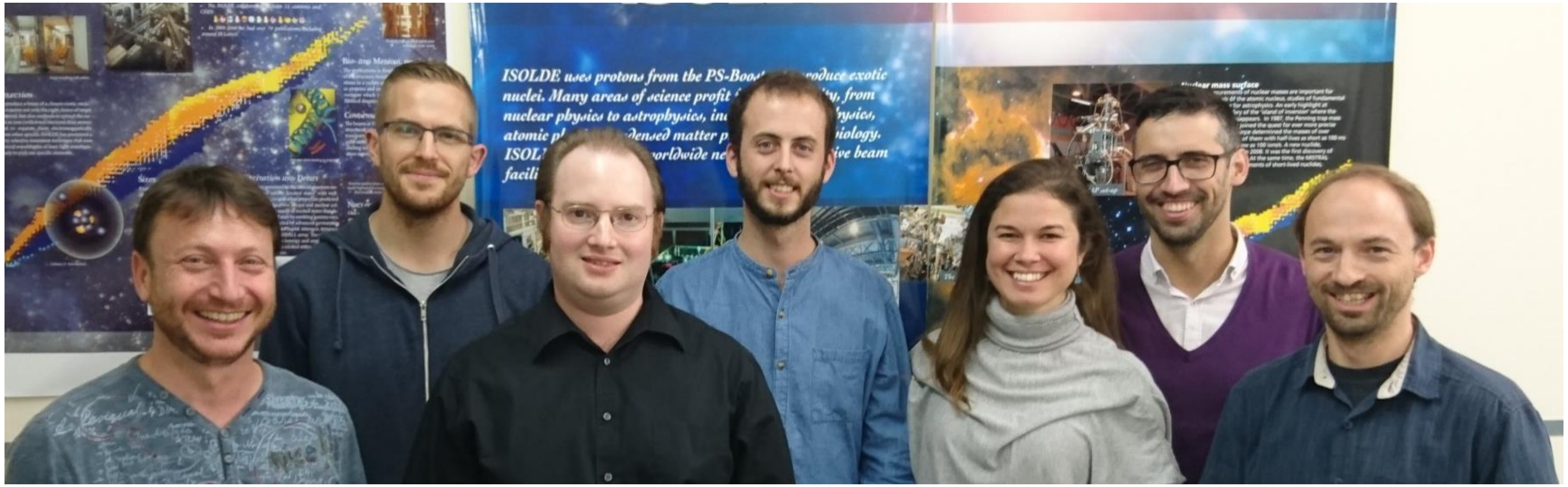
TISD possibilities in LS2 vs INTC requests

Sebastian ROTHE
EN-STI-RBS

ENGINEERING
DEPARTMENT

ISOLDE Target and Ion Source Development team 2018



Thierry Stora, David Leimbach, Jochen Ballof, Ferran Boix Pamies, Yisel Martinez, Joao Pedro Ramos, Sebastian Rothe

ISOLDE Target and Ion Source Development team LS2

David Leimbach

Thierry Stora

Jochen Ballof

Sebastian Rothe

+ 30% of R.Heinke, VISC from ~2020

60Zn

Exp/ LOI	Isotope	Target	Ion source	Experiment	Yield (target)	Yield (setup)	Status/comment
P448	60Zn	ZrO2/Y 2O3	RILIS	Miniball	2.1e5 pps	4.20E+04	Physics case interesting. However INTC recommended TISD as isobaric contaminants could hinder physics.

- Y2O3 nano: derogation process successful, possible to produce again
- Matches well with Zn case

23/05/2016 12:55 DAY ISO HRS isoop@CWO-197-REX

on mass 60, there is mostly 60Cu, but also some 60Zn. Finished on mass 60, cycling to 71Se16O

ZrO target #551

146Ce / 148Ce

Exp/ LOI	Isotope	Target	Ion source	Experiment	Yield (target)	Yield (setup)	Status/comment
LOI169	146Ce; 148Ce	UC/ThC	VD5	Miniball	TISD	TISD	Molecular beam. Flourination of beam. Currently low on Miniball priorities but still of interest.

- Fluorides (or oxides)

146Ce19F 1.9 E7
146Ba19F 2.3 E4 (under estimated)
146La19F 6.2 E6 (tbc.)

148Ce19F 1.3 E6
148Ba19F 4.7 E3 (under estimated)
148La19F 1.1 E4 (under estimated)

20/07/2017 12:58 DAY ISO GPS Full Shift

Yields before and after fluorination measured as follows:
Measured w gammas if not indicated otherwise.

Mass Yield /uC before Yield /uC with 0.1 bar CF4
142Ba19F 2.0 E8 6.7 E8

144Ba19F 1.3 E7 3.6 E7
2.1 E7 (betas) 6.5 E7 (betas)
144La19F 5.8 E5

146Ce19F 1.9 E7
146Ba19F 2.3 E4 (under estimated)
146La19F 6.2 E6 (tbc.)

148ce 19F 1.3 E6
148Ba19F 4.7 E3 (under estimated)
148La19F 1.1 E4 (under estimated)

We did not see BaF2 within our detection limit.
Contamination on 142Ba19F could not be checked due to long half life of 142La.

Contamination on 144Ba19F are only in the order of 1%.

Fluorination seems to have stabilized. U/UF/UF2 ratios can be checked once per day.

/srr/JPR

#612 ZrO2

- Further tests at REX ?

77-83Ge

Exp/ LOI	Isotope	Target	Ion source	Experiment	Yield (target)	Yield (setup)	Status/comment
LOI170	77-83Ge	UC + 34S; ThO2	VD5 or RILIS	COLLAPS	TISD	TISD	Request for exploration of production of neutron rich Ge isotopes. Neutron deficient ran in 2018. Control of molecular beams still difficult

- Sulphide molecular beams in development (J.Ballof, FELL)
- Molecular breakup to be studied (TISD+RBS)
- Laser scheme exists

17-26F

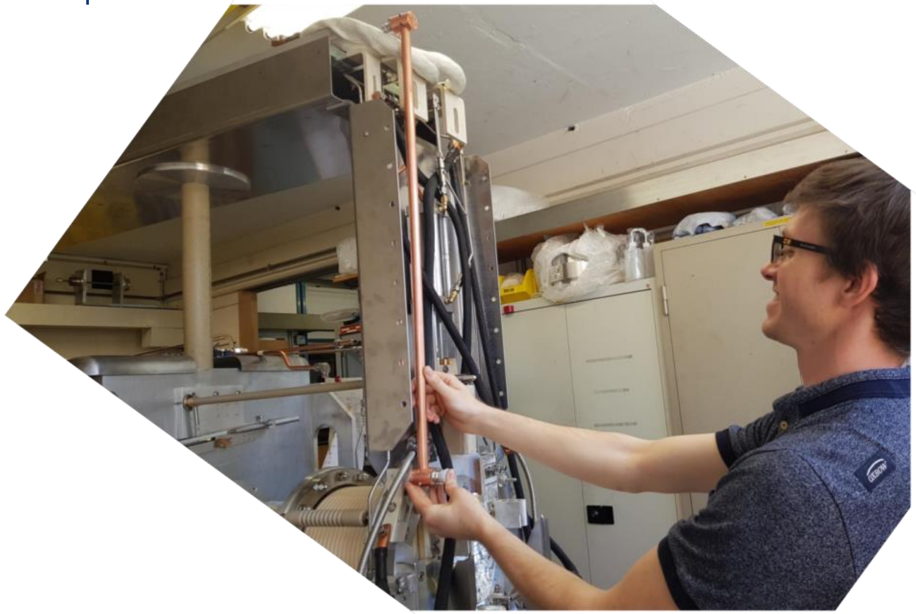
Exp/ LOI	Isotope	Target	Ion source	Experiment	Yield (target)	Yield (setup)	Status/comment
LOI171	17-26F	SiC?	MK4?	CRIS	TISD	TISD	Request for neutron rich F isotopes (perhaps negative) for CRIS.

- Kenis ion source being reconstructed / investigated (D.Leimbach, DOCT)
- SiC nanofibers collaboration w/ TRIUMF

211Po; 212Po; 219Po; 220Po

Exp/ LOI	Isotope	Target	Ion source	Experiment	Yield (target)	Yield (setup)	Status/comment
IS456	211Po; 212Po; 219Po; 220Po	UC	LIST (new)	Windmill	2e4;2e4; 3e1;10		Long standing request for these Po isotopes. RILIS + quartz line or modfified LIST.

- Goal: After LS2, LIST shall be standard ion source and available at GPS and HRS
- R.Heinke (KU Leuven, VISC) hired to work on MELISSA / LIST integration and Development



98Zr

Exp/ LOI	Isotope	Target	Ion source	Experiment	Yield (target)	Yield (setup)	Status/comment
LOI179	98Zr	Ucx	Surface	Miniball	TISD	TISD	Request for measurement of characteristics of this beam (via decay of 98Rb, 98Sr or 98Y).

- Technique should be studied and established
- COMPLIS ?

80Zr

Exp/ LOI	Isotope	Target	Ion source	Experiment	Yield (target)	Yield (setup)	Status/comment
LOI207	80Zr	TBD	VD5	Miniball	TISD	TISD	Highly refractive 80Zr isotopes requested. "similar to Hf development" i.e. via flourination.

- Tricky
- JPR working on concept

229Pa and 228Th

Exp/ LOI	Isotope	Target	Ion source	Experiment	Yield (target)	Yield (setup)	Status/comment
LOI173	228X 229X	UC/ThC	Surface	Test then MB	TISD	TISD	Beam composition of Mass = 228 and 229.

- Fits well to **LISA Network**
- 2 DOCT students working on actinide beams at ISOLDE from ~2020
- Pa and Th laser schemes exist
- Molecular beams + breakup to be investigated

^{70,72}Se

- IS597
- Se(CO)x molecular beams or laser ionized
- Molecular route followed by J.Ballof (FELL)
- Requires improved infrastructure

Developments towards the delivery of selenium ion beams at ISOLDE

K. Chrysalidis[1,2a], J. Ballof[1,3b], Ch.E. Düllmann[3,4,5], V.N. Fedosseev[1], C. Granados[1], B.A. Marsh[1], Y. Martinez Palenzuela[1,6], J.P. Ramos[1], S. Rothe[1], T. Stora[1], and K. Wendt[2]

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Submitted, in review

8B, RaF, BaF etc.

- Fluorination generally works well
- Moving from SF6 to CF4 improves stability
- Other reactive gases under investigation (J.Ballof, FELL)
- Irradiation at MEDICIS point, then careful fluorination + extraction worked well for RaF at CRIS

Studying molecular beam formation

Concept for a dedicated development unit for molecular beams

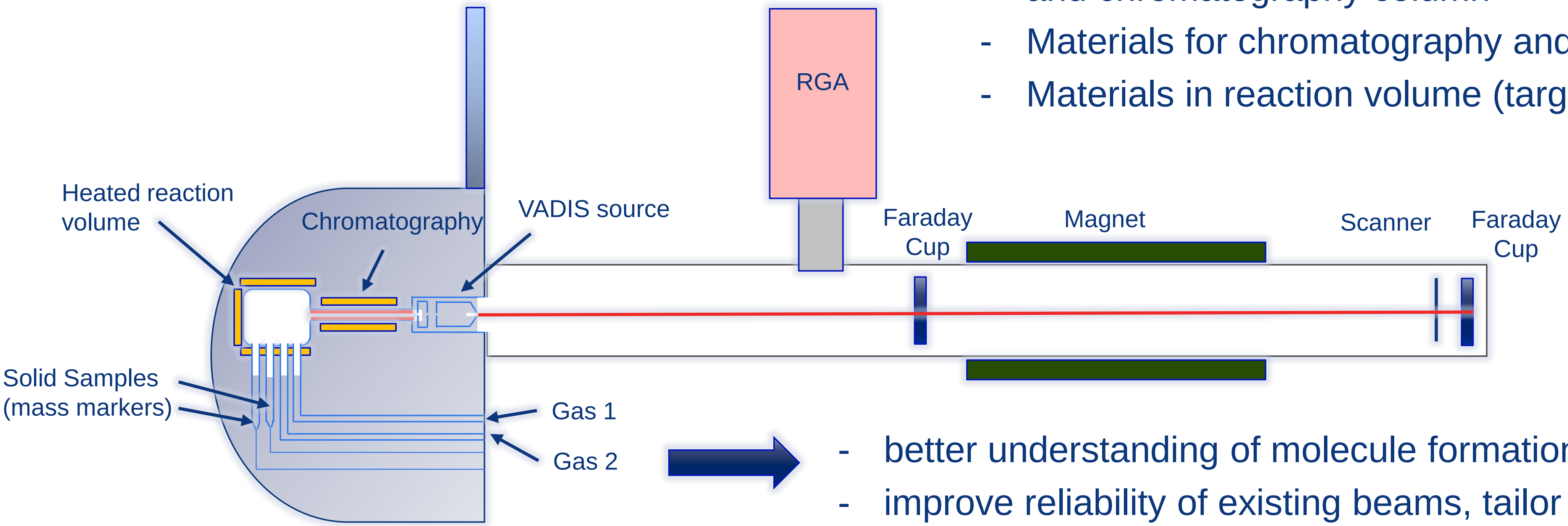
J.Ballof

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)

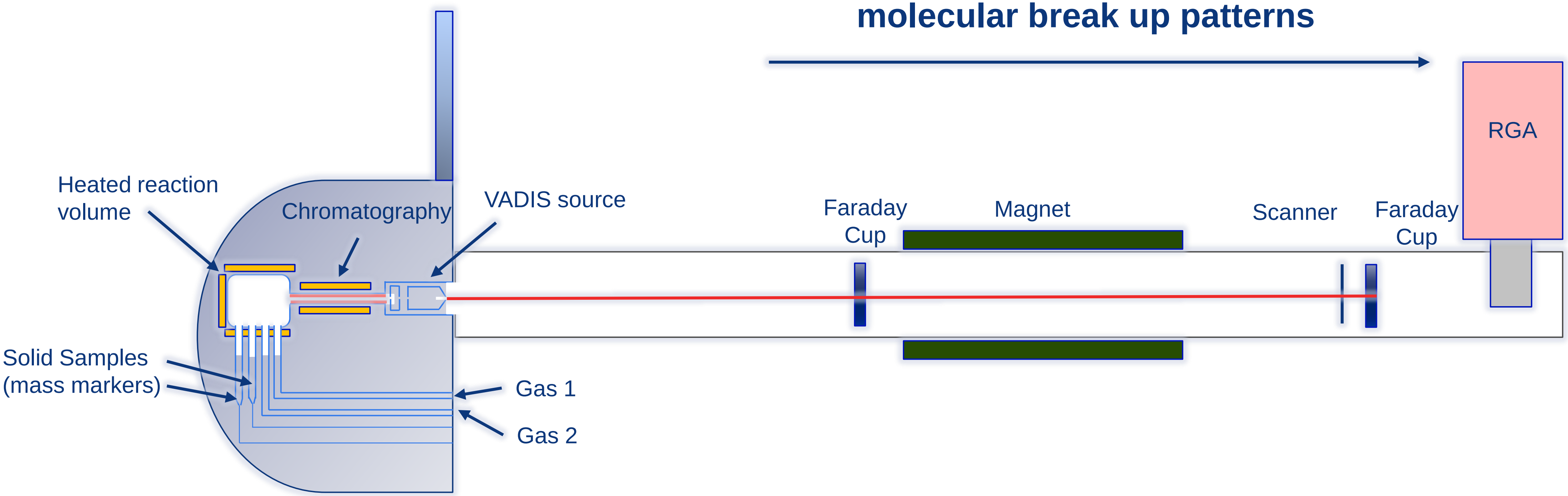


- better understanding of molecule formation
- improve reliability of existing beams, tailor new beams

Studying molecular beam formation

Concept for a dedicated development unit for molecular beams

- Move residual gas analyzer to identify separated beam composition through **molecular break up patterns**

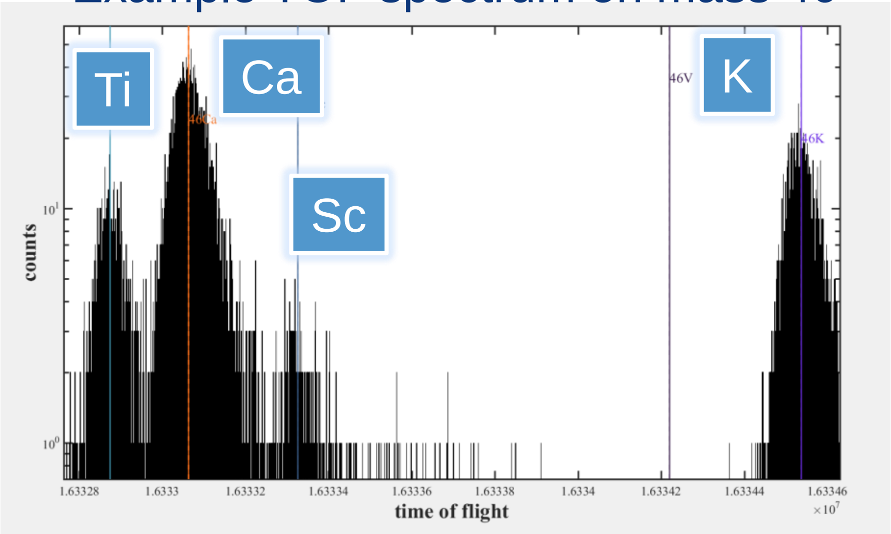


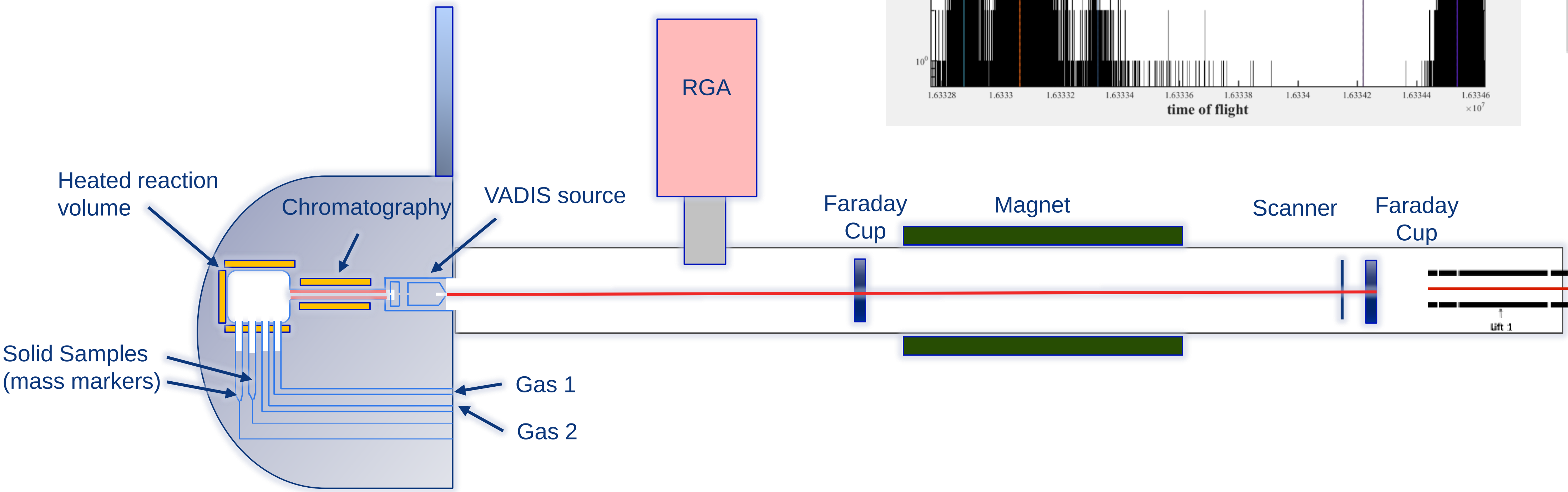
Studying molecular beam formation

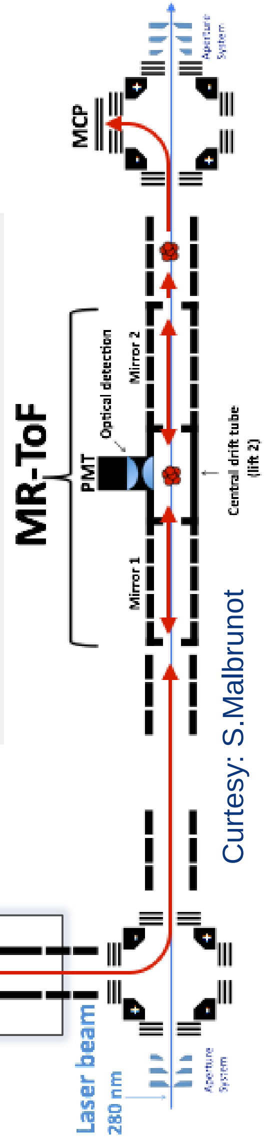
Concept for a dedicated development unit for molecular beams

- Add **Multi Reflection Time of Flight (MR-ToF)** mass spectrometer: allows ISOBAR separation.
- Collaboration with MIRACLS experiment launched

Example TOF spectrum on mass 46







Curtesy: S.Malbrunot

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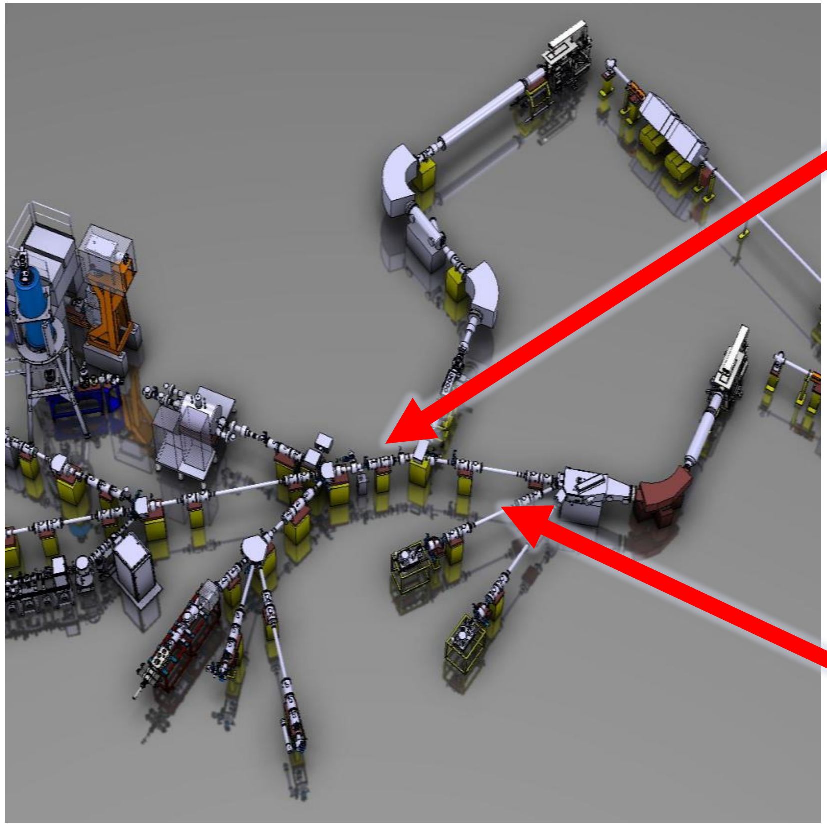
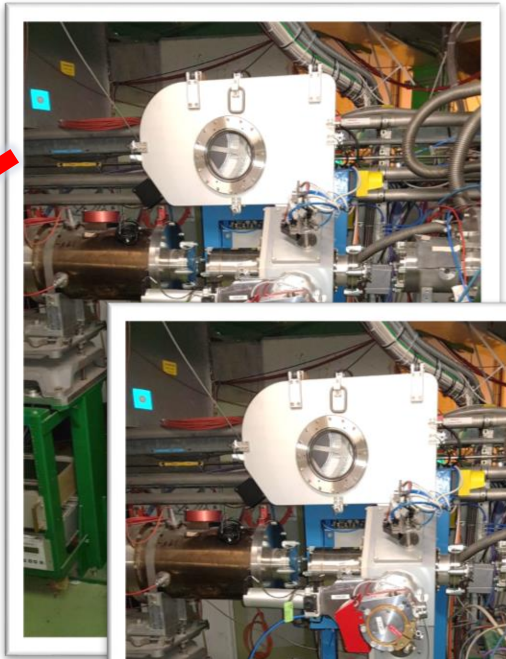
THE ISOLDE Yield station

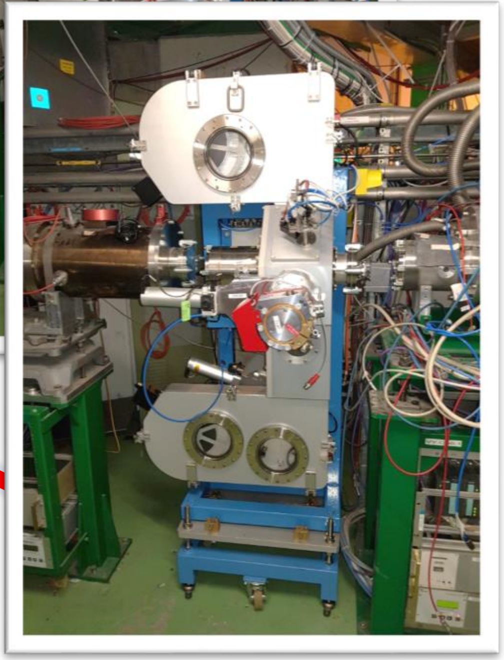
- To be used to establish yields at beginning and at end of experiment
- P.scan
- Target and ion source optimization

T.Giles, S.Warren

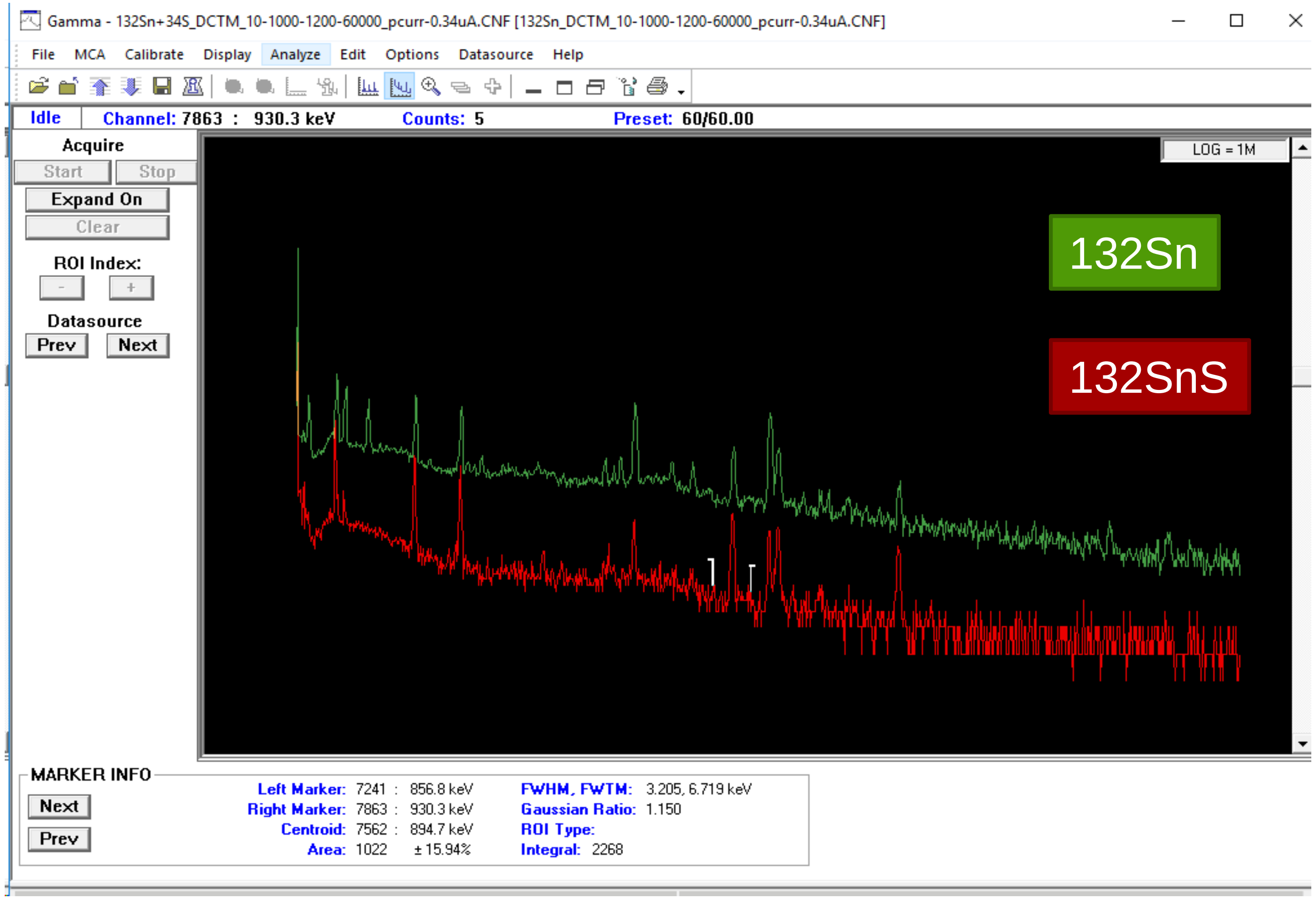
- **Proposal: install spare at GLM**
  - Used for beam development
  - Can be used in p.sharing mode with minimal impact to ISOLDE physics
  - Opportunistic development**,** in-source laser spectroscopy
  - Upgrade (LS3…): integrate MT-ToF-MS







Molecular tin beams : $^{132}Sn^{34}S$



- Comparing gamma spectra of ^{132}Sn and $^{132}Sn^{34}S$

Mass marker design for 34-Sulphur as reactant

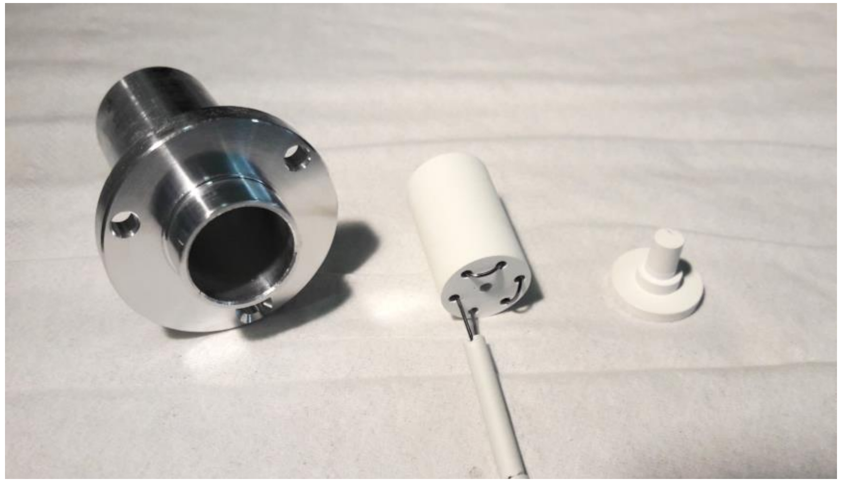
Observed problem:

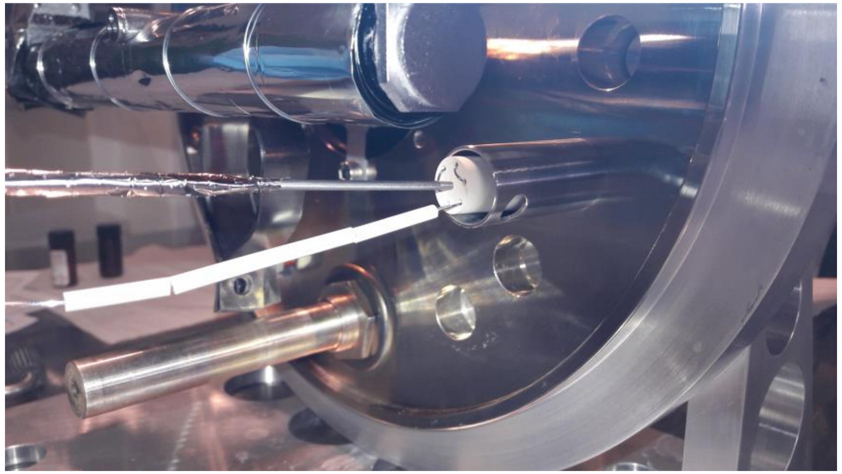
- Yield drops over time as S continues to evaporate from conventional oven
- -> Uncontrolled release.

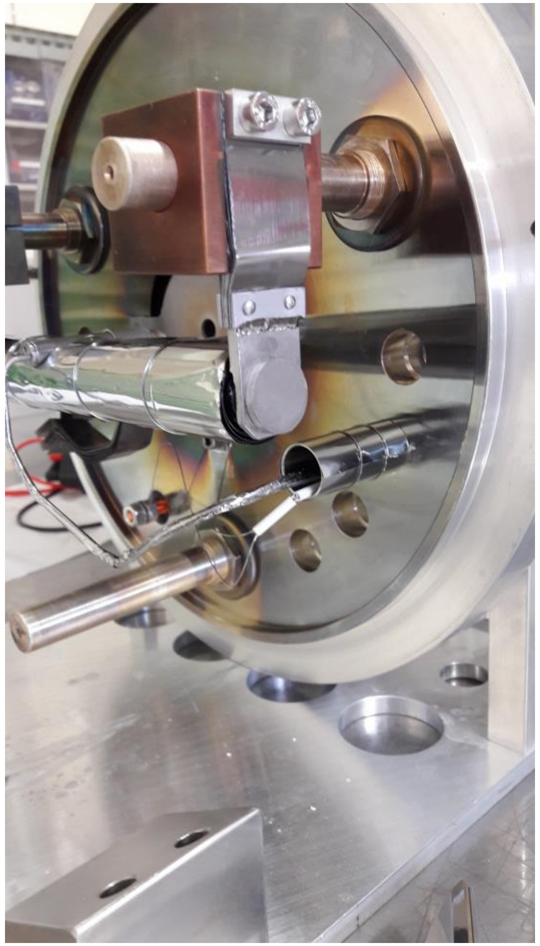
New design:

- Sulphur reservoir placed in water cooled base plate.
- No line of sight with hot surfaces.
- Ohmic heating through Ta wire heats BN chamber
- -> Controlled release.

- Tested at ISOLDE
- Design now further tested at SPES





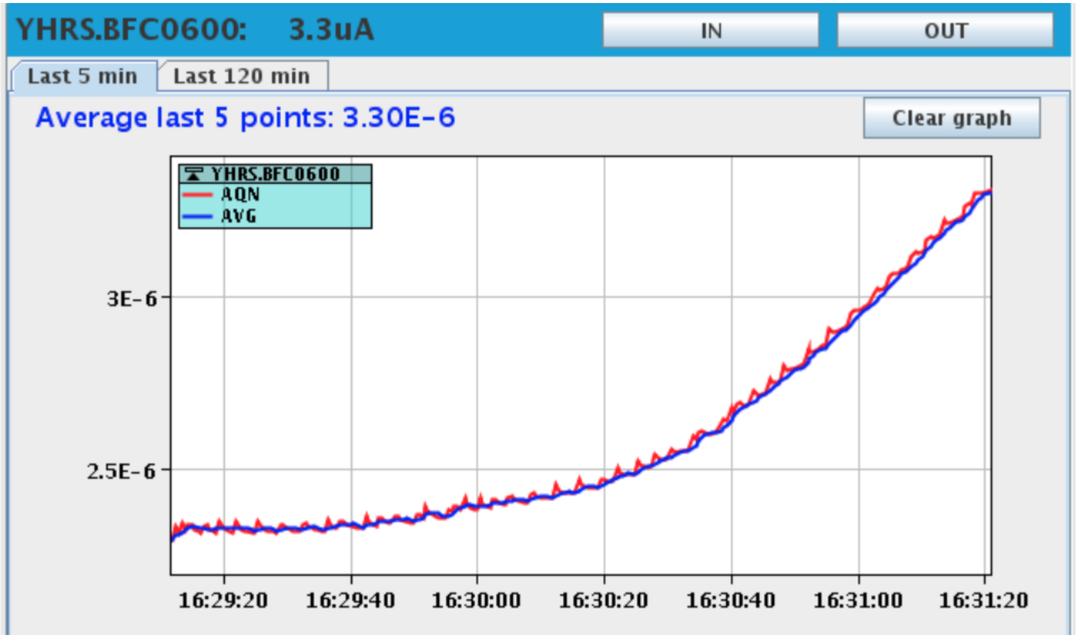


Sulphur mass marker on-line

08/09/2018 16:30 DAY ISO HRS

Significant increase in total current after heating up Oven2 from 5 to 6.5 A.

/JAR/Miniball



- Reacts at relatively low currents
- Heater can be optimized to allow finer steps

SnS beams next steps

- Further testing of SnS extraction planned at ALTO

LoI for Radioactive online yield and release measurements of SnS

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Target Materials

	What	Why	How	Where	Who
started	Ensure non-actinide nano material production	faster release/higher yields	Derogation / Collaboration / Initiate non-actinide nano lab at CERN	Offline chemical lab /?/?	JPR
in progress	Optimize target heating	Reproducibility Uniformity of temperature	Collaboration w. SPES	Offline Pump stand	DOCT1 / FELL1
started	Investigate UCx sintering	Optimize Release	Sequential thermal treatment + characterization / on-line sintering at synchrotron beam line	Class A + MME labs / tbd	JPR,srr
in progress	Investigate Material Pre-treatment	Avoid contamination	Chemical reactions (etching etc)	Chemical lab Offline	Srr, Collaborations ?
started	Study Molecular beam chemistry	Volatilization and/or Purification	Develop dedicated setup	Offline /ext.	JB Collaborations
in progress	Optimize UCx production	Reproducibility	More observables during production	Class A	srr
done	Investigate ThCx	Higher yields in specific regions	FLUKA, reactivating procedures	Class A	BC,JPR

Target Materials

done

in progress

To do

What	Why	How	Where	Who
Neutron converter (s)	High Purity High Production	Design iteration	ISOLDE	JPR, coll. With TRIUMF
Mass marker development	More control, Avoid cold spots	Simulation, Iterative testing	Pump stand + RGA	DL, FELL Collaboration
Autopsy of used targets	Learn from failure, improve future designs	List of priorities, Open targets in hot cell	ISOLDE Hot cell	PGH

Ion sources

	What	Why	How	Where	Who
in progress	VADLIS 2.0	Improve RILIS mode Validate reliability	Simulations Design iterations Testing	Offline	DL, ISBM
To do	COLD VD7	CO beams, fragile molecules	review design (from PS), construct, test	Offline	DOCT2, FELL2
in progress	Ion source simulation	Starting point for optimization	VSIM Collaboration	in silico	DL, FELL SCK
started	TOFLIS	Beam purity	High ohmic cavity Drift region Fast beam gating Integrate LIST	Offline ISOLDE	SW, Fell1, ISBM
done To do	2 Photon laser ionization	Resolution for in source spectroscopy isomer selectivity Accessibility to other elements	Mirror in ion source PI-LIST	offline	KC, RH
in progress	Negative ion source	Yield, purity Rectify design	Simulation, testing. Develop new low work-function materials	offline	DL, FELL

Ion sources

What	Why	How	Where	Who
Integrated yields + stress test	Optimize lifetime + efficiency	Long-time performance tests, destructive tests	New ion source test stand	DL, FBP, FELL
RILIS General R&D	Increased range of accessible elements, isomer selectivity, reliability	Spectral range Laser and lab infrastructure, Bandwidth optimization, ion source developments	RILIS, Offline	RILIS & ISBM

To do

in progress

Dedicated session in next GUI

Infrastructure

	What	Why	How	Where	Who
started	Improve VADIS gas distribution system	Measure pressure Ensure purity	Add gas loop, recirculation pump & filters	OFFLINE, then ISOLDE	JB, FELL
started	Upgrade beam gate switches	No spares. No high frequency possible	Test fast BG during 2018 at GPS Specify product with manufacturer	OFFLINE, ISOLDE	SW, srr ISBM
started	Build second pump stand	Dedicated ion source test stand Lifetime tests + integrated yield measurements	Copy of existing Pump stand	LARIS, then OFFLINE	DL, BC
started	Intensify use of RGA	Monitor Target and ion source behavior already during heating process	Survey, then purchase .	Offline, Pumpstands, Class A	Srr, LV support
in progress	Improving YIELD database	Link to target documentation Add yield prediction Add user interface Add interface to CRIBE	Test during 2018, collect feature requests	CERN	JB, FELL2, srr, Users

Infrastructure

Status	What	Why	How	Where	Who
started	Improve target documentation	Spread of information -> Single entry document required. Track target location, link to control system	EDMS, infor, Link databases	ISOLDE	srr, BE-OP, Target production, RP, Users, LV support
started	Upgrade Isolde Timing System	Not very user friendly	Review specification	ISOLDE	TG
in progress	Lasers at OFFLINE 2 and MEDICIS	RILIS is most efficient and selective ion source.	Install full laser systems	Offline 2 Medicis	RILIS, KU LEUVEN/PROMED, Umz,
in progress	RILIS control system upgrade	Current system not easy to maintain by LV support	Employ (shared) PJAS Refactoring of RILIS control software	RILIS	BM, PJAS @ LV support
in progress	Development of unified controls system for Offline machines	Synergies, Still features missing Improve stability More automation	Employ (shared) PJAS Dedicated development time at offline machines.	OFFLINE	srr, PJAS@LV Support
To do	Improve target health monitoring	Enable preventive actions	Link production rates from experiments permanent yield checks set up display for target health	OFFLINE, ISOLDE	srr, Users, BE-OP, LV support