

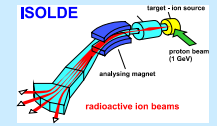
# Technical Report for ISOLDE

Mats Lindroos

Mats Lindroos



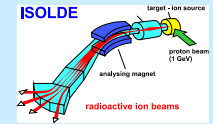
# Outline



- Shutdown work
  - General maintenance work
  - Survey of target area and drawings data base
  - Ventilation
  - REX
- RILIS upgrade and LARIS commissioning
- Target R&D



# Shutdown status

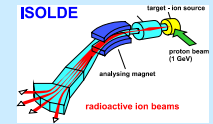


- ISCOOL consolidation (repair vacuum leaks, repair RF amplifier, integrate controls, etc) - ongoing
- New stand-alone target water-cooling (separation from vacuum system) - ongoing
- Replacement of the vacuum pumps at the GPS separator - done
- Integration of REX into the ISOLDE controls, new applications and update of existing ones - ongoing
- Target-zone ventilation modifications (activated air release at GPS FE) - studies done - ongoing
- Replacement main target-zone ventilation motor - done
- Yearly maintenance on vacuum, water, power (HV), etc. - ongoing

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# Survey and drawings

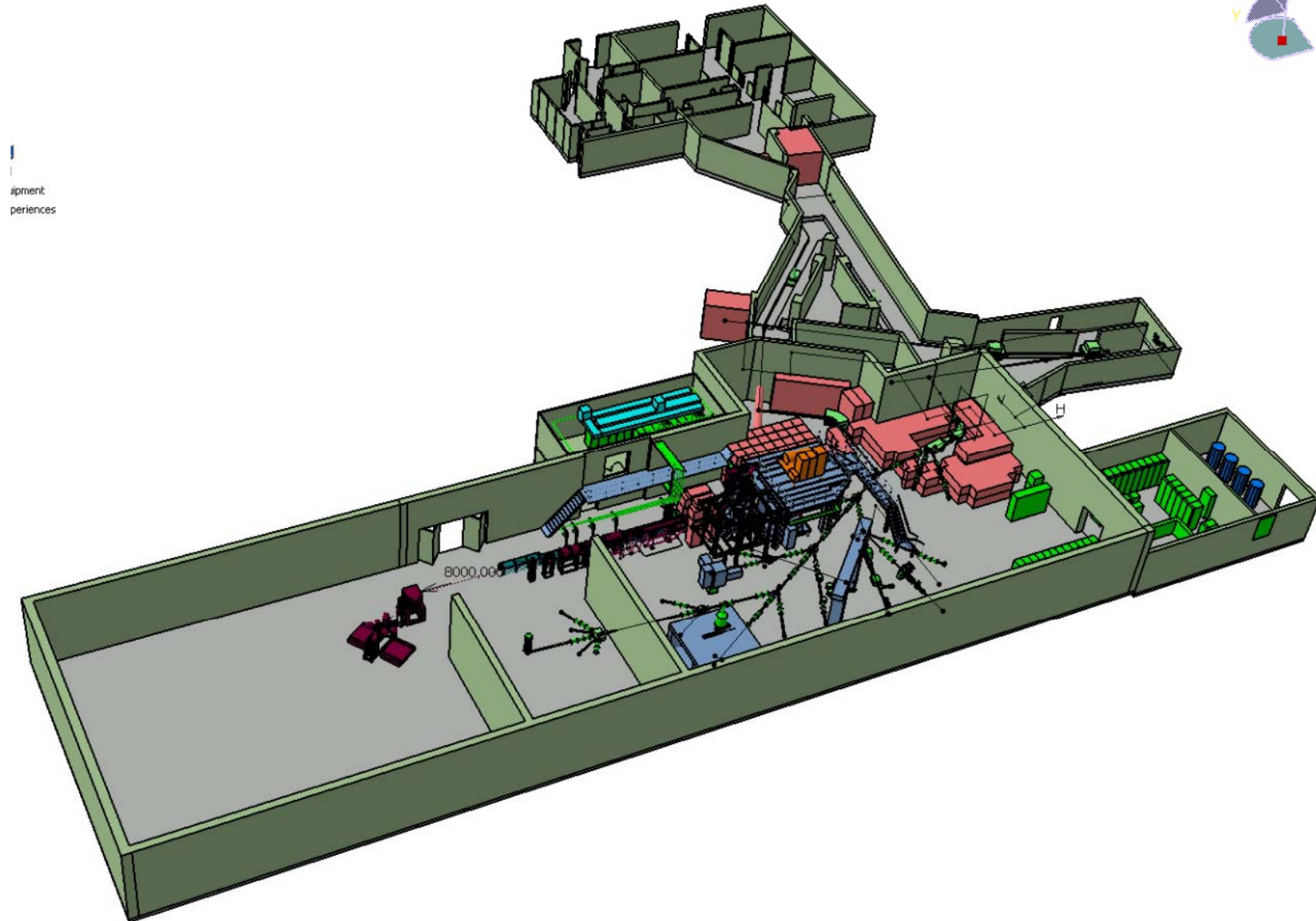
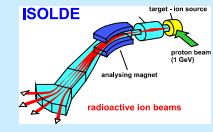


- In view of HIE-ISOLDE:
  - Out-door survey of target area shielding (hill) in progress
  - 3D scan of target area will be done in the 1<sup>st</sup> week of April
  - Class A lab structural survey to verify and improve drawings
- Lay-out drawings of ISOLDE hall
  - Drawings available in the hall (pin board) and on the CERN drawings database

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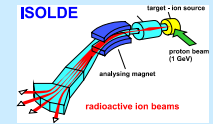
# Lay-out drawing



Equipment  
experiences



# Installation of target cooling water distribution panel

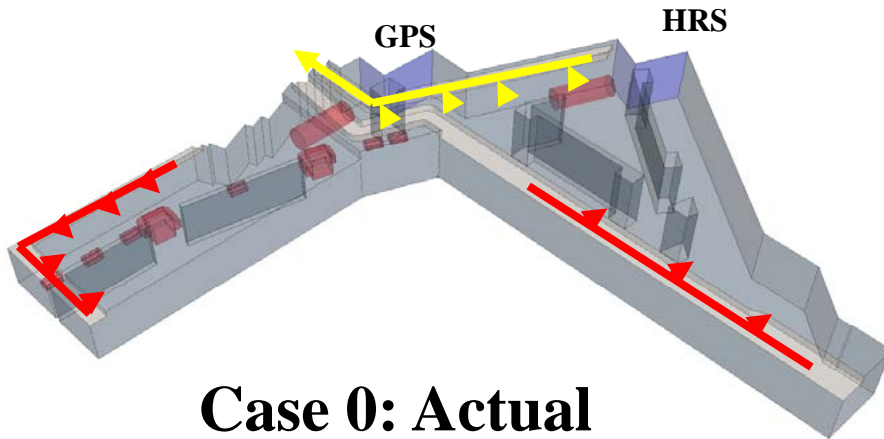
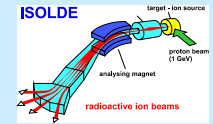


- Separation of water and vacuum in automat where one sometimes interferes with the other
- Outcome of "white powder" meeting, will no longer be an orphan.
- Support from TS-CV
- Easier access

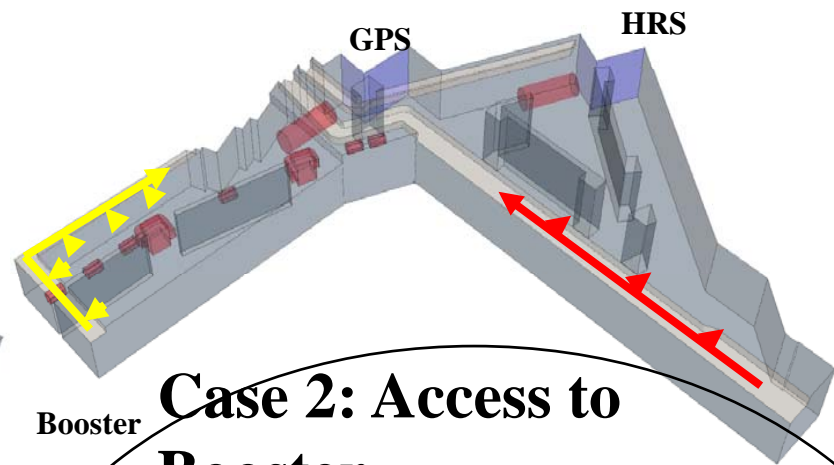
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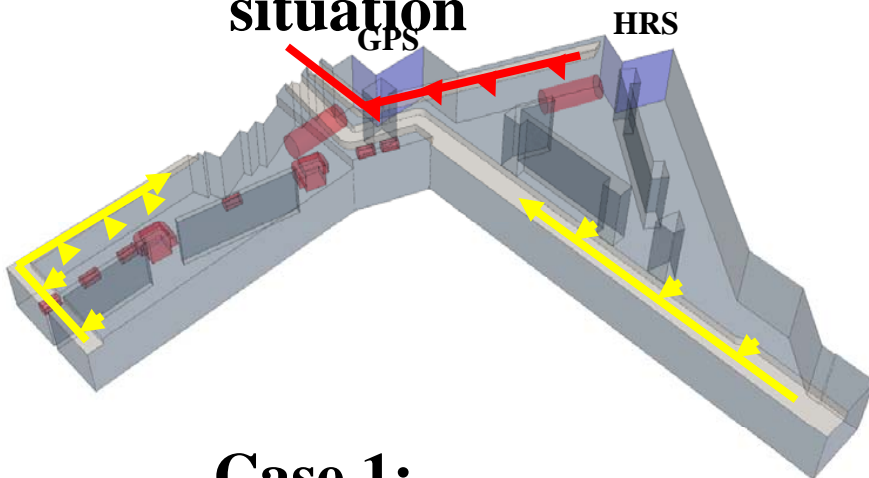
# Ventilation scenarios



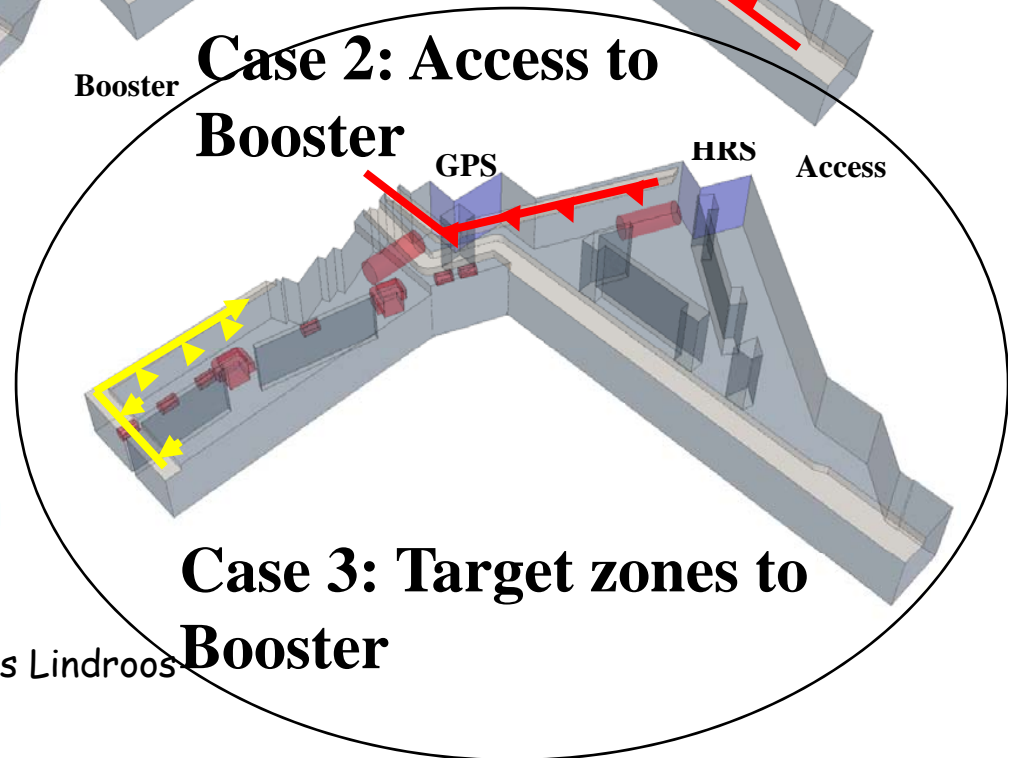
**Case 0: Actual situation**



**Case 2: Access to Booster**



**Case 1: Inversion**

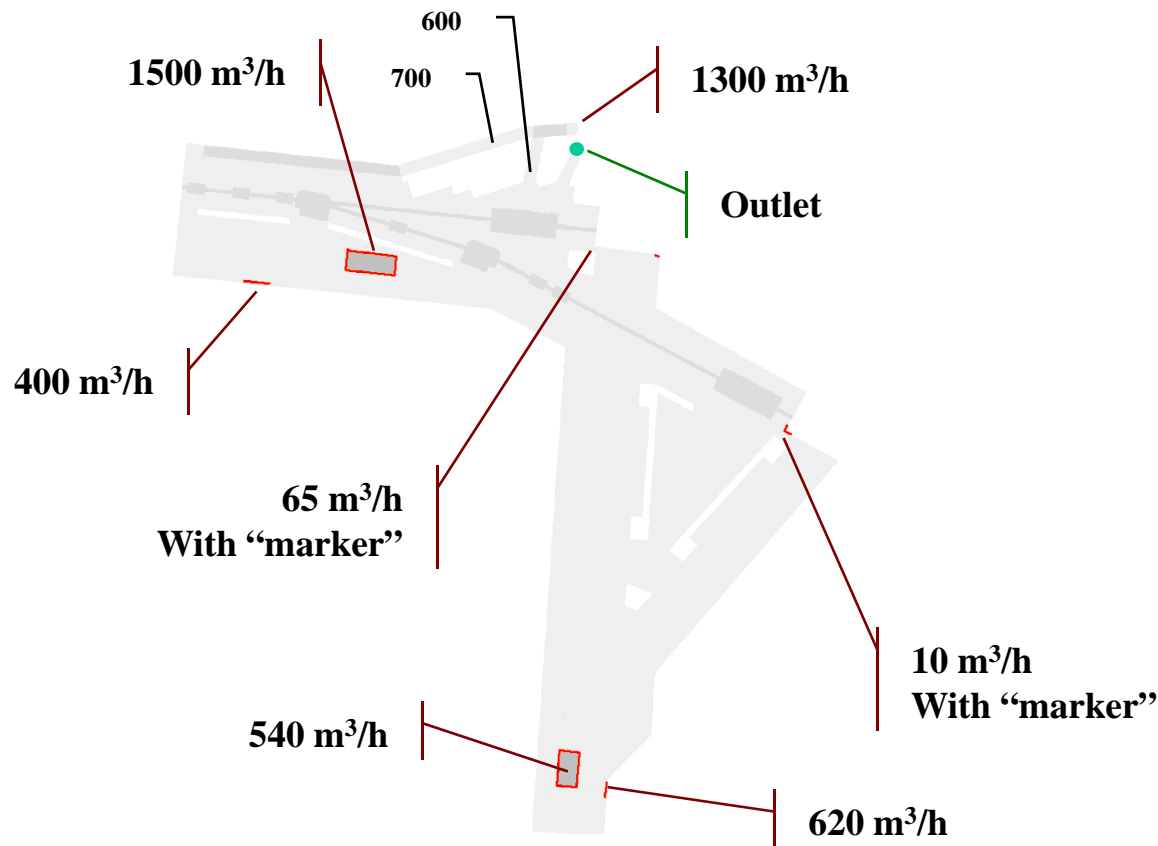
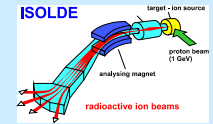


**Case 3: Target zones to Booster**

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# Ventilation measurements



Measurements done in  
"beam mode" during  
2007/2008 shutdown

Objective: To minimize  
leaks so as to reduce debit  
whilst maintaining  $\Delta P$

Total inflow :

4500 m<sup>3</sup>/h

Air Temperature :

20 °C

Magnets Temperature :

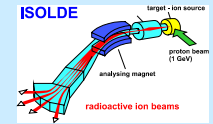
35 °C

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# Radioactive Waste Management: Target Dismantling



- Separation of target materials into 4 categories as required by NAGRA
  - Aluminium, target material and ion source, other metals, organics and ceramics.
- Radiation dose levels are limiting the number of targets that can be dismantled
- Contamination by default due to coupling to the Front End
- Systematic measurements of alpha/beta contamination for waste characterization

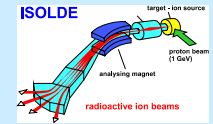
Campaign	No. of targets	Total Personnel dose ( $\mu\text{Sv}$ )	Average personnel dose / target ( $\mu\text{Sv}$ )	Max dose per target ( $\mu\text{Sv/h}$ )
1	24	100	4	15 (at 40cm)
2	30	500	17	3000 (contact)



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# Future projects

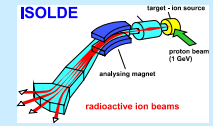


- HIE-ISOLDE: Alignment system setup in the target-zone - ongoing
- FE6 preparations - ongoing
- Preparations LA line for commissioning the new tape station (April 2008) - to start
- 'Tunnel' studies for covering the REX Linac to shield x-rays from RF when running at high energy - ongoing
- Studies to use a UPC unit for target heating protection in case of a power-cut-done
- HIE-linac study in progress

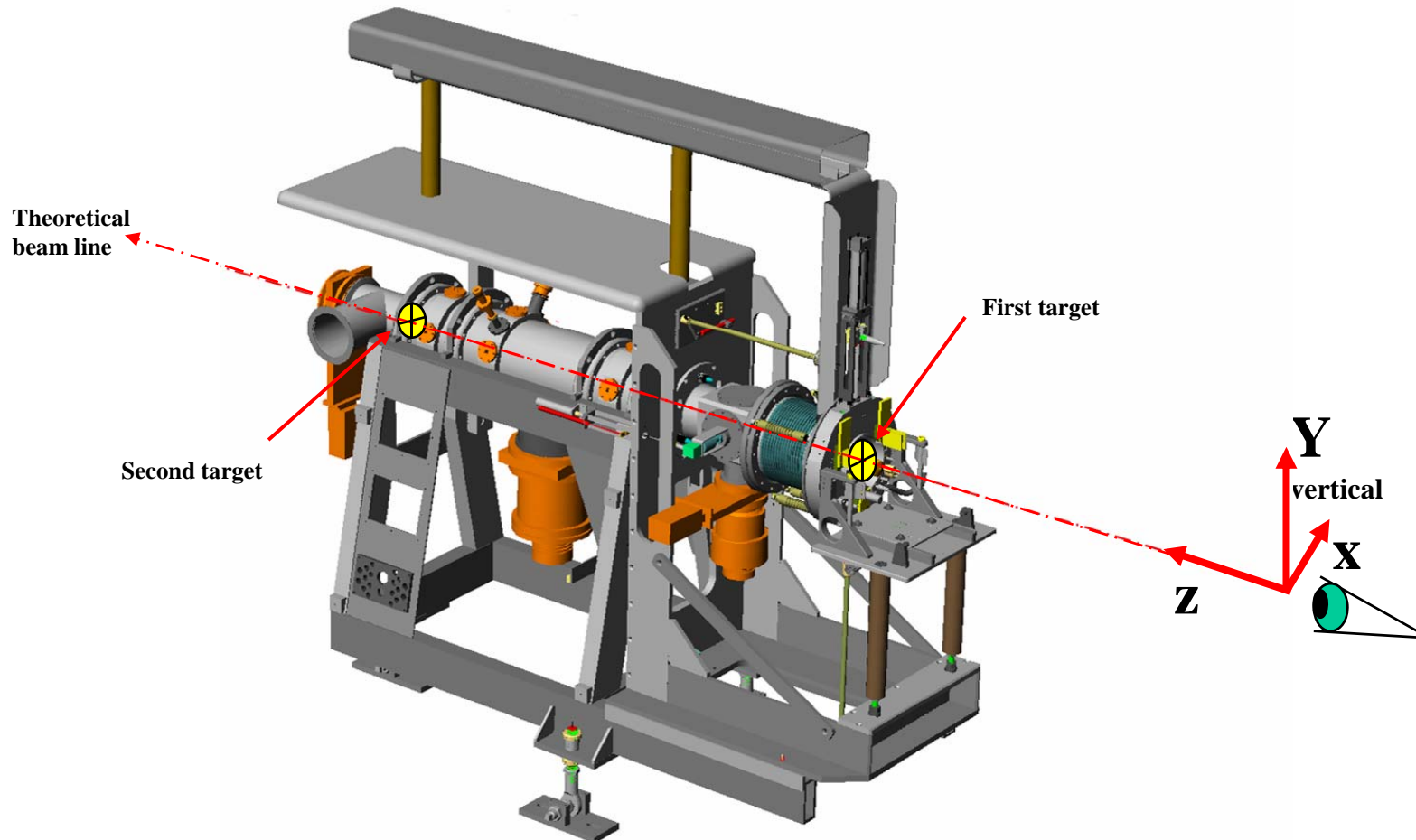
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# Alignment in the target area



- The theoretical beam line is defined by two targets on the Frontend
  - first target on the coupling cone
  - second target on the end flange



# Linac shutdown works : main projects

## \* RF

**IHS stability above 50kW**

- Coupling loop was dismantled and cleaned
- RF parameters of the cavity have been checked: loop adaptation, Q-factor, position of tuners parasitic resonance ...

**Consolidation of water cooling interlocks on the cavities**

- Replacement of mechanical flow-sensors by thermal flow-sensors : material as arrived, installation foreseen in the coming weeks



## \* Cooling and ventilation

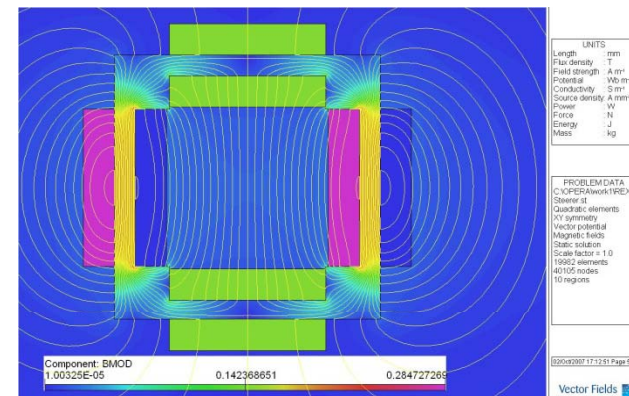
**Modification of RF room ventilation: ventilation in close circuit to improve cleanliness in the amplifiers**

- Modification of the circuit is done
- Some modifications and tuning of the cooling unit remain to be done (end of February)

## \* Magnets

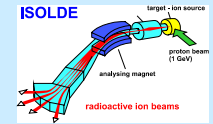
**Replacement of linac's magnetic steerers**

- Design of new magnets started
- Use of available power supplies
- installation foreseen for next shutdown





# REX Low energy shutdown works: main projects



## \* REXTRAP trapping structure

exchange insulators and upgrade the internal connection cables

-> suppress electric discharges

enlarge the internal differential pumping diaphragms

-> hope for increased trap efficiency

## \* REXTRAP RF excitation

adjust and consolidate the RF excitation electronics

-> avoid antiresonance -> better efficiency

## \* REXTRAP - proposal for complete trap consolidation

-> support for controls, power, RF, beam diagnostics)

## \* REXEBIS solenoid

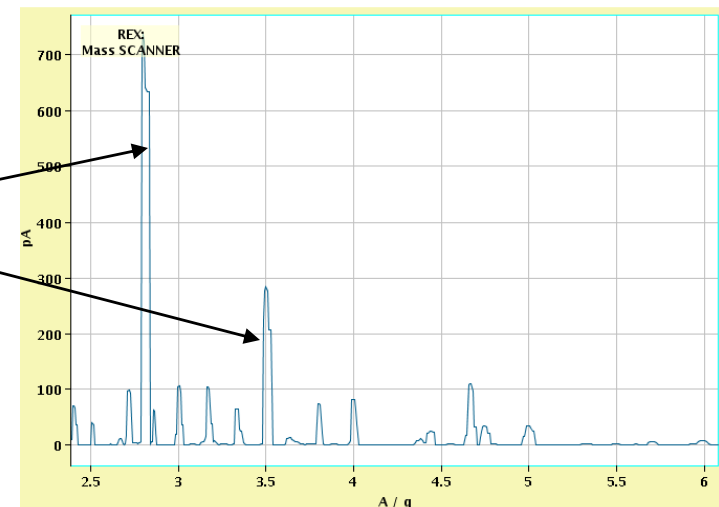
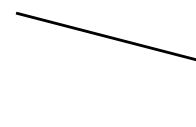
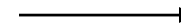
find the reason for the LHe filling blockage in the cryostat

## \* REXEBIS mass spectrum

identify the reason for the very large (>500 epA) N-peaks  
numerous investigations have failed until now

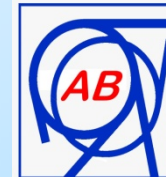
## \* Beam diagnostics

make application programmes for the beam diagnostics

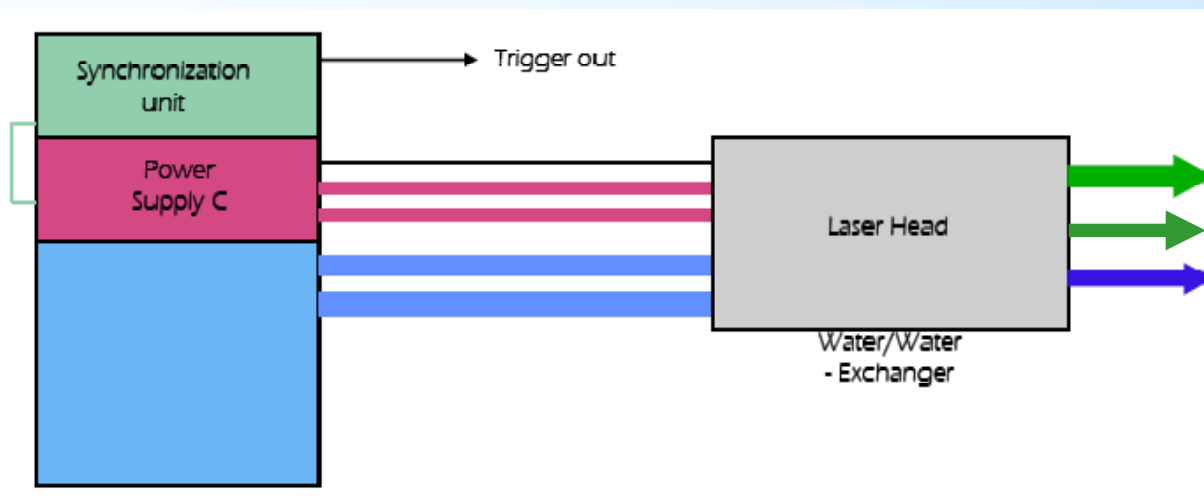




# New solid state lasers for RILIS



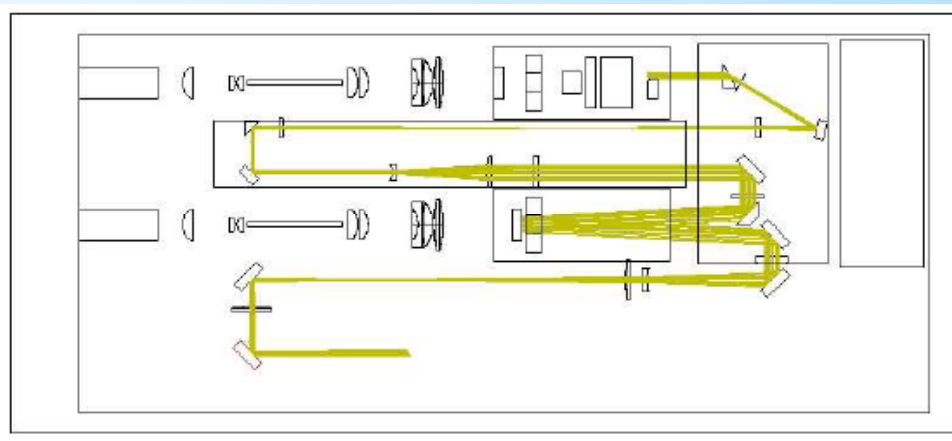
Build by EdgeWave GmbH, to be delivered in February



Green Beam A  
70-80W @ 532nm

Green Beam B  
10-15W @ 532nm

UV Beam  
15-20W @ 355nm



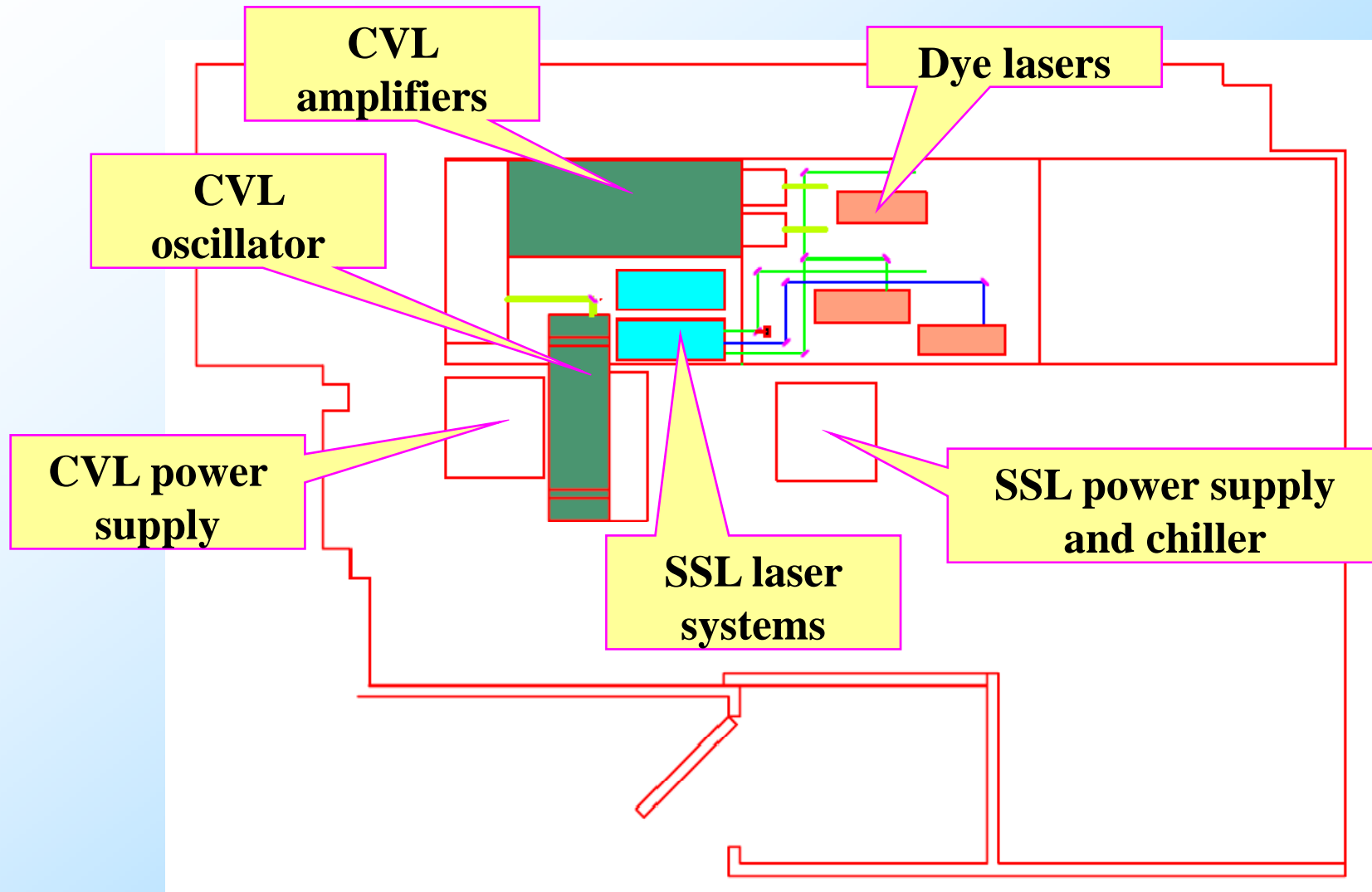
Scheme of the Nd:YAG oscillator - amplifier

- EdgeWave will build a spare laser head and power supply.
- The spare laser will be shipped to CERN before April 2008.

Warranty period = 2 years  
+ 2 years of warranty extension included



# SSL implementation in RILIS room





## Primary objectives:

- Investigate new ionization schemes (free from ISOLDE scheduling)
- Improve upon current schemes that rely on non-resonant ionization
  - search for auto-ionizing states
- Prepare for RILIS transition to Solid State Laser system
  - different wavelength range (532 nm and 355 nm pumped dye lasers)

## Secondary objectives:

- Investigate RILIS selectivity improvements
  - HFS measurements (isomer selectivity)
  - Hot cavity optimization / material testing

## Tertiary objectives:

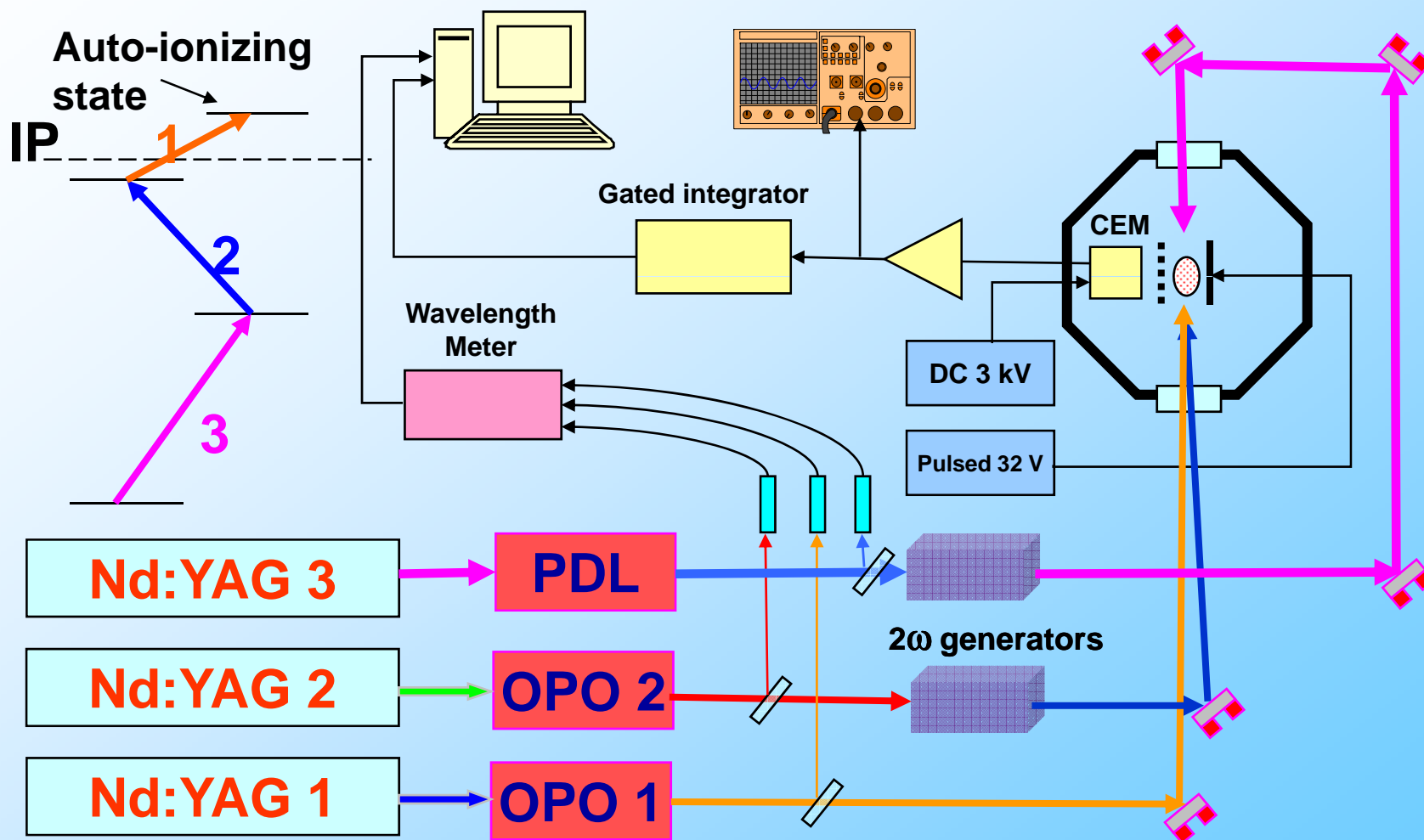
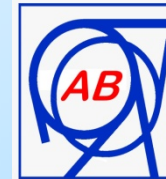
- Questions related to fundamental atomic spectroscopy, e.g. accurate determination of atomic ionization potentials.

**CERN/KTH collaboration**





# LARIS laser photoinization spectrometer



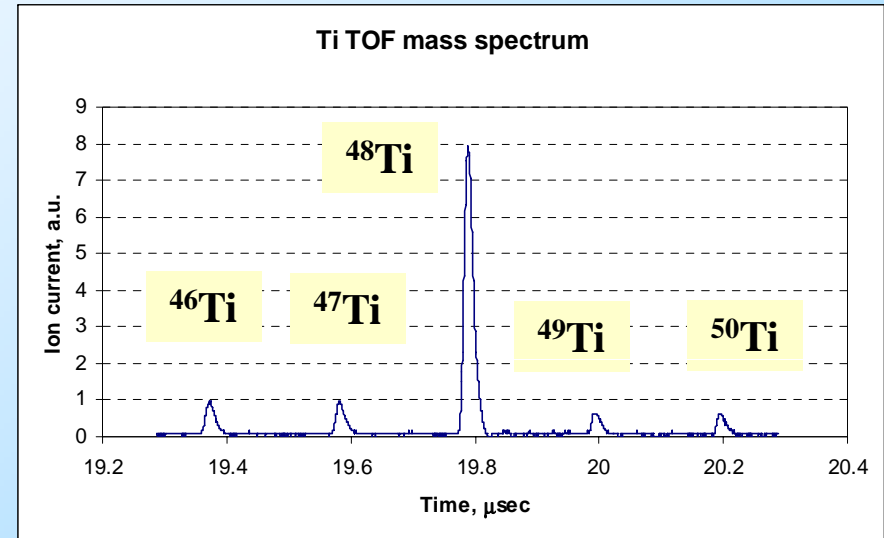
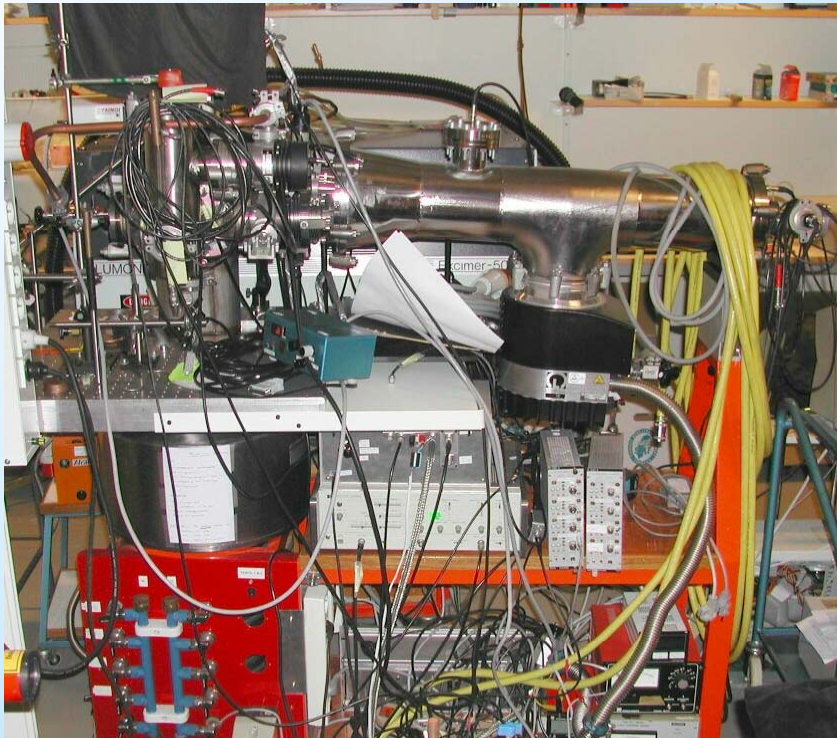


# RIMS spectroscopy



To acquire higher resolution laser spectra for specific isotopes

- Measure isotope shifts for stable isotopes
- Measure HFS for different atomic transitions in various ionization schemes
- Feasibility study for *isomer separation*



**Titanium atoms were:**

**Ablated out of rod by Nd:YAG laser**

**Transported by Ar gas**

**Ionized by MOPO beam (294.2 nm)**

**Mass-separated in TOF mass-spectrometer**

**Detected with MCP**

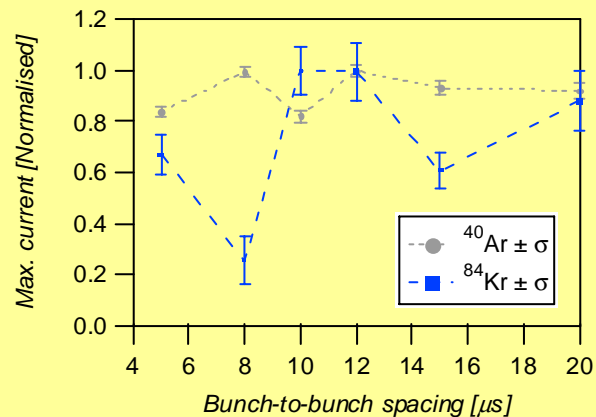
## Motivation

- PSB proton beam incident on ISOLDE targets is pulsed.
- Large instantaneous power deposition.
- Target lifetime affected.

	Current	Power
Average	1.92 $\mu$ A	2.7 kW
Bunch	8.36 A	11.7 GW

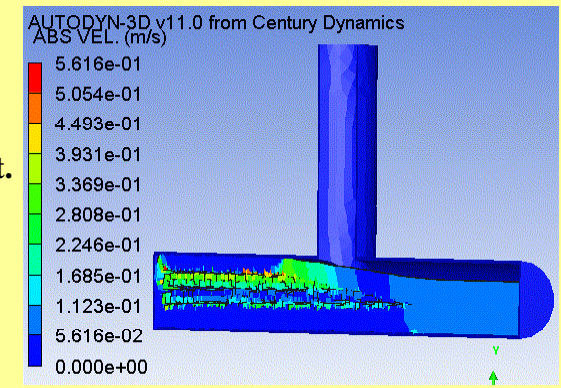
## Online tests 2007:

- Pb target #305 / MK3 ion source.
- PSB staggered beam.
- Varied PSB bunch-to-bunch spacing.



## Simulations

- ISOLDE Pb target geometry.
- FLUKA: energy deposition.
- AUTODYN: internal energy transients.
- Results:
  - Pressure wave period  $\sim 10 \mu\text{s}$ .
  - Constructive interference if PSB bunch-to-bunch spacing close to  $10 \mu\text{s}$ .



**Pb velocity profile:**  
1 ms after p beam impact.

## Outlook:

- Better understanding of pulsed beam effects for liquid metal target operation beyond  $10^{13}$  ppp at HIE-ISOLDE.
- EURISOL to go for cw beam.
  - liquid metal loops required to dissipate heat deposited on 100 kW direct targets.

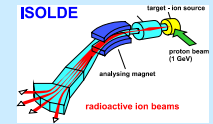


Hydrodynamics of ISOLDE liquid metal targets

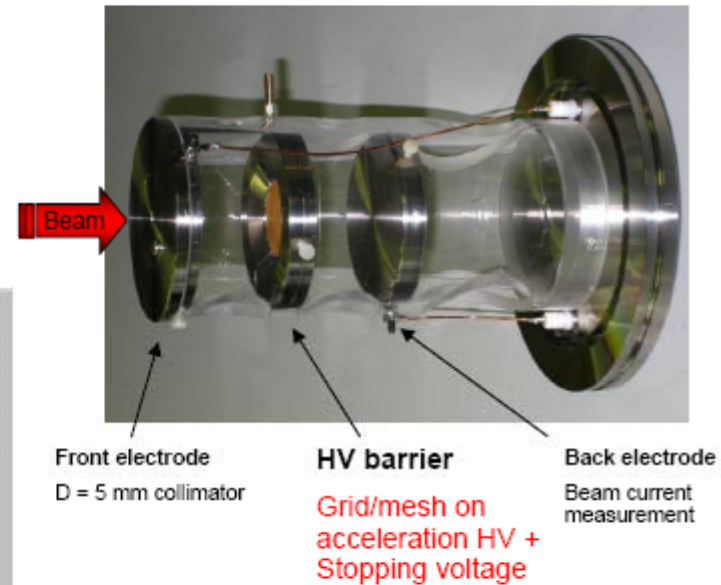
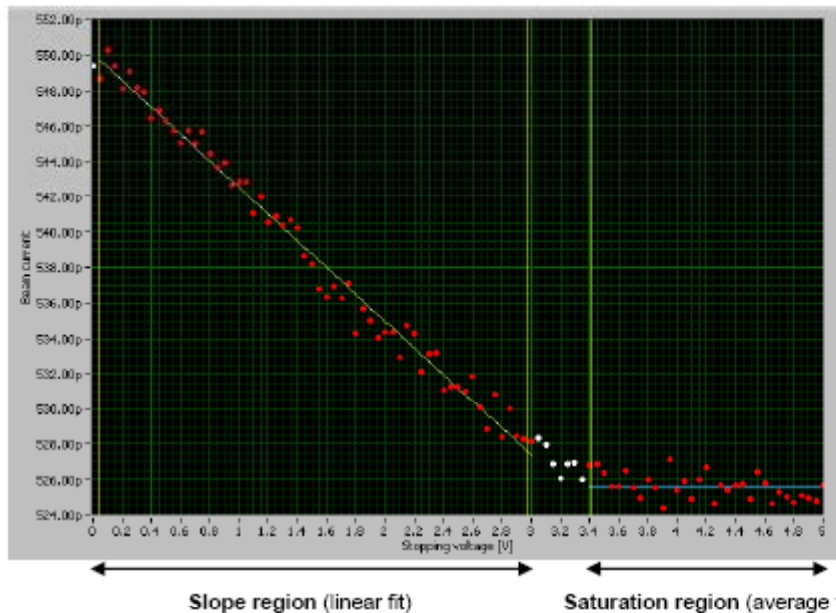
L. Bruno, R. Catherall, J. Lettry, E. Noah, T. Stora



# Beam energy measurements (P. Suominen, L. Penescu)



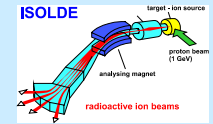
- Based on method developed at JYFL, Finland
- To extract information about beam
  - plasma potential
  - energy distribution
  - ion temperature distribution



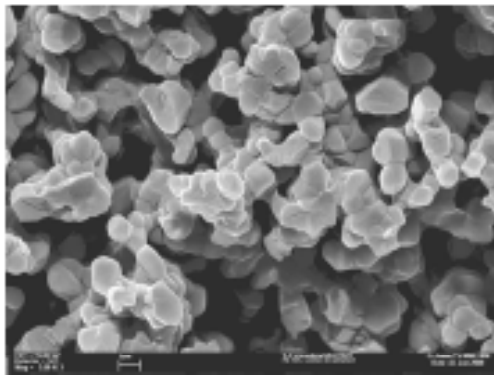
- Determined plasma potential is the x-coordinate of data fits crossing point (in this example about 3.2 V)



# 1st detailed analysis of an ISOL(DE) target material after irradiation

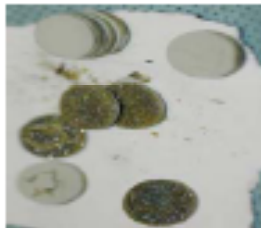


## Microstructure



Record  $^{21}\text{Mg}$  yields for COLLAPS,  
 $^{17}\text{F}$  beam for astrophysics at REX-ISOLDE

Nano – sub- $\mu\text{m}$  target material SiC-334

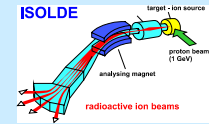


Recrystallization  
cracks identification  
Very limited sintering

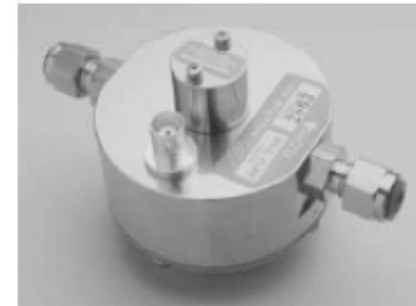
S. Fernandes et al., AB dept  
TS-MME, A. Dorsival SC-RP



# Ion source response time investigation (L. Penescu, P. Suominen, et al.)



- Controlled **gas injection** through a piezo valve:
  - time precision: ~2ms
  - adjustable flow rate
- Measurement of the **extracted current** variation

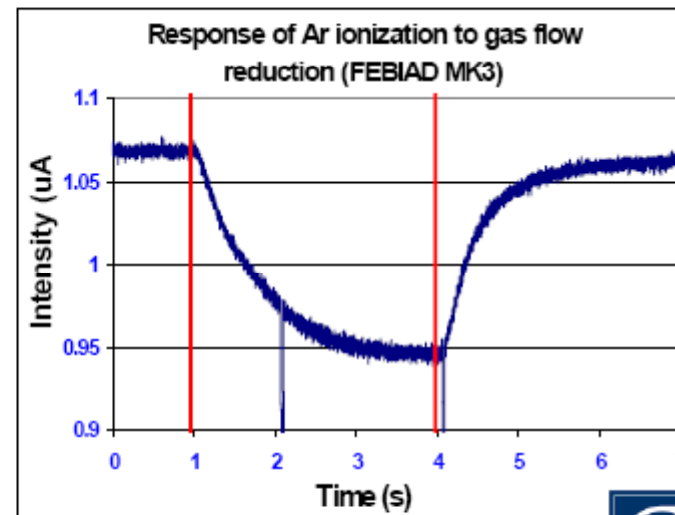
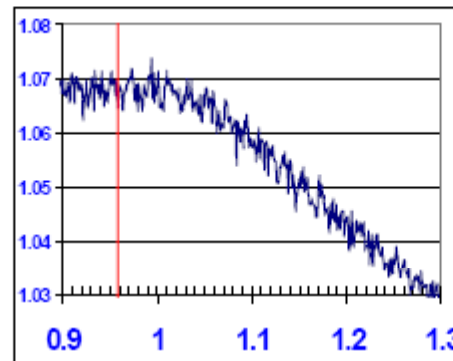


## Convolution of several processes:

- neutral effusion from the valve to the ion source;
- gas pumping;
- ionization.

## Access to:

- ionization time
- effusion time



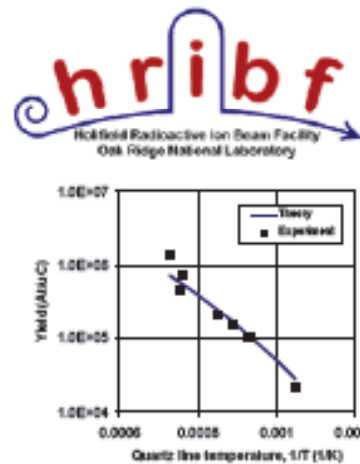
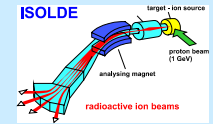
## Application:

- volatile gases at room temperature (CF<sub>4</sub>, Ar, SO<sub>2</sub>, ...)





# TISD Collaborations



## Selective trapping materials

## Nanomaterials

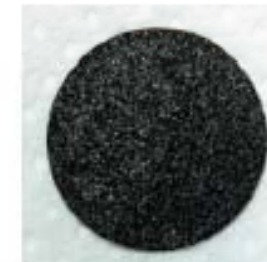


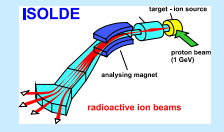
High-power targetry

**EURISOL**  
*Design Study*



## UCx





ISOLDE

HE