

# Technical News

Richard Catherall EN-STI

ISOLDE Technical Coordinator

ISCC meeting 28<sup>th</sup> June 2016

# Outline

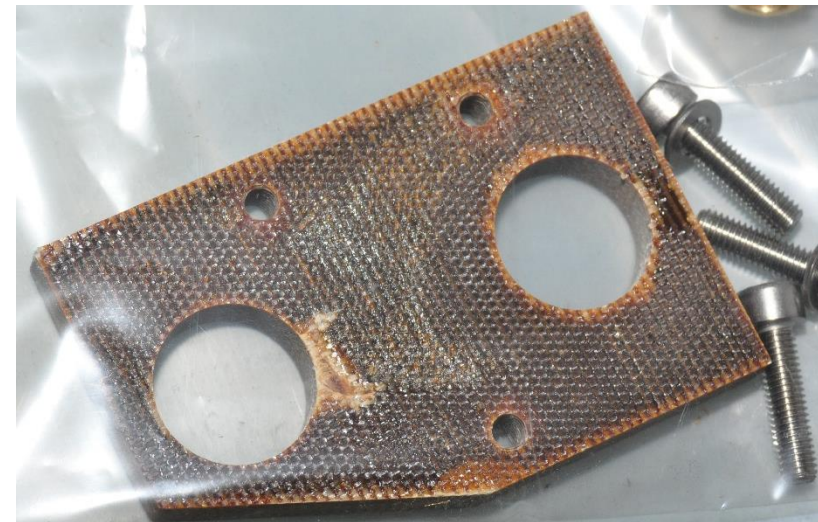
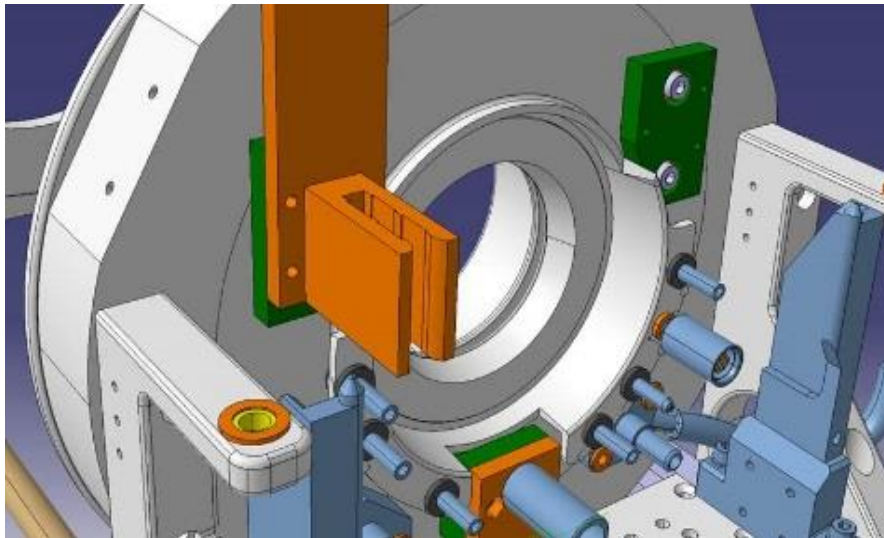
- Start up
  - Frontend issues
  - Consequences
- Target developments
- RILIS developments
- MEDICIS
- Pill Press & Tape station
- HT tests

# The ISOLDE Start up 2016

- Cold check started on the 10<sup>th</sup> March instead of the 1<sup>st</sup> March for a number of reasons:
  - Delay in the modification of the target cooling water resulting from the investigation of the water leak above the RILIS barrack last year
  - Failure of GPS Frontend connectors (target and line) insulation blocks
    - Replaced with new insulators. Investigation on old insulators on-going
  - Short circuit on HRS Frontend resulting in the inability to operate target. Insulation temporarily repaired. A more permanent solution will be implemented on Friday 18<sup>th</sup> March.
  - Beam diagnostics in HRS suffering from recurring noise problems. To be replaced for the 3<sup>rd</sup> time on Friday 18<sup>th</sup> March
  - Test target #350 on GPS had an open circuit on the anode. Replaced with target #557 Ta surface ion source.
  - Strange behaviour with GPS optics. Proceed by exchanging target #557 before further machine investigations (on-going)
  - LIEBE target preparations. All foreseen activities successfully completed however there are doubts on the Hypertak connector supports and compatibility with HT. Investigations and a better solution under way.
  - 3 successive breakdowns of GPS HT power supply. Repaired thanks to the efficiency of TE-ABT-EC
- Repetitive issues with controls globally:
  - Inca, Fesa, magnet controls, working sets, databases, plc memories...etc
  - All contributing to a very slow and difficult start up of the machine

# Replacement of electrical insulators on GPS FE

- Discovered damaged insulator on target connector GPS
- All 3 were damaged
- Replaced with new insulators
- Untightened screw caused a short circuit preventing correct target and line heating



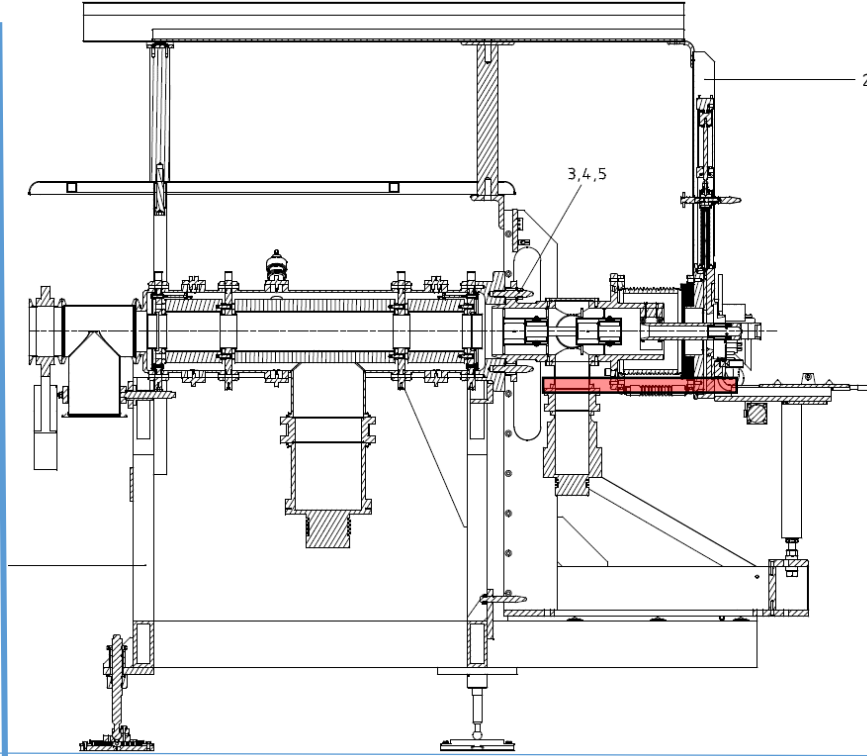
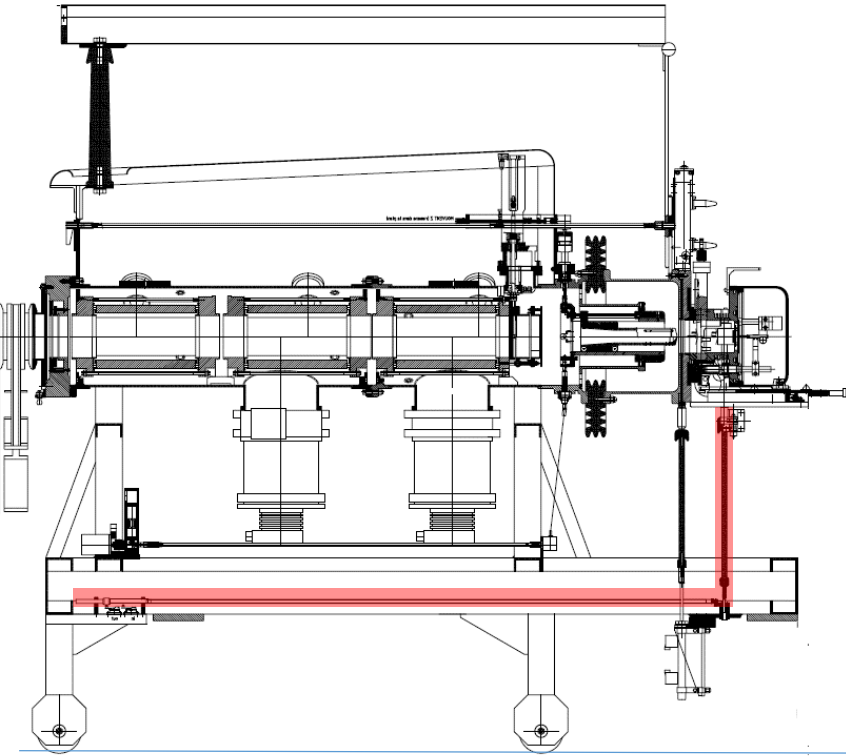
FE 1991 ... 2009 (FE 1, 2, 3, 4)



FE 2010 ... 2018 (FE 6, 7)



FE 2020 ... 2024



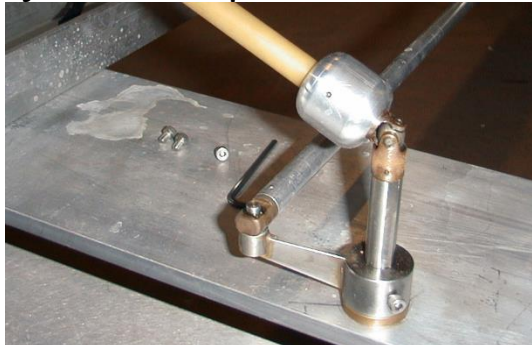
# Détection de position Clamps

## PROPOSITIONS:

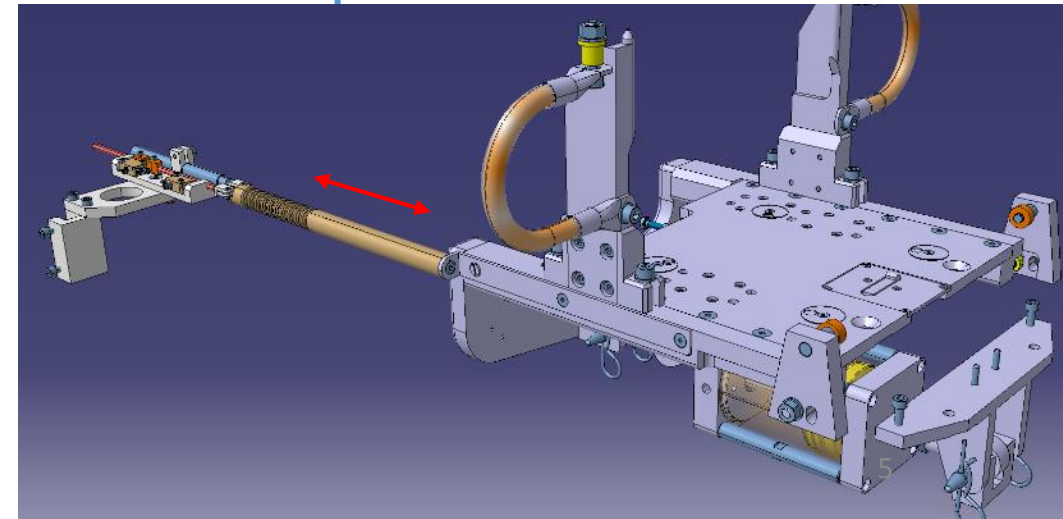
- Voir Retour Expérience à venir



- Uniquement switches (pas de potentiomètre)
- Renvoi avec articulation et tringlerie
- Problèmes de jeux et de précision



- Adjonction d'un potentiomètre linéaire
- Système avec switches dans l'axe du mouvement
- Jeux très limité



# Front end consolidation design review

- Consolidate the existing design for future operations
- Accommodate new features for operations, maintenance and target development
- Improve reliability to reduce the number of interventions and maintenance
  
- Interesting ideas were presented and yet to be reviewed before implementation.
  - Planned for next week

# Consequences

- Laser ion source cold check delayed but may still be feasible before taking protons.
  - Will move RILIS target to HRS
- $^7\text{Be}$  target was postponed until the first week of April to allow for more machine preparation time.
- HRS working fine and had produced beam for the checking of beam lines further downstream but no time available to investigate RFQ Cooler transmission
- GPS optics and separator still under investigation.
  - Became operational as from 17 March
- Overall a lot of last minute repairs and checks before taking protons
  - Emphasises the need for a longer cold check out period dedicated to starting up the separators
- Protons taken on 4<sup>th</sup> April (SEM grid tests GPS)

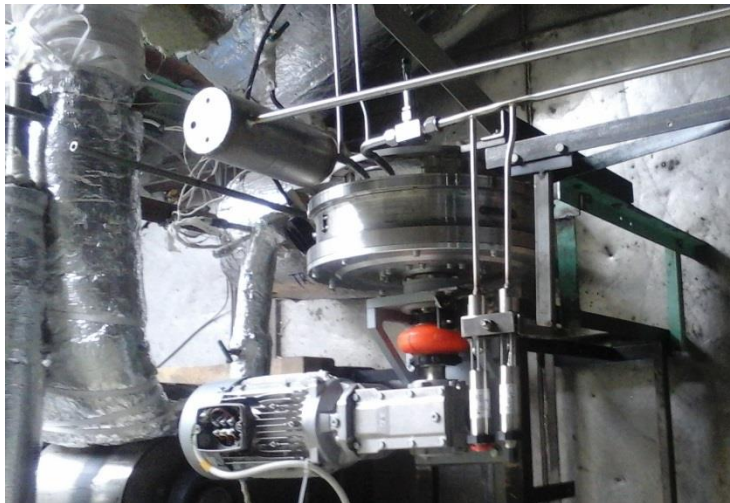
# Outline

- Start up
  - Frontend issues
  - Consequences
- **Target developments**
- RILIS developments
- MEDICIS
- Pill Press & Tape station
- HT tests



# The LIEBE project: toward short lived isotopes

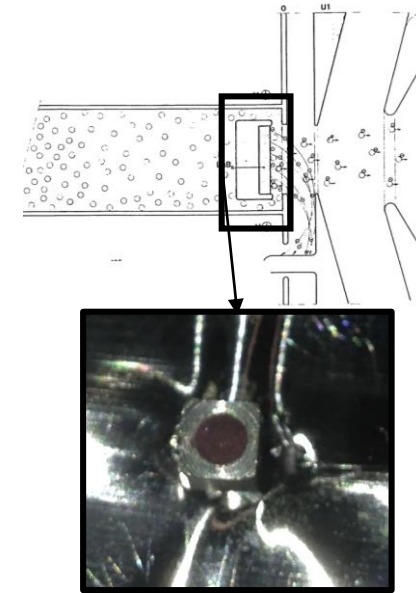
- Preparation of LIEBE tests in spring 2016:
  - Installation of 100+ cables in the target area
  - Full installation sequence tested with the Kuka robot
- Production of target on-going:
  - All parts produced,
  - First sub-assembly done, heating elements installed & tested,
  - Test of the pump on-going at IPUL laboratory.



# Negative beams @ PSB : Target tests

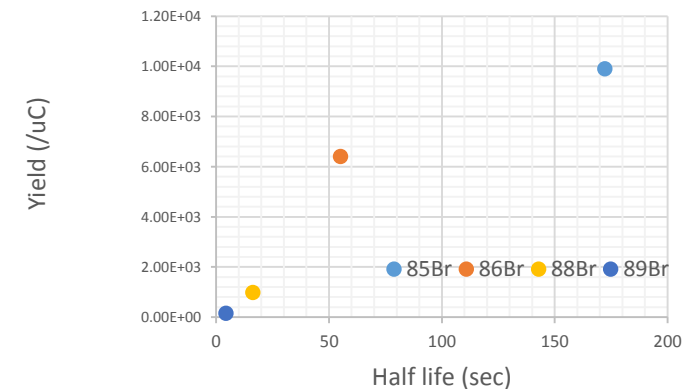
## Th/Ta-MK4 576

- TISD + negative At beams delivered to Lol148 in June 2016
- Mixed Th/Ta target charge



- MK4 (LaB6 pellet) : Ionization Efficiency: **10%** on Br : very stable ion source operation
- Slow release and good **stability** of production over time (5 days of operation)
- **Measured beam on-line:**
- At- beams : not available elsewhere?

Bromine beam



- 204At (9.2min)  $\approx 9e3/uC \rightarrow 5e3 /uC$  after 5 days
- 206At (29.4min)  $\approx 6e3 /uC$
- I:
  - 122I (3.6min)  $\approx 6e5 /uC$
  - 128I (25min)  $\approx 9e5 /uC$
  - 137I (24.2sec)  $\approx 9e4 /uC$
  - 138I (6.4sec)  $\approx 9e4 /uC$
- Cl:
  - 38Cl (37.18min)  $\approx 1e5 /uC$
  - 40Cl (1.35min)  $\approx 9e4 /uC$
  - 41Cl (38.4sec)  $\approx 3.5e2 /uC$
  - 42Cl (6.9sec)  $\approx 1.4e1 /uC$

TISD team, Target production team, offline testing team

# Neutron deficient germanium sulfide beams

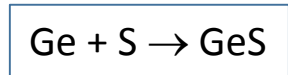
33	As 74.92160	As 64 40 ms	As 65 0.19 s	As 66 96 ms	As 67 42.5 s	As 68 2.53 m	As 69 15.1 m	As 70 53 m	As 71 65.28 h	As 72 26.0 h	As 73 80.3 d	As 74 17.77 d	As 75 100	
Ge 60 ?	Ge 61 40 ms	Ge 62 130 ms	Ge 63 95 ms	Ge 64 64 s	Ge 65 31 s	Ge 66 2.3 h	Ge 67 18.7 m	Ge 68 270.82 d	Ge 69 39.0 h	Ge 70 20.38	Ge 71 11.43 d	Ge 72 27.31	Ge 73 7.76	Ge 74 36.72
	Ga 60 70 ms	Ga 61 168 ms	Ga 62 115.99 ms	Ga 63 31.4 s	Ga 64 2.62 m	Ga 65 15 m	Ga 66 9.4 h	Ga 67 78.3 h	Ga 68 67.63 m	Ga 69 60.108	Ga 70 21.15 m	Ga 71 39.892	Ga 72 14.1 h	Ga 73 4.86 h

Database yields (ions / uC)

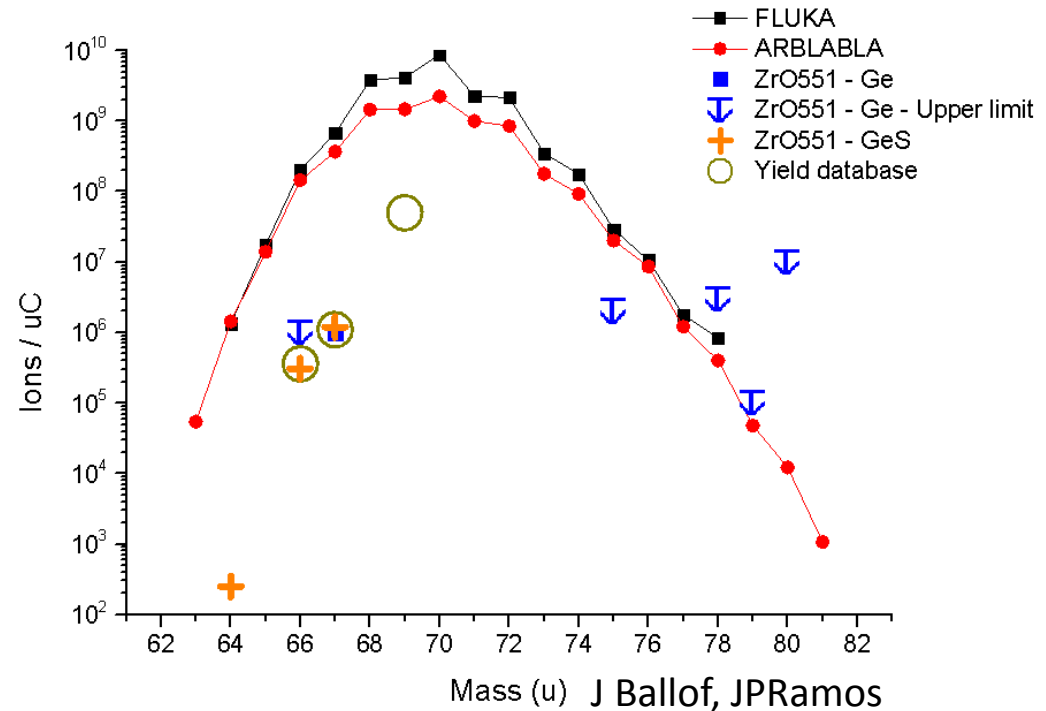
Mass	Ge	Ga
66	3.6E+05	4.4E+08
67	1.1E+06	8.0E+08
68	5.0E+07	6.1E+08

Atomic Ge beams come with strong **isobaric contaminations** of Ga, AlCl and others

➔ Solution:  
Shift to other mass region

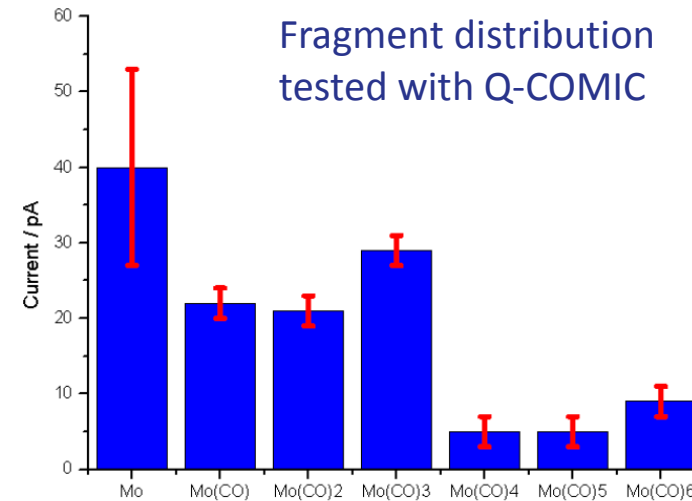
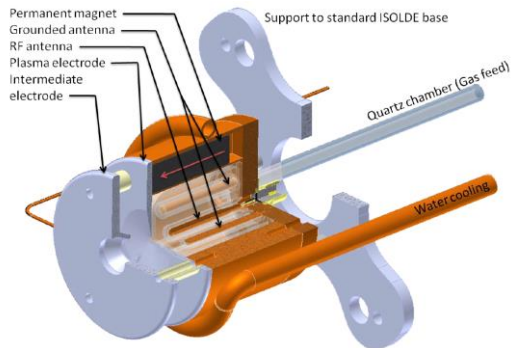
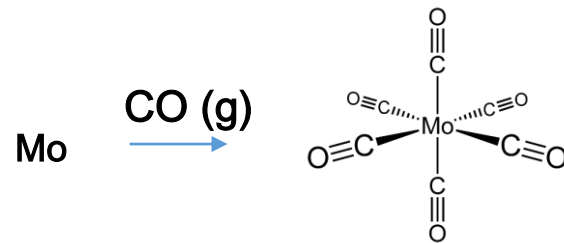
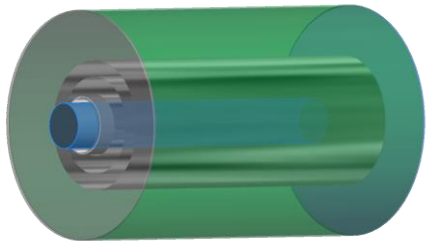
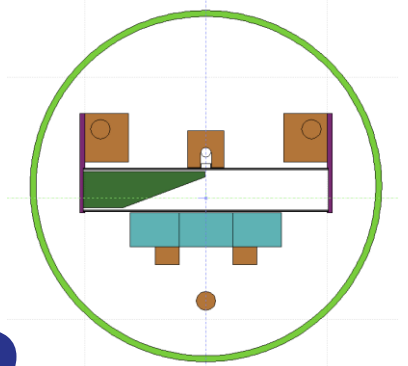
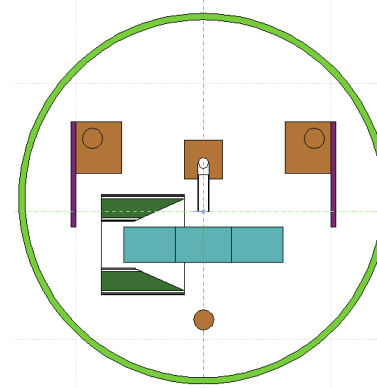


- Sulfur supplied by mass marker
- Database yields can be obtained  
Ratio  $^{67}Ge / ^{67}Ge^{32}S = 1 / 1$
- Significantly lower contaminations



# Neutron Converter and molecular beams within ENSAR 2 – BeamLab

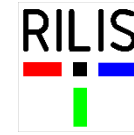
- Build the optimized converter for ISOLDE
  - Collaboration with TRIUMF and SCK.CEN
  - Cope with higher beam powers 50kW
  - Different target and ion source systems
  - Eg Molecular beams of MCO<sub>x</sub>



# Outline

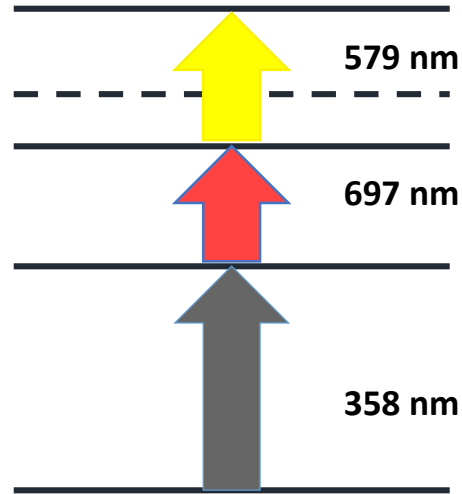
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- **RILIS developments**
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# RILIS ionization scheme development milestones in April 2016

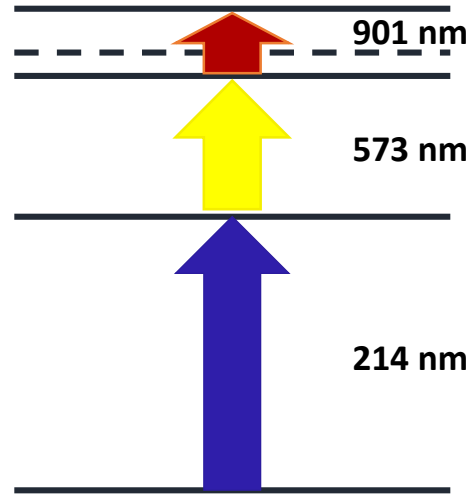


Performed during the ISOLDE startup period and the first physics run of 2016

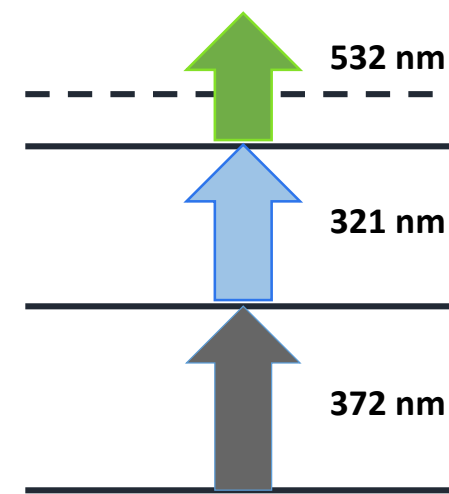
## Cr (first on-line run)



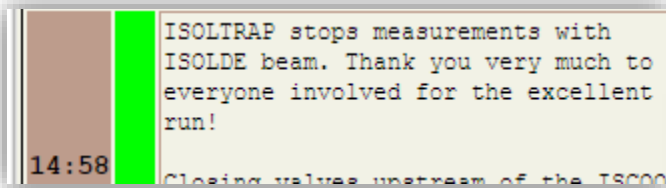
## Te (efficiency verification)



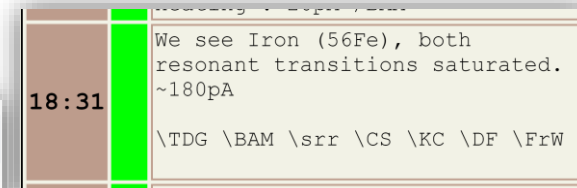
## Fe (initial demonstration)



18%



ISOLDE HRS logbook 18/4/2016

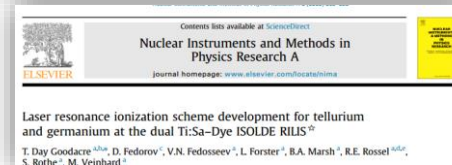


ISOLDE HRS logbook 19/4/2016

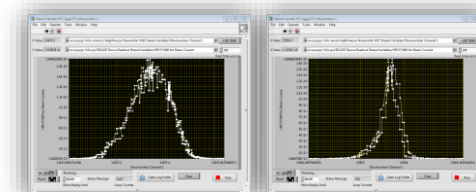
Identification of autoionizing states of atomic chromium for resonance photo-ionization at the ISOLDE-RILIS

T. Day Goodacre<sup>a,b</sup>, K. Chrysalidis<sup>a,d</sup>, D. Fedorov<sup>c</sup>, V. N. Fedosseev<sup>a</sup>, B. A. Marsh<sup>a</sup>, P. Molkanov<sup>c</sup>, R. E. Rosse<sup>1,d,e</sup>, S. Rothe<sup>a</sup>, C. Seiffert<sup>d</sup>

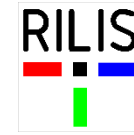
<http://arxiv.org/abs/1512.07875v1>



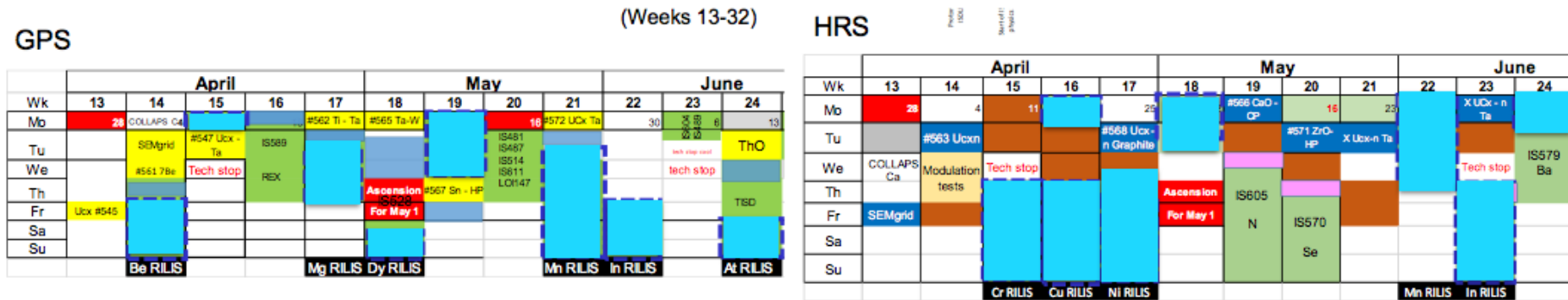
<http://dx.doi.org/10.1016/j.nima.2015.10.066>



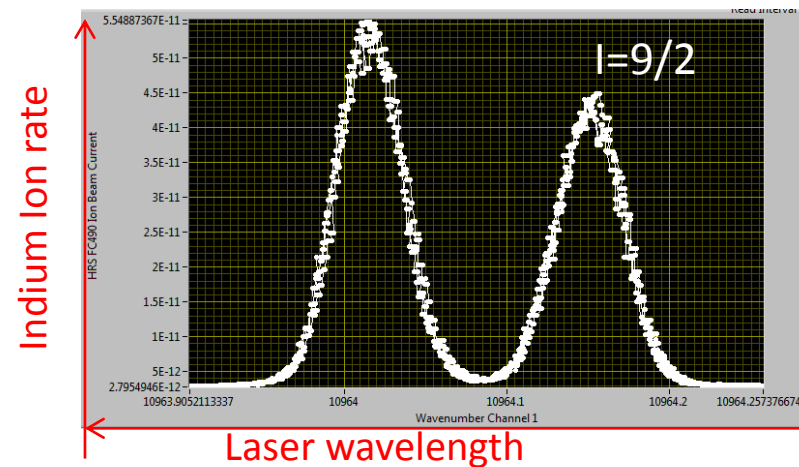
# RILIS operation @ ISOLDE in 2016



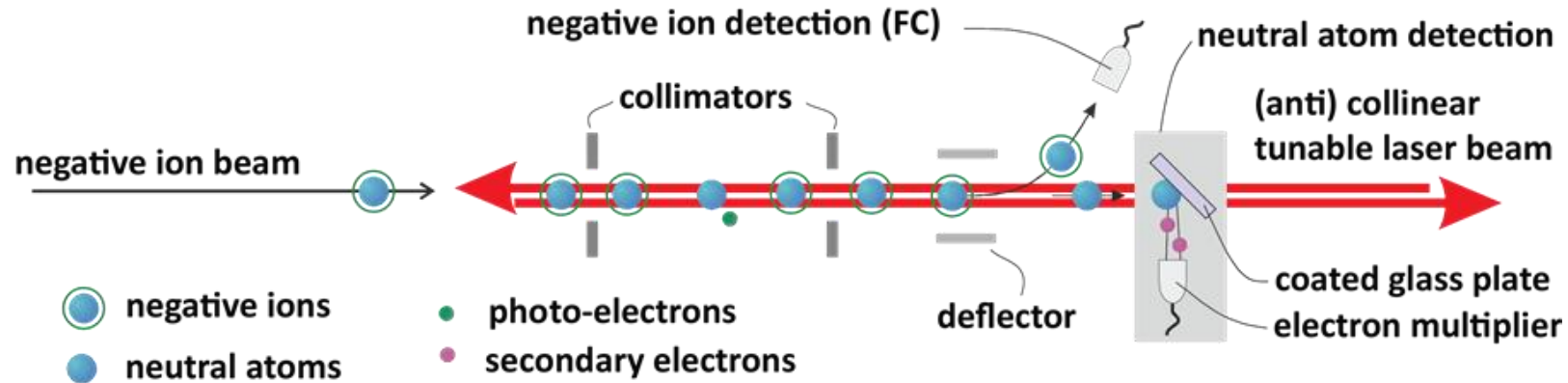
- 9 RILIS runs so far in 2016: *Cr, Cu, Cu, Mg, Ni, Dy, Mn, Mn, In*



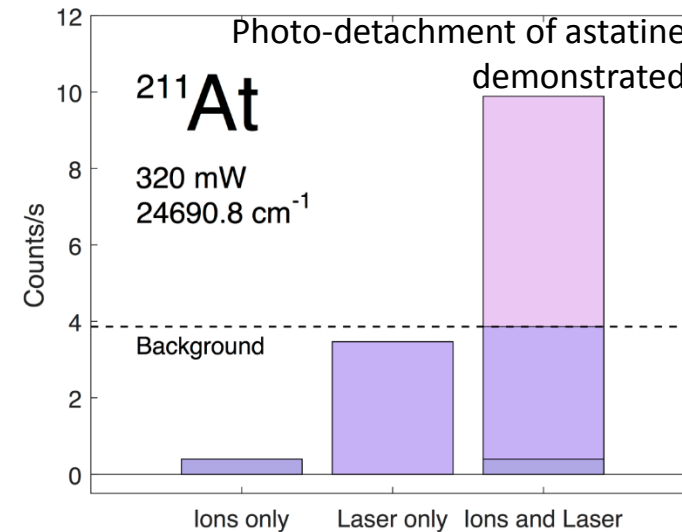
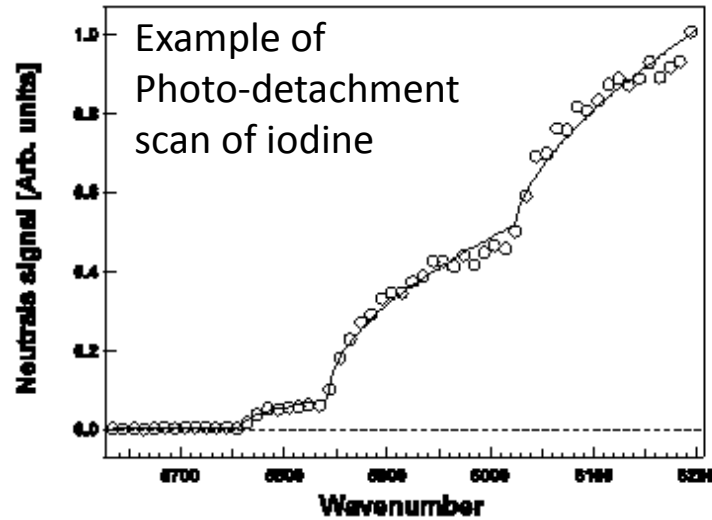
- RILIS-ionized **Beryllium-7** sample preparation for n-TOF
- First isomer-selectively RILIS-ionized **indium** beams



# Photo-detachment of negative astatine ions



Possibly the world's first demonstration of a photo-detachment of a radioactive ion beam!



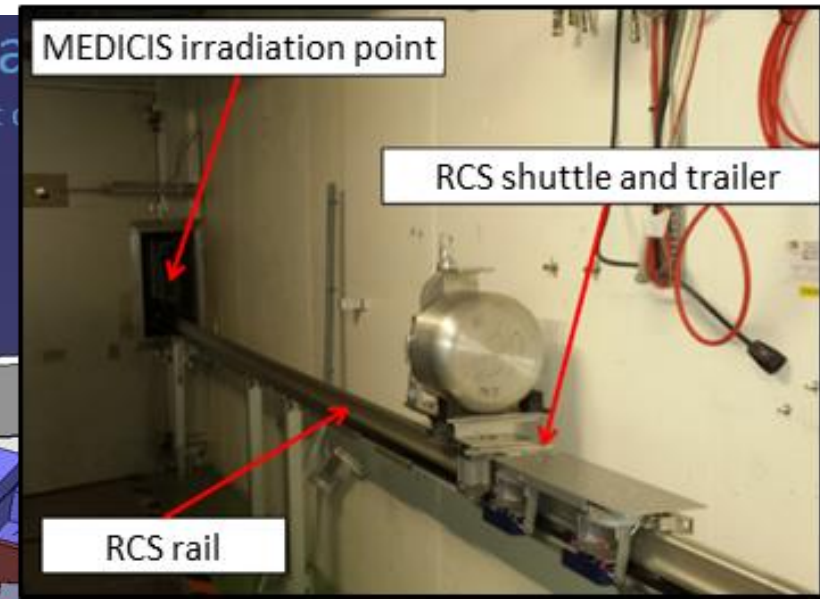
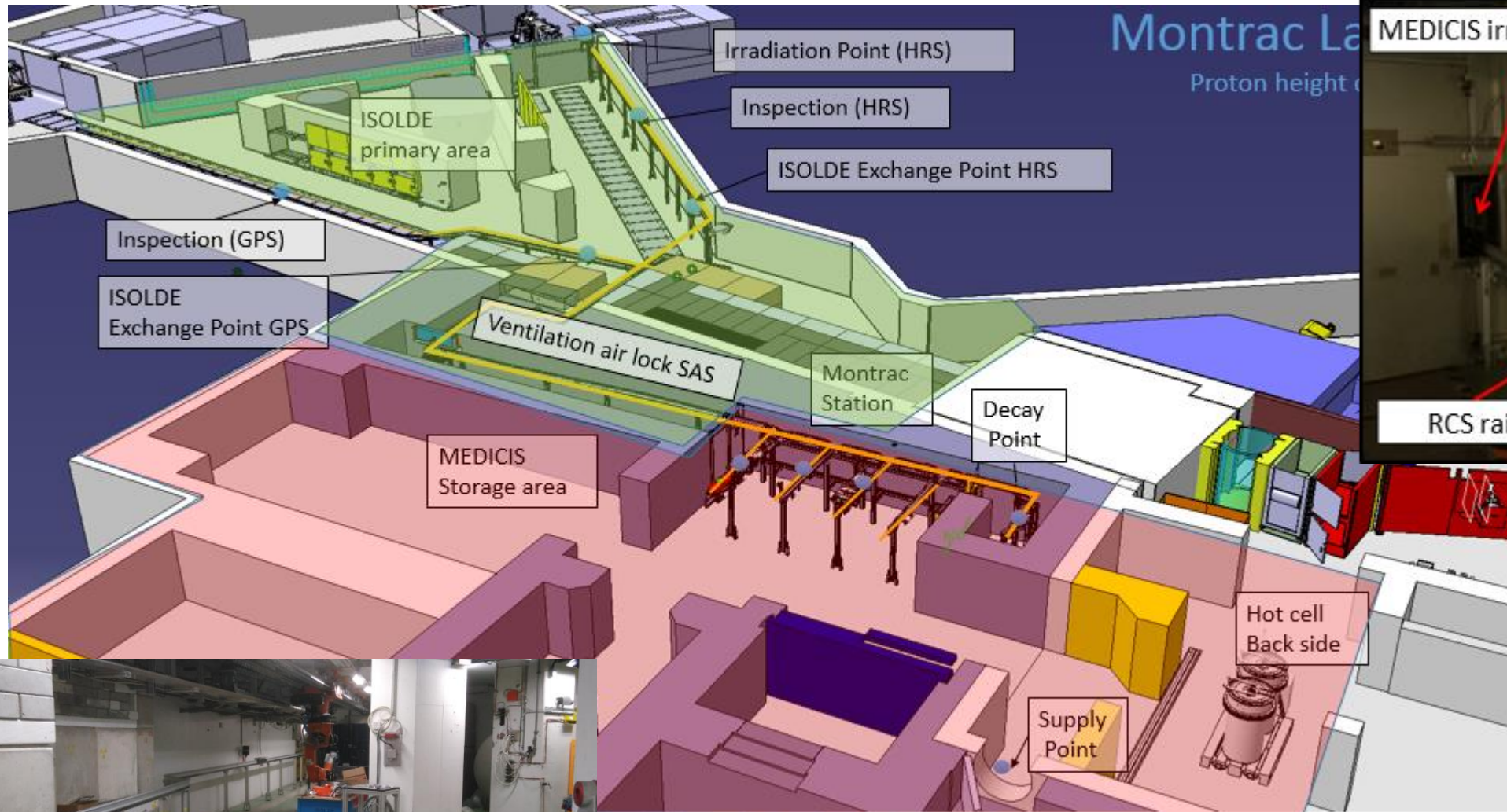
Successful completion of LOI I-148, now ready for data-taking for experiment IS-615



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- **MEDICIS**
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# CERN-MEDICIS



Installation is progressing  
Reviews of cost to completion, operation and safety done  
MoU in pipeline in collaboration with legal service

MEDICIS project team,

# Outline

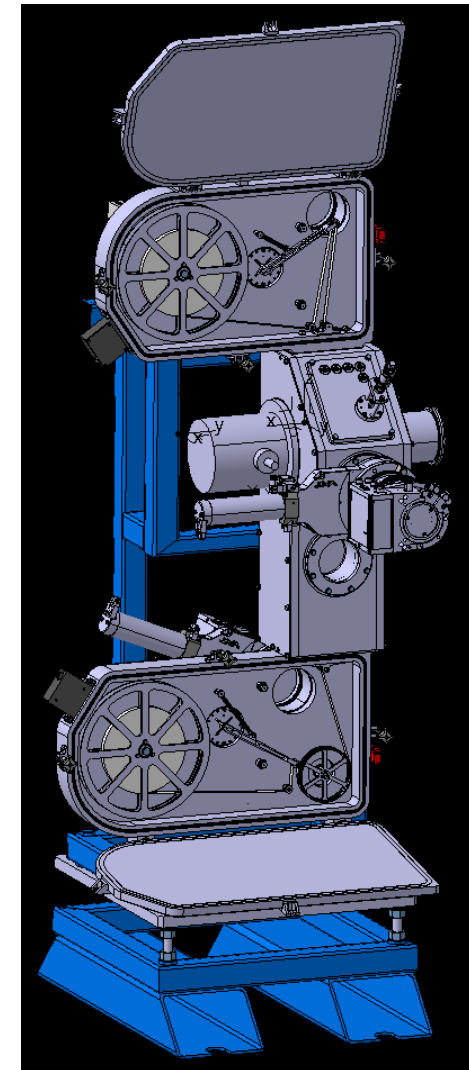
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# New Pill Press & Tape station

- Delivered and installed in ground floor chemistry lab



Tape station fully installed on LA2 beam line  
(Almost) Ready for testing with beam



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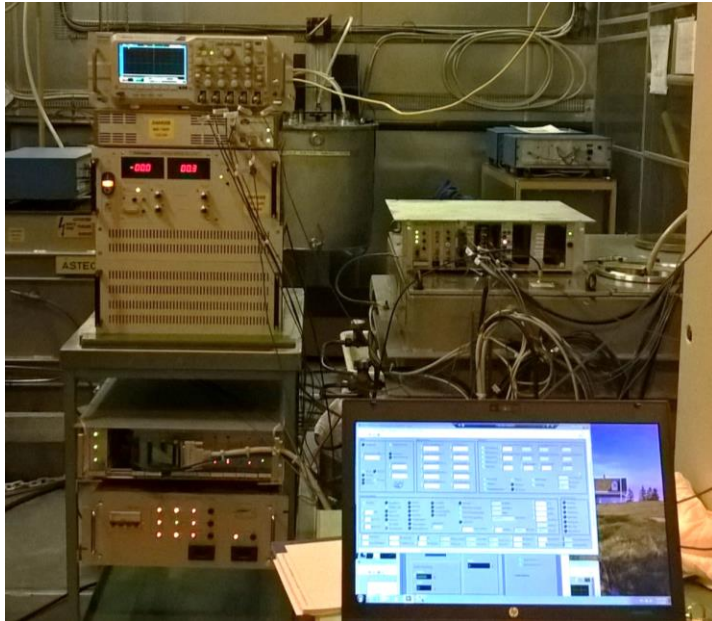
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## A new 60kV modulator for ISOLDE

The new modulator has been tested in operation at the ISOLDE facility during a dedicated MD.

The new set-up was installed in the HT room running in pulse mode with the ISOLDE target load installed and with proton beam.

<https://edms.cern.ch/document/1620992/1>



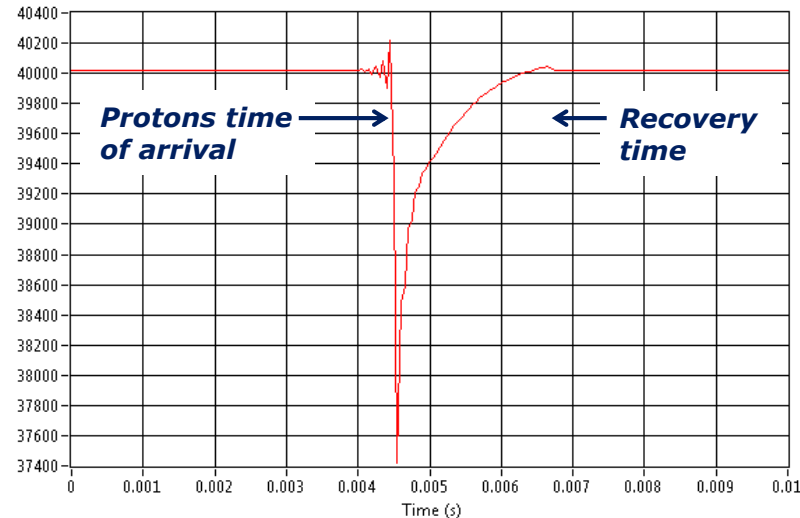
Prototype installation in ASTEC tank (ISOLDE HT room)

## MD test results

The validation tests of the new device has been realized with the *most severe beam induced leakage current* target up to the maximum proton pulse intensity.

Testing conditions\* :

The operational voltage range for the test was limited to 30kV due to the replacement of a broken HV amplifier. The global recovery loop gain was also reduced, resulting in a slower transient response.

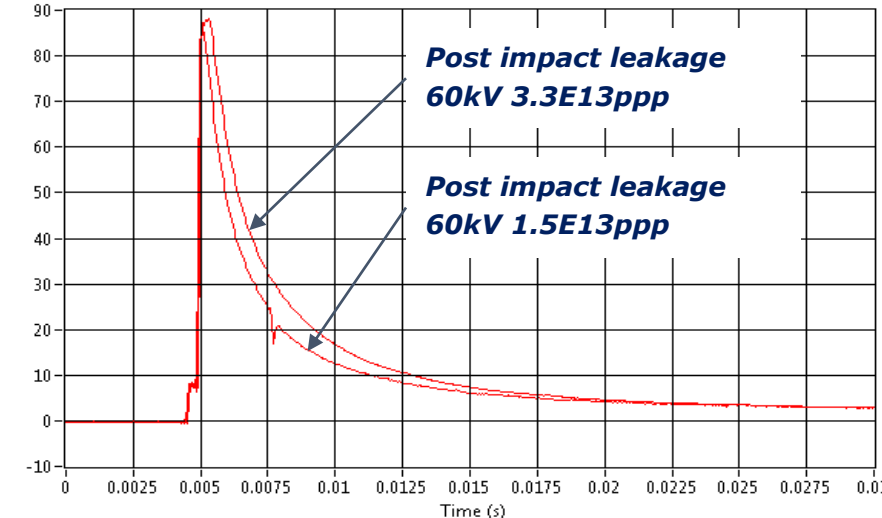


HV recovery signal (V) : 3.3E13ppp at 1.4Gev – HV = 40kV

A substantial gain in terms of recovery time over the actual modulator was achieved.

	30 kv	40 kv	50 kv*	60 kv*
1.5E13 ppp	1.2 ms	1.6 ms	2 ms	-
3.3E13 ppp	1.6 ms	2.5 ms	-	-

Based on these results an upgrade of the prototype is envisaged to adapt it to the measured loading. As a first approximation, the post impact induced leakage is proportional to  $N^{0.5}$ , N being the burst intensity.



Beam induced leakage current (mA) : 3.3E13ppp at 1.4Gev

# LS2 Plans

Richard Catherall

ISOLDE Technical Coordinator

# Agenda for LS2

- LS2 start -> December 2018
- LS2 end -> end of 2020 (?)
- Hope to start ISOLDE with stable beam/off-line physics mid-2020
  
- Change Frontends of both separators
  
- Re-alignment of ISOLDE beam lines?



# Front End Change

- Justification
  - Coming to the end of their lifetime.
    - Failures of insulation and mechanical parts, vacuum pumps to be replaced...etc
  - Profit to make improvements of existing design for more reliability
    - Outlined in a recent Frontend Design Review
  - The proposed changes will be relatively minor/failsafe
    - Recent experience has shown that even minor changes can have knock on effects in the long term
    - Difficult to test changes in similar harsh conditions

# ISOLDE Consolidation

- On-going consolidation over the next 5 years

Work package	Group
Frontends x2 +1 Reserve	EN-STI
Tape station	EN-STI
Vacuum	TE-VSC
Cameras for target area	EN-STI
Off line 2	EN-STI
Beam diagnostics electronic and mechanics	BE-BI
RILIS laser power supplies	EN-STI
60kV modulator	TE-ABT
Magnets (separators and REX triplet spares)	TE-MSD