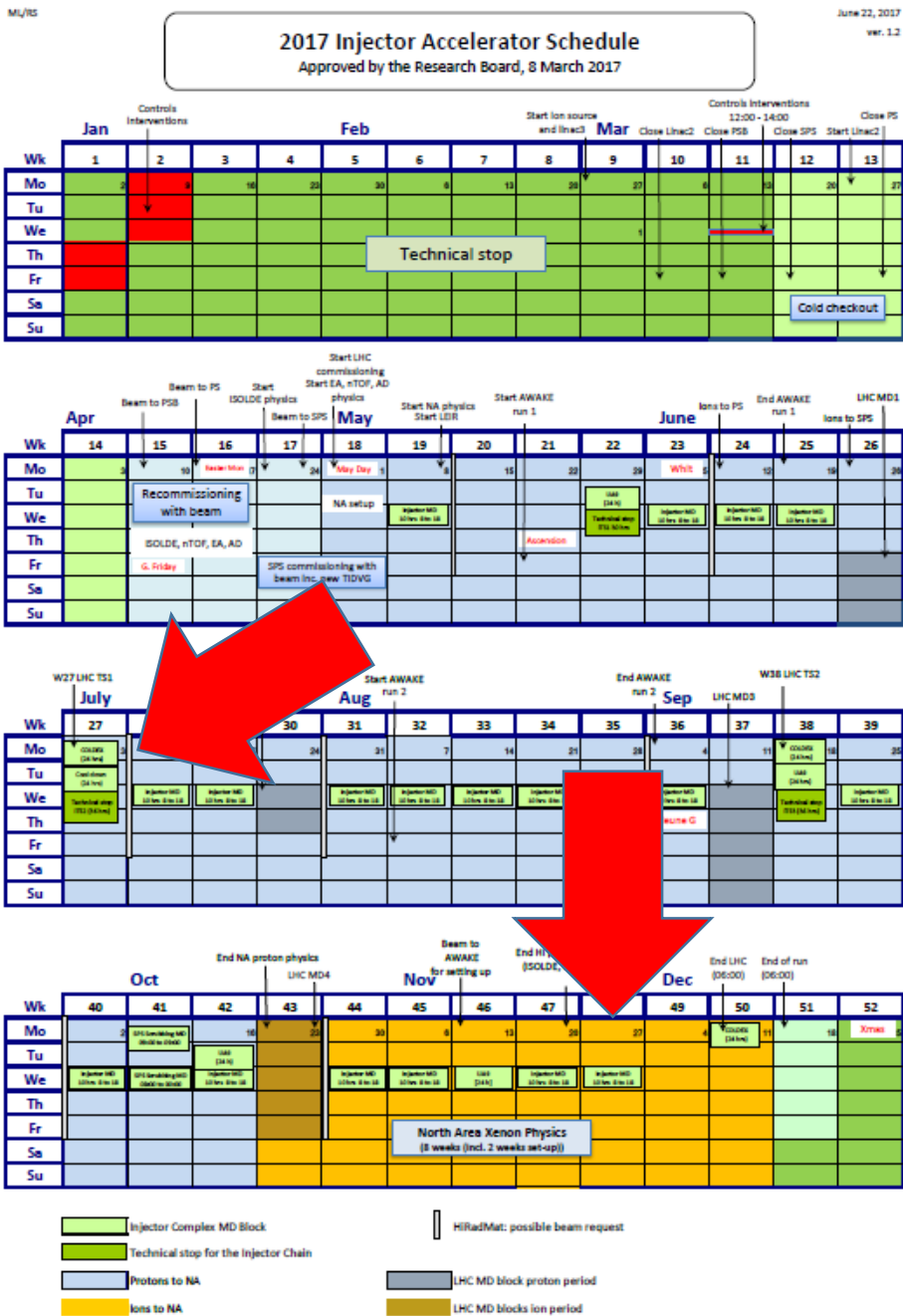


ISOLDE physics coordinator report: ISCC 27th June 2017

Karl Johnston



- Planning for 2017
- Schedule so far: preparation for HIE-ISOLDE
- Safety/collections



Close

Apr

Wk	14
Mo	
Tu	
We	
Th	
Fr	
Sa	
Su	

July

Wk	27
Mo	
Tu	
We	Injector MD 10 hrs 8 to 10
Th	
Fr	
Sa	
Su	

Wk	40
Mo	
Tu	
We	Injector MD 10 hrs 8 to 10
Th	
Fr	
Sa	
Su	

SPS

26
26
Injector MD 18 hrs 8 to 18

39
25
Injector MD 18 hrs 8 to 18

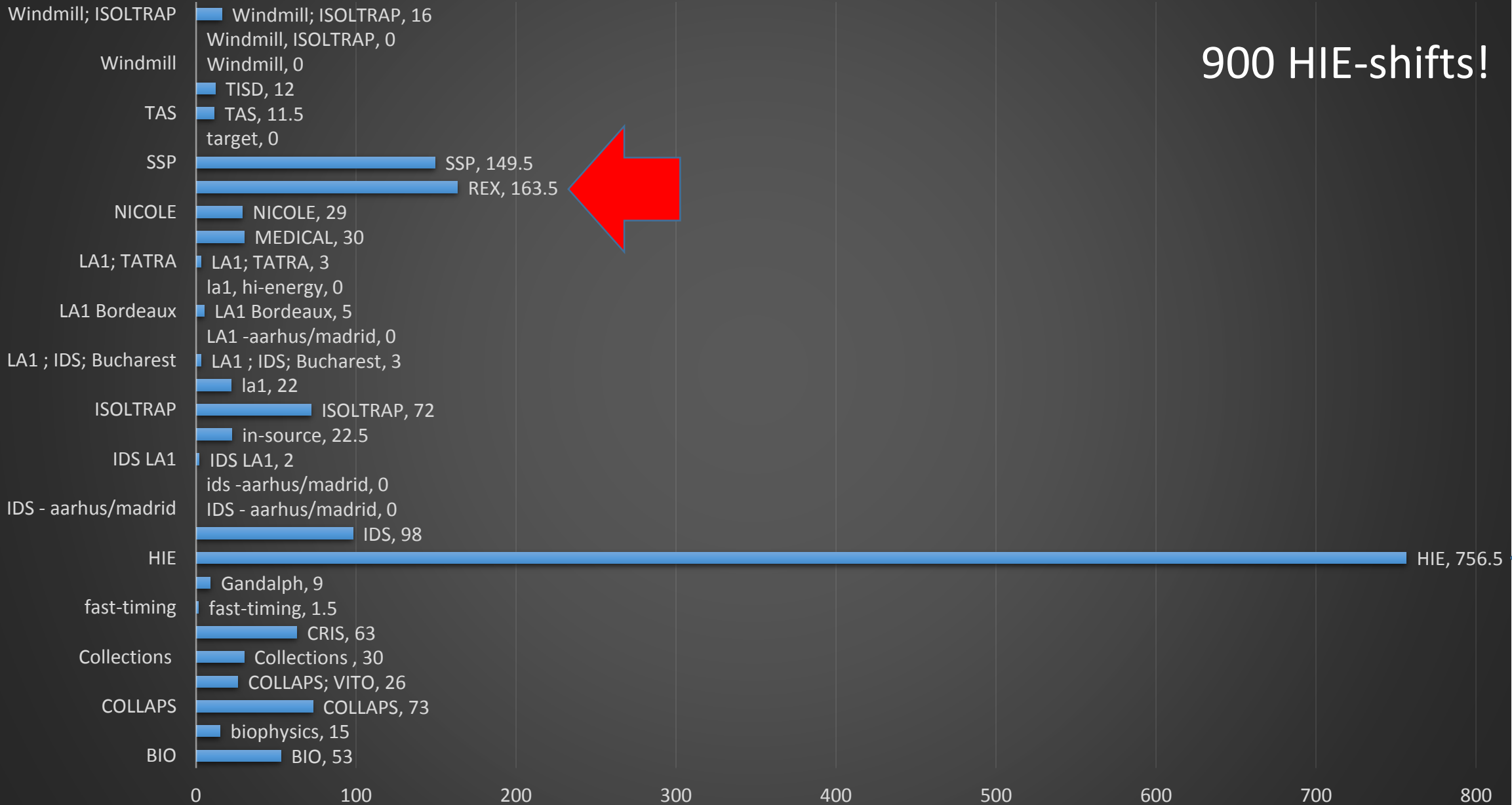
52
mas 25

Accelerator schedule

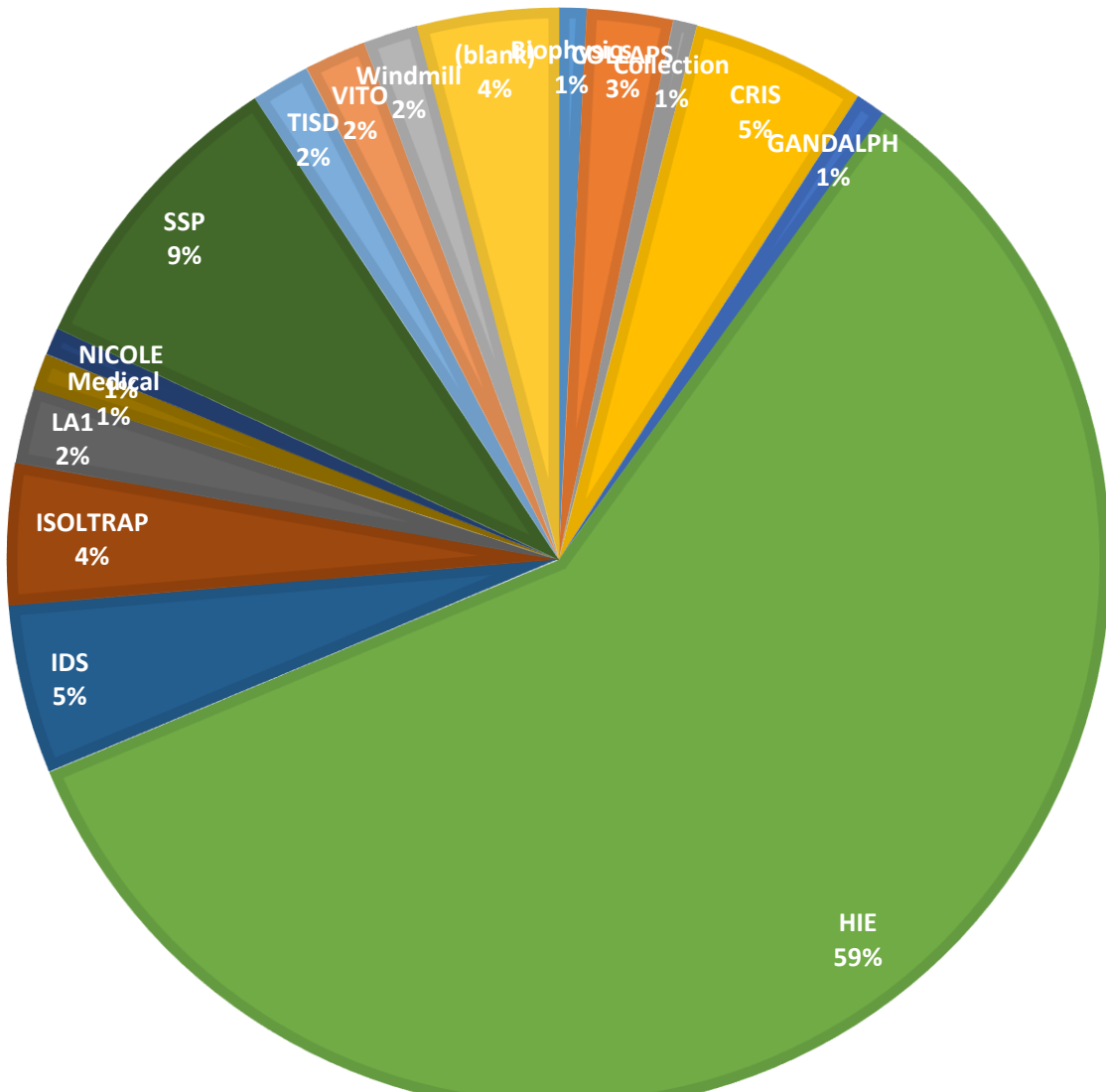
- Difficult technical stop next week, now shifted by a day, hopefully enough to allow for 72Se delivery to Miniball....
- Possibility of running until 27th November, waiting on feedback from RP

Total of outstanding shifts (February 2017)

900 HIE-shifts!



BEAM REQUESTS 2017



- Biophysics
- COLLAPS
- Collection
- CRIS
- GANDALPH
- HIE
- IDS
- ISOLTRAP
- LA1
- Medical
- NICOLE
- SSP
- TISD
- VITO
- Windmill

Row Labels	Sum of Requested shifts (summary)
Biophysics	8
COLLAPS	25
Collection	7
CRIS	50.5
GANDALPH	9
HIE	583
IDS	49.001
ISOLTRAP	41
LA1	22
Medical	10.5
NICOLE	8
SSP	88
TISD	17
VITO	18
Windmill	16
(blank)	41
Grand Total	993.001

49 HIE-ISOLDE Experiments; 27 requested beam in 2017

ISOLDE Schedule 2017: weeks 17 - 36

GPS	April				May				June				July				August						
Week	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
Monday	10	17	24	1	8	15	#513 MWNC	22	29	5	12	19	26	3	10	17	24	31	7	Sn VD5	14	#610 CaO	21
Tuesday				(IS611)										setting	Test colls	#607 UC Ta	142Ba						
Wednesday		SEMgrid				#599 Ti foils		Tech stop															
Thursday							Ascension																
Friday	Easter	#595 UC - n		#575 UC - CP		IS453		#601 UC - n		IS576													
Saturday	Easter					IS634				IS578	#603 UC - n												
Sunday	Easter		IS632		IS490		IS633		IS580		IS608												
			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	15C	Dy RILIS

Good runs for:

- ~ 100 shifts delivered so far
- Need to check earlier re-used targets, allocate time in cold check-out.
- New control room (now with AC) can lead to distance from machine...

*IS528: pending safety clearance

HRS																						
Week	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Monday																						
Tuesday																						
Wednesday						TISD		Tech stop														
Thursday	SEMgrid		(IS632)				Ascension															
Friday	Easter	#597 UC - n		#597 remains		#600 UC - Ta																
Saturday	Easter	Stable tests for IS601																				
Sunday	Easter		IS639																			
		35Ar	In RILIS	In RILIS			Al RILIS		51-53K		Cd RILIS							35Ar			98Kr/48Ar	Ni RILIS



Target change

CERN holiday

Setting up/proton scan/yield

Physics GPS

Physics HRS

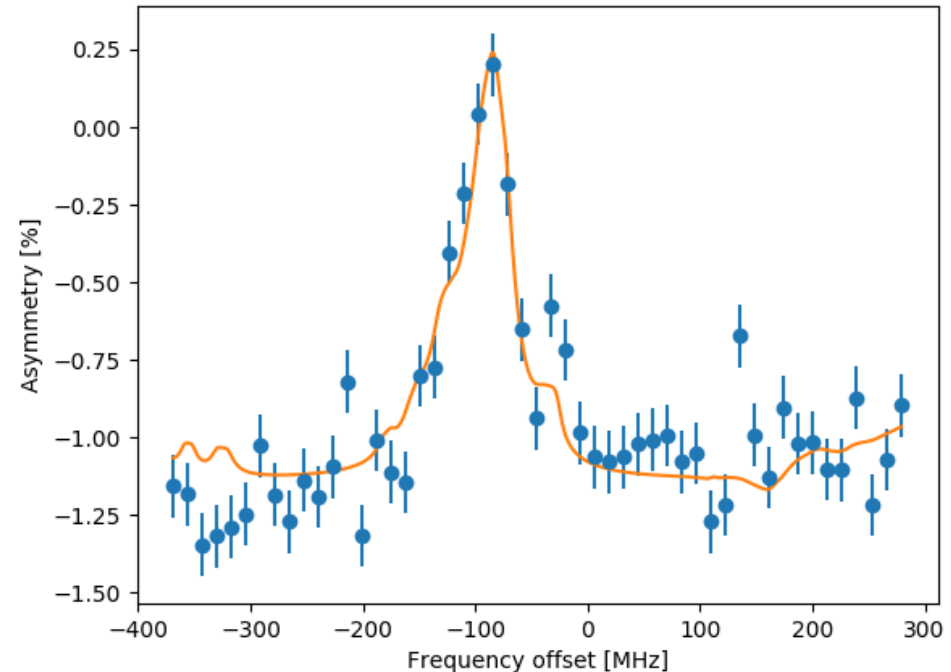
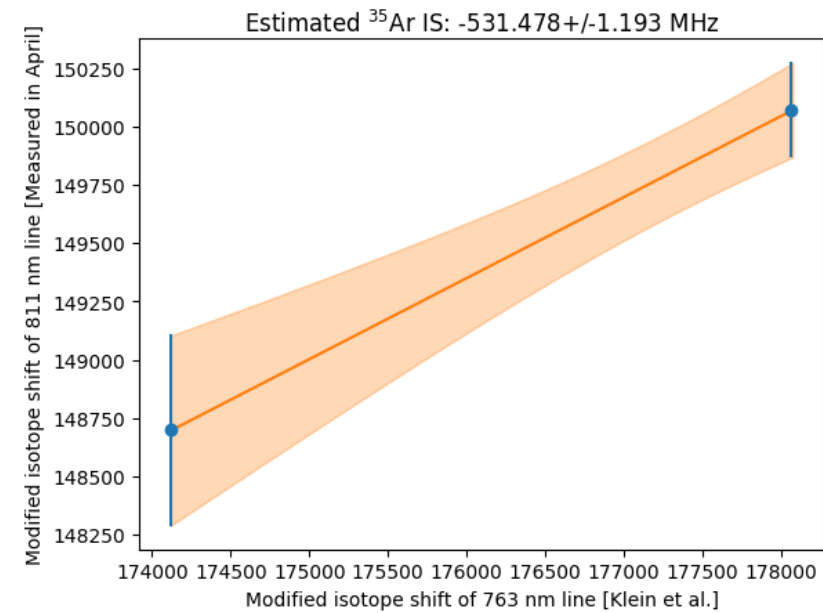
RILIS run

First run on ^{35}Ar at laser polarization beamline

Final aim of the experiment:

measure beta decay asymmetry parameter of ^{35}Ar mirror decay using spin polarized beam
-> determine Fermi to Gamow-Teller ratio
-> contribute to determination of V_{ud} CKM matrix element

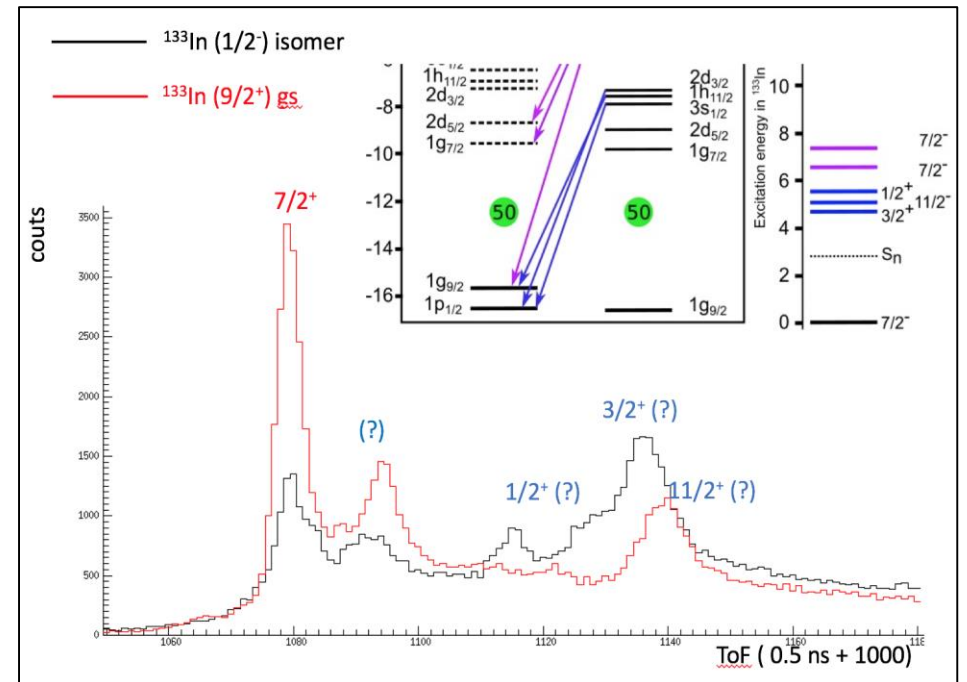
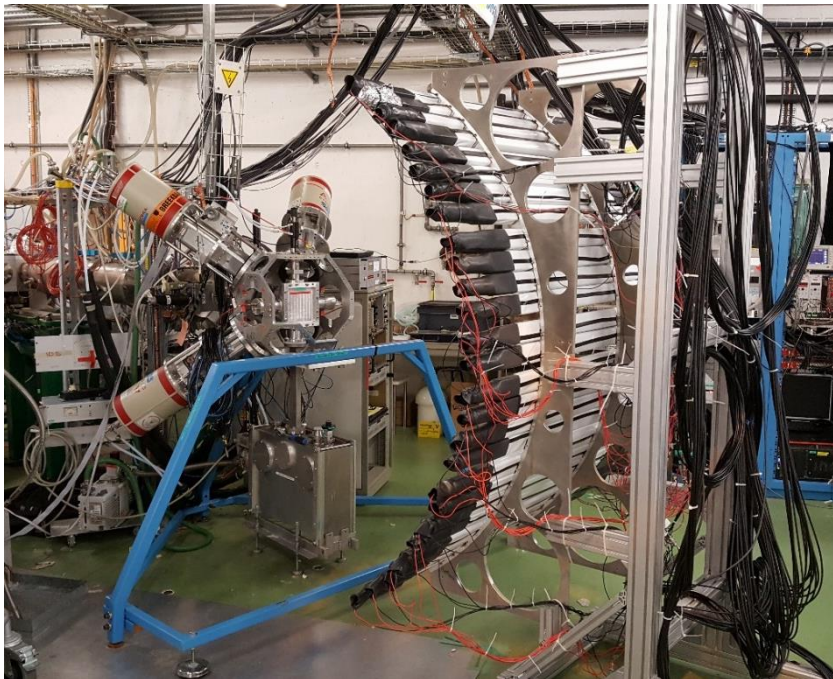
- **Aim of May beamtime:** identify host material with longest relaxation time for final experiment
- **Stable beam:** bunched beam laser spectroscopy on $^{36,40}\text{Ar}$
- **Radioactive beam:** β -asymmetry scans, relaxation time and decoupling curve measurements for several crystals



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 \sim 900 ions/uC (\sim 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

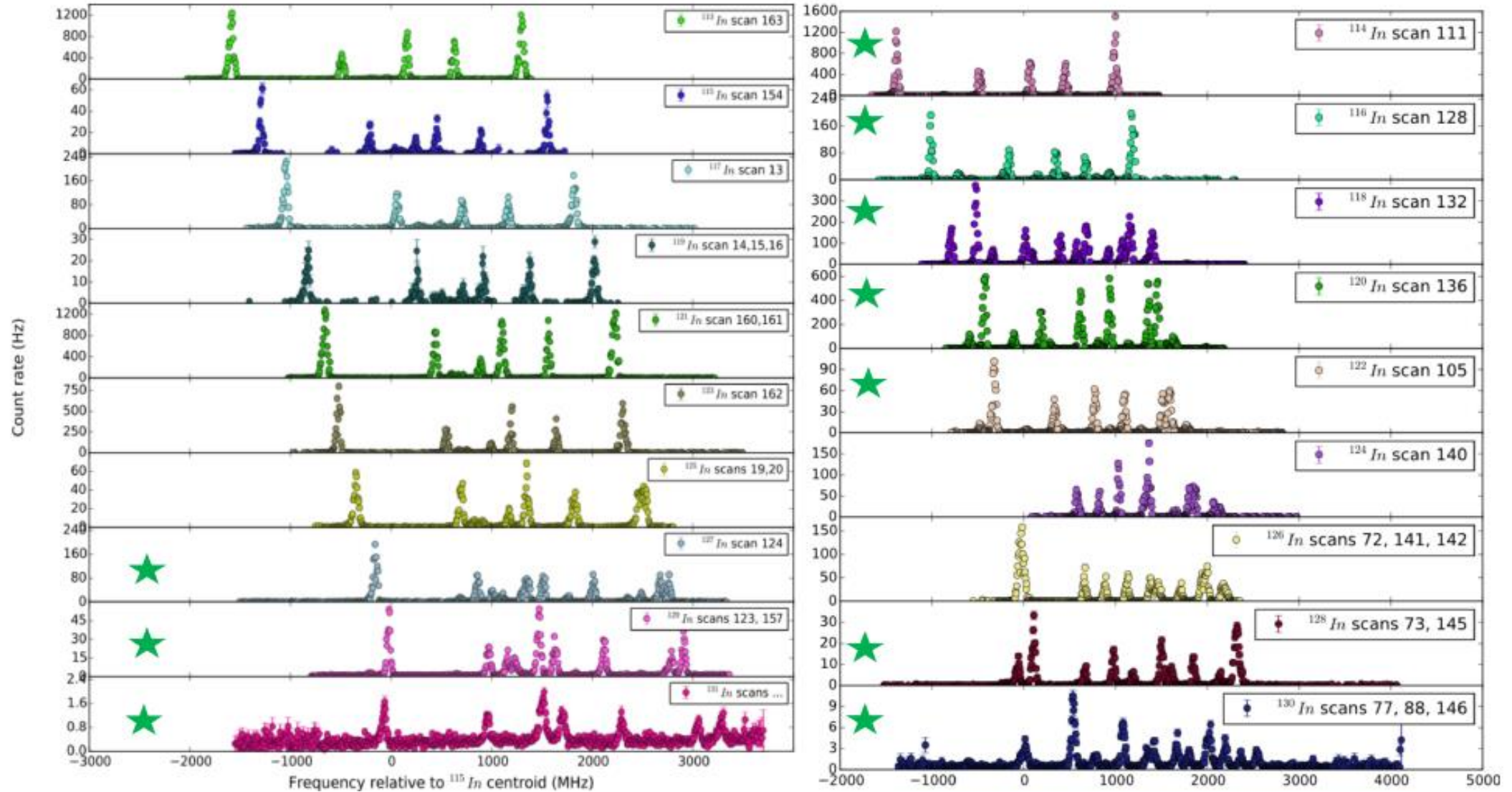




RESULTS CRIS Experiments on neutron-rich In

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

(New results ★)



Summary

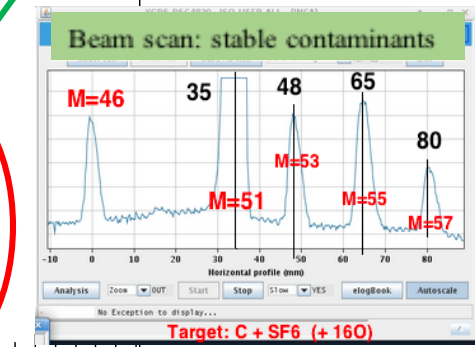
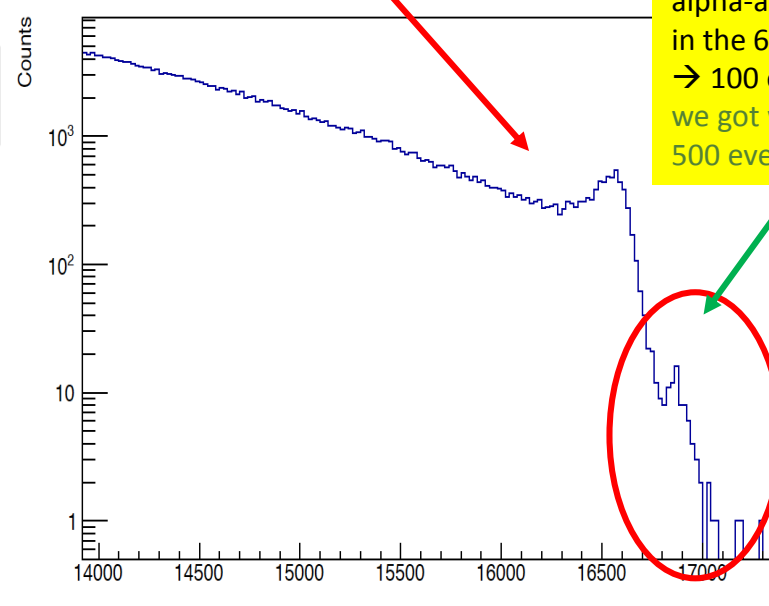
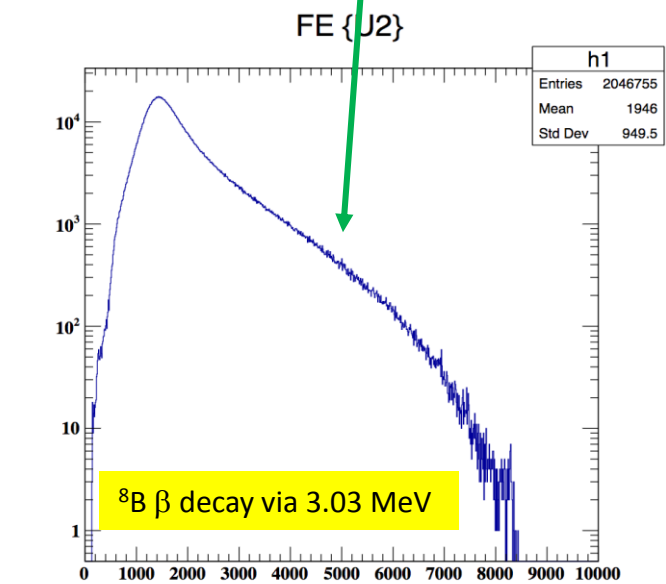
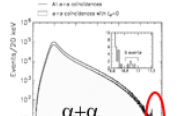
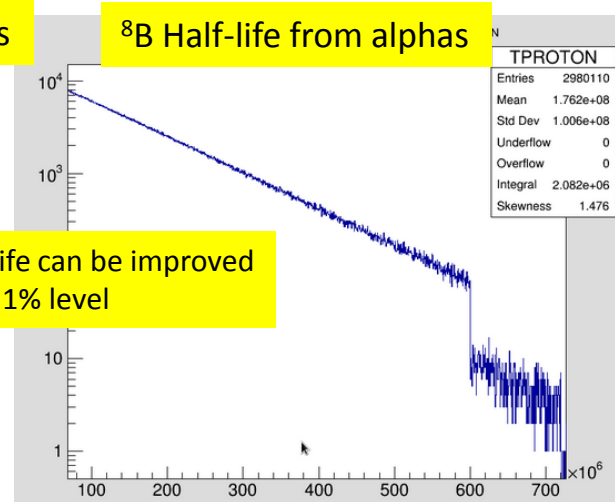
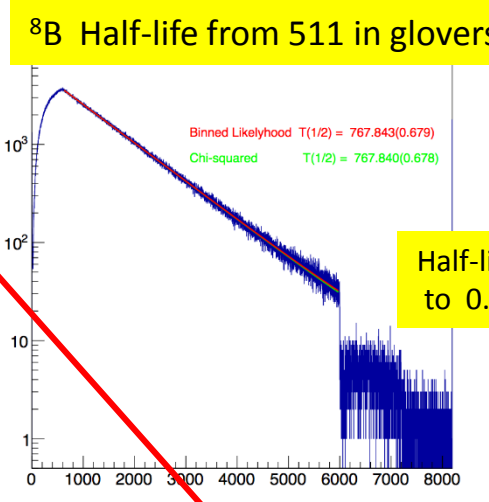
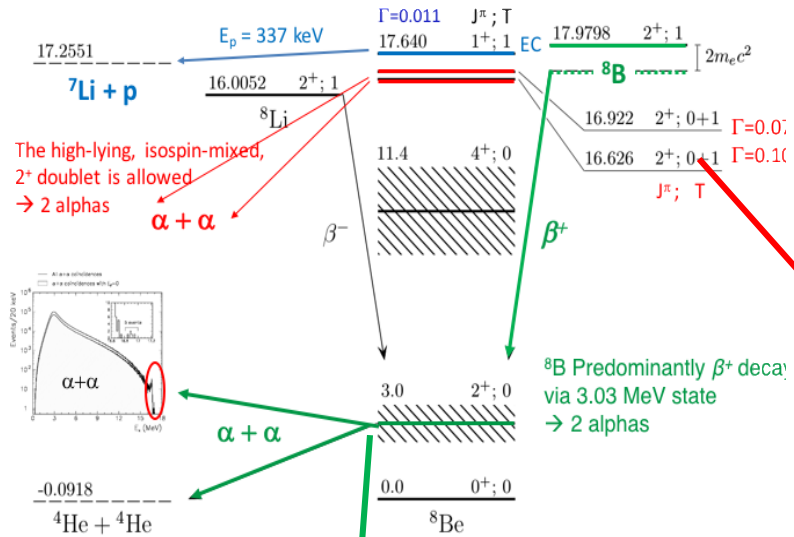
- A successful experimental campaign!
Several new results for electromagnetic moments and charge radii of:
 - 1+ states in 114, 116, 118, 120, 122
 - 9/2 states in 129, 131
 - 1/2 states in 127, 129 and 131
 - high spin isomers ($>21/2$) in 127, 129
 - ground and isomeric states in 128 3+, 8-
 - ground and isomeric states in 130: 1-, 10-, 5+
- The high efficiency and high selectivity of CRIS was demonstrated
- Yields were about two orders of magnitude lower, and the contamination higher than expected. Perhaps due to the accidental vent of the target at high temperature (?).

Outlook

- Extending the measurements up to ^{134}In are feasible with same background conditions but expected In yields. Additional developments are ongoing to further improve background suppression.
- Solid bases for future CRIS experiments towards ^{100}In

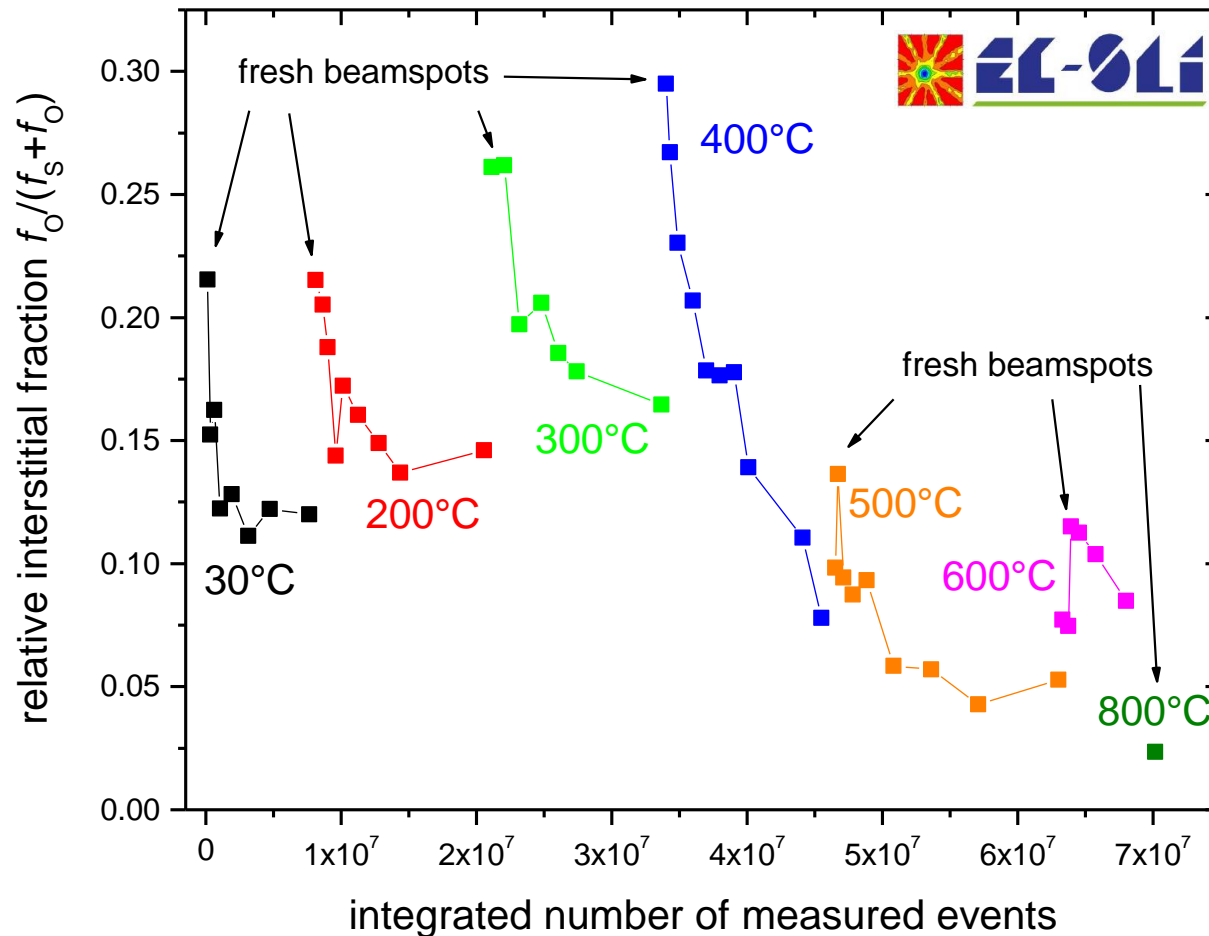
Electron capture of ^8B into highly excited states in ^8Be . IS633@IDS

9 shifts 26-29 May 2017



M46: BF_2 yield about 40k $^8\text{B}/\mu\text{C}$

IS634: Fluence dependence of interstitial ^{27}Mg in GaN



- Continuing our work initiated in *Phys. Rev. Lett.* **118**, 095501(2017)

- Complex balance of interstitial vs substitutional Mg as function of temperature, doping type and implanted fluence
- reason: amphoteric character of Mg and its interaction with Ga vacancies
 $\text{Mg}_i + V_{\text{Ga}} \rightarrow \text{Mg}_{\text{Ga}}$
- Impact: prospects for more efficient *p*-type doping of GaN (high-power electronics, optoelectronics...)

K experiment at CRIS - IS620

Goal of the experiment:

- Measuring the hyperfine structure of $^{52,53}\text{K}$
- Investigating the proposed shell closers at $N=32,34$

Experiment could only access long-lived K isotopes $^{38-48}\text{K}$

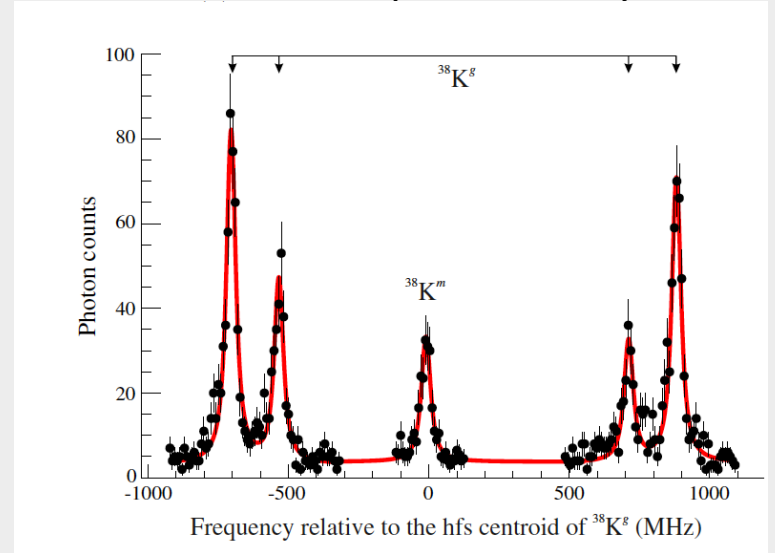
--due to the unusual performance of the target

However,

- CRIS measured the hyperfine structure of $^{38-48}\text{K}$
 - Using the new laser stabilization system
 - With one spectrum of ^{49}K (only at the beginning of run)
- Performed systematic studies – the effect of:
 - Laser power
 - Timing of laser pulseson the resolution/line shapes in hyperfine spectra

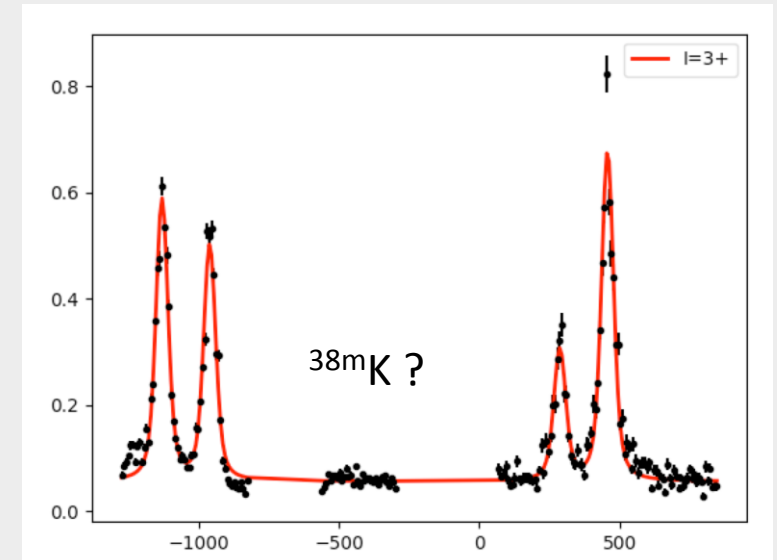
Spectra from COLLAPS 2012

$^{38}\text{g,mK}$ similar production yields

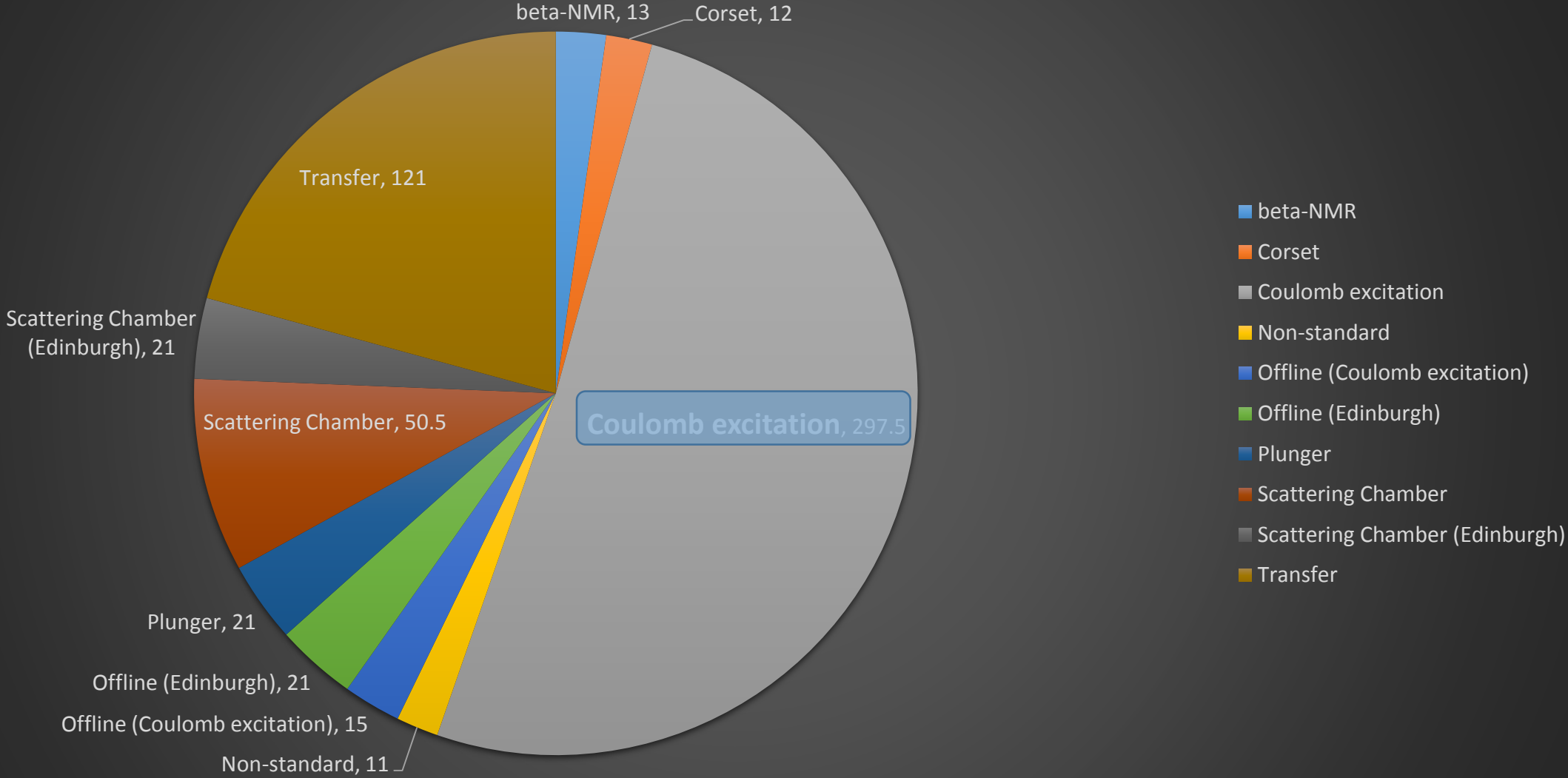


Spectra from CRIS 2016

^{38}mK was not released from target



Break down of shift requests for 2017: HIE-ISOLDE



Draft planning 2017 (timetable no longer valid...but experiments essentially the same). Some limits on HIE...(manpower)

GPS

(1)		(2)		July			(4)			August			September			October				November						
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47					
26	3	10	17	24	31	7	14	Ta-GdB6 21	28	4	11	18	25	2	9	16	23	Pb - VD5 30	6	13	20					
	setting		Collections?	(3)	IS553: 142Ba		IS619: 15C @4.3MeV/u (XT03)	(5)	IS528(med)	SSP Cd run (in parallel) STAGISO	(7)	IS546: 140Nd @ 4.5MeV/u	IS528	negative run?	Ta - Ta	(9)	IS561 9Li @ ~ 7.3MeV.u (XT03)	UC - Ta	(10)	IS596: 136Te @ 4.5MeV/u	(11)	IS547 206Hg @ 5.5MeV/u	(13)	IS629: 28Mg @ 5.5MeV/u		
ZrO2 -HP	IS597 72Se @ 4.4MeV/u	IS569 70Se @ 5.5MeV/u	UC Ta	IS553: 144Ba @ 4.1MeV/u	CaO		@4.3MeV/u (XT03)	IS558: 140Sm @ 4.65MeV	Sn - VD7		IS546: 140Nd @ 4.5MeV/u															
Se (mol) beam			Ba beams			15C		15C	Sm RILIS	Dy RILIS	Dy RILIS							RILIS			RILIS Mg					
RILIS backup																										
						XT03																				

Te TISD has been performed. Experiment probably can't run with Cs contamination. Require LIST/Molecular beam

July													November								
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
26	3	10	17	24	31	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20
			Physics HRS?					CRIS (Ga)	(6)		For VITO	(8)			UC reuse						(12)
		UC reuse		UC reuse		UC reuse		Uc - Ta	IS572 94Rb @ 5.5MeV/u	IS572 94Rb @ 5.5MeV/u	VITO...	IS562: 108Sn @ 5.5MeV/u	CRIS take Sn								
IS574					Collaps Ni?																
Cd RILIS					Ni RILIS?			Ga RILIS?	Rb (surface)	Rb (surface)	Na or K?	Sn RILIS	Sn RILIS			Sn RILIS					RILIS Cu

HRS

Focus on GPS for HIE ISOLDE. Potentially good for laser spectroscopy
 ~ 13/27 experiments possible
 ~ 235 shifts for HIE ISOLDE

Setting up HIE – ISOLDE physics Low energy physics

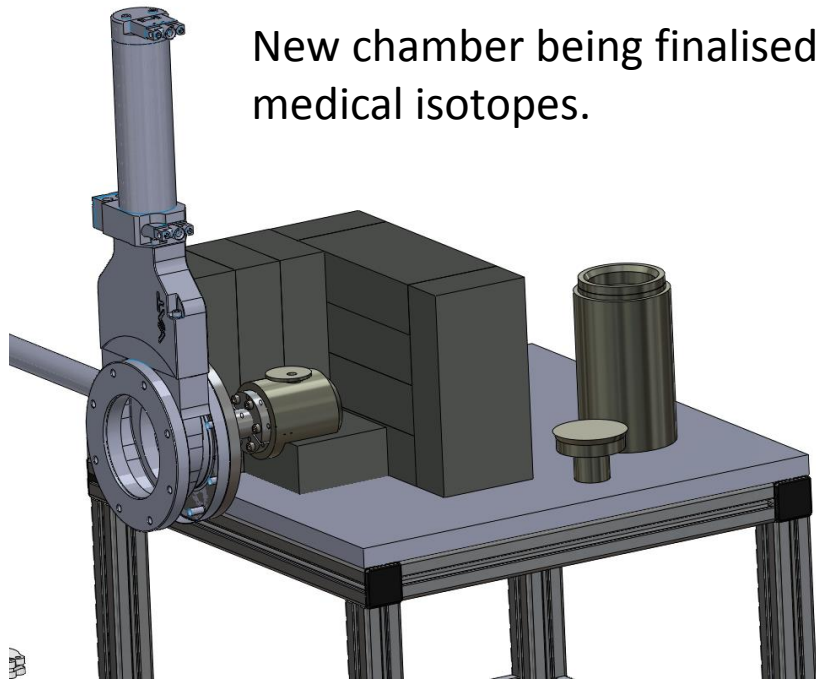
XT03

Collections at ISOLDE

2016, finger dose threshold passed during collections of Tb isotopes for medicine

Visit and response from OFSP required improvements in how collections are planned at ISOLDE.
(especially for extremity doses)

New chamber being finalised for medical isotopes.



- Restrictions have also affected the solid state programme (even though the dose rates are far below medical collections).
- Currently a very heavy load in terms of preparation, but also for RP requirements.
- Confusion about safety hierarchy.
- Review of the situation may ease some of these issues.

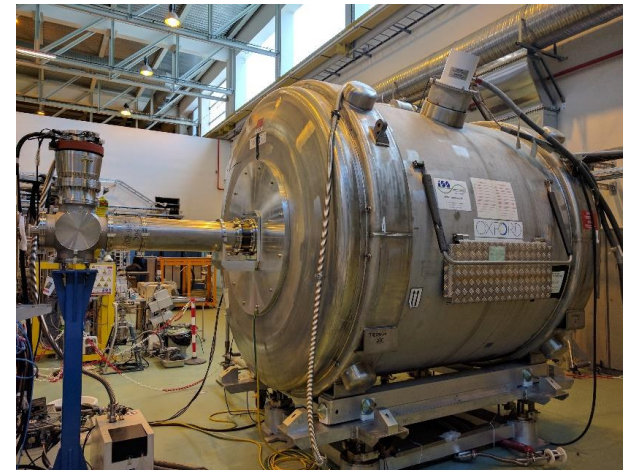
Initial review from Mn/In run

C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
ISOTOPE OF INTEREST	HALF-LIFE	UNIT	DECAY MODE						REQUEST ED BEAM	NUMBER OF ATOMS	NUMBER OF SAMPLE	ACTIVITY [Bq]	LA [Bq]	FRACTION LA	E β endpoint MeV	I β	γ CONSTA	H*(10) @ 40cm [μ Sv/h]	H'(0.07) @ 10cm [mSv/h]	DPUI [Sv/Bq]	
			ϵ	$\beta+$	$\beta-$	e-	IT	α													γ
Mn-56	2.58 h				•				•	Mn-56	1.0E+12	1	7.5E+07	3E+07	2.5E+00	2.848	0.55	0.275	1.0E+02	1.9E+02	2.00E-10
Mn-57	1.42 m				•	•			•	Mn-57	1.6E+11	1	3.0E+08	n.a.	n.a.	2.676	0.75	0.037	2.9E+01	3.3E+02	n.a.
Mn-59	4.59 s				•				•	Mn-59	n.a.	1	9.2E+05	n.a.	n.a.	5.184	0.21	n.a.	5.4E-05	2.0E+00	n.a.
Fe-59	44.529 d				•				•	Mn-59	5.0E+11	1	9.0E+04	2E+06	4.5E-02	0.466	0.53	0.175	9.1E-02	1.6E-01	3.20E-09
In-119	18 m				•		•		•	In-119	1.0E+11	n.a.	7.0E+08	2E+08	2.4E+00	no data	no data	0.029	5.4E-05	1.9E+00	2.90E-11

Optimised setup: lots of plexiglass....

IMPACT	Isotope	Handling tasks	Collective Dose [μ Sv]	Max. Indiv. Dose [μ Sv]	Participants	Average Indiv. Dose [μ Sv]
96816	Mn-56 Mn-59	Sample holder removal Goniometre check & setting	68	15	9	7.5
96911	Mn-57	31 Chemical tests (estimations for 5 tests)	30	10	9	3.3
96798	Mn-57	Lid exchange Online acquisition @ GLM	51	9	14	3.6
96821	In-119	Lid exchange Online acquisition @ GLM	14	3	11	1.3

Arrival and installation of ISS: ready for stable beams late in the year?



Also, successful re-energising of the WISARD magnet to 9T....