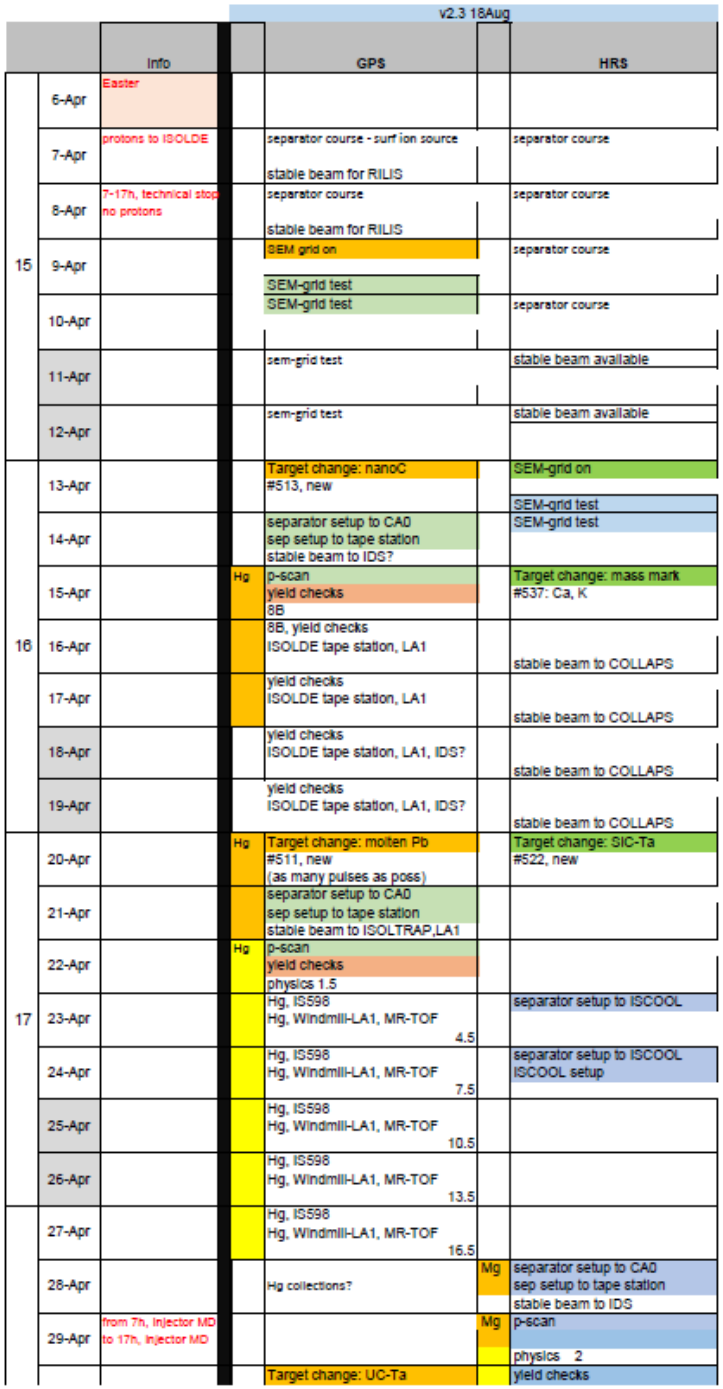

ISOLDE

Physics coordinator report: Overview of 2015

Karl Johnston



v2.3 18Aug

		Info		GPS		HRS
	6-Apr	Easter				
	7-Apr	protons to ISOLDE		separator course - surf ion source stable beam for RILIS		separator course
	8-Apr	7-17h, technical stop no protons		separator course stable beam for RILIS		separator course
15	9-Apr			SEM grid on SEM-grid test		separator course
	10-Apr			SEM-grid test		separator course
	11-Apr			sem-grid test		stable beam available
	12-Apr			sem-grid test		stable beam available
	13-Apr			Target change: nanoC #513, new		SEM-grid on SEM-grid test
	14-Apr			separator setup to CA0 sep setup to tape station stable beam to IDS?		SEM-grid test
	15-Apr		Hg	p-scan yield checks 8B		Target change: mass mark #537: Ca, K
16	16-Apr			8B, yield checks ISOLDE tape station, LA1		stable beam to COLLAPS
	17-Apr			yield checks ISOLDE tape station, LA1		stable beam to COLLAPS
	18-Apr			yield checks ISOLDE tape station, LA1, IDS?		stable beam to COLLAPS
	19-Apr			yield checks ISOLDE tape station, LA1, IDS?		stable beam to COLLAPS
	20-Apr		Hg	Target change: molten Pb #511, new (as many pulses as poss)		Target change: SIC-Ta #522, new
	21-Apr			separator setup to CA0 sep setup to tape station stable beam to ISOLTRAP,LA1		
	22-Apr		Hg	p-scan yield checks physics 1.5		
17	23-Apr			Hg, IS598 Hg, Windmill-LA1, MR-TOF 4.5		separator setup to ISCOOL
	24-Apr			Hg, IS598 Hg, Windmill-LA1, MR-TOF 7.5		separator setup to ISCOOL ISCOOL setup
	25-Apr			Hg, IS598 Hg, Windmill-LA1, MR-TOF 10.5		
	26-Apr			Hg, IS598 Hg, Windmill-LA1, MR-TOF 13.5		
	27-Apr			Hg, IS598 Hg, Windmill-LA1, MR-TOF 16.5		
	28-Apr			Hg collections?	Mg	separator setup to CA0 sep setup to tape station stable beam to IDS
	29-Apr	from 7h, Injector MD to 17h, Injector MD			Mg	p-scan physics 2
				Target change: UC-Ta		yield checks

- Protons to ISOLDE since 9 April
- Physics started April 15

- Low energy until October when HIE-ISOLDE started.

- 471 Low Energy shifts requested
- 373 scheduled; ~260.5 delivered 70% (prel counting)

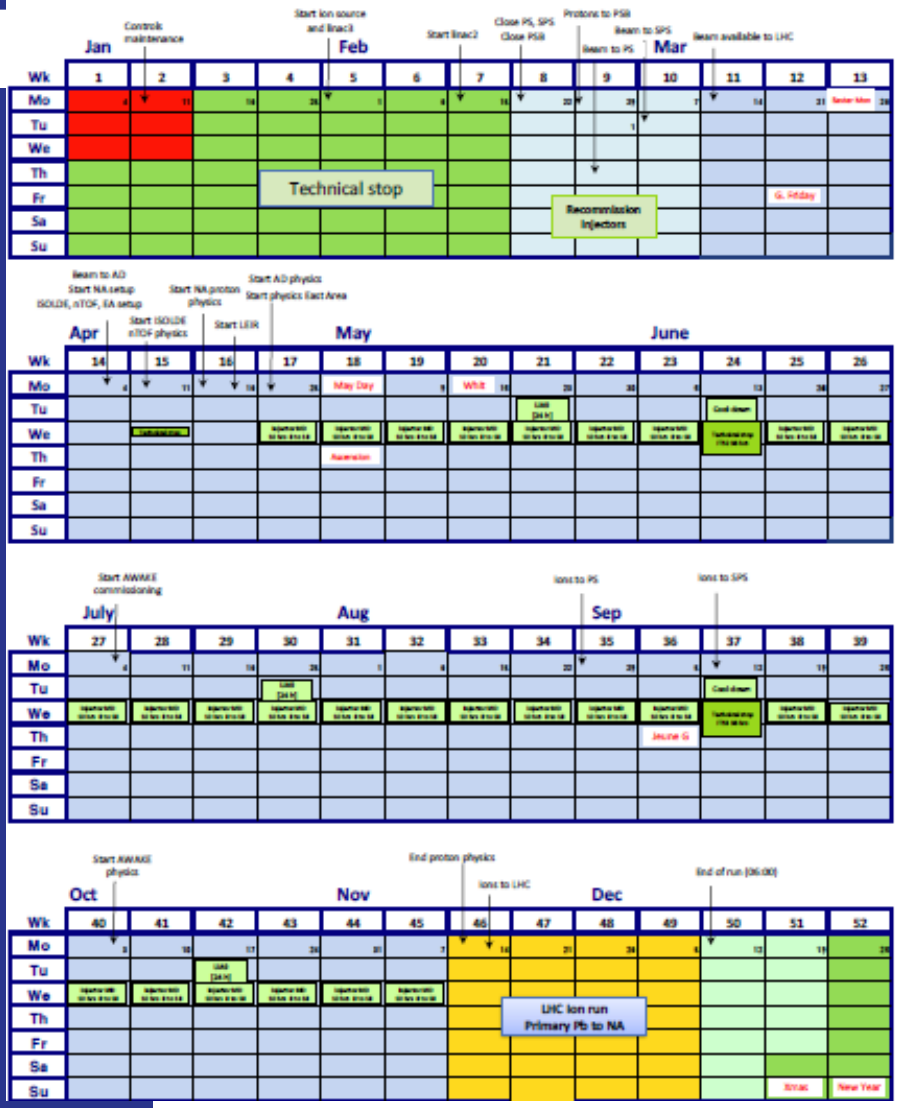
ISOLDE weekly schedule

wk 46 v1 09-Nov

				GPS	HRS	CA0	p's	other	visits
Monday	09/11/2015	AM	Zn	HIE ISOLDE during the day	End of STAGISO for LA2 @ 0900	GPS	GPS (standard, ~ 40%)		
		PM							
		night		REX mode overnight?					
Tuesday	10/11/2015	AM	Zn	HIE ISOLDE during the day	Target change Ucx #547 during setup of HIE-ISOLDE, else Wednesday	GPS	GPS (standard, ~ 40%)		
		PM							
		night		REX mode overnight?					
Wednesday	11/11/2015	AM	Zn	HIE ISOLDE during the day		GPS	GPS (standard, ~ 40%)		
		PM			Setup of beam through Separator & cooler				
		night		REX mode overnight?					
Thursday	12/11/2015	AM	Zn	HIE ISOLDE during the day	Set up in bunched mode	GPS	GPS (standard, ~ 40%)		
		PM							
		night		short collections in LA1?	Stable beam to CRIS				
Friday	13/11/2015	AM	Zn	HIE ISOLDE during the day	Proton scan on HRS	GPS	GPS (standard, ~ 40%)		
		PM							
		night		Couple of hours of K for IDS?	CRIS	GPS/HRS	HRS (standard, ~ 40%)		
Saturday	14/11/2015	AM							
		PM							
		night			CRIS	HRS			
Sunday	15/11/2015	AM							
		PM							
		night							
Monday	16/11/2015	AM		End of Protons 2015 @ 0600		HRS			
		PM							
		night							
Tuesday	17/11/2015	AM							
		PM							
		night							

- Protons end next Monday @ 0600
- Running period of 30 weeks.
- Since 22nd October, in special “HIE-ISOLDE” mode

Preliminary schedule for 2016



Based on the length of the YETS 2015-16 & EYETS 16-17 [ATS-PM-MS-0001]:

- Beam to LHC: March 14th.
- Physics at Isolde & nTOF: April 11th.
- p-physics at North Area: April 18th. (Awake October 3rd)
- East Area & AD physics: April 25th.
- Proton -> Pb November 14th.
- End of run December 12th.

INTC physics: 31 weeks. (~1.8x10^{19} pot for nTOF)

NA FT physics: 30 weeks (p) + 4 weeks (Pb)

AD & EA: 29 weeks.

Weekly MDs, 3 Technical stops, UA9 runs indicative (tbd by SPSC). SPS scrubbing likely needed, but no dedicated scrubbing run.

(Henric wilkins)

Overview of planned experiments (HIE ISOLDE apart)

- In-source laser spectroscopy on Hg and Au (RILIS + WINDMILL + ISOLTRAP)
- : Po, 34Mg, Cu

- IDS: decay of 20Mg
- Cd, K , Mg for IDS
- 68Mn to IDS

- SSP/biophyics/:
  - Mn and In for EC/Mossbauer
  - Cd, Ag & Hg for PAC
  - Rare earths for SSP

- CRIS: Ga, Fr, Cu

- N-rich Mn and 53-54Ca to COLLAPS

- Tb isotopes for medicine
- LA1: decay of 10C
- LA1: 11Be βp emission
- Negative At ions

Issues of the year

Already seen many issues from Thierry….

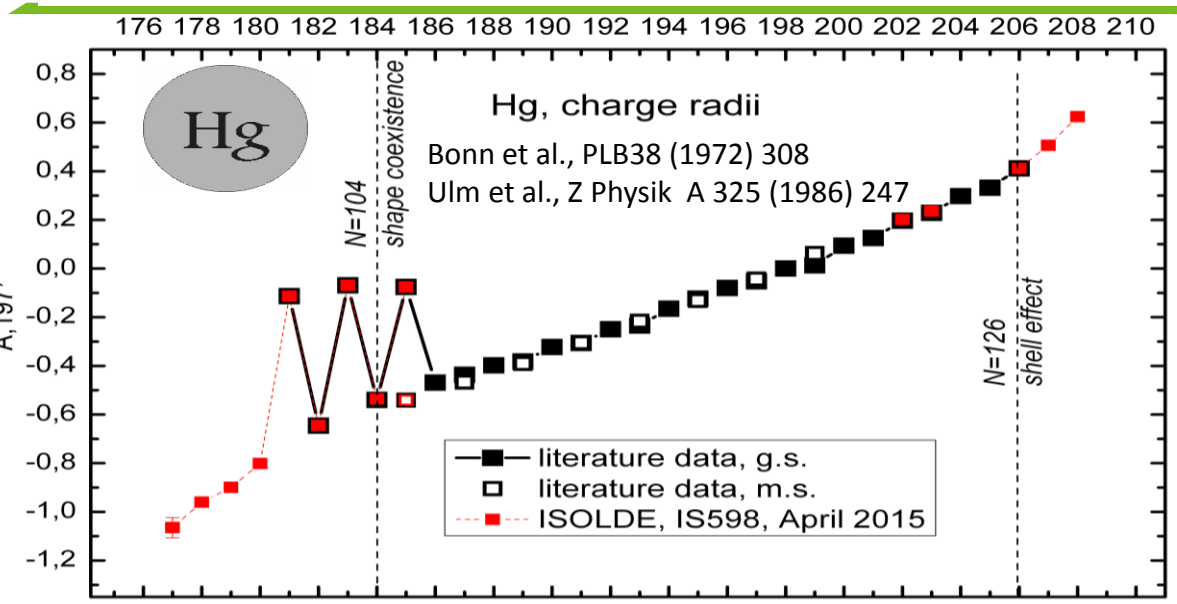
In addition:

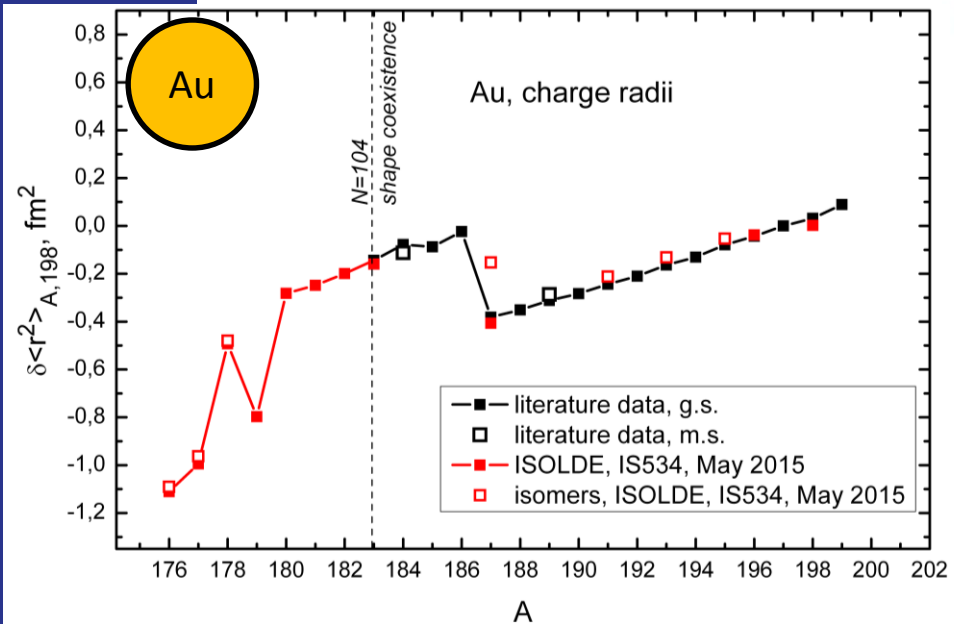
- RFQ: transmission issues
- Controls in general
- Proton BTY lines to the targets
- 60kV (even 50kV?)

- Positive aspects:
  - Optimiser → **big thanks to Jake Palmer for his work on this.**
  - Faster cycling of the HRS magnets

> 75 % of ISOLDE Physics

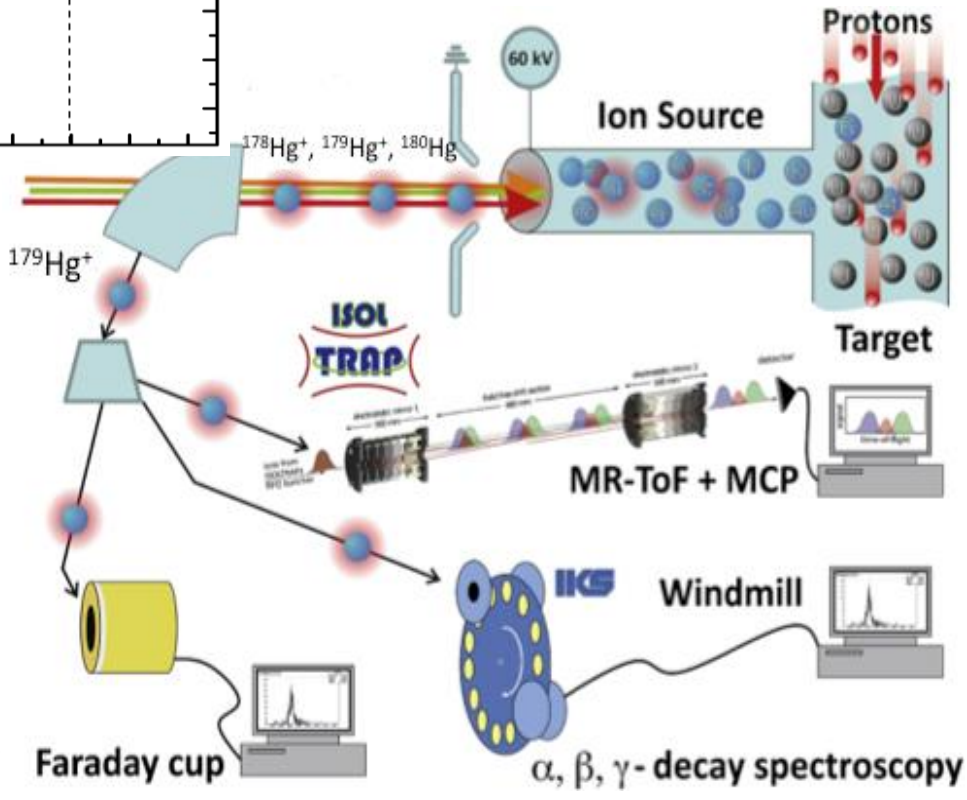
Lasers + ion traps: n-def Hg & Au isotopes





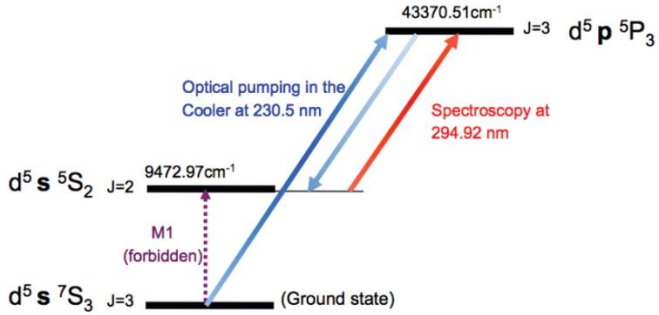
RILIS, Windmill, ISOLTRAP teams

- Several techniques combined
- RILIS lasers to probe the hyperfine structure of Hg & Au isotopes
- Detection:
  - Alpha spectroscopy with Windmill
  - Selective ion counting in MR-ToF



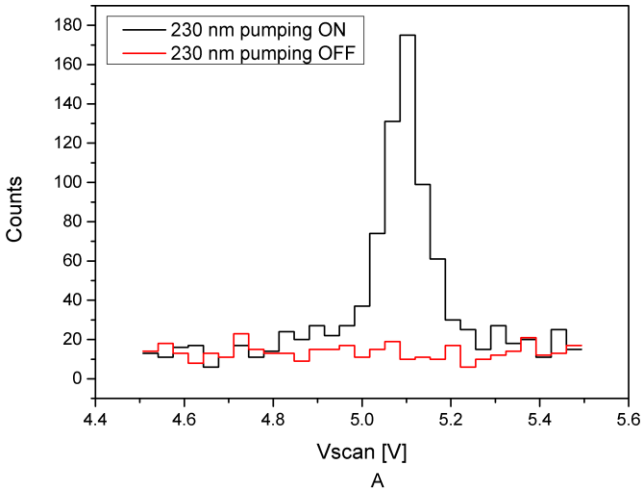
COLLAPS Mn – June 2015

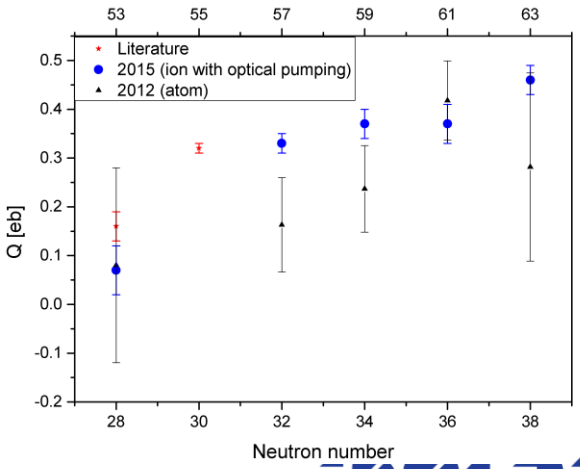
- **First successful application of optical pumping in ISCOOL**
  - Enhancement of metastable state population



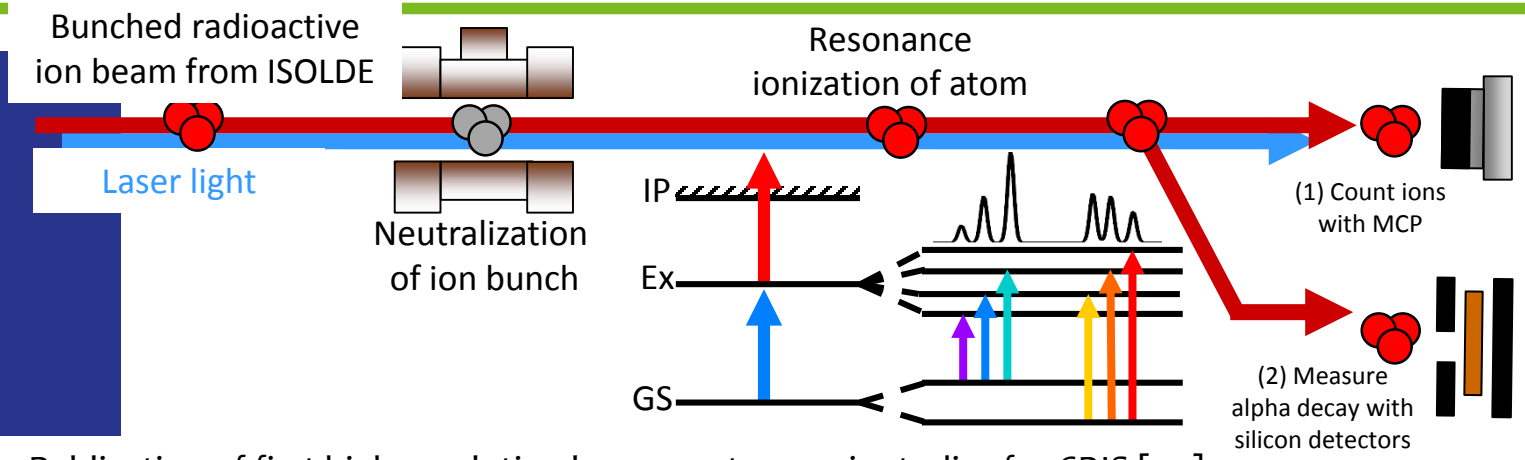
- Quadrupole moments of odd-even Mn from N = 28 up to N = 38
  - Precision on Q between 5 – 10 %
  - Illustrates increase in Q towards N = 40: physics goal is reached
  - N = 40 out of reach, at least partly because …
- Limited in intensity by target problems
  - Yield per proton pulse ok with 2 pulses, decreased with more pulses
  - Flooding due to Rb mass marker or oxygen release due oxidation of target or … ?

$^5S_2$ (metastable) → $^5P_3$ ionic transition
Enhancement using optical pumping





The CRIS experiment: Highlights from 2015

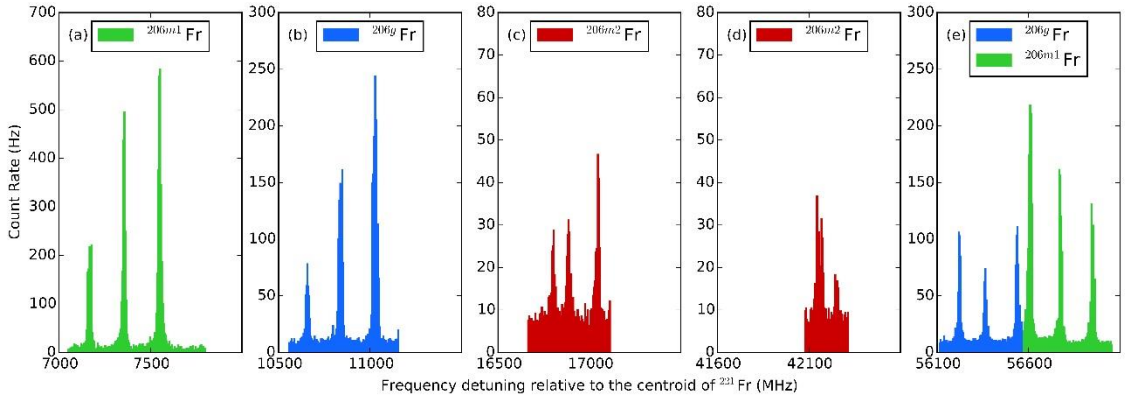


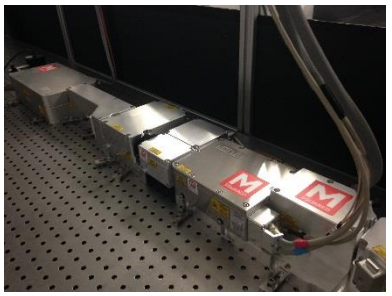
- Publication of first high-resolution laser spectroscopic studies for CRIS [1-3]
- High-resolution laser spectroscopy measurements of copper and gallium isotopes
- Commissioning of new laser lab in Building 508 and installation of new narrow-linewidth high-powered Ti:Sa laser system
- Installation of new pneumatically-controlled Faraday cups and new segmented Faraday cup
- Installation of positive-ion MCP for high-sensitivity studies
- Use of DSS2.0 with the ISOLTRAP setup for polonium decay studies
- New distributed data acquisition and control system with dedicated machines for each experimental component

[1] R.P. de Groote *et al.*, PRL 115, 132501 (2015)

[2] K.M. Lynch *et al.*, In preparation (2015)

[3] G. Farooq-Smith *et al.*, In preparation (2015)





Letter of Intent : I-148

Measurement of electron affinities of radioactive elements

LOI I148

Objectives of the LOI:

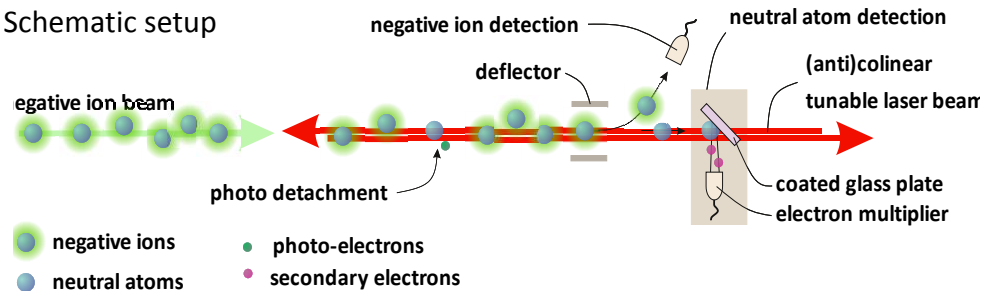
1. Yield measurement for astatine and polonium using negative ion source
2. Check beam transport of negative ions to experimental setups

Outcome: Iodine EA measured in new beamline

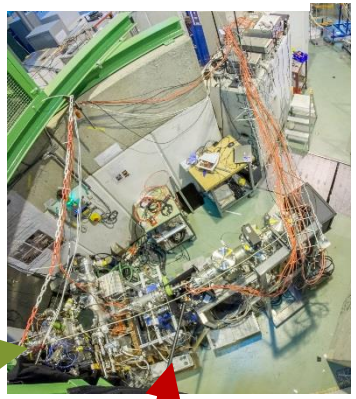
- ✓ ~ -460 pA of ^{127}I measured on GPS FC.490, ISOLDE wire scanners are working fine
- ✓ Integration of the GANDALPH chamber at ISOLDE GLM beamline
- ✓ Setup of a RILIS laser beam path to GLM + laser safety
- ✓ Integration into RILIS DAQ
- ✓ Achieved low 10^{-8} mbar vacuum through differential pumping
- ✓ ~ 8% transmission to the neutral detector
- ✓ photodetachment signal obtained using the iodine beam
- ✓ Threshold still measurable at very low ion rates (<1 pA, FC noise), At would have been feasible
- ❑ Yield measurements for radiogenic isotopes

Full proposal to be submitted 2016

Schematic setup

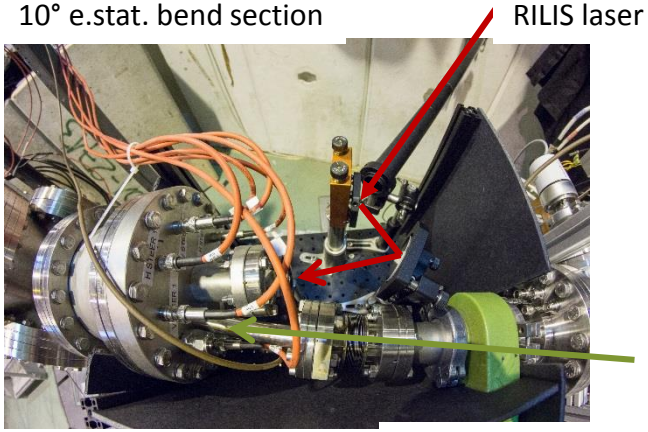


GLM with GANDALPH



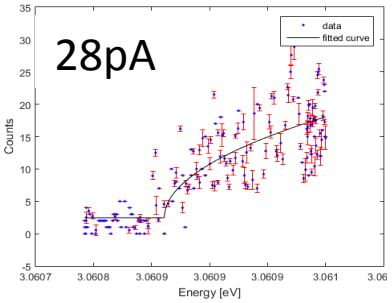
10° e.stat. bend section

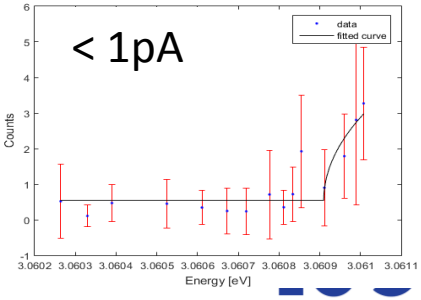
RILIS laser



Ion beam from GLM

Detachment threshold measurements of iodine (simulating different yields)



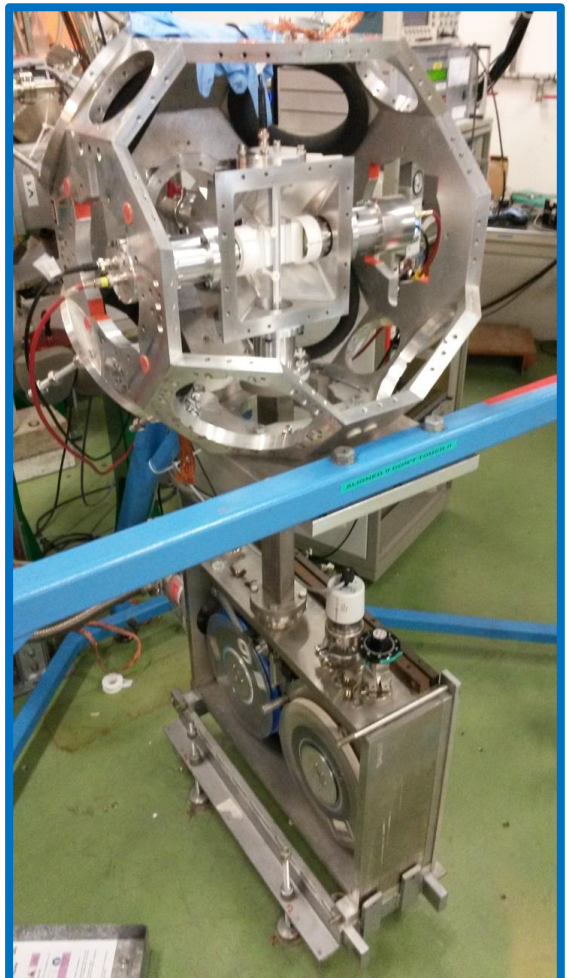


IS599, IS600: VANDLE Campaign

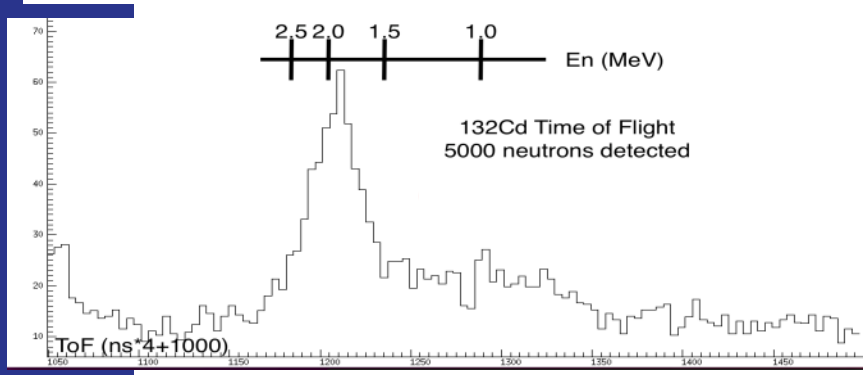
ISOLDE Decay Station

VANDLE - Versatile Array for Neutron Detection at Low Energies

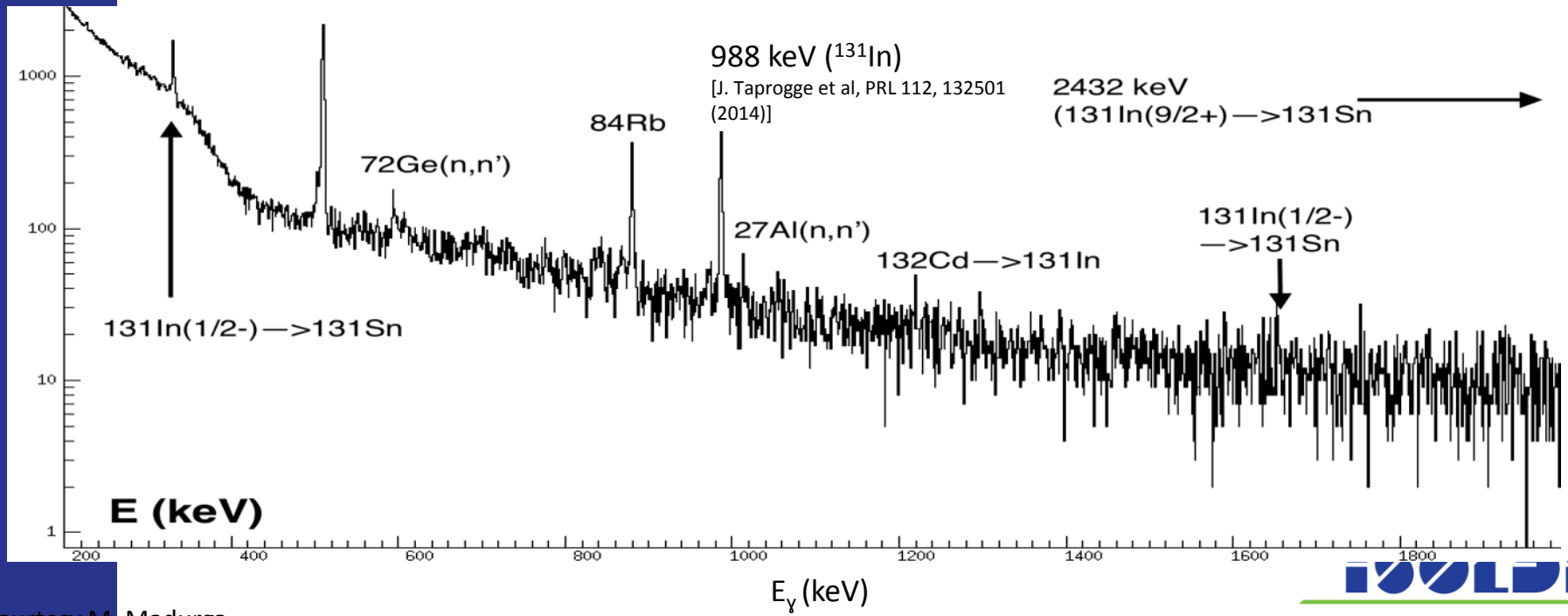
- Implantation on Tape
- 2 or 4 HPGe Clovers
- 1 Central Plastic scintillator
- VANDLE Medium and Small bars



IS600: Beta-delayed Neutron Spectroscopy of $^{130-132}$Cd Isotopes with the ISOLDE Decay Station and the VANDLE array

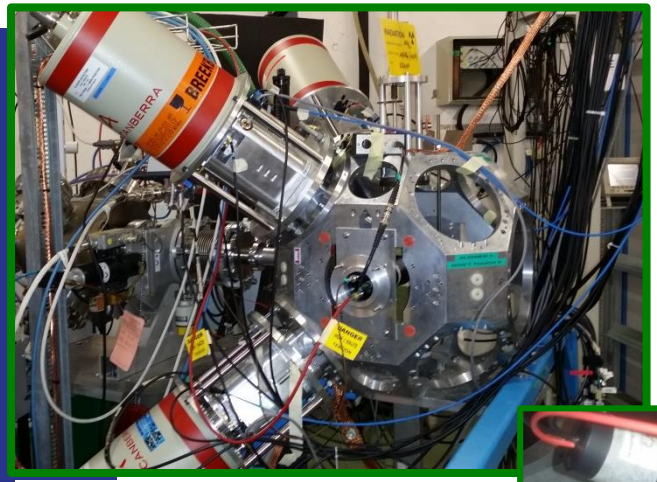


- Beta decay of ^{132}Cd:
  - 988 keV line observed
  - High-energy resonant neutron emission observed!



Courtesy M. Madurga

IS590: Characterization of the low-lying 0^+ and 2^+ states of ^{68}Ni

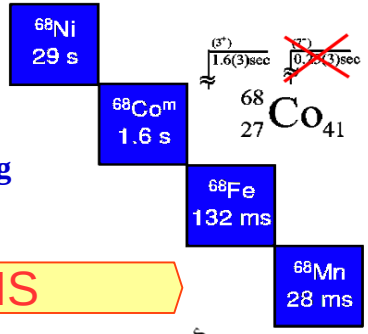


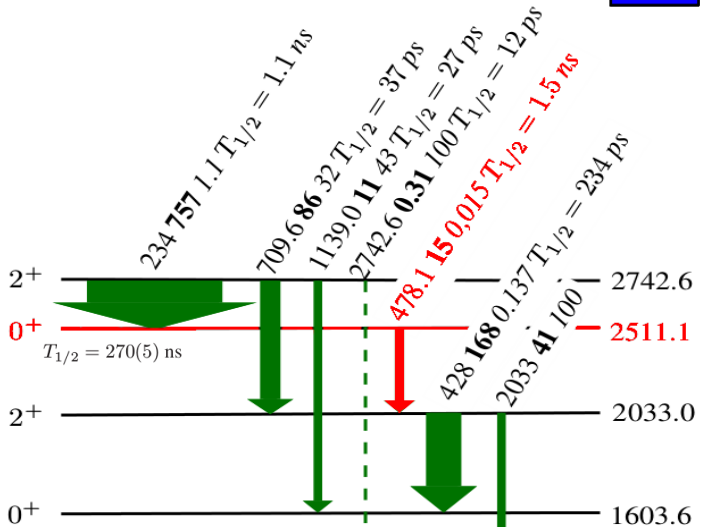
Setup configuration for lifetime measurements

- Implantation on Tape
- 4 Ge Clovers at Backward angles
- 2 $LaBr_3$
- 1 plastic scintillator
- $^{68}Mn \rightarrow {}^{68}Fe \rightarrow {}^{68}Co^m \rightarrow {}^{68}Ni$
- ^{68}Mn yields: ~5 ions/μC

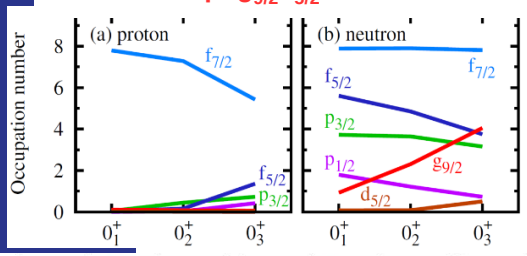
Decay Chain:

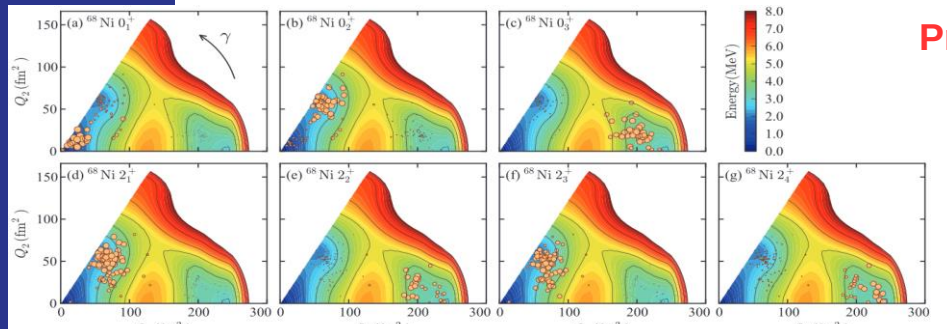
Feeding of the ^{68}Ni low-lying states via $^{68}Co^m$





Monte Carlo Shell Model calculations: pf $g_{9/2}d_{5/2}$ shell





Potential energy surfaces (PESs) obtained from MCSM calculations

F. Flavigny et *al.*, PRC91, 034310 (2015)
Y. Tsunoda et *al.*, Phys.Rev.C89,031301(R)(2014).

Preliminary (from online analysis):

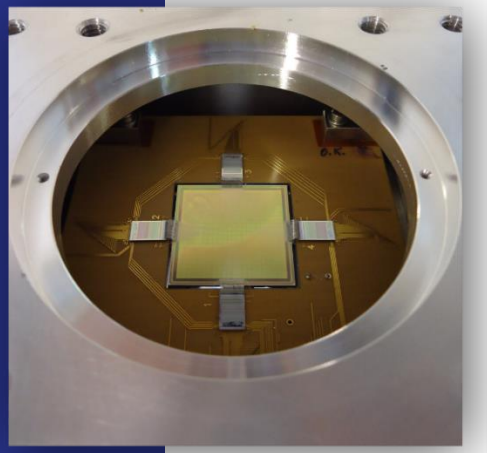
- **Successful target tests** performed in close collab. with the ISOLDE target team → **High yields and low Ga contamination**
- Possible **new transitions** observed in the decay chain
- **Analysis** to extract the **partial half-life** of the 478-keV transition is **ongoing**
- **Higher statistics** would potentially provide a **new refined level scheme** (e.g. solved true summing effects)

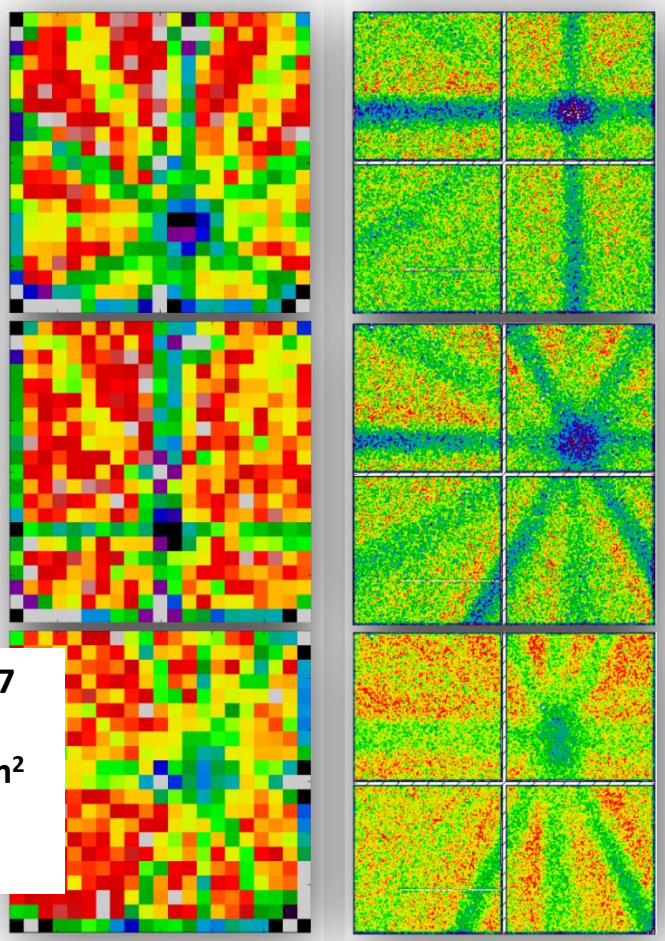
⇒Off-line analysis is ongoing (C. Sotty)

- Courtesy of C. Sotty

First on-line run with Timepix
^{24}Na : GaN β^- - Emission Channeling

Si PAD detector 22x22 1.4mm pixels





Timepix Quad detector 512x512 55µm pixels

Medipix Colaboratio

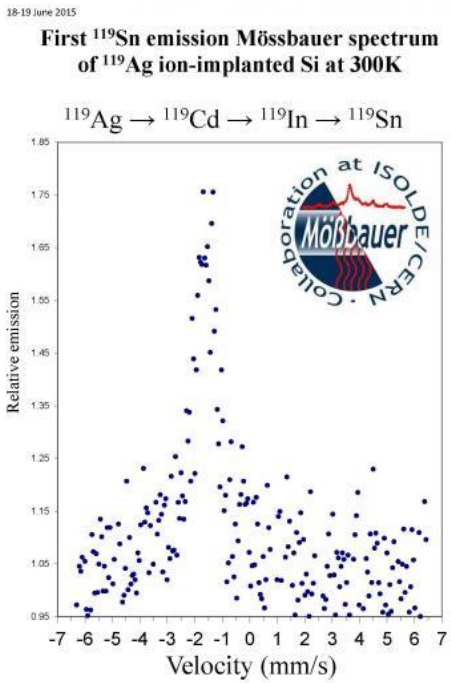
2012-2014 NEW FAST VATAGP7 PAD detector
(22x22 = 484 pads 1.4 x 1.4 mm^2
> 5.5 kHz

^{24}Na on GaN after annealing at 800ºC
September 2015

- **QUAD Medipix**
  → High position resolution
  - Improvement on **displacement** and **multiple** sites determination
- Medipix collaboration supporting further R&D with **TIMEPIX 3**
  → **1.5ns** time resolution
  → **~40M** hits/s/cm^2
  - **Will combine high position resolution with low sample damage**

Mossbauer experiments

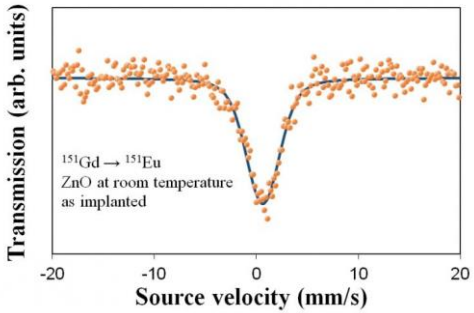
- First ^{119}Sn emission Mössbauer spectrum of ^{119}Ag ion-implanted Si at 300K was measured at ISOLDE/CERN.
(^{119}Ag → ^{119}Cd →^{119}In → ^{119}Sn)



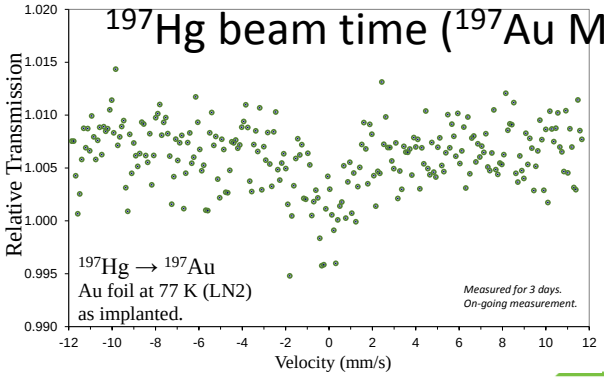
- May 2015: Mn/In beamtime
  - Laser ionized ^{119}In → 10^9 ^{119}In/s (**factor 20**)

    (good measurement in minutes instead of questionable in hour)

- June/July 2015: Dy beamtime
  - Test of ^{152}Dy for ^{152}Eu eMS
  - Samples made in minutes
  - Measurements of ~20 samples ongoing



^{197}Hg beam time (^{197}Au Mössbauer)

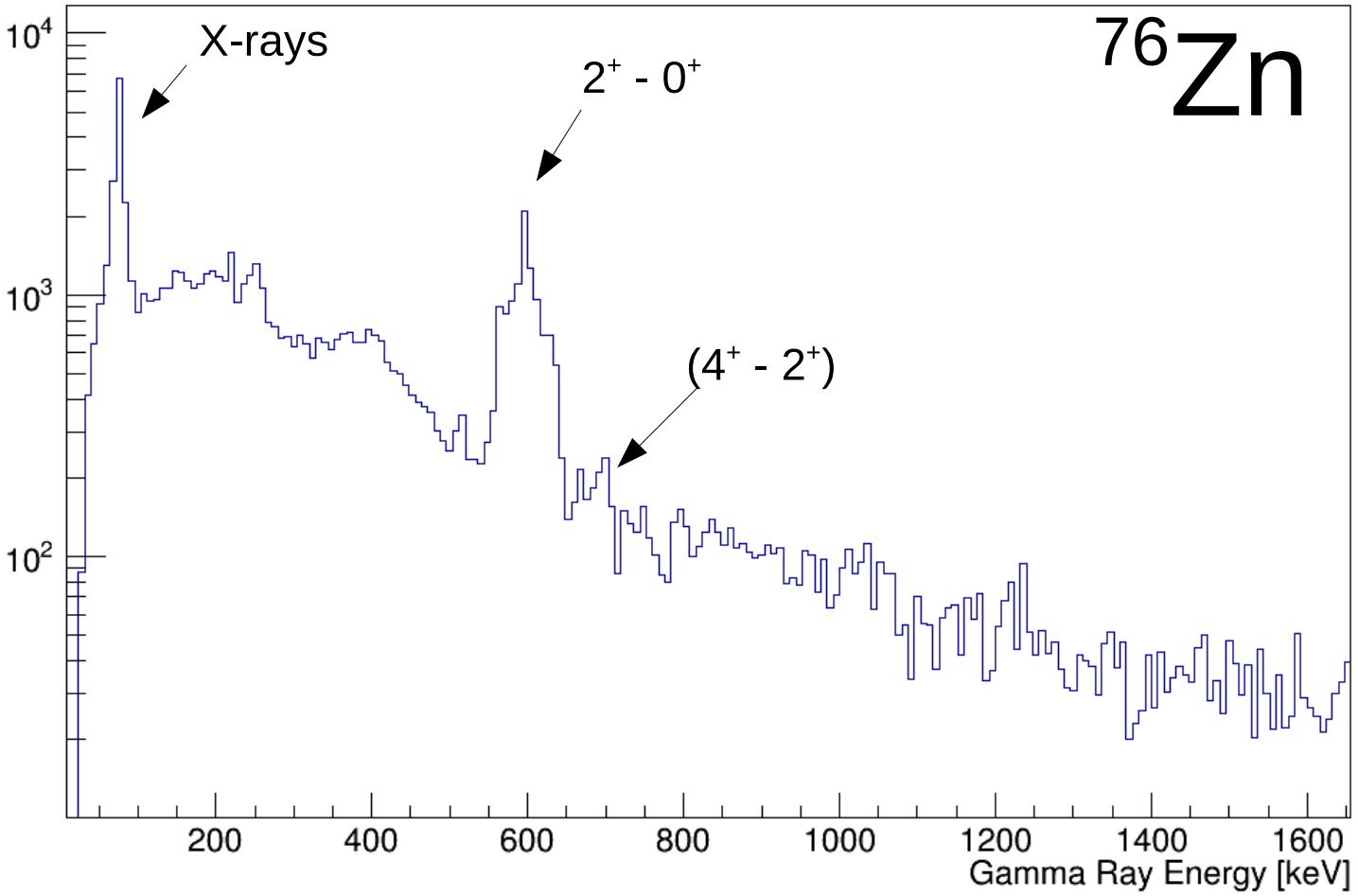


22nd October…..

1st beam of $^{74}Zn^{25+}$ to HIE-ISOLDE
Now running on ^{76}Zn

- Special beam permit: operation of cryomodules only during working hours, and not during weekend.
- However, stability of the lasers allowed for night-time operation of Zn → opportunistic REX run during off-hours.
- Heavy load on the operators but greatly appreciated by the users.

- Now a need to have a workshop to organise and discuss priorities for next year


^{76}Zn
X-rays
$2^+ - 0^+$
$(4^+ - 2^+)$
10^4
10^3
10^2
200
400
600
800
1000
1200
1400
1600
Gamma Ray Energy [keV]

Access to ISOLDE

Users with and without dosimeter: (www.cern.ch/isolde/get-access-isolde-facility)

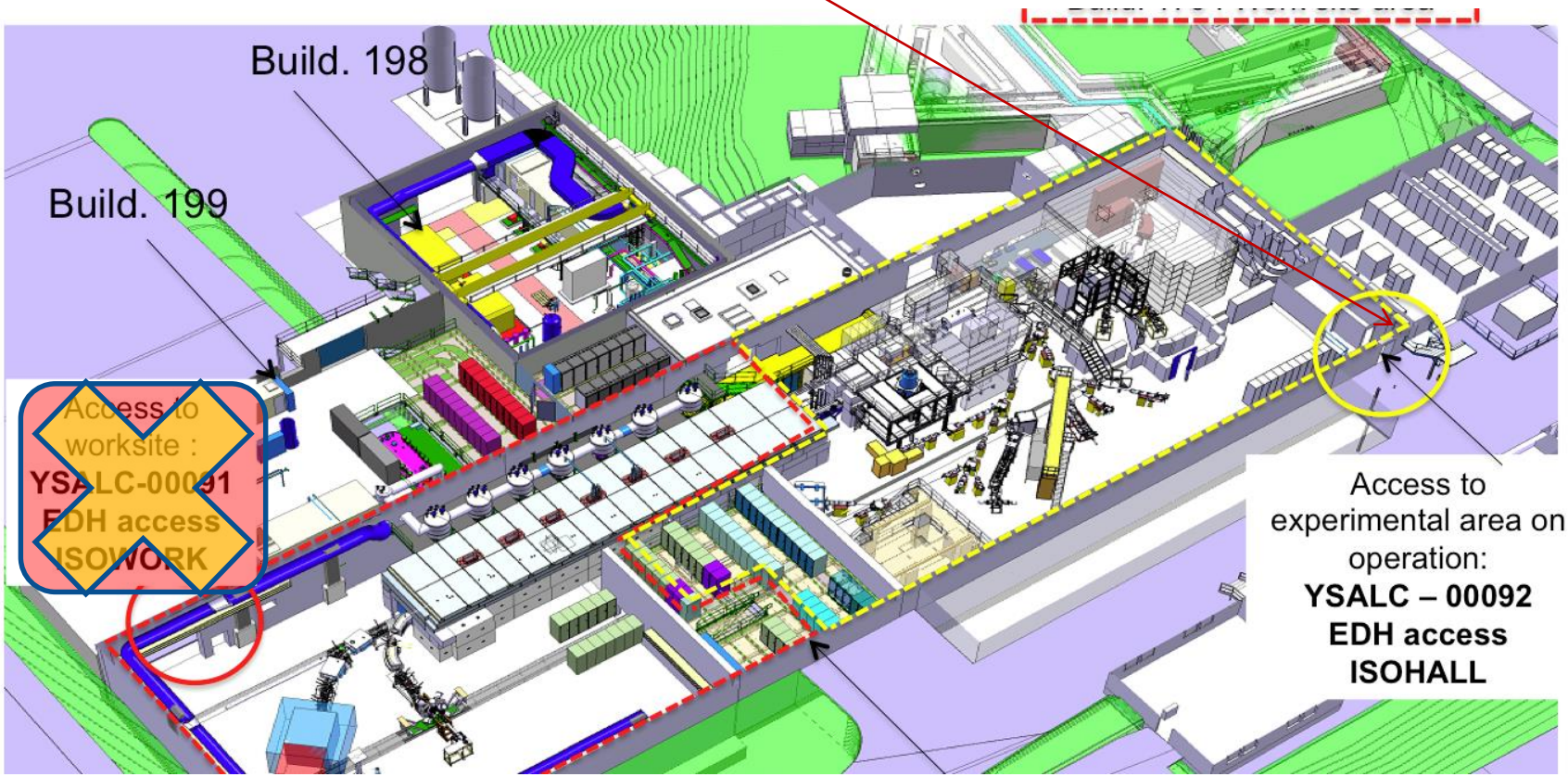
- No temporary dosimeters possible → has been fairly successful .
- Institute form → also fairly successful

- Training
  - Currently Tuesdays @ 1300:
  - Follow 2-h RP ISOLDE practical course
  - 1 hour electrical course.
  - Under negotiation to optimise things for next year

- NOTE for training – registration min 1 week before, only via EDH (new users-preregistration via email, but once registered: also via EDH)
- Now being applied…leading to some confusion.

Access to ISOLDE

- Suppression of ISOWORK
- Access to HIE-ISOLDE recommended for only local physicists when moving equipment
- Access for users from Jura side for all, **since May 2015:**
  - **NEW: Tourniquet operational, opens via dosimeter**
  - **ISOLDE door still opens with CERN card (to be changed soon)**
  - **Soon: Card reader to be moved to ground floor of 508 for dosemeters**



Visits to ISOLDE

- RP watching even more closely

- ISOLDE as Controlled RP area:
- Only professional visits allowed
  - Our suggestion – university students, uni and school teachers, VIPs
- Non-professional visits access on case-by-case basis
  - High-school students above 16y
  - Private-public visits: friends, family

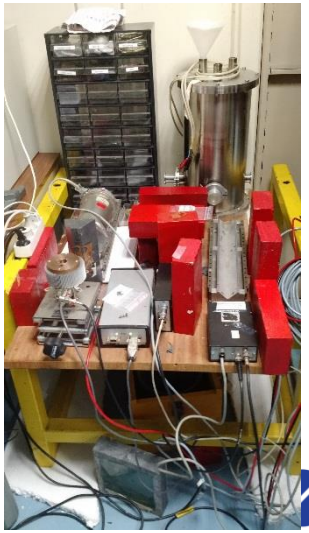
- No visits during the opening of beamlines or making high-intensity collections
- All visits
  - announced to me, Richard & Kara
  - Included in weekly schedule
  - discussed and (not-)approved in Tuesday Isolde technical meeting
  - Dedicated calendar available https://espace.cern.ch/isolde-visits-info/_layouts/15/start.aspx#/Lists/Calendar/calendar.aspx

- RP make a survey prior to **each** visit.

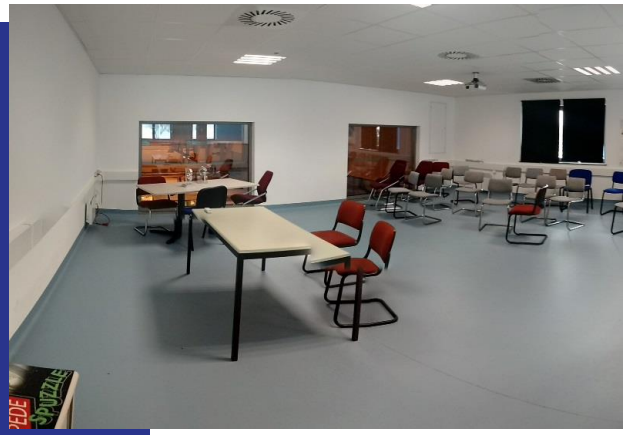
Building 508

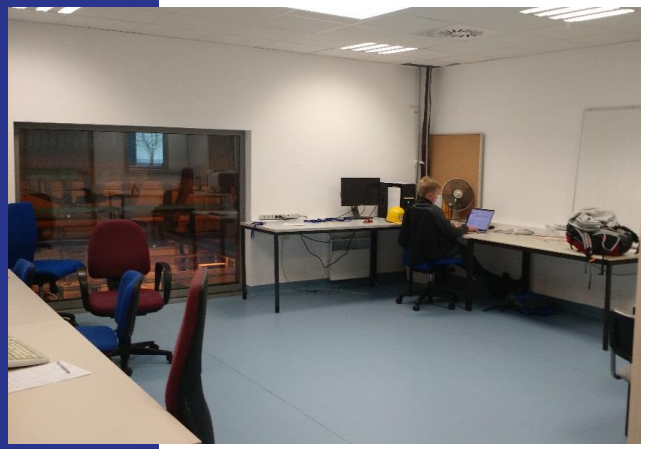
Installation of labs…SSP/chemistry

Lasers: COLLAPS/CRIS
Tooling workshop etc



Building 508





- Kitchen and new control room furniture arriving next week (
- Still issues with the entrance doors….
- Water cooling for the laser labs has been ordered.
- Air conditioning leaks…has been addressed

Building 275

Old SSP lab is now emptied and decontaminated.
Awaiting report from RP
Installation of new offline setups

Building now shared with AD

Still a lot of material to be stored/cleared.


ISOLDE