

# TISD activities in 2017

Sebastian ROTHE  
EN-STI-RBS



ENGINEERING  
DEPARTMENT

# Target and ion Source Development (TISD) mandate

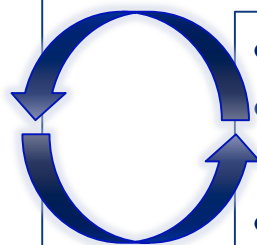


J.Ballof Y.Martinez T.Stora M.Delonca S.Rothe J.Ramos

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

Constant development 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



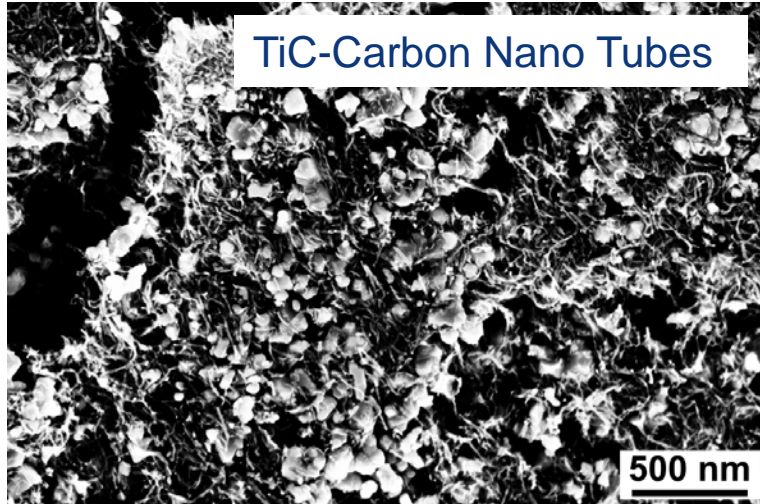
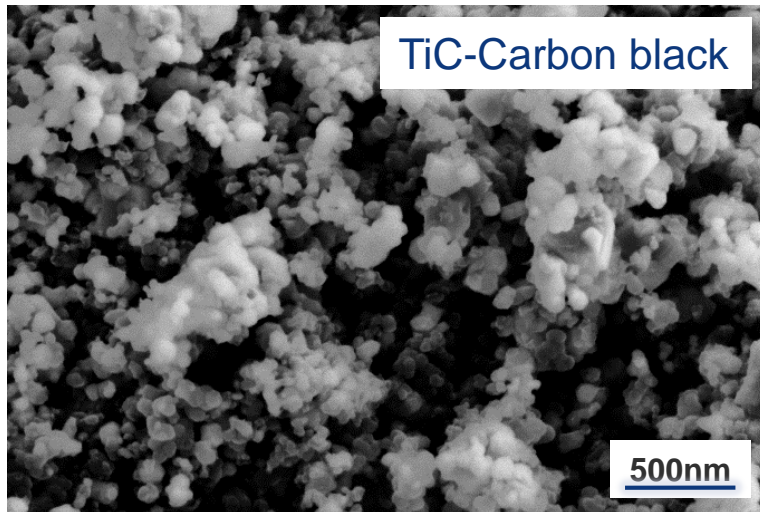
- yield & release study
- ion source efficiency measurements
- prototype tests

Sharing same resources as the ISOLDE physics program

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

# Outline

- Ongoing developments
  - Nano materials
  - LIEBE tests
  - Molecular beams
  - Negative ion source
  - p2n Converter
- TISD @ ISOLDE summary



2016

Beams extracted:

- Li (high)
- Na (very high)
- K (similar)
- Ca (much lower)

Probable chemical reaction  
with carbon black



2017 ?

Short lived K  
and Ca beams

Si beams?

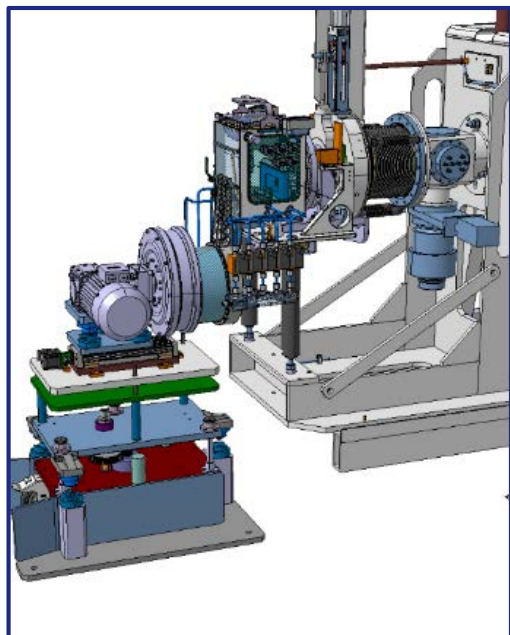
INTC-I-176

- Pending permission to work with non-pyrophoric nano-materials

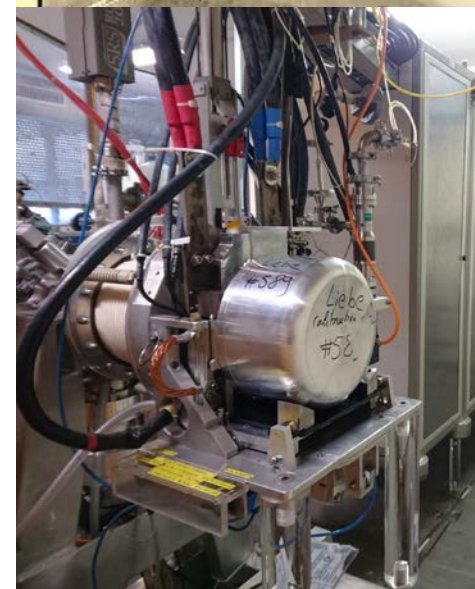
J.P. Ramos, PhD Thesis, EPFL/CERN (2017), CERN-THESIS-2016-247



# The LIEBE target – design & manufacturing



- Assembly on-going
- Ion source reached nominal efficiency
- Extensive off-line tests Q3
- On-line @ GPS Q4



# Negative ion source development

## MK4 “Pellet” LaB6 (on-line 2016)

- Yields stable over time
- Slow release for Th/Ta foils (as expected)
  - > ThO fiber target required
- Good agreement between theory and experiment

## Prototype “Tubular” GdB6 (on-line 2015)

- Low yields due to poisoning
- unstable operation
- further development required

RILIS Atomic beam unit PISA



Pumpstand



## Scope:

- Test different materials
- robustness to thermal stress
- investigate poisoning and regeneration

## Phase 1 “Electron emission” (April)

- external heater + beam extraction system (~PISA)

## Phase 2 “Poisoning/Regeneration” (June)

- Pumpstand with beam extraction system (+ Residual gas analyser)

## Phase 3 “Eficiencies” (August)

- Select material and geometry
- OFFLINE (3x1 weeks)
  
- 1 Master student (Gothenburg Univ.) starting April

# Molecular beams: Metal-Carbonyls

Motivation Potentially 9 new beams with the same method!

1																	2
H																	He
3	4											5	6	7	8	9	10
Li	Be											B	C	N	O	F	Ne
11	12											13	14	15	16	17	18
Na	Mg											Al	Si	P	S	Cl	Ar
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
55	56	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs	Ba	La...	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn

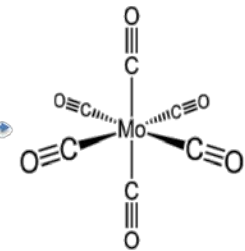
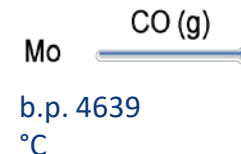
Legend:  Beam available  
 Form carbonyls

**Letter of intent**  
INTC-I-178

RP-process study 86Nb  
Medical isotopes 191Os  
Laser spectroscopy W-Ir

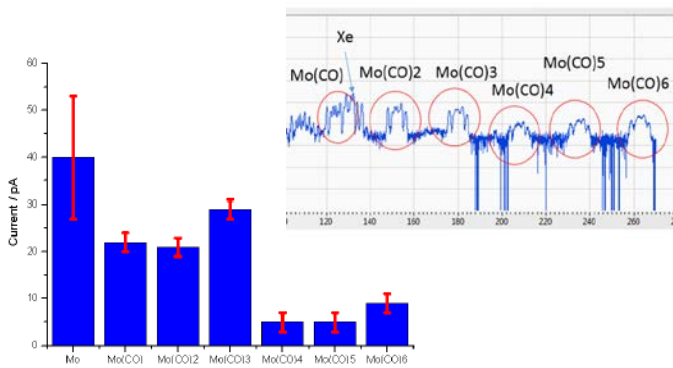
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## Method

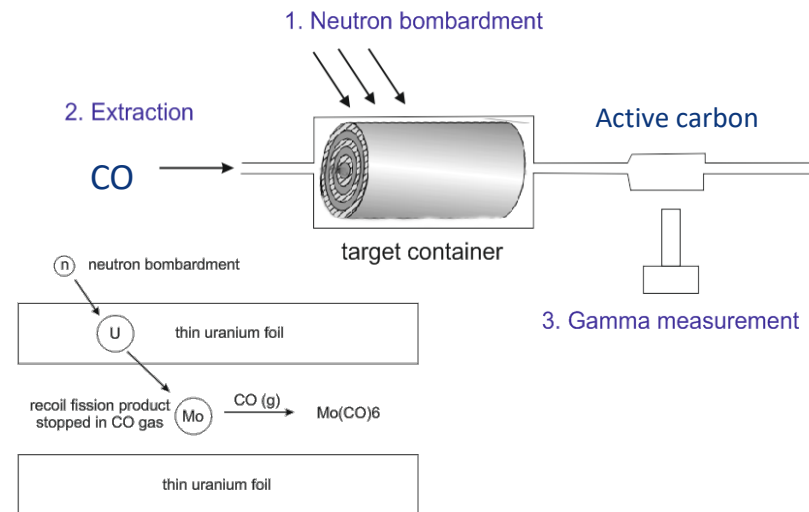


**volatile!**

## First results: OFFLINE



## M(CO)x formation at MEDICIS irradiation point



- Validate production and stopping simulations
- Carbonyl formation and survival



# Ion source simulations: VSim



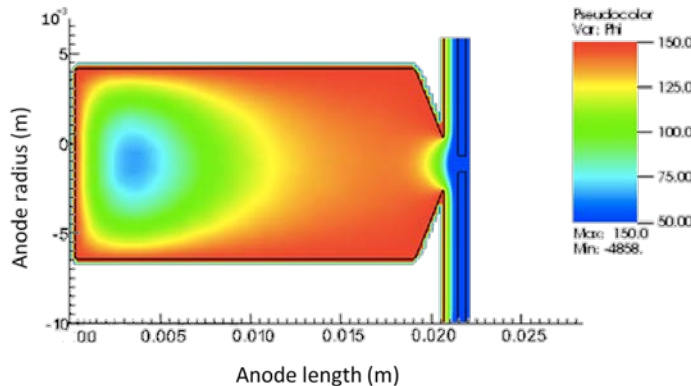
Is a flexible, multiplatform, multiphysics software tool for running computationally intensive electromagnetic, electrostatic, magnetostatic, and plasma simulations in the presence of complex dielectric, magnetic, and metallic shapes.

(<https://www.txcorp.com/vsim>)

1 kCHF per core / year

License purchased for 2016/17

## Current: Full Simulation VADIS ion source



- 1<sup>st</sup> reproduction of electrostatic field distribution inside the VADIS using PIC code
- Optimize the anode geometry to reduce inactive volume for an increased efficiency/faster ion extraction
- Determine beam emittance and energy spread, compare with experimental results
- Better understanding of the processes taking place in the volume
- Precise description of the plasma properties

## Future :

Establish collaboration with other facilities using VSim (e.g. SCK.CEN)

Extend studies to other ion sources:

ToF-LIS dynamics

Negative ion source geometries



# p2n-converter development

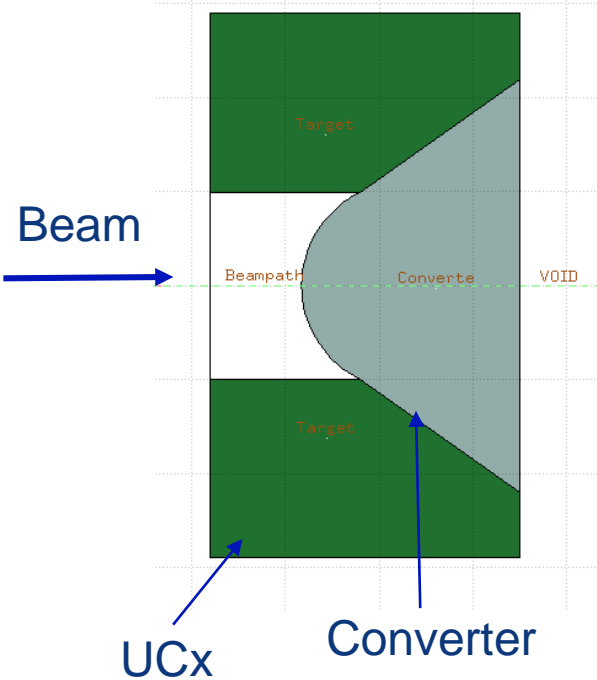
Within CERN-TRIUMF MoU + SCK-CEN



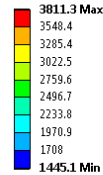
J.P. Ramos



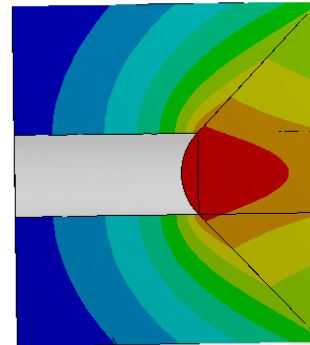
50 kW , 500 MeV beam



J: Steady-State Thermal  
Temperature 2  
Type: Temperature  
Unit: °C  
Time: 10  
31-Jan-17 15:10

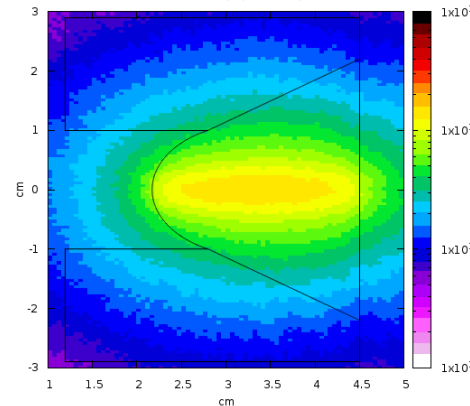


ANSYS

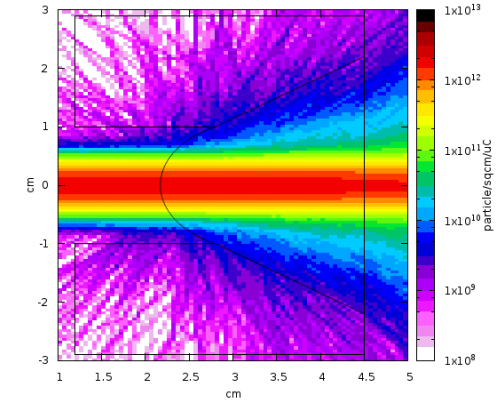


FLUKA

Neutron Fluence Map (particle/sqcm/UC)



Proton Fluence Map (particle/sqcm/UC)



Preliminary time line:

Apr-2017

Sep-2017

Jan->May-2018

?-2018

Aug->Dec-2018

Concept Design + Offline Tests

Prototype ready

**ISOLDE test**

TRIUMF tests



07.FEB.2017

S.ROTHE | 78th ISOLDE Collaboration Committee meeting

# Expected TISD @ ISOLDE

- Sc: Ti foils (CF4, RILIS)
- Te: yields with RILIS
- M(CO)<sub>x</sub> formation @ MEDICIS irradiation point
- ThO felt + Negative ion source
- LIEBE @ GPS-online
- STAGISO beam test
- Si from UCx
- TiC-CNT (pending safety clearance)



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