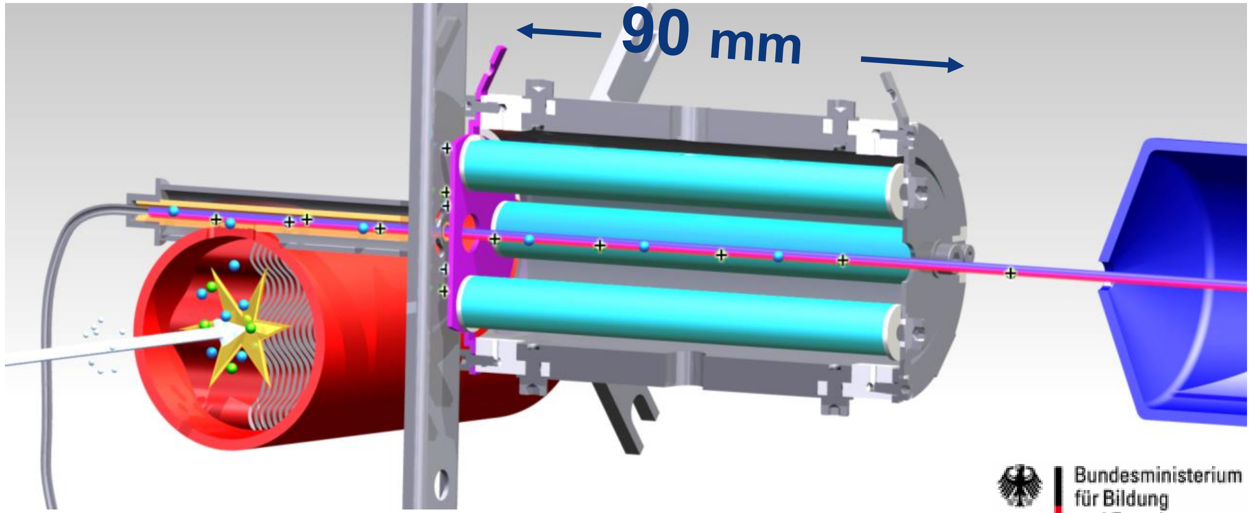


Telemax robot

- Operational review to be scheduled
- Target to be installed on GPS end of October 2018

LIST v 1.0

HFS studies of polonium / supression of francium (IS456, September 2012)



Isobaric suppression > 1000, efficiency loss ≈ 50

On-line implementation and first operation of the Laser Ion Source and Trap at ISOLDE/CERN, D. Fink et al**., NIMB 344**, 83-95 (2015)

In-Source Laser Spectroscopy with the Laser Ion Source and Trap: First Direct Study of the Ground-State Properties ^{217,219}*Po*, D. Fink et al., **PRX 5**, 011018 (2015)

LIST v 2.0

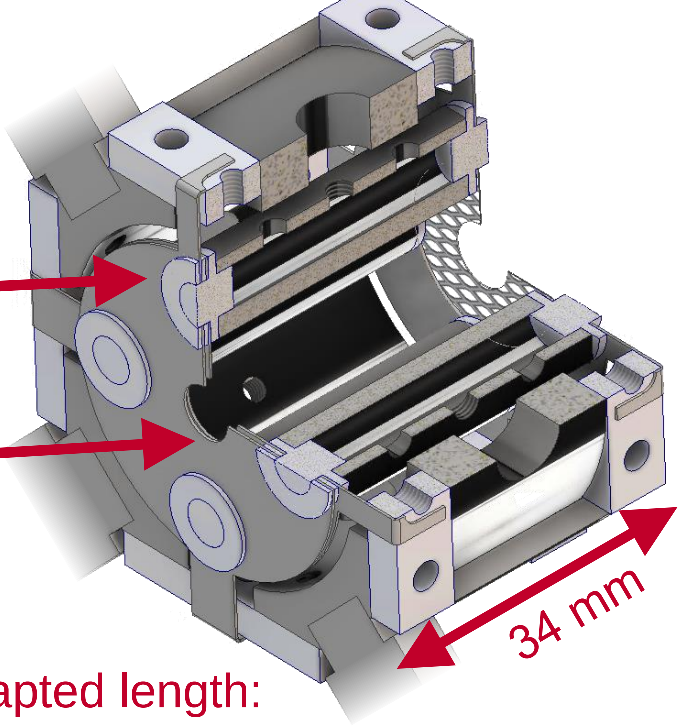
Upgraded 2018 **LIST** laser ion source for

INTC-P-459: Measurement of the super-allowed branching ratio of ^{22}Mg

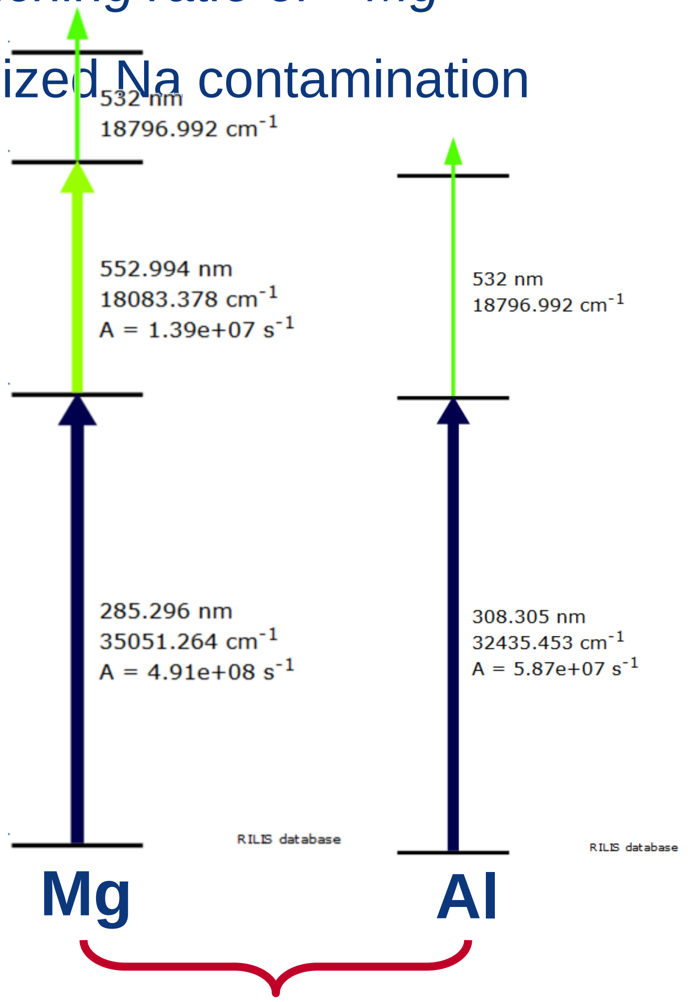
- Laser ionization of Mg - suppression of surface ionized Na contamination

Compact isolator design:
Narrow spacing to atomizer

Dual repeller:
Ion and electron suppression



Adapted length:
Reduced deposition and compatibility to additional purification techniques



Ideal opportunity for Al yield checks

- Operation analog to 2012
- 1 unit available, 2 more machined at JGU workshop right now
- Robot handling tests with mock up unit in shutdown

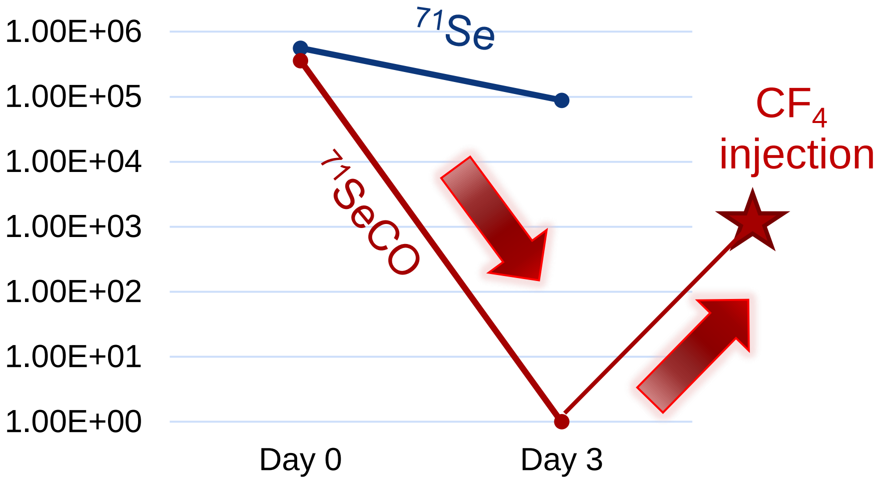
Neutron deficient SeCO beams

Principle: Se + CO → SeCO

Shifting the mass to get pure beams

Beam available since many years.

but….



- SeCO gone after a few days
- Atomic Se still released after days

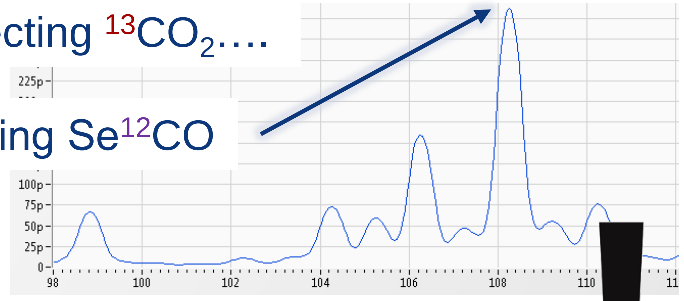
Target #605 and #612

Zirconia fibers, stabilized with ca. 10% Yttria

Why does SeCO disappear, even if we inject CO_2?

Injecting $^{13}CO_2$….

…extracting $Se^{12}CO$



Injected CO_2 gas does not promote SeCO formation!

What's the source of carbon?

Carbon from the ion source?

-> Placed graphite grid, but still depleting

Carbon from the target material?

-> EDS (preliminary) shows no carbon in ZrO fibers

Indications, that CF_4 gas might serve as carbon source. Work in progress.

Studying molecular beam formation

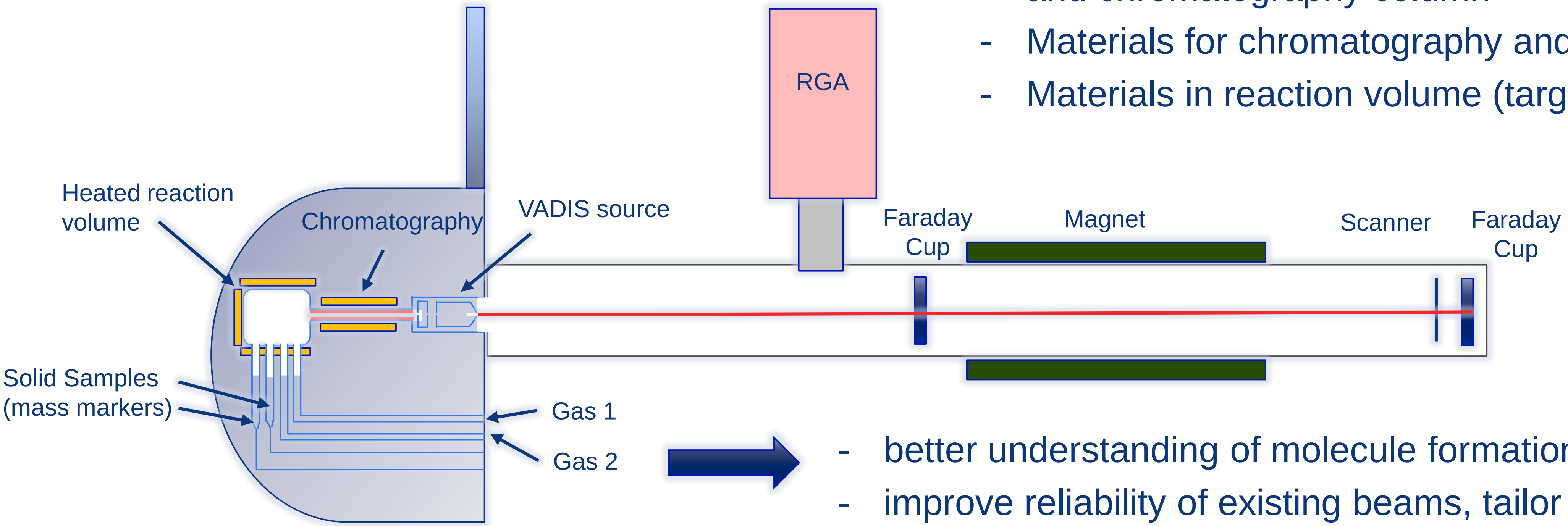
Concept for a dedicated development unit for molecular beams

Study chemical reactions

- Injection of gases and vapor of solid samples into reaction volume
- Suppression by quartz and other materials

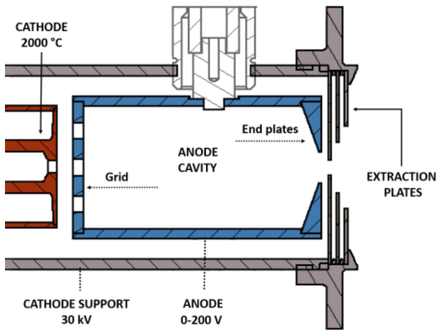
Parameters

- 2 gases, controllable flow rates
- 2 mass markers
- Controllable temperatures in reaction volume and chromatography column
- Materials for chromatography and
- Materials in reaction volume (target matrix)

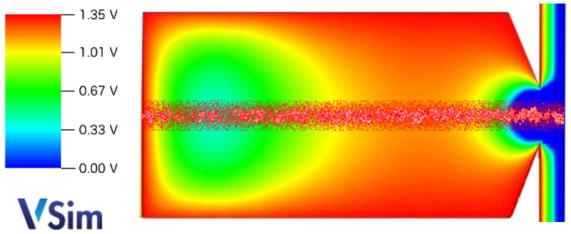


- better understanding of molecule formation
- improve reliability of existing beams, tailor new beams

VADLIS Development



$V_{extraction} = 0$ V

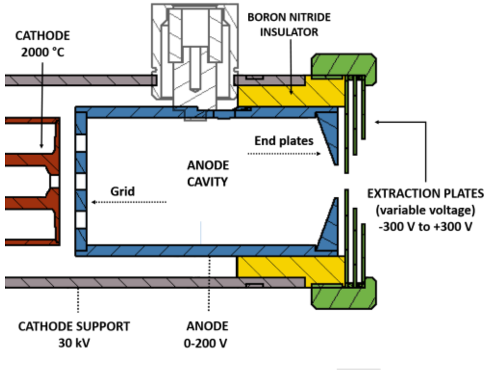


Standard VADIS

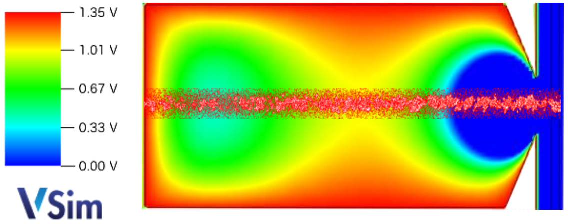
=

FEBIAD MK5 (but with Mo anode)

PhD work: Yisel Martinez



$V_{extraction} = -100$ V



Prototype tested for Ga at OFFLINE 1

At least 2 X efficiency improvement

Continued work of PhD student David Leimbach

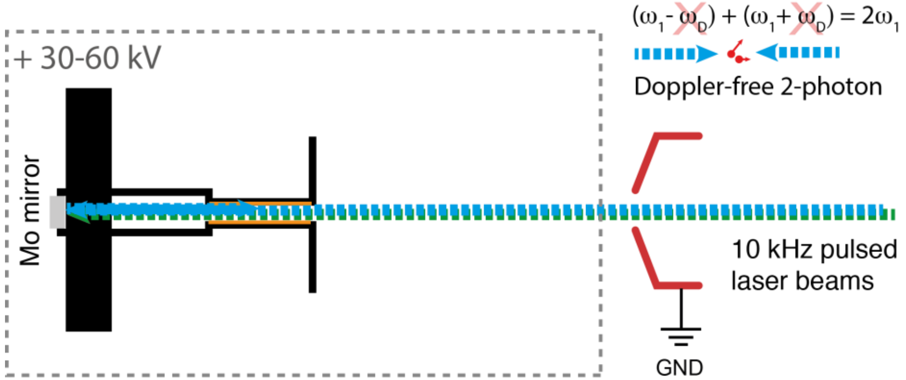
Tested at Online at ISOLDE for Hg, Mo, Mg (target #630)

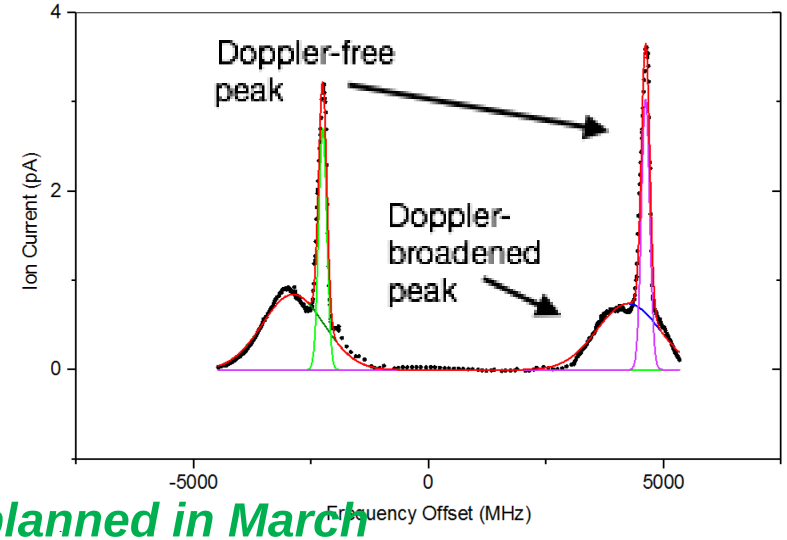
Factor of >2 improvement in RILIS-mode efficiency for all cases

RILIS Startup Development

1) two-photon spectroscopy of stable Si and Rb.

PhD project: Katerina Chrysalidis

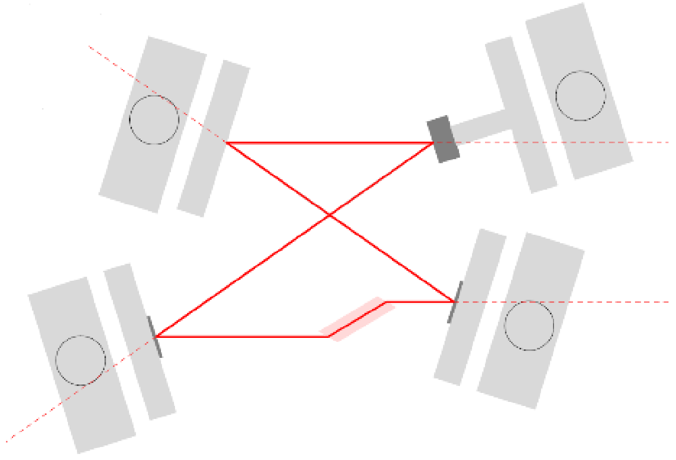




Tests planned in March

2) Samarium Efficiency measurement with alternative Blue-Blue scheme.

Injection-seeded
NB Ring Ti:Sa



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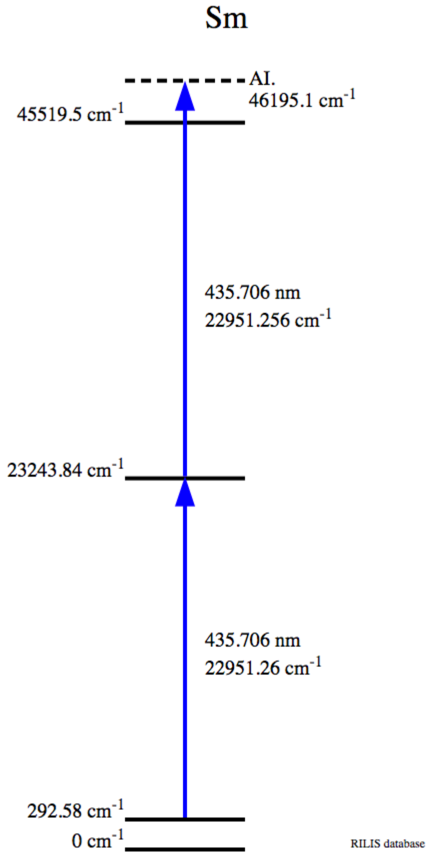
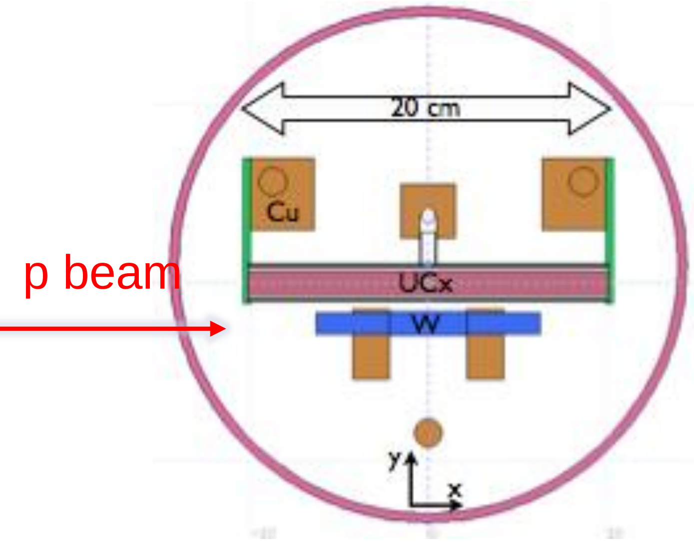
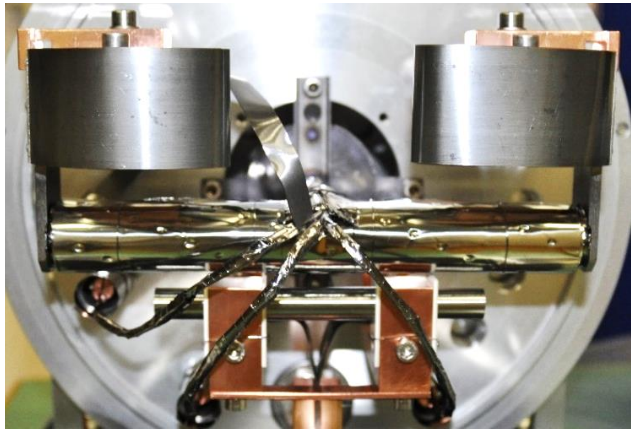
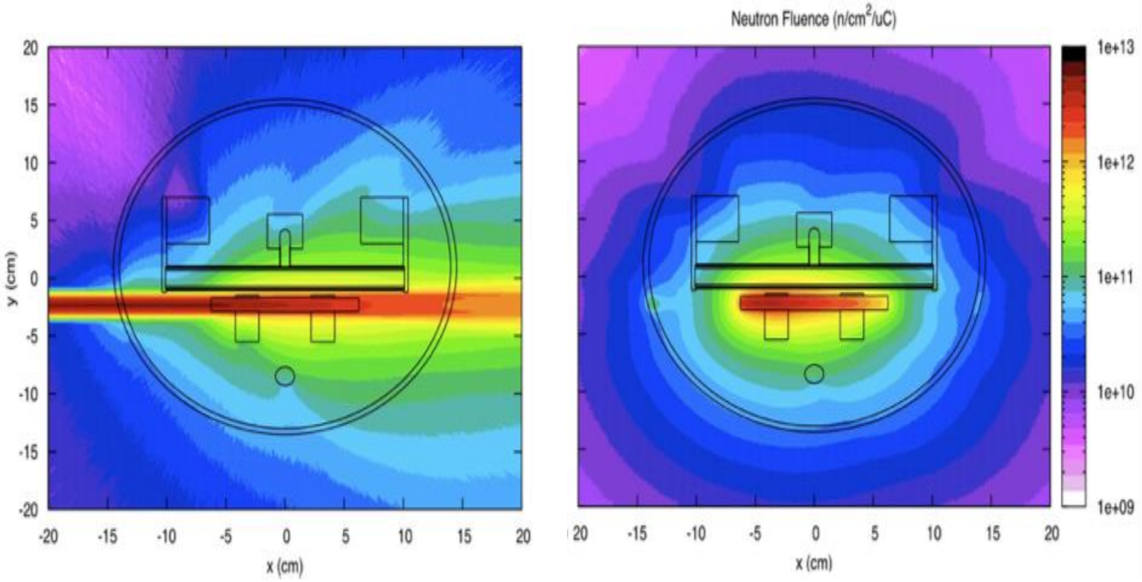


p2n-converter 1.0







Brings high purity neutron-induced fission fragments

TRIUMF

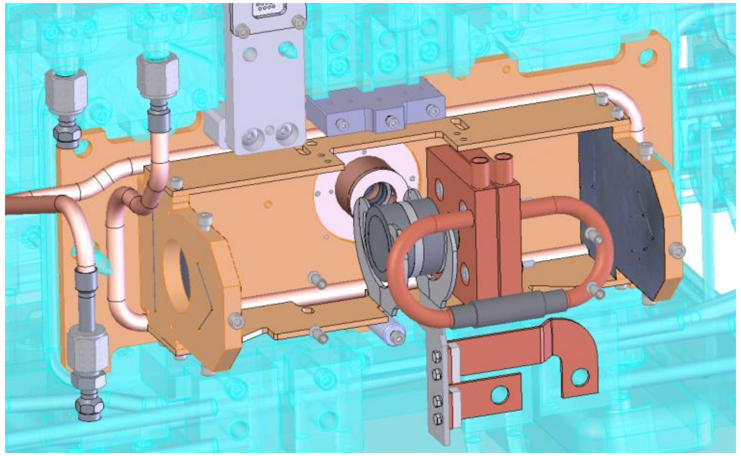
500 MeV
100 µA
cw
50 kW

ISOLDE

1.4 GeV	2.0 GeV
2 µA	6 µA
<u>pulsed</u>	<u>pulsed</u>
2.8 kW	**12 kW**

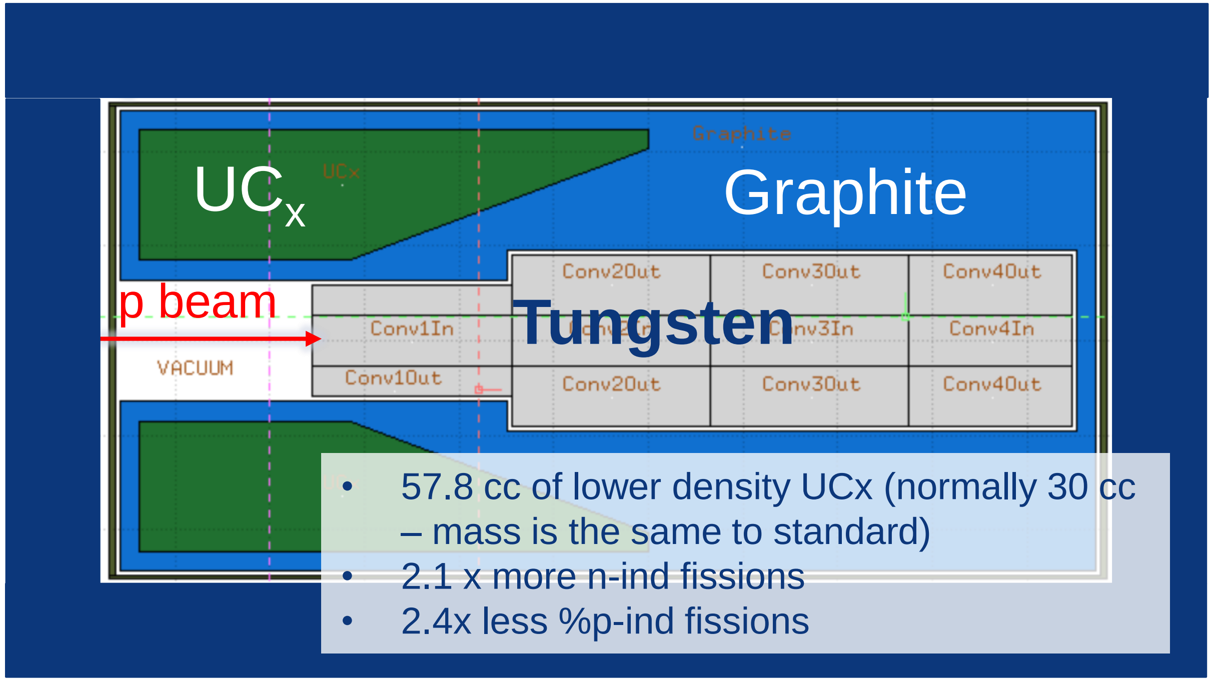
Collaboration started to design two p2n-converters:

- <u>Improve the one of ISOLDE</u>
- Design one for TRIUMF ISAC

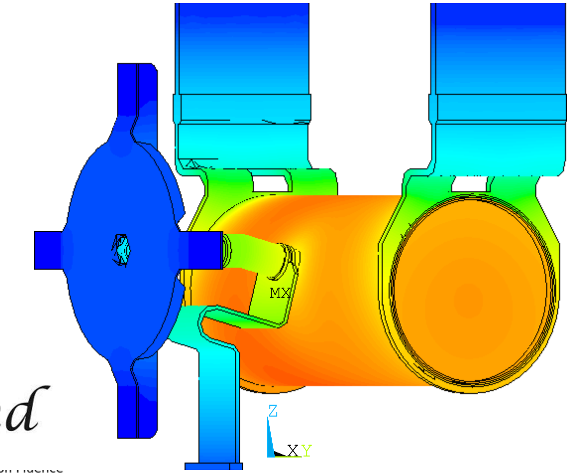


L. Egoriti, et al. (TRIUMF)

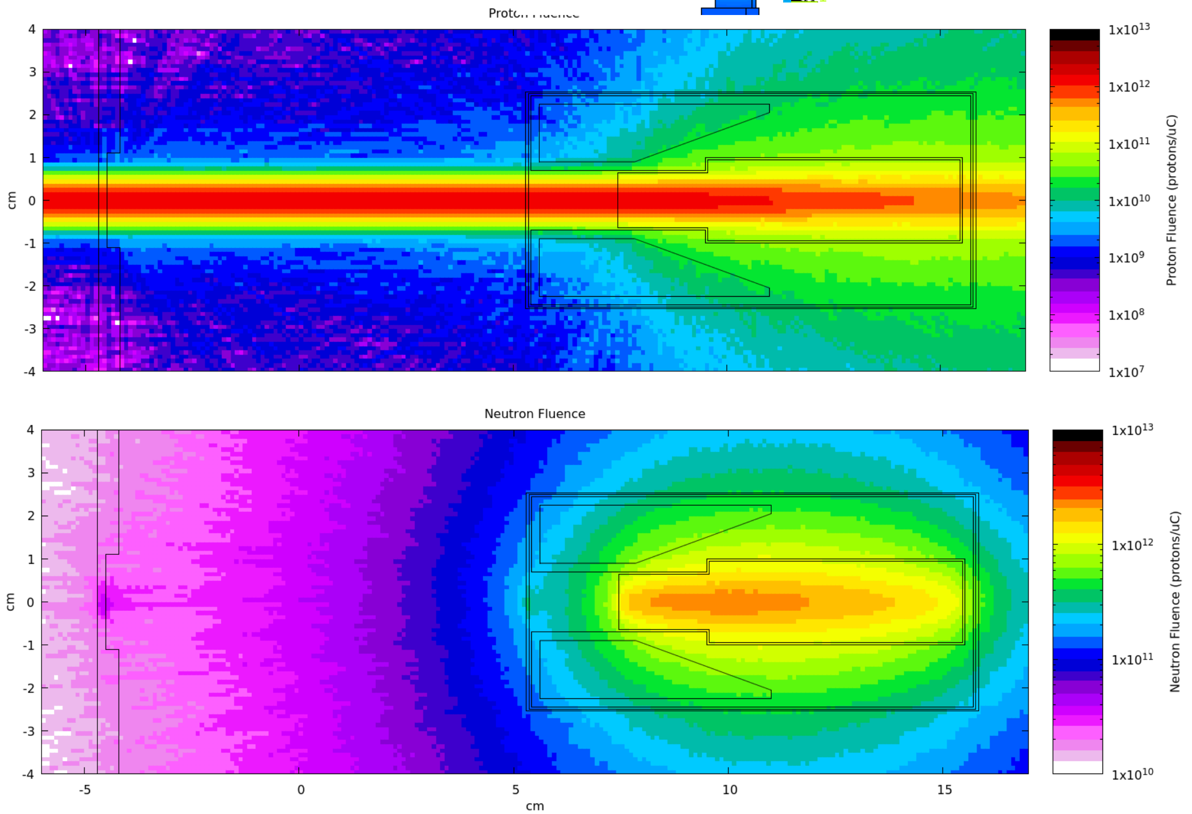
p2n-converter 2.0



- 57.8 cc of lower density UCx (normally 30 cc – mass is the same to standard)
- 2.1 x more n-ind fissions
- 2.4x less %p-ind fissions



MEDICIS Promed



- Normal shielding – several metal foils stacked
- **New shielding: Sigratherm material – 1 cm thick**

Converter will act as internal heat source

TISD @ ISOLDE, 2018
(in order of appearance)

Dedicated TISD

- RILIS offline work Q1-Q2
- LIST 2.0 Q2
- M(CO)x formation @ MEDICIS irradiation point Q2-Q3
- p2n converter prototype test Q3-Q4
- LIEBE online Q4

Opportunistic TISD

- RILIS 2photon online Q1-Q4
- Si yields Q2-Q4
- VADLIS 1.5 online use Q2-Q4

Thanks to the TISD and RILIS teams