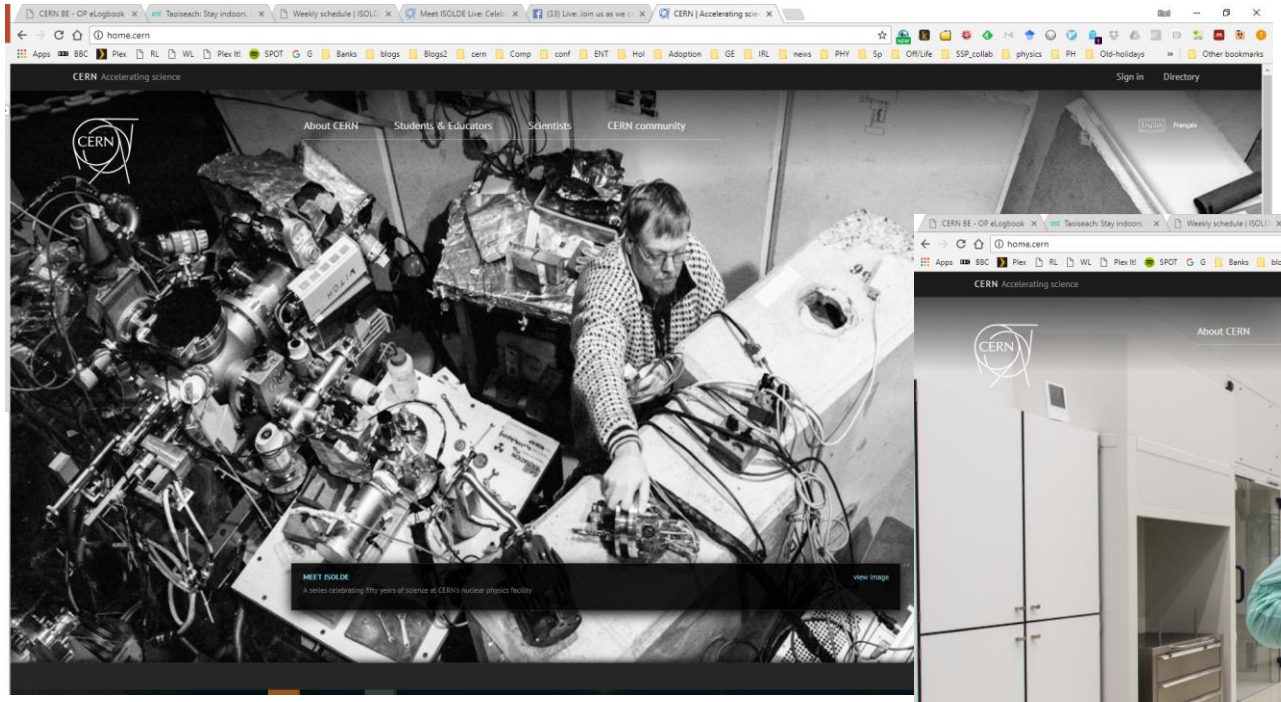
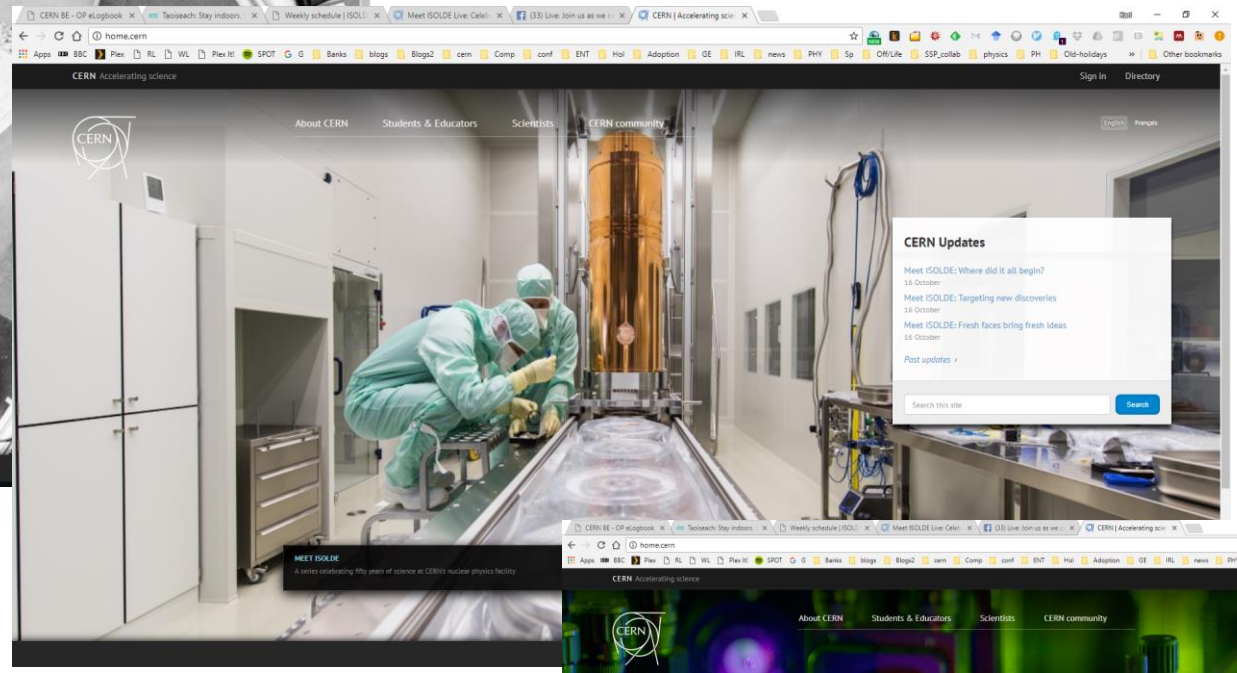
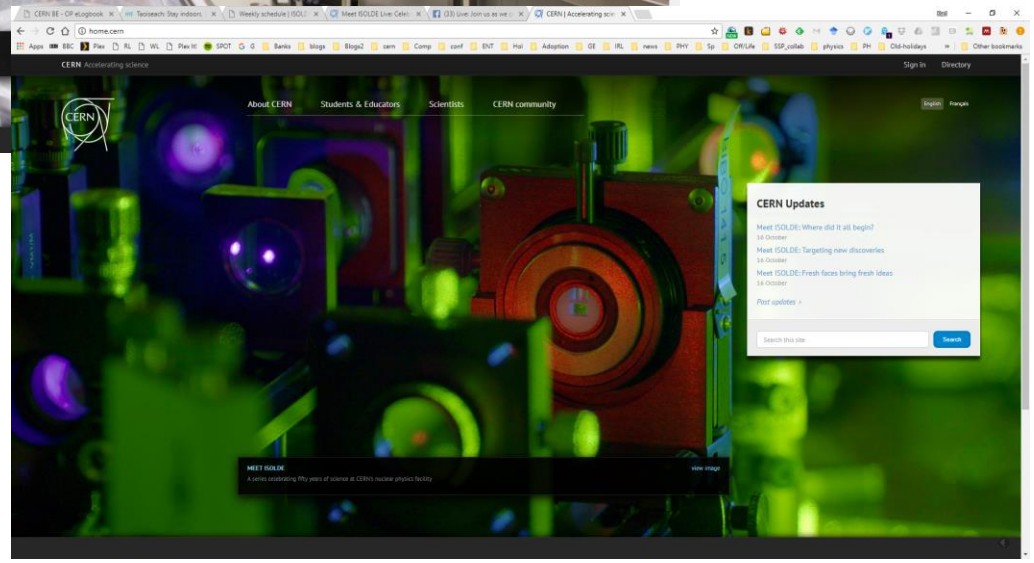
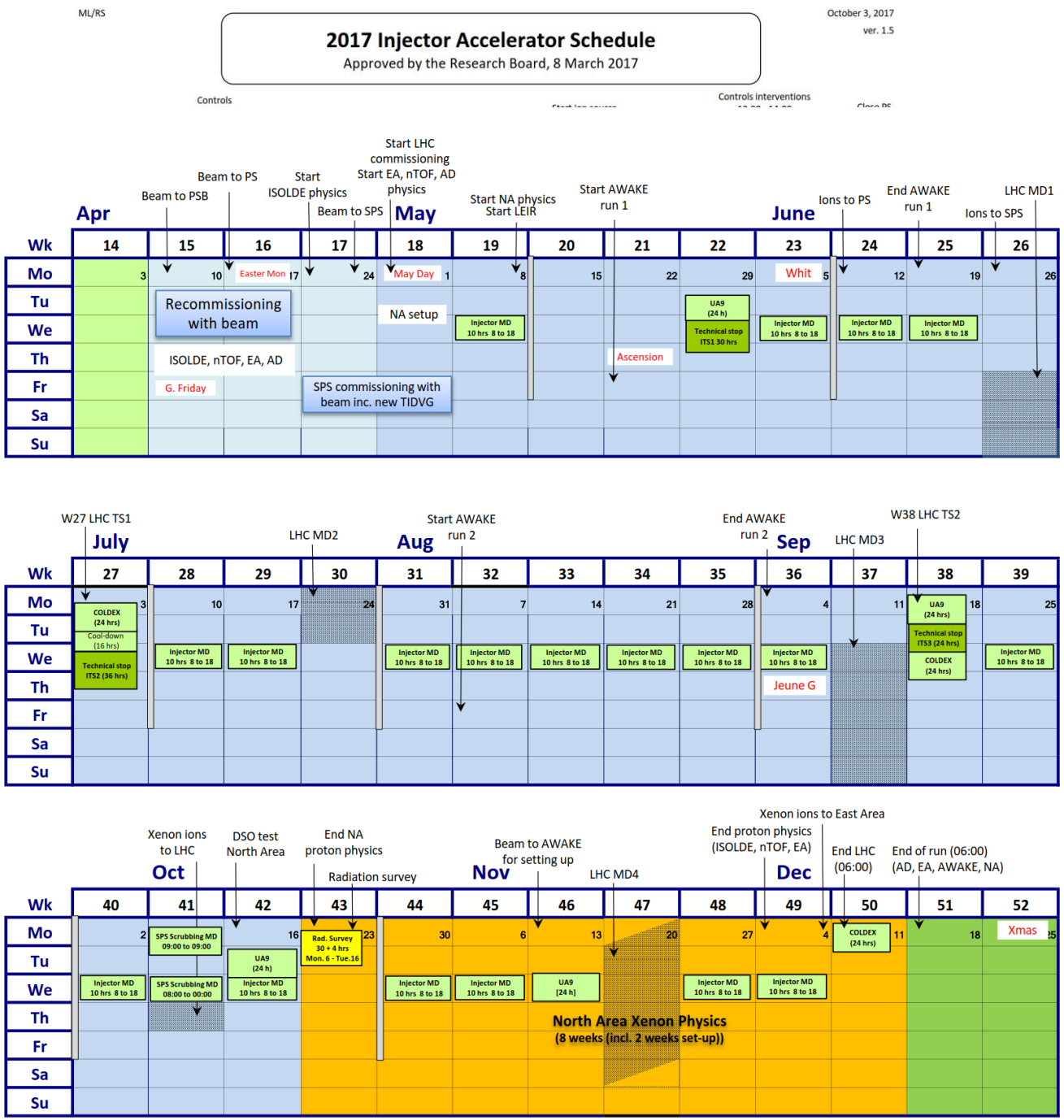






2017 running period and plans for 2018

Karl Johnston



- Protons to ISOLDE for physics from week 17
- Original end of protons was week 47 (Nov 20th)
- Negotiated extension of two extra weeks
- 224 days of physics

ISOLDE Schedule 2017: weeks 16 - 48

GPS	April		May					June				July					August				September				October					November				Dec
Wk	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Mo	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	4
TU			(IS611)									setting	#612 ZrO2-HP	#607 UC Ta	142Ba			#534 Sn VD5	#613 CaO		IS528* IS638/ISOLTRAP/RILIS						XT03			XT03				
WE	SEMgrid				#599 Ti foils		Tech stop					Tech stop								XT03	Jeûne		Tech stop		(IS528)					#513			End of protons 2017: 4th Dec @ 0600
TH						Ascension															#611 UC - Re			(IS528)									
FR	#595 UC - n		#575 UC - CP		IS453		# 601 UC - n	IS578	#603 UC - n		#605 ZrO2 -HP	IS597 72Se @ 4.4MeV/u (IS626)	IS569 70Se @ 5.5MeV/u (IS612)	Set for 4.1MeV/u		#608 Ta - GdB6	IS558 140Sm @ 4.65MeV/u	IS611 IS638 IS640	IS619 15C @ 4.3 MeV/u		#609 Ta GdB6			#534 Sn	IS585 IS514 IS636 IS640 IS647	IS561 9Li @ 7.3MeV/u	#619 Pb VD5		IS547 206Hg @ 4.1MeV/u IS515 IS585 IS602 IS640 (199Hg)	XT03	LIEBE	TISD: LIEBE tests	
SA					IS634			IS580																						Stable C for REX trap			
SU		IS632		IS490		IS633		IS630		(Windmill) IS608				Stable tests if not ready for protons	IS553: 144Ba @ 4.1MeV/u				IS619 15C @ 4.3 MeV/u	IS572 94Rb @ 6.3MeV/u		IS546 @ 3.6 (or) 4.5MeV/u					IS607 59Cu @ various; 64Cu for IS626				(Hg RILIS?)	
		In RILIS	In RILIS	98Kr/48Ar	Mg RILIS	8B		Mn RILIS	In RILIS	Bi RILIS		Se (mol) beam		BaF beams	BaF beams		Sm RILIS	Cd beams	15C	15C	Dy RILIS	Rb beams		Nd RILIS		Cd beams	Li beams		Hg beams	Cu RILIS				

Re-used target: leaking

Had to re-use#513…

Se beams…

Ge beams…

TISD/Dy week

Incorrect ion source proton stop difficult setup: machine+experiment

VADIS + VADLIS mode

LIEBE tests impossible: replaced by UO/VADIS tests

Low/no yields; HRS problems

Issue with leaking targets not seen in 2017: except for one used and new unit.

HIE ISOLDE quite reliable, but still a heavy load on operators especially for light and molecular beams.

Also heavy load on the local support.

HRS	April		May					June								October					November				Dec
Wk	16	17	18	19	20	21	22	23	24	25	26	27	39	40	41	42	43	44	45	46	47	48	49
Mo	17	24	1	8	15	22	29	5	12	19	26		25	2	#620 LaC 9	16	23	30	6	13	20	27	4
TU	#596 CaO	IS601			TISD	TISD																	
WE		(IS632)				Ascension	Tech stop					Tech st							Installation of plunger begins	IS628 22Ne @ 5.5MeV/u	IS628 28Mg @ 5.5MeV/u	UC (used)	End of protons 2017: 4th Dec @ 0600
TH													#595 UC n			#628 UC - n				#623 SiC (tbc)			
FR		#597 UC - n		#597 remains		#600 UC - Ta		#602 UC - W		#604 UC q n				IS571	IS562 108Sn @ 4.4MeV/u		IS573 121-136Sn			IS628 22Ne @ 5.5MeV/u	(tbc) IS645 VITO	
SA	Stable tests for IS601																						
SU			IS639				IS617		IS620		IS574												
		35Ar	In RILIS	In RILIS			Al RILIS		51-53K		Cd RILIS			Ga RILIS	Sn RILIS		Sn RILIS				Mg RILIS		

Target change

CERN holiday

Setting up/proton scan/yield

Physics GPS

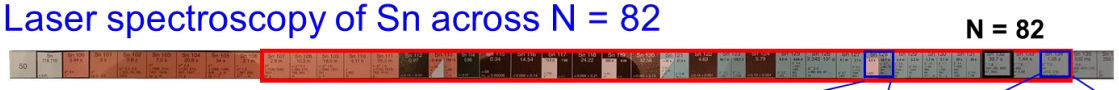
Physics HRS

KJ: 06.10.17

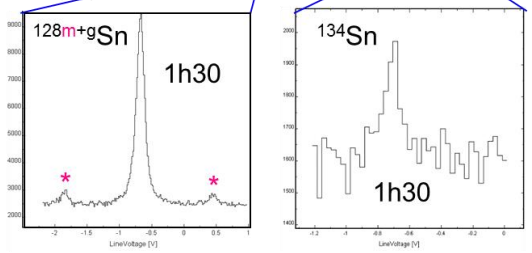
Laser spectroscopy…

The year 2017 for COLLAPS

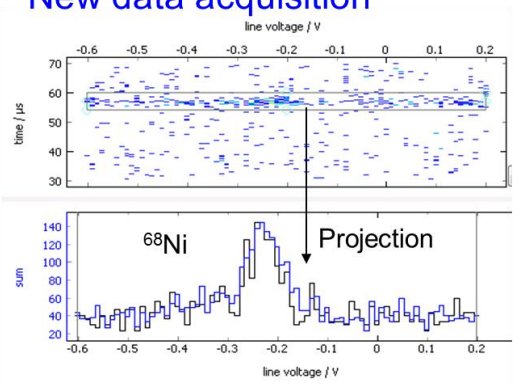
Laser spectroscopy of Sn across N = 82



- Atomic transition complementary to the one used in 2016:
  - Combining both gives firm μ, Q, radii
  - Resolve weakly produced isomers
- > 20 isotopes in 3 days!
  - N = 57 up to N = 84



New data acquisition



Photon timing wrt bunch extraction

Line voltage (freq)

Problems ☹

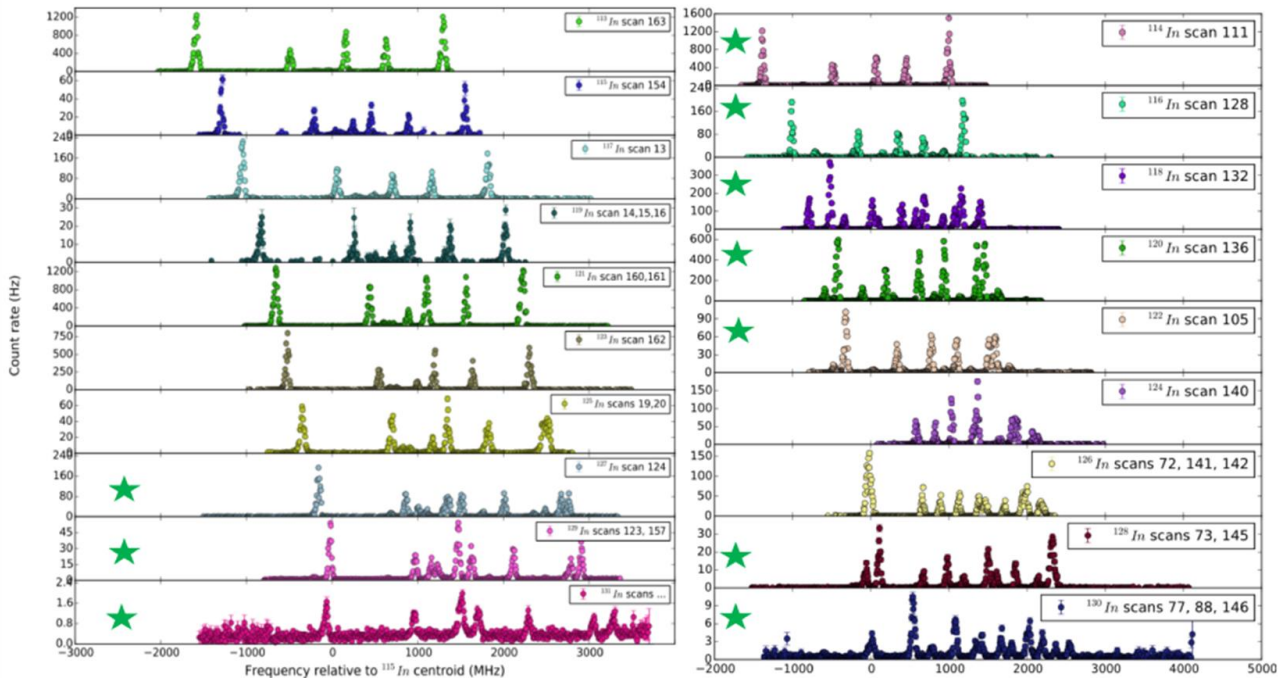
- Unexpectedly low Al and Ni yields: key cases out of reach
- Long ISOLDE set-up times despite (much appreciated!) efforts of technical teams

CRIS

RESULTS CRIS Experiments on neutron-rich In

From ^{113}In up to ^{131}In

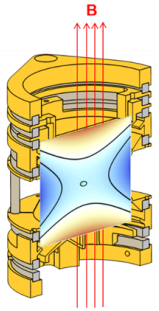
(New results ★)



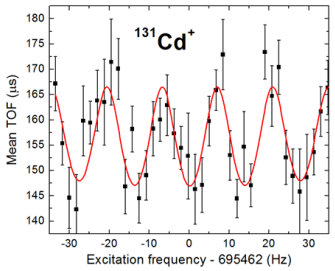
- Difficult year for Laser spectroscopy: 2/3 runs either failed or had difficulties: Al/K/Ga/Ni
- Good runs for In (CRIS) and Sn (COLLAPS)

Precision mass spectrometry of ^{131,132}Cd

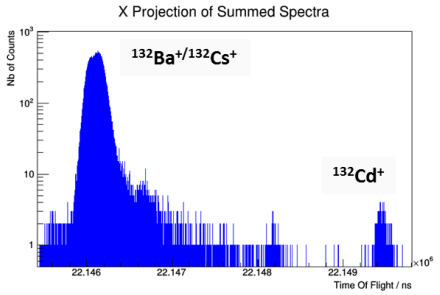
June 2017 – UC_x-converter + quartz + RILIS: high-quality cadmium beams.



Precision Penning trap



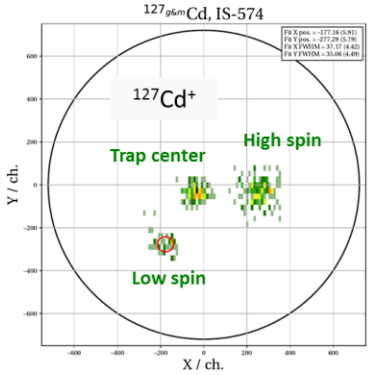
Penning trap confirms and improves the MR-TOF mass of ^{131}Cd from 2014.



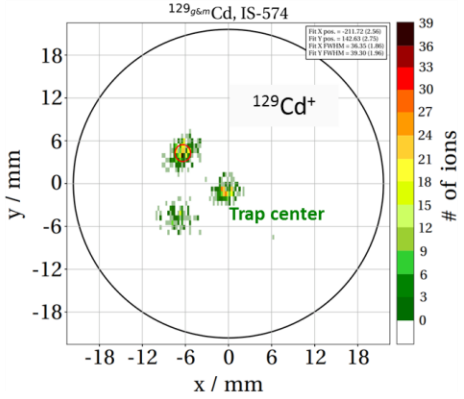
MR-TOF MS allows first mass measurement of ^{132}Cd.

Isomer separation in ^{127,129}Cd with PI-ICR

The PI-ICR technique allowed fast and optimal separation of the isomeric states in the odd-A cadmium isotopes.



Measurement time 209 ms

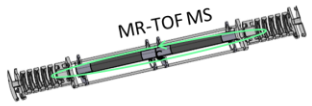


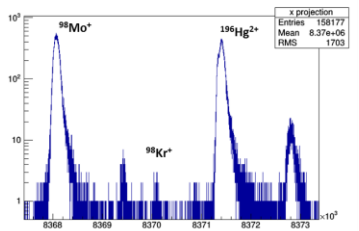
Measurement time 106 ms

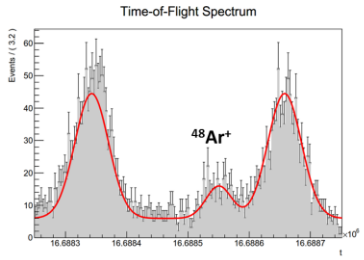
J. Karthein, master thesis 2017.

MR-TOF mass measurements of ^{48}Ar and ^{98}Kr

August 2017 – UC_x with cold plasma: a challenge for the MR-TOF MS sensitivity







Strength of the N = 28 shell closure

Onset of deformation in the A≈100 region

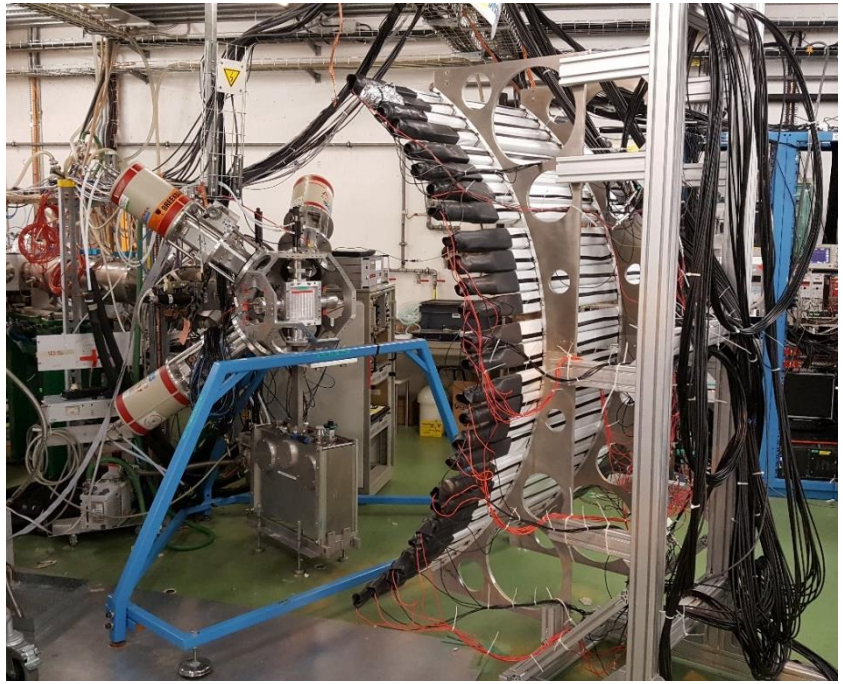
ISOLTRAP:

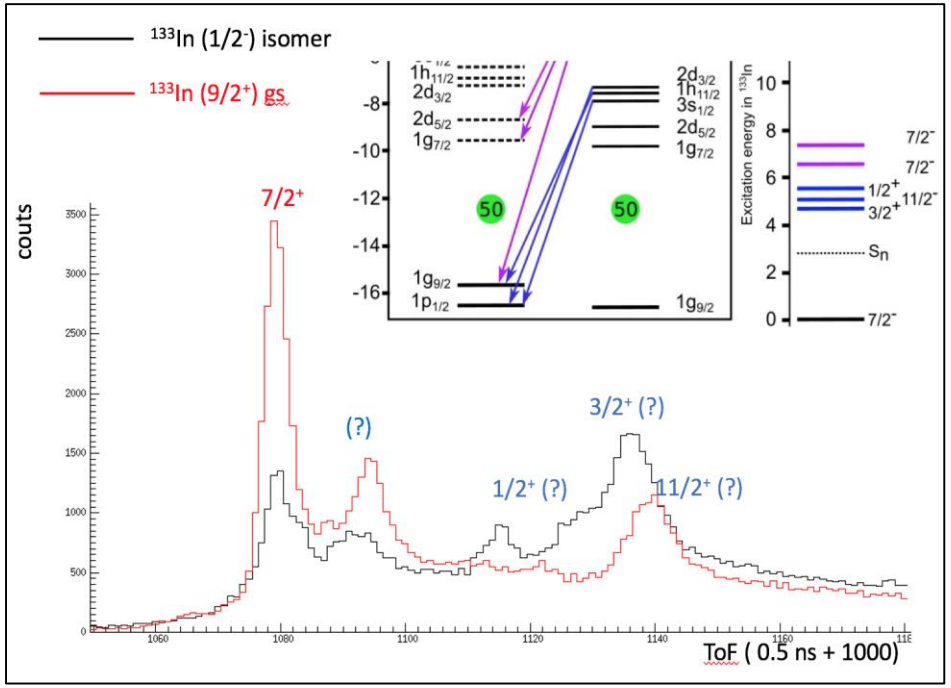
Successful 132Cd run and noble gases. Performance of PI – ICR ever-improving. Opportunistic runs less successful in terms of results, but fruitful for devices and assisting with TISD/RILIS.

IS632 at IDS: Neutron unbound single particle states in ^{133}Sn from the beta decay of ^{133}In

- The IDS Neutron Detector and HPGe Clovers were used
- ToF calibrations with ^{17}N from the HRS CaO target.
- Production of ^{133}In ~ 900 ions/uC (~70% transmission from GPS)
- Using RILIS, both isomer and gs in ^{133}In were selectively ionized

- Clear resonances were observed, to be clarified in the offline analysis using neutron-gamma coincidences

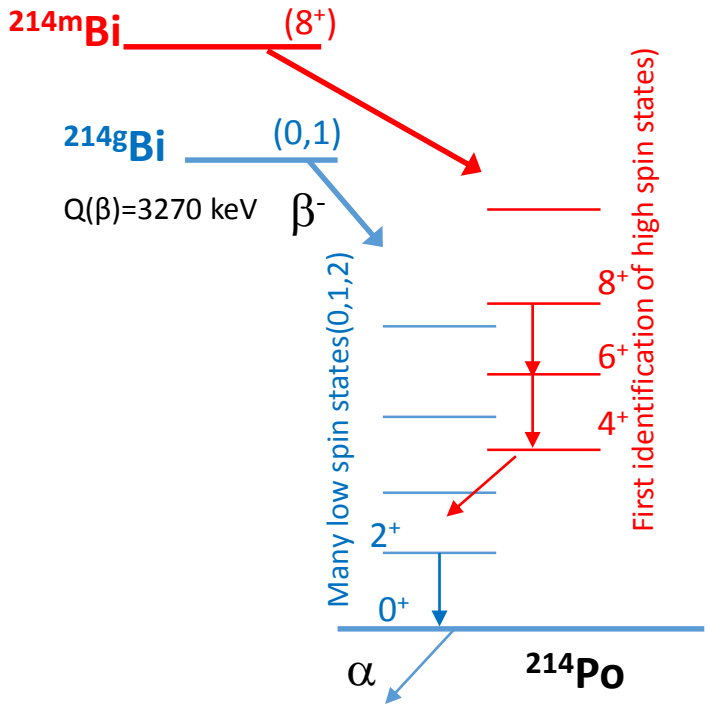




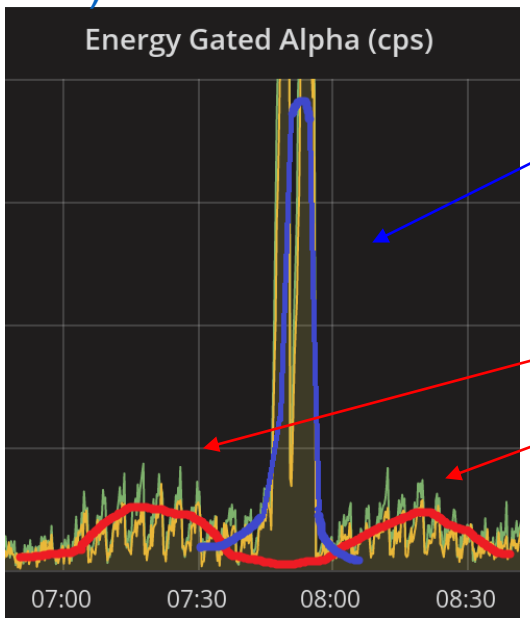
IS608-II, Laser spectroscopy of Bi isotopes a GPS (21-26 June 2017)
Windmill-IDS-RILIS Collaboration

- First collaboration between Windmill and IDS teams
- Demonstrated unique power of IDS for HFS studies
- ^{188m1,193,193m,195,195m,197,197m,200m2,203m,214,214m,215,215m}Bi were measured (many new results!)
- **Issue 1: the target could not deliver $^{216-218}$Bi (which were 'easily' produced in IS608 in 2016)**
- **Issue 2: Mass-contaminating tails at many masses of interest due to abundantly-produced Fr's, need to preferentially use HRS for this region**

Decay pattern and $T_{1/2}$ for IS measured for the 1st time, identifies new band in ^{214}Po



An example: Direct identification and spectroscopy of high-spin isomer in ^{214}Bi (including HFS/isomer shift measurements, spin…)



^{214}Bi^{g} hfs (new)

^{214}Bi^{m} hfs (new)

Overall, a successful run, due to very strong sensitivity of IDS to long-lived, β-decaying isotopes

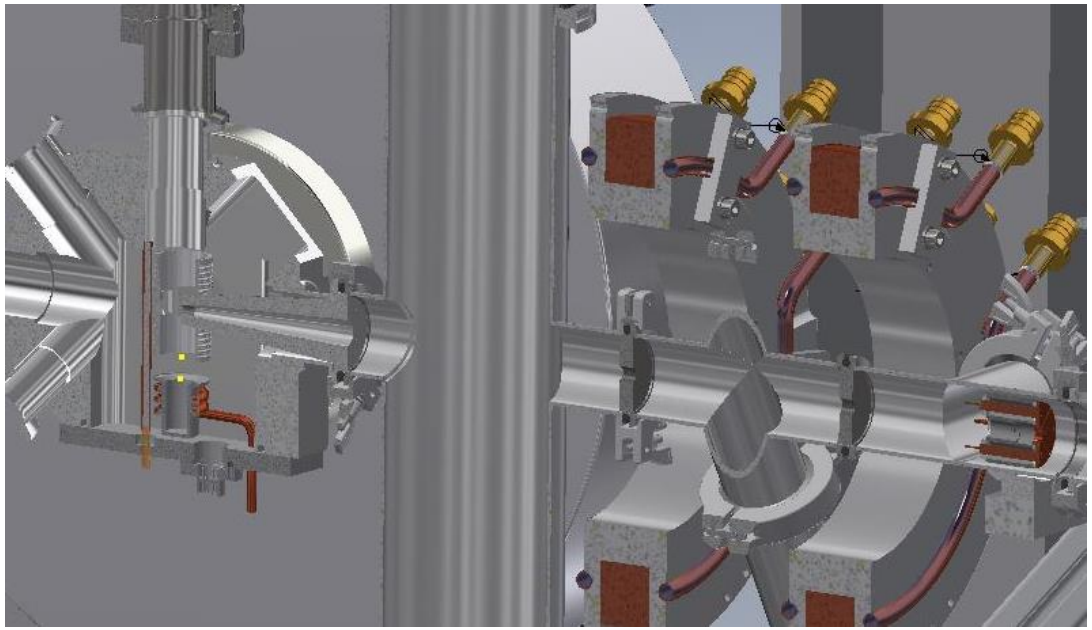
2 beamtimes on liquid β-NMR

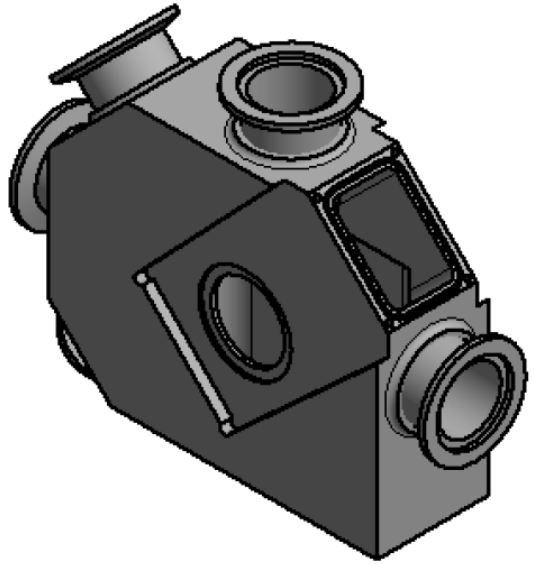
Compact β-detectors with Si PMTs (U Tennessee)

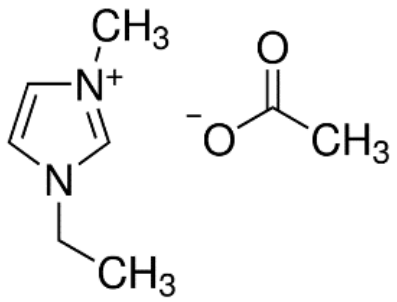
New liquid b-NMR chamber, differential pumping and transitional field system

Liquid handling system

1st NMR signal at VITO!



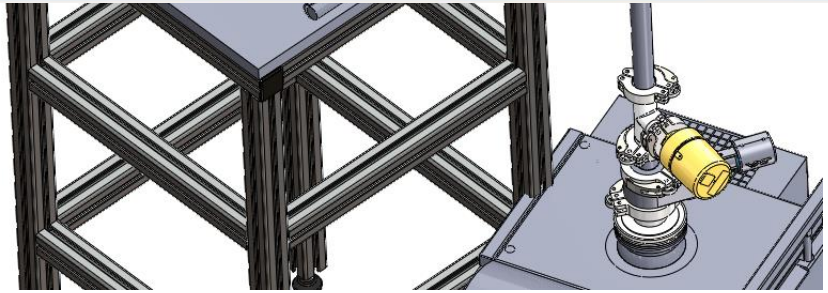


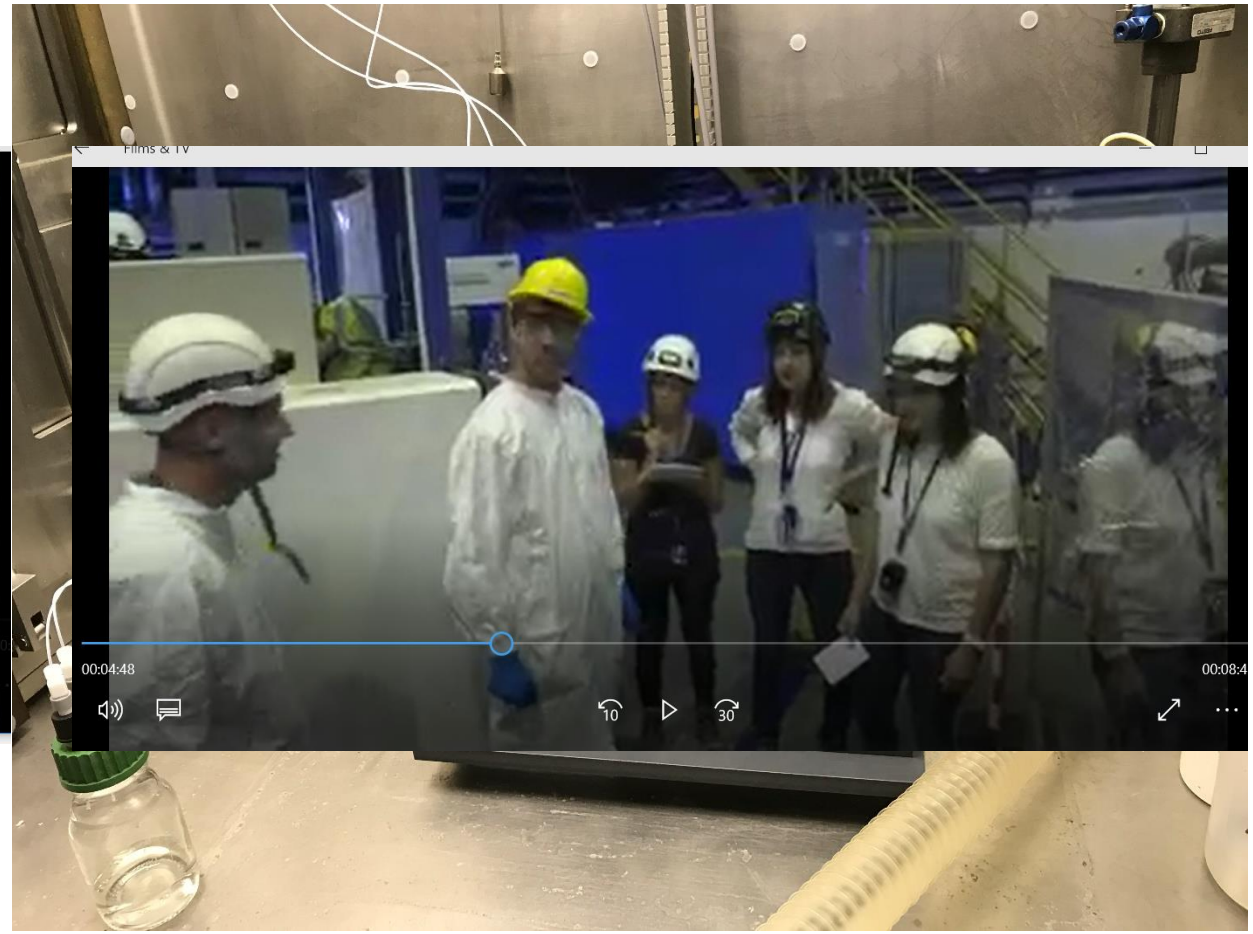


IS645

Thanks to Magda Kowalska

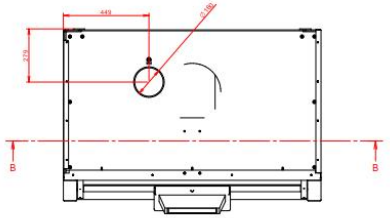
IS528: new collection chamber and separation system

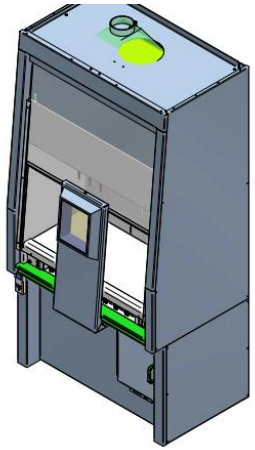


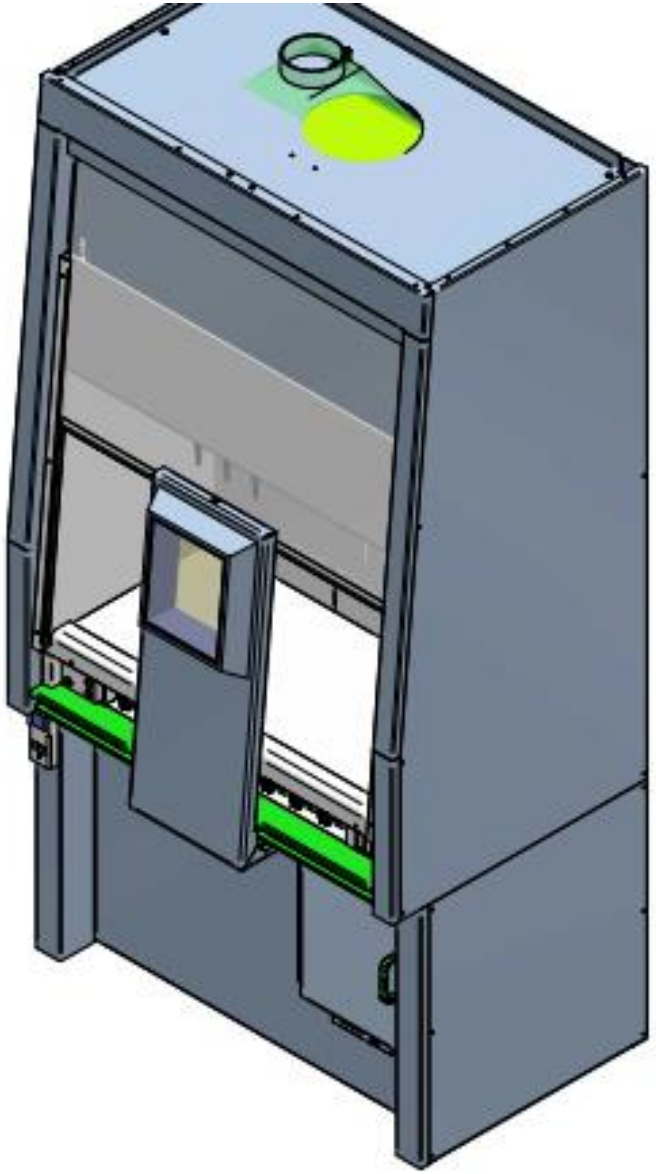


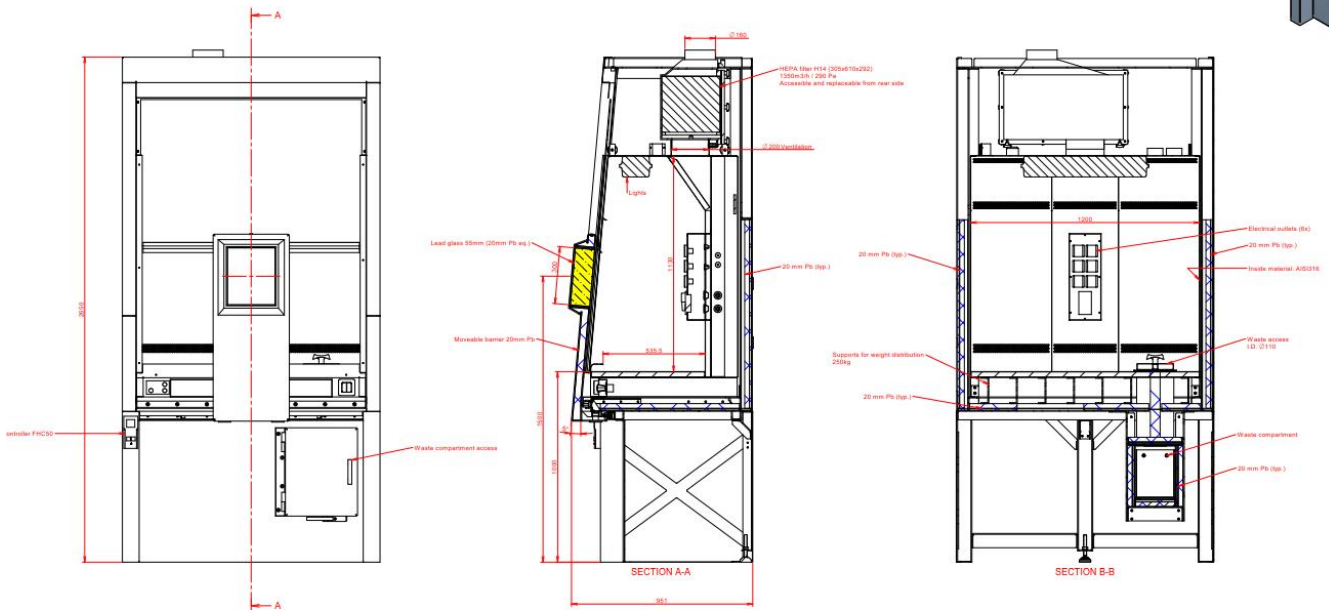
Ergonomy around GLM/GHM area

New working group to optimise the space. New shielded fume cupboard ordered (paid by EP). Due to arrive in coming weeks.









IS453/634: Emission channelling

PRL **118,** 095501 (2017) PHYSICAL REVIEW LETTERS week ending 3 MARCH 2017

Lattice Location of Mg in GaN: A Fresh Look at Doping Limitations

U. Wahl,[1,*] L. M. Amorim,[2] V. Augustyns,[2] A. Costa,[1] E. David-Bosne,[1] T. A. L. Lima,[2] G. Lippertz,[2] J. G. Correia,[1] M. R. da Silva,[3] M. J. Kappers,[4] K. Temst,[2] A. Vantomme,[2] and L. M. C. Pereira[2]
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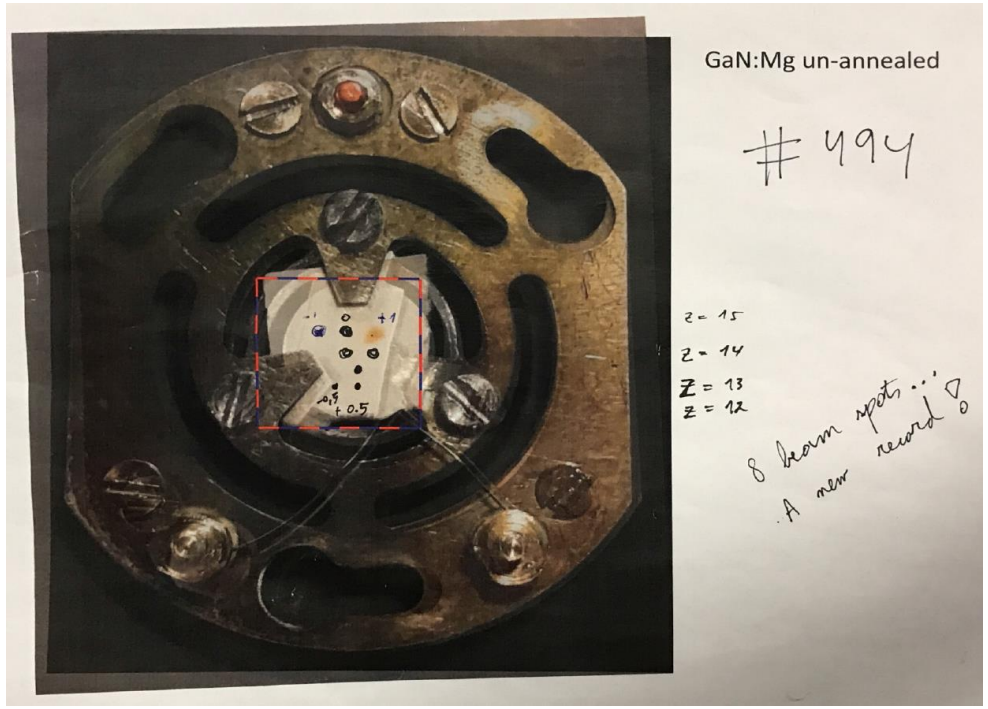
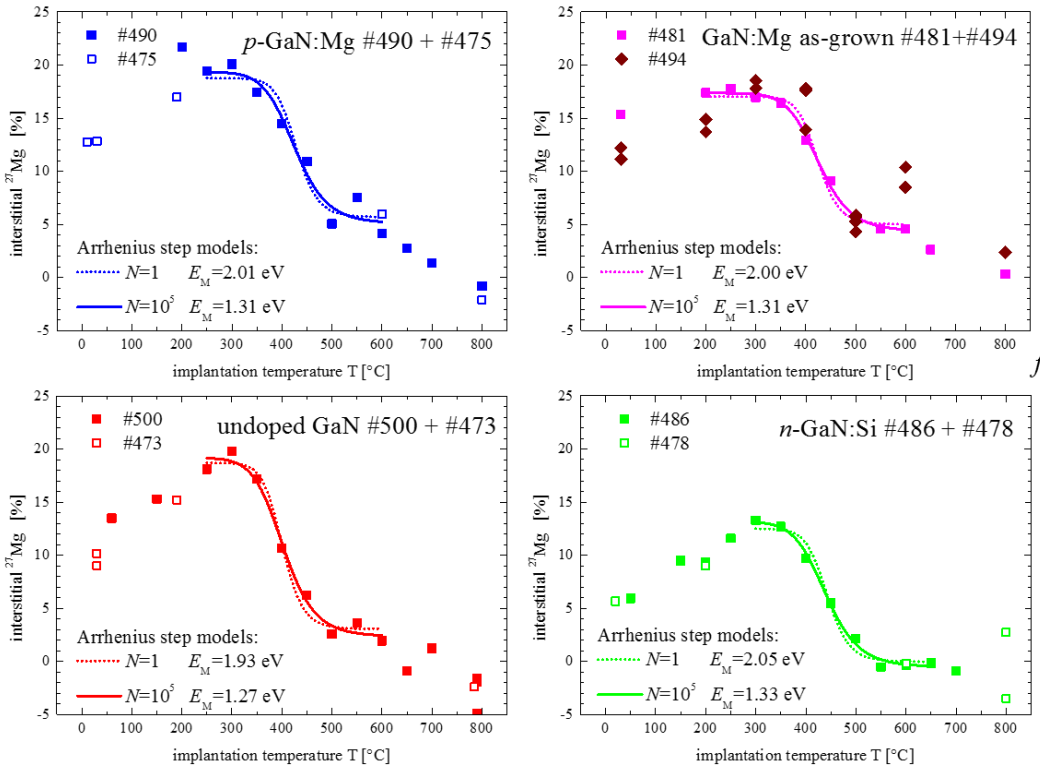
(Received 14 November 2016; published 1 March 2017)

Amphoteric nature of Mg in GaN



Site change $^{27}Mg_i \rightarrow {}^{27}Mg_{Ga}$ in different GaN doping types: Arrhenius curves



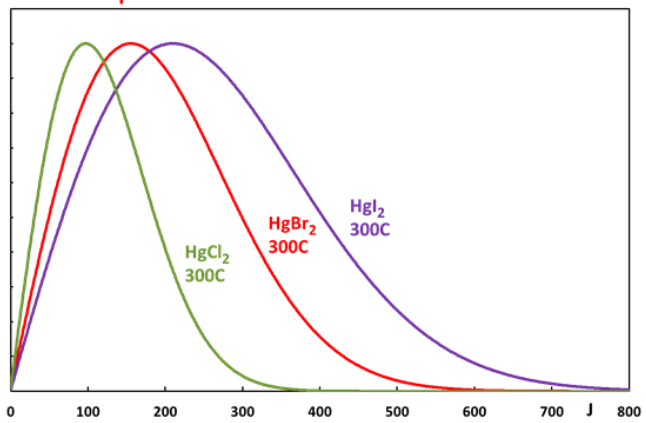
$f_i = f_{i0}\, N\, \nu_0 \tau \exp[-E_M/k_B T]$
with attempt frequency
$\nu_0 = 2\times10^{13}$ s^{-1}

- **Estimated activation energy for migration of Mg_i in all doping types $E_M \approx 1.27$–2.01 eV.**
- **Number of jumps $N=10^5$ $E_M \approx 1.3$ eV always fits a bit better…**

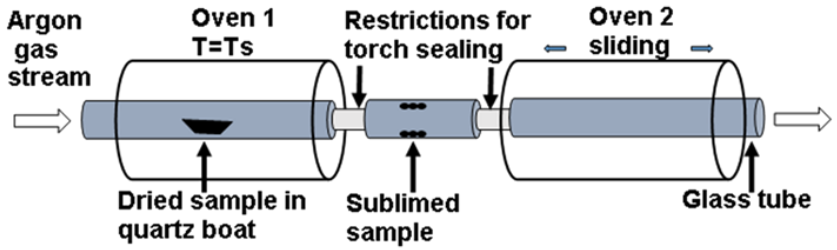
IS640: PAC studies of isolated small Cd and Hg molecules

Thanks to Juliana Schell and H. Haas

Population of J states



The Technique



Measure the quadrupole interaction in some free Hg and Cd molecules by PAC

Basic idea: In a linear molecule the EFG (V_{zz}^{mol}) is along the molecular axis

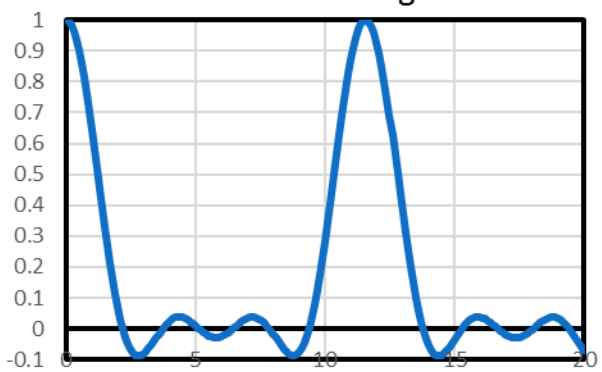
The rotation axis J is always perpendicular to the molecular axis

The EFG along J is then, independent of J: $V_{zz}^{rot} = -1/2\ V_{zz}^{mol}$

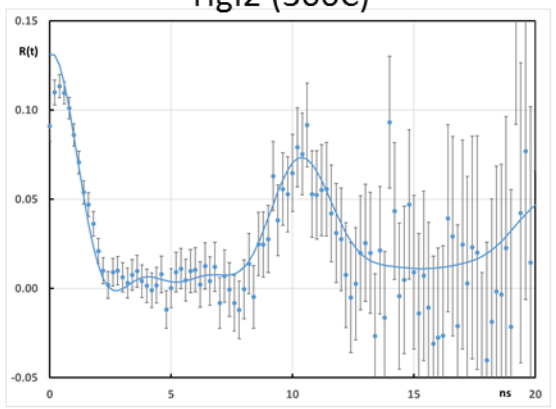
For large J the splitting frequency should be independent of J!

An old idea, but early experiments (Berkeley, Bonn) in the 1970s have failed

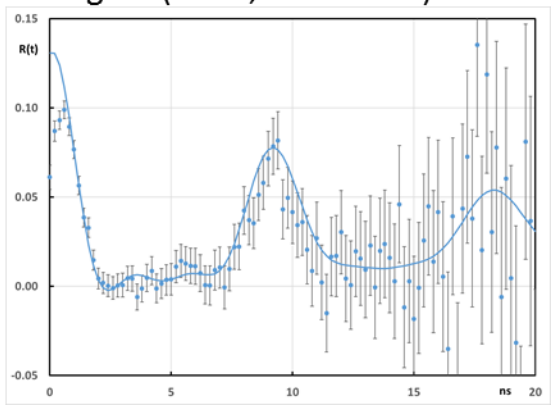
Free molecules in gas



HgI2 (300C)

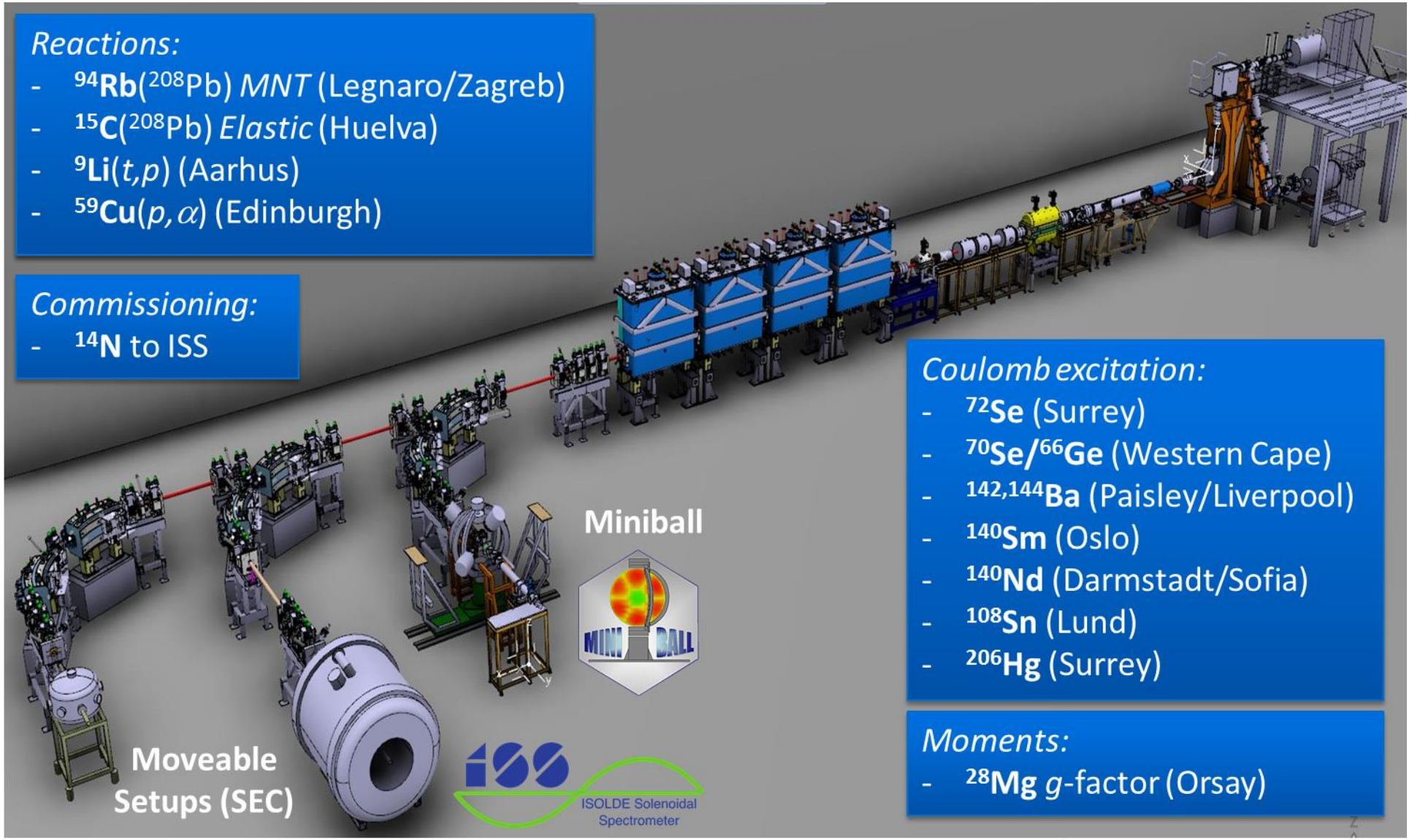


HgCl2 (300C, 2mbar Cl2)



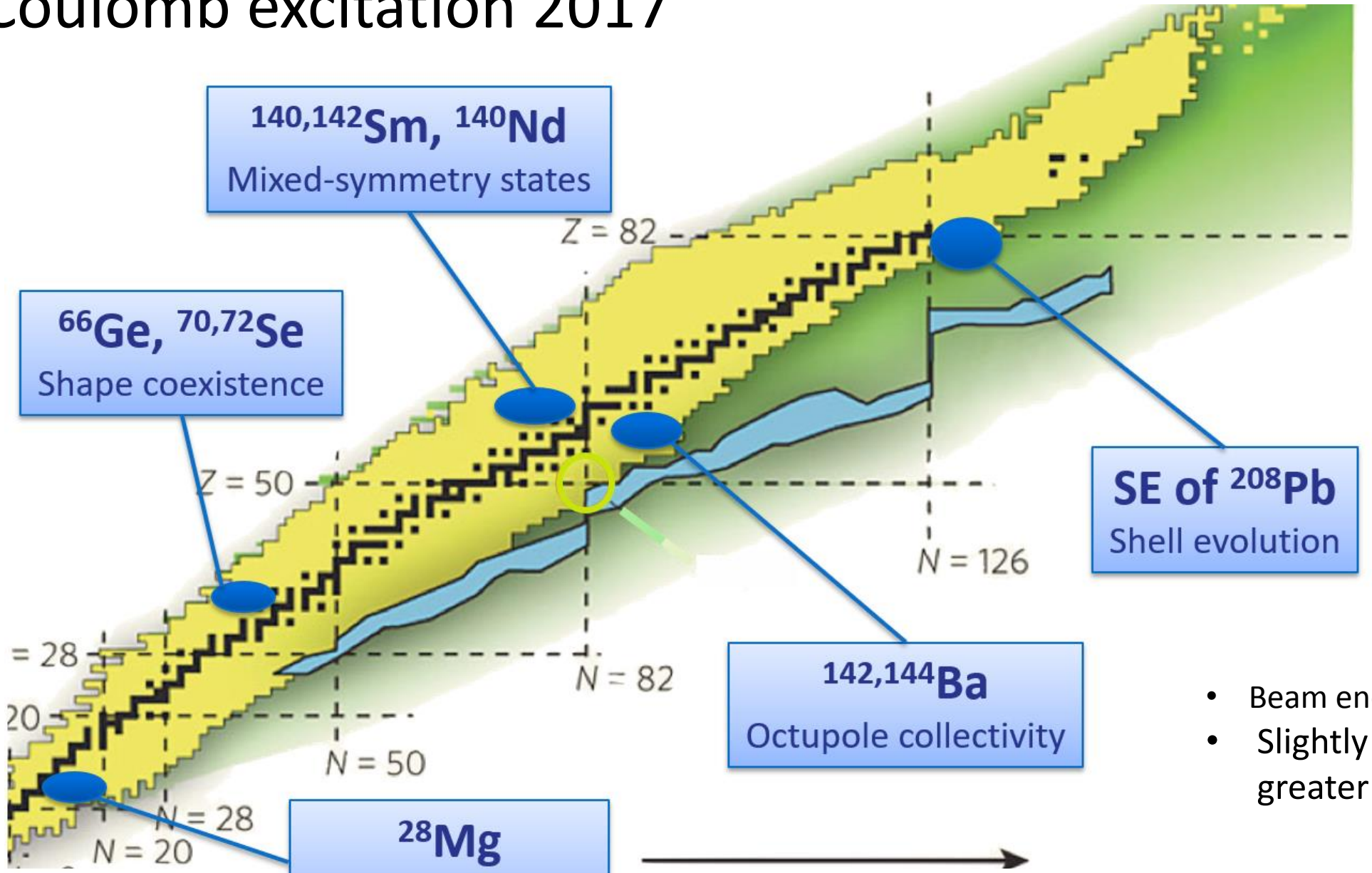
Overview of HIE ISOLDE runs 2017

Liberally borrowed from Liam Gaffney's talk to the ISOLDE workshop



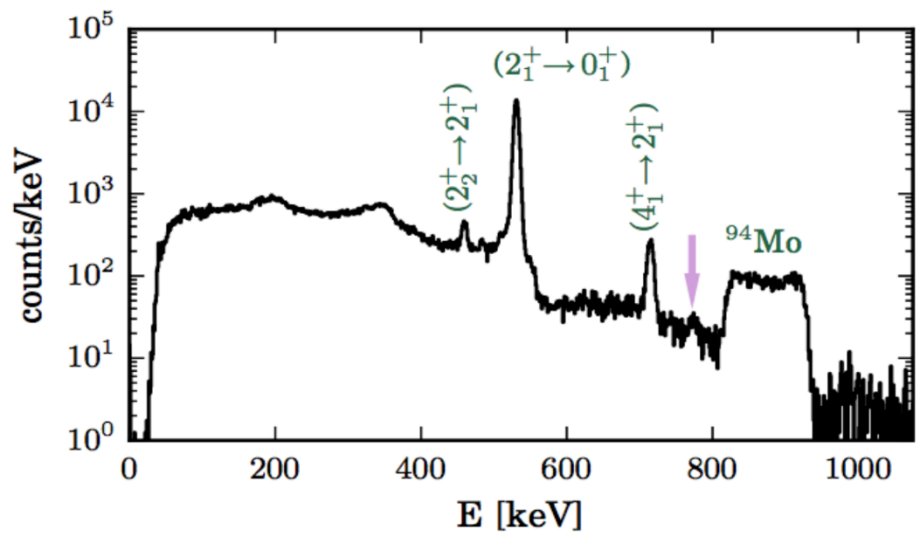
12 Experiments scheduled (and mostly possible) from 7th July till 4th Dec

Coulomb excitation 2017



- Beam energies ~ 4.4 – 5.5MeV/u
- Slightly conservative to enable greater number of experiments.

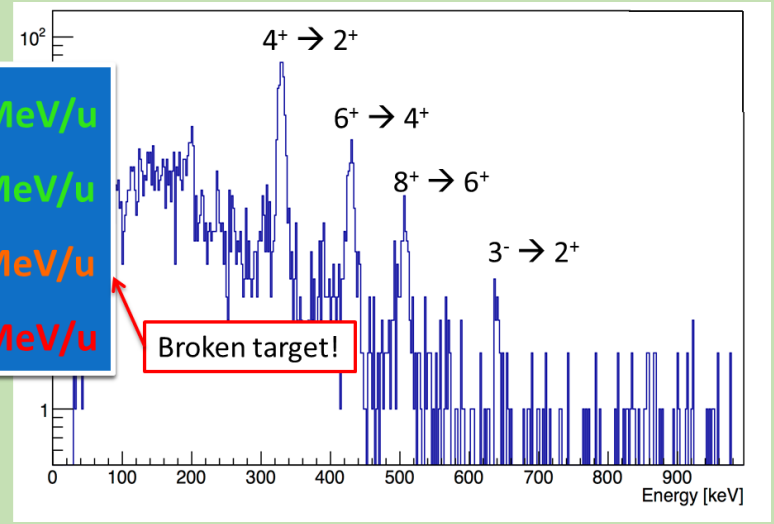
IS558: 140Sm

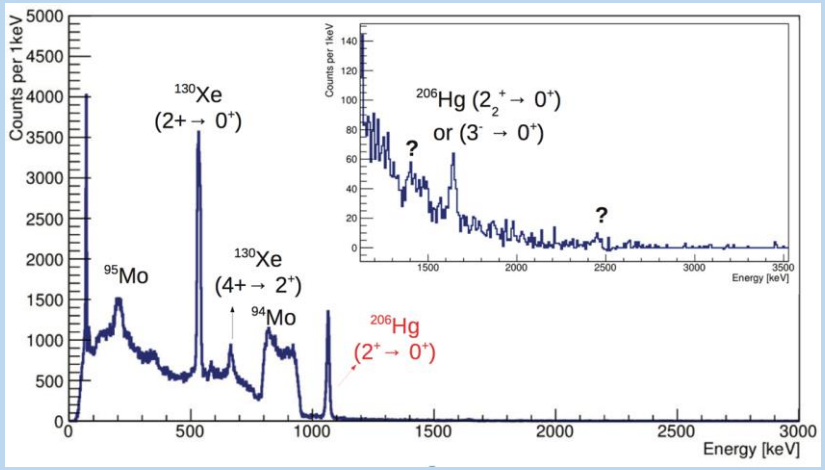


- New two-step RILIS scheme with one laser
  - Yields 3x proposal request!
- Attempt at ^{138}Sm → Too much ^{138}Ba.

IS553: 144Ba on 208Pb

1) ^{144}Ba on ^{208}Pb @ 4.3 MeV/u
2) ^{144}Ba on ^{58}Ni @ 3.4 MeV/u
3) ^{142}Ba on ^{58}Ni @ 3.4 MeV/u
4) ^{142}Ba on ^{208}Pb @ 4.3 MeV/u





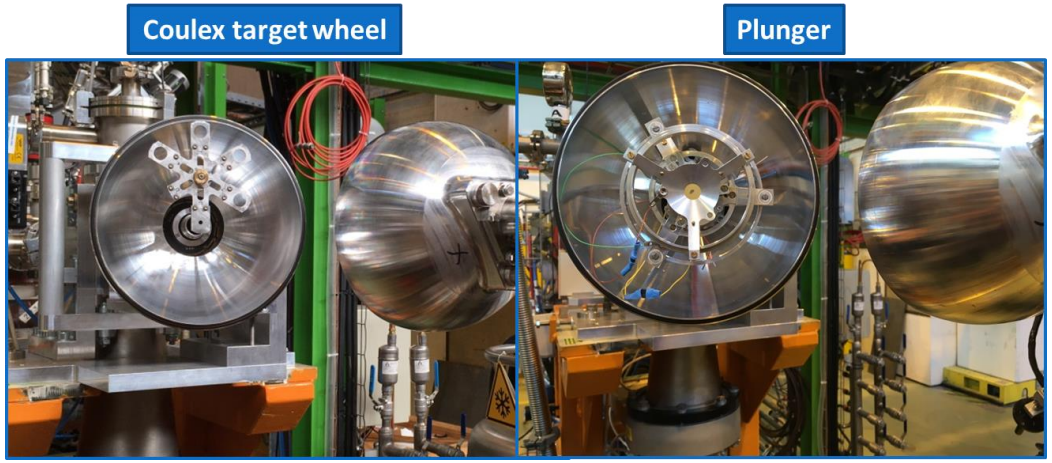
IS547: collectivity around 206Hg

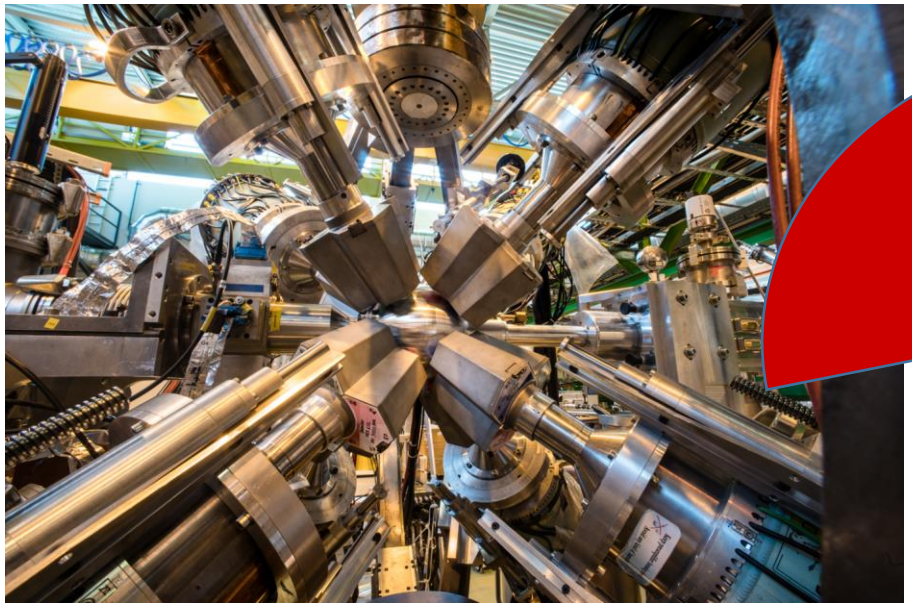
Analysis started on potentially interesting new states.

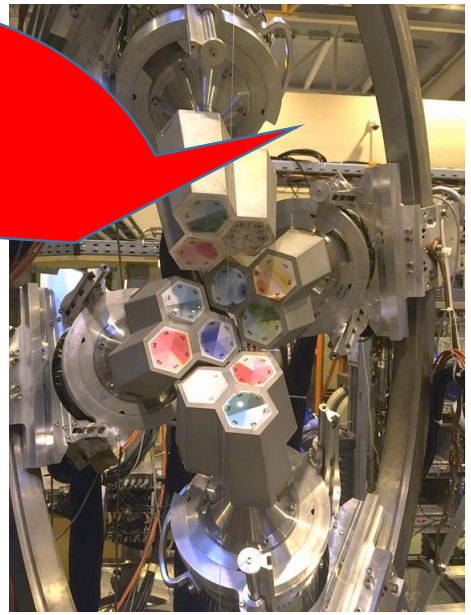
IS628: plunger measurements on ^{28}Mg

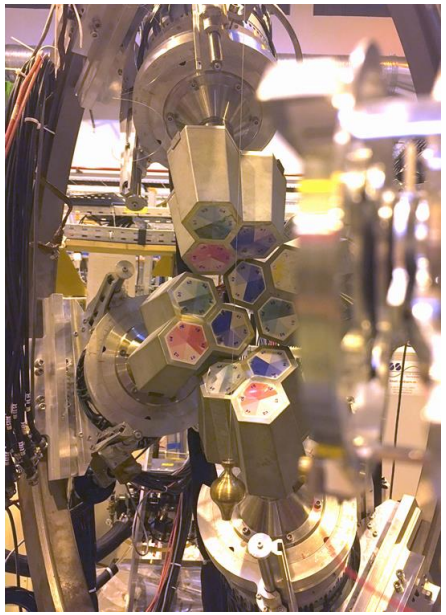
- New plunger chamber installed for 2017.
- Developed at IKP Köln.
- Excited-state lifetime measurements, g-factors, etc.

- ^{22}Ne stable beam from EBIS @ 5.5 MeV/*u*:
  - TDRIV → Zero-point calibration of target-degrader (*plunger*)
  - (*d,n*) → Angles of Ge detectors from Doppler shift (*target wheel*).
  - Required a week of stable beam….





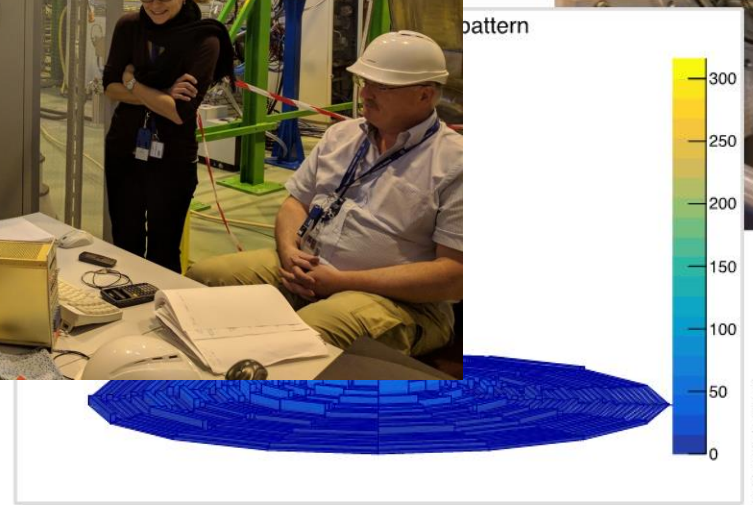




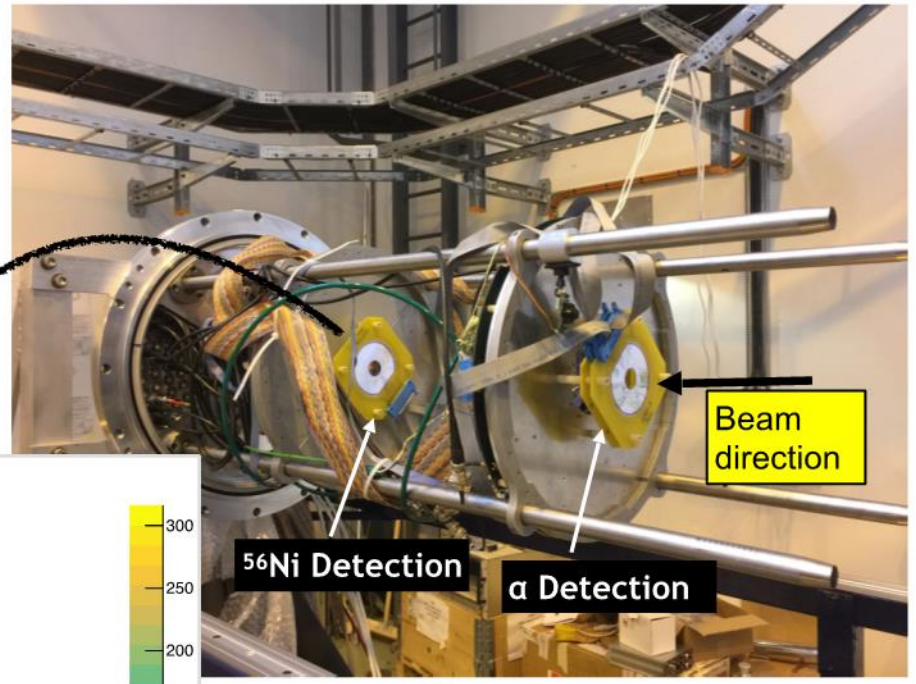
Nuclear astrophysics – IS607

- $^{59}Cu(p,\alpha)$ – Implications for nucleosynthesis in core collapse supernovae

$^{59}Cu(p,\alpha)^{56}Ni$ cross-section



Experimental Setup



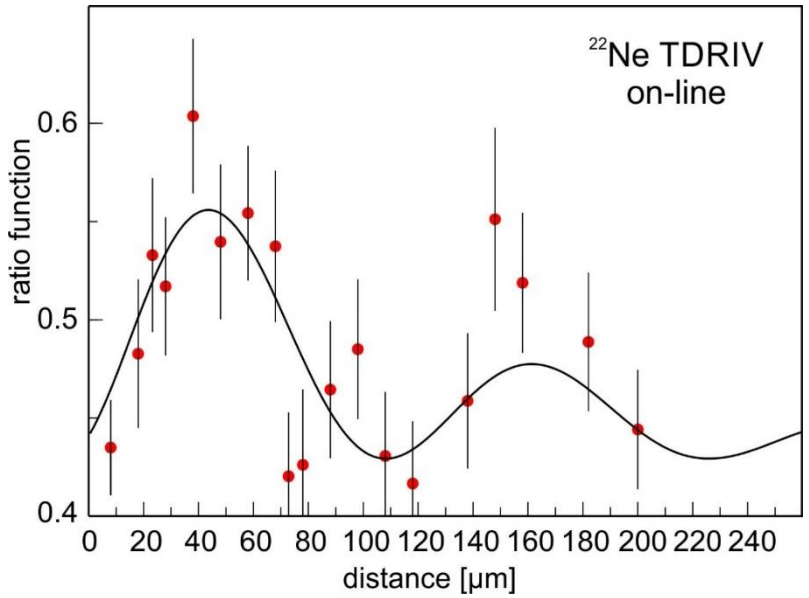
THE UNIVERSITY of EDINBURGH

Rutherford scattering of beam on ^{12}C in the CH_2 target

Thanks to Claudia Lederer-Woods and Ruchi Garg

IS628 TDRIV on ^{28}Mg – on-line results

- First Miniball plunger experiment
- Calibration run with ^{22}Ne beam
  - known g factor
  - observed expected frequency
- **(Very)** High intensity ^{28}Mg beam – 5x10^{6} pps/μCu
- Some difficulties with RIB scattered in the chamber
- **Very promising results for ^{28}Mg TDRIV** – presently under analysis

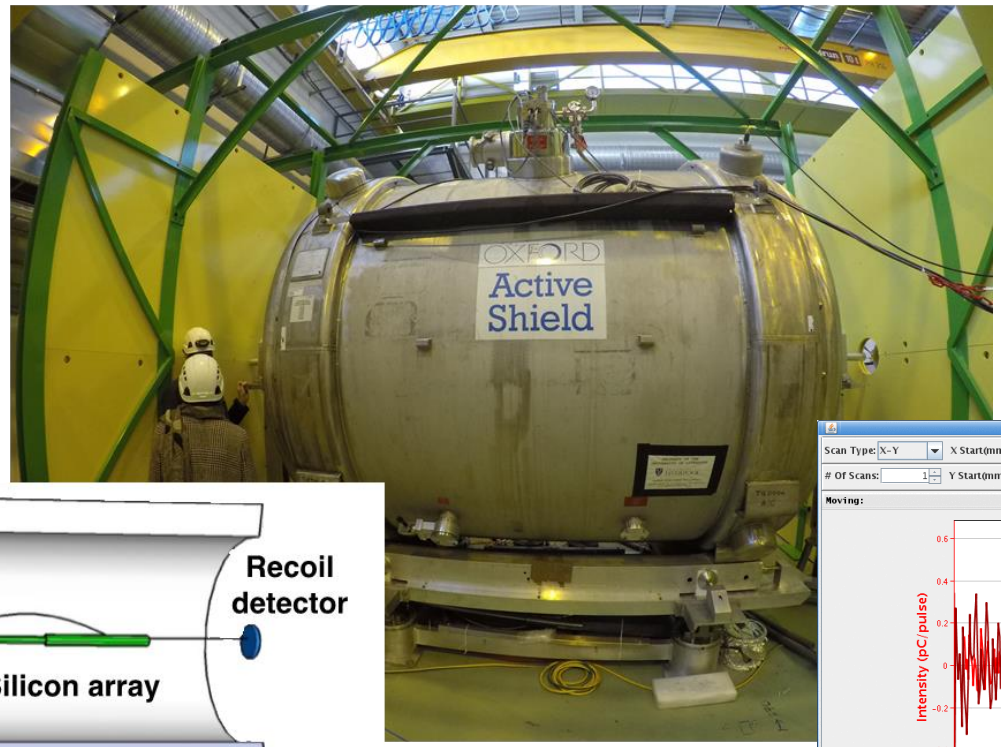


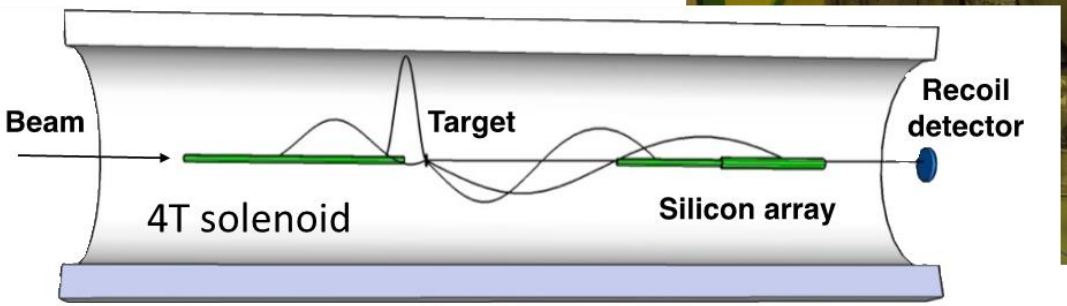
Thanks to Georgi Georgiev

ISOLDE Solenoidal Spectrometer

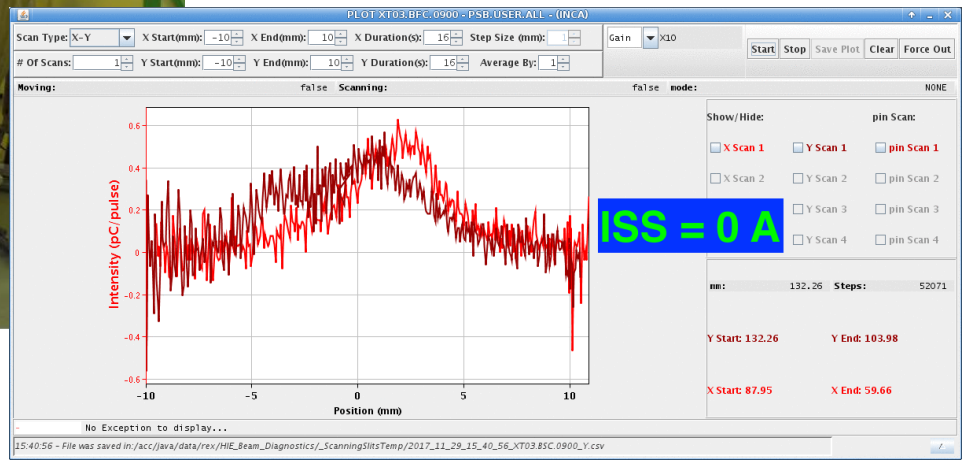
- Tight schedule over last 2 months.
  - Shielding
  - Energising to 2.5 T (x2)
  - Field mapping
  - Vacuum
  - Beam tests
- Ready for **RIB in 2018!!**
  - ^{206}Hg(*d*,*p*)
  - ^{28}Mg(*d*,*p*)

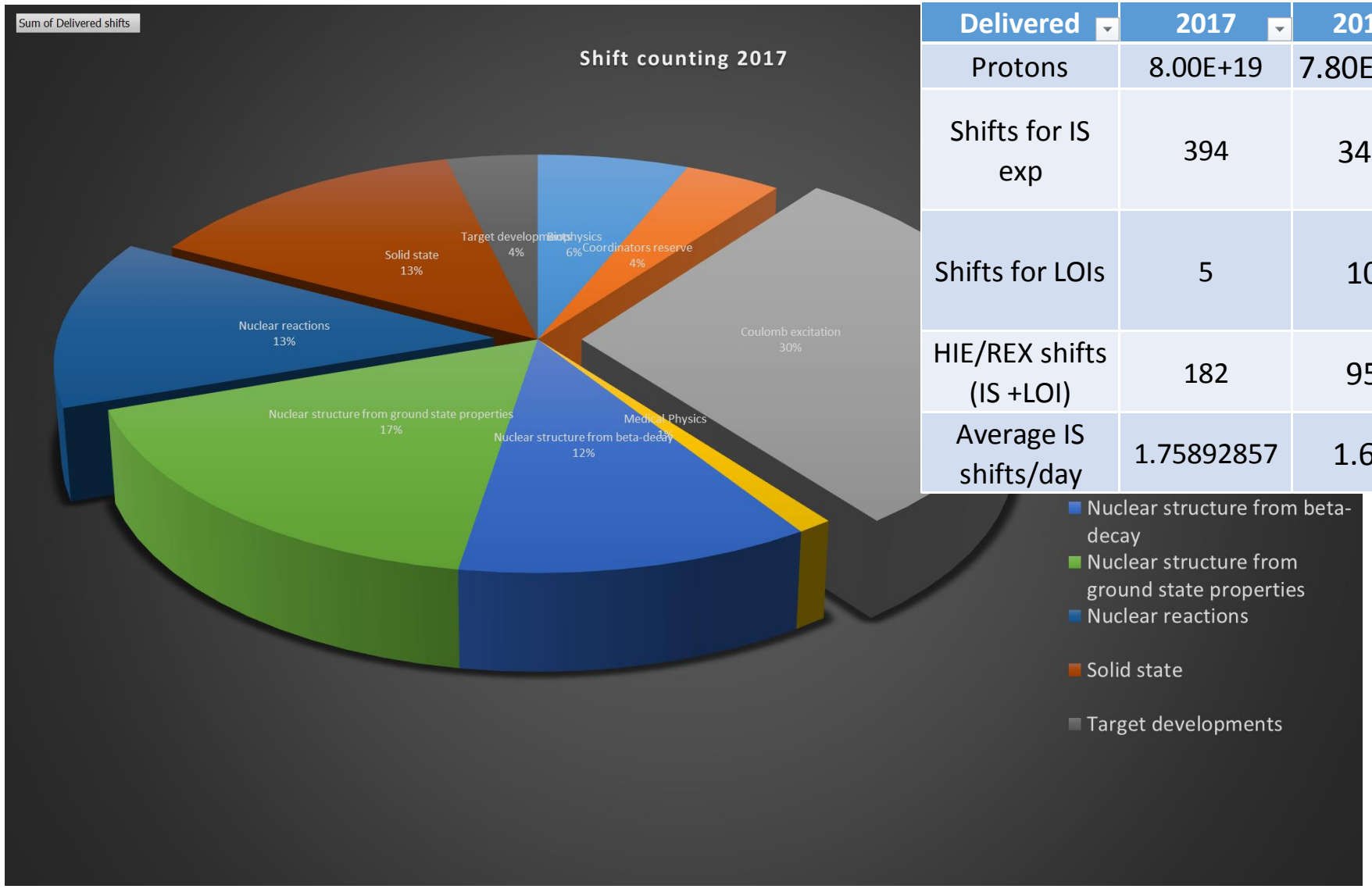
ISOLDE Solenoidal Spectrometer





Helical orbit spectrometer principle

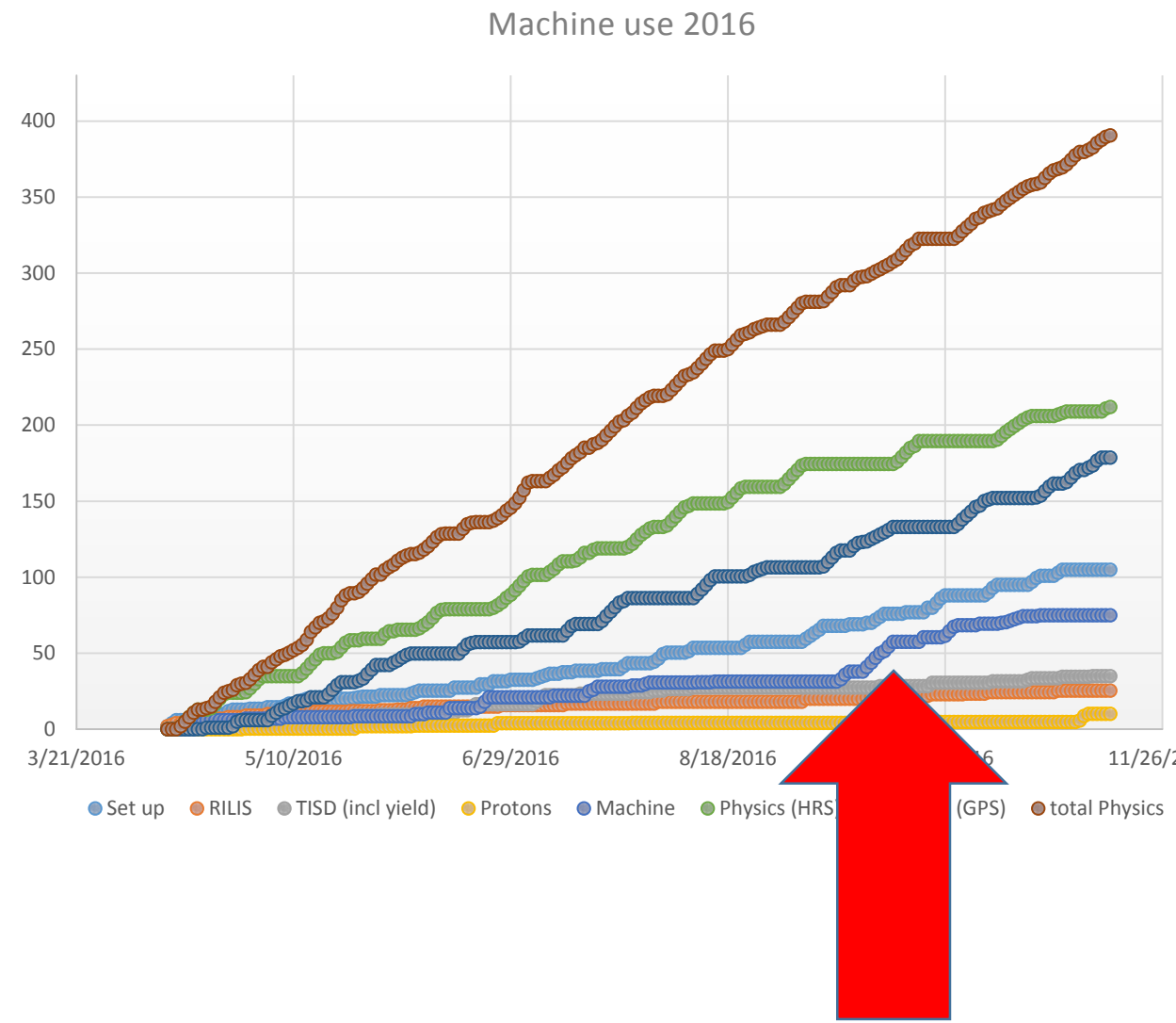


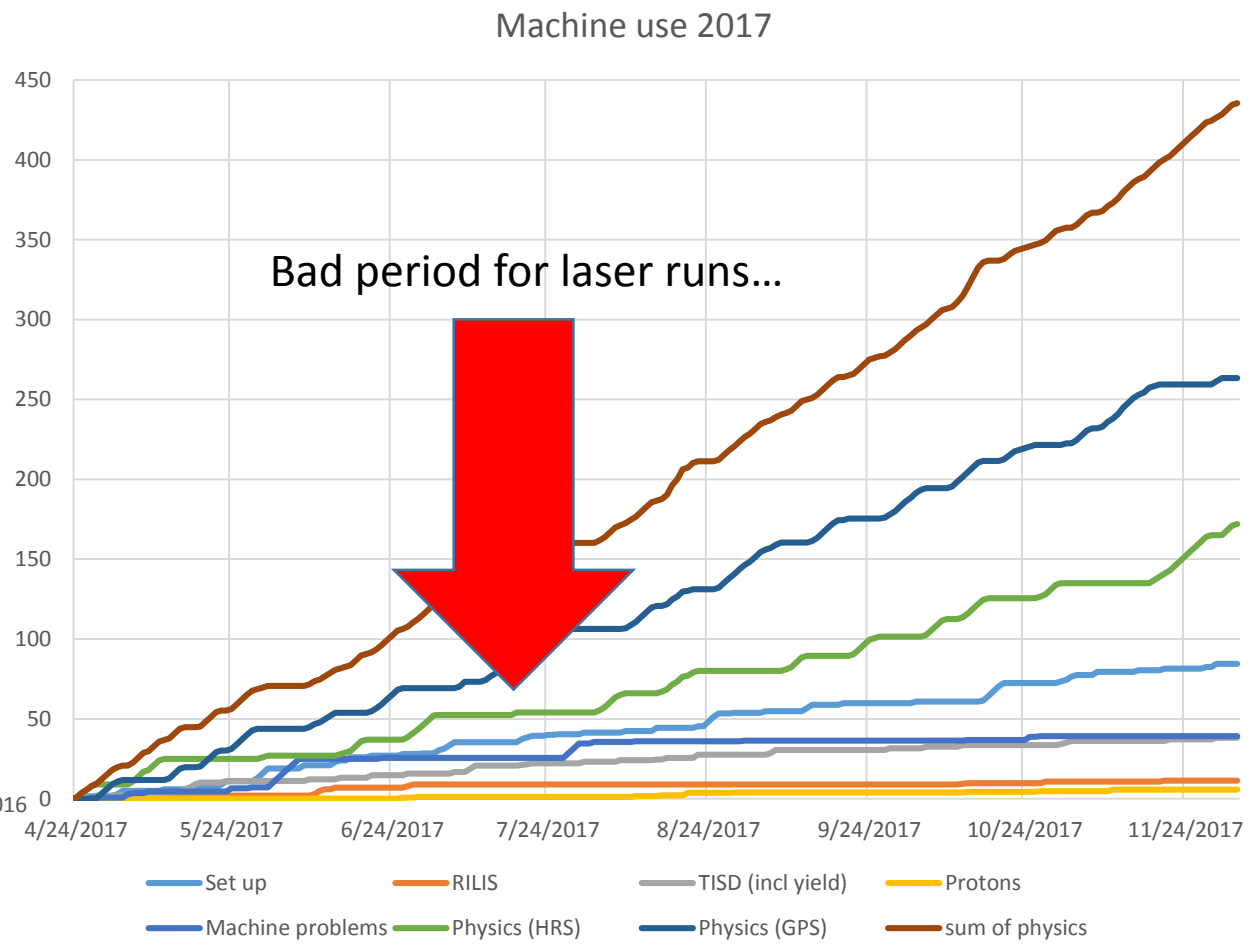


Delivered	2017	2016	2015	2014	2012	2011
Protons	8.00E+19	7.80E+19	9.40E+19	5.50E+19	1.15E+20	8.05E+19
Shifts for IS exp	394	343	263	208.5	416	313.5
Shifts for LOIs	5	10	4	6.5	15.5	16
HIE/REX shifts (IS +LOI)	182	95	Special	-	221.5	190.5
Average IS shifts/day	1.75892857	1.65	1.4	1.55	1.61	1.55

Row Labels	Count of Experiment
Biophysics	3
COLLAPS	3
CRIS	3
HIE	11
IDS	2
ISOLTRAP	3
Medical	1
SSP	14
TISD	1
VITO	2
Windmill	1
Coord reserve	1
HIE	1
Grand Total	**46**

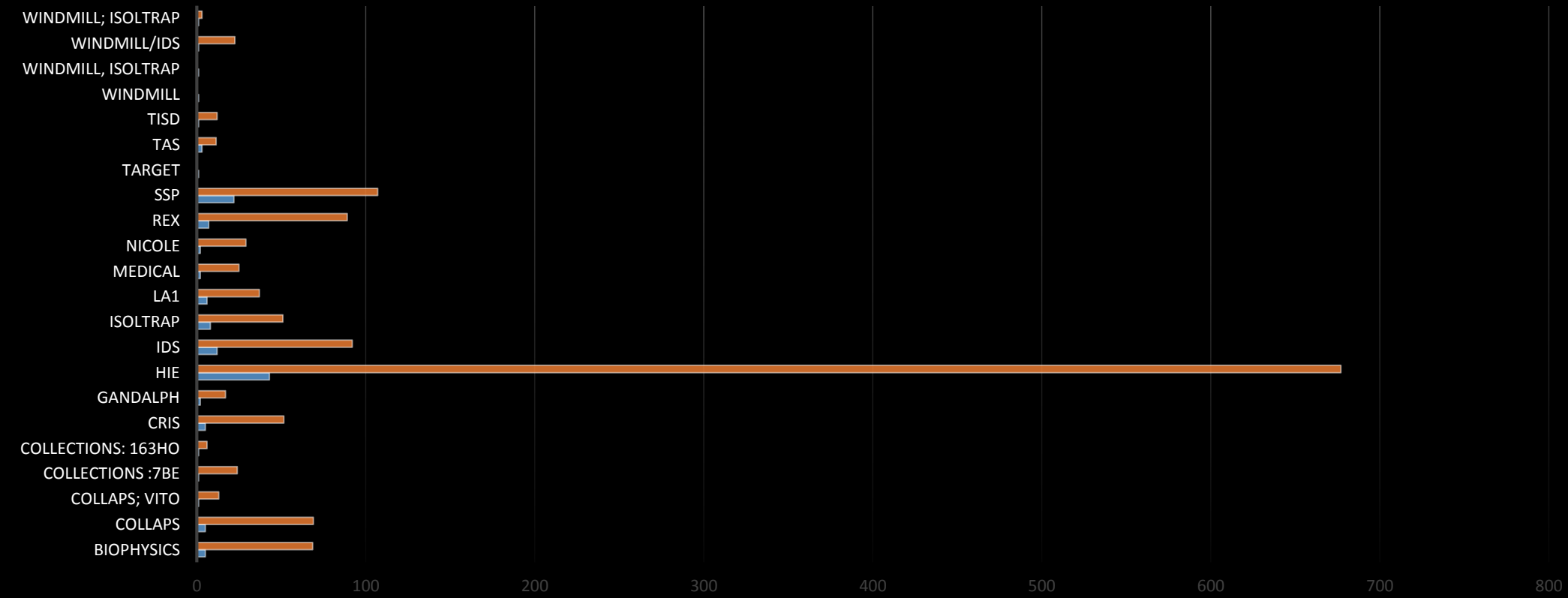
In total 427 RIB shifts delivered in 2017





2017: much less downtime; no weekends lost; fewer broken targets; more efficient running strategy

Summary of backlog



	biophysics	COLLAPS	COLLAPS; VITO	Collections :7Be	Collections: 163Ho	CRIS	Gandalph	HIE	IDS	ISOLTRAP	la1	MEDICAL	NICOLE	REX	SSP	target	TAS	TISD	Windmill	Windmill, ISOLTRAP	Windmill/IDS	Windmill; ISOLTRAP
Sum of Remaining shifts beginning 2018	68.5	69	13	24	6	51.5	17	677	92	51	37	25	29	89	107	0	11.5	12	0	0	22.5	3
Count of Exp. no.	5	5	1	1	1	5	2	43	12	8	6	2	2	7	22	1	3	1	1	1	1	1

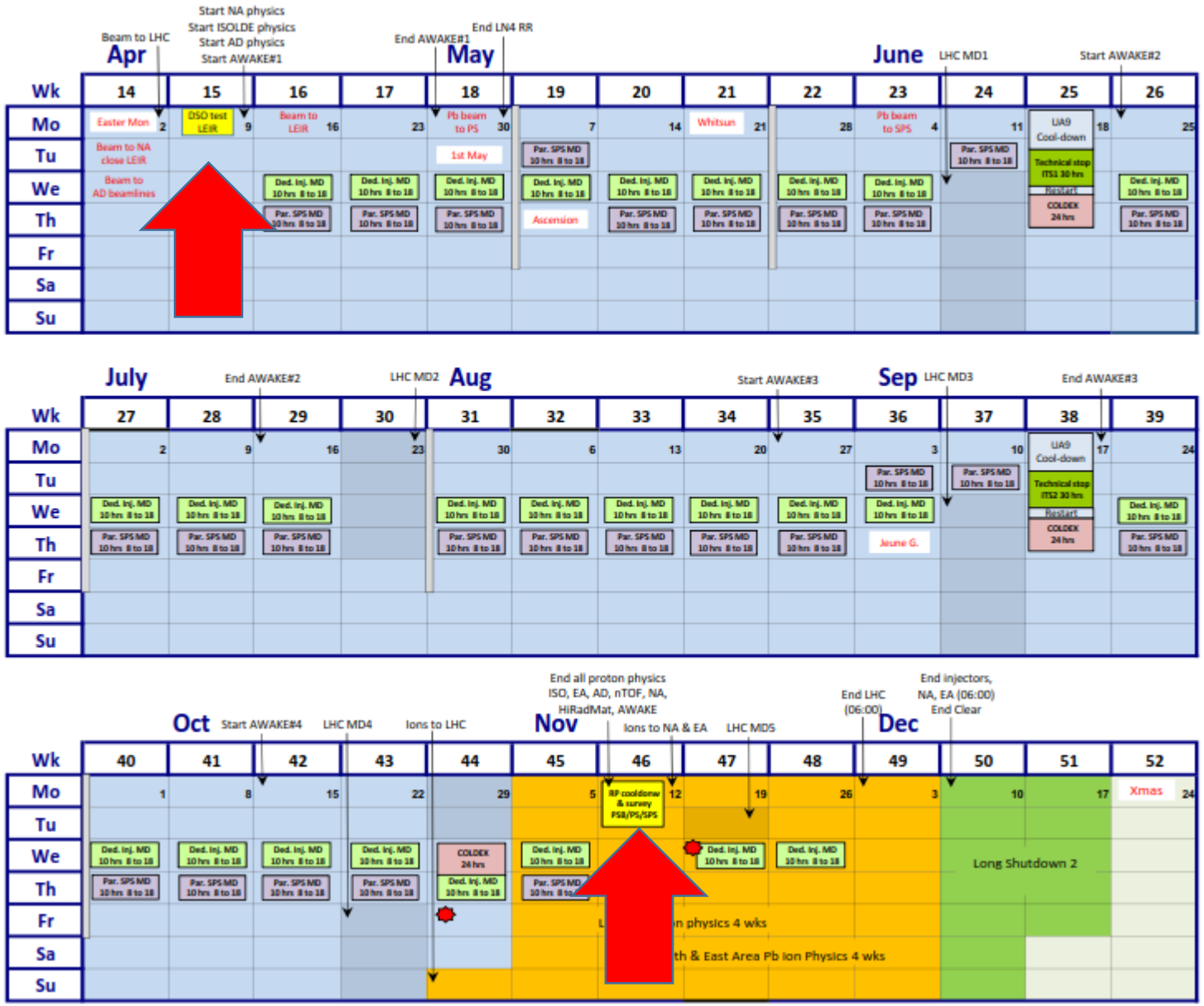
INTC 58: Still very popular!

Row Labels	Number of proposals
HIE	7
Laser spectroscopy	1
nTOF	6
SSP	3
(blank)	
New	1
ISOLTRAP	1
TISD	1
Biophysics	1
Grand Total	**21**

Row Labels	Sum of shifts requested
HIE	131
Laser spectroscopy	18
nTOF	0
SSP	19
(blank)	
New	0
ISOLTRAP	8
TISD	0
Biophysics	13
Grand Total	**189**

Strategy for re-evaluating shifts to be discussed later this year

CERN accelerator schedule 2018



Protons available for physics to ISOLDE from 9th April – 12th November 2018.

217 days for physics (compared to 224 in 2017)

HIE ISOLDE expected to start similarly to 2017 i.e. ~ July 9. this leads to ~ 126 days available for HIE ISOLDE, compared to 150 in 2017.

Dedicated low energy block from 9th April: ~ 90 days for LE.

Interleave HIE and LE runs as in 2017.

Strategy for HIE: 4CMS so optimized for reactions. Starting with CE then switch to T-Rex; XT03 and ISS to be accommodated.

Preparation of Schedule 2018

Beam requests received yesterday. Currently being compiled. In addition to usual suspects, LIST beams and negative ion requests….

- Draft of low energy runs till ~ mid-June by late Feb- early March.
- Mid-June – end of September released around early May
- Rest of year in mid-July

Schedule will be discussed at a technical advisory panel (similar to what's done for INTC proposals) to avoid any surprises in terms of targets, ion sources, machine parameters and recent developments. In addition, safety aspects can be addressed.

Hostel still reserves 10 rooms 1 month in advance of experiments running.

ENSAR2 funding forms sent around upon release of schedule.

Safety and training etc

Required training for **ISOHALL**

Online:

- Safety at CERN
- RP supervised
- Basic electrical awareness
- Radiation Protection - Controlled area (refreseher…new)

Hands-on:

- Electrical awareness
- RP handling

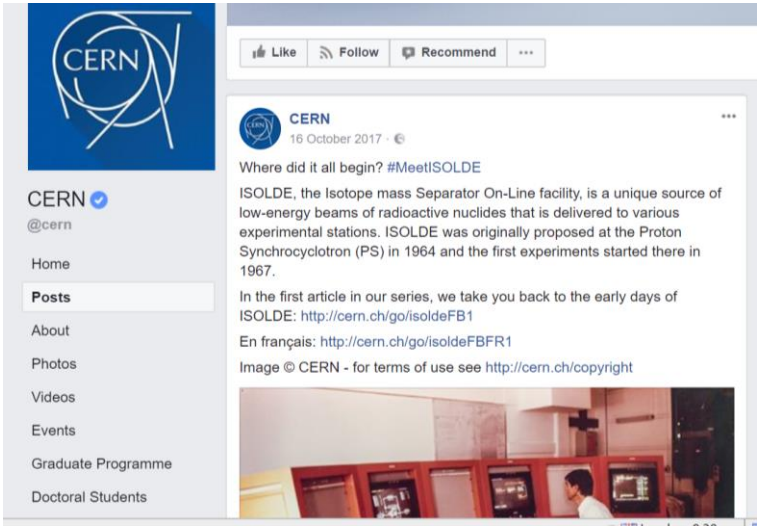
Every Tuesday @ 1300 – 1700), training centre Prevessin.

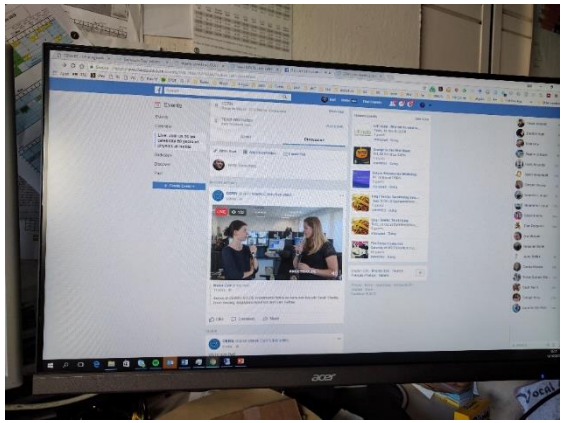
External trainer: Recent cancellations have been a problem. Discussions underway to mitigate this.

Required training ranks

Code	Description
10010	Safety at CERN
10750	ISOLDE - Experimental Hall - Radiation Protection - Handling
10860	ISOLDE - Experimental Hall - Electrical Safety - Handling

ISOLDE webpage a little unclear: to be re-freshed soon





Updating of CERN timeline: with 2-4 contributions from ISOLDE in microcosm