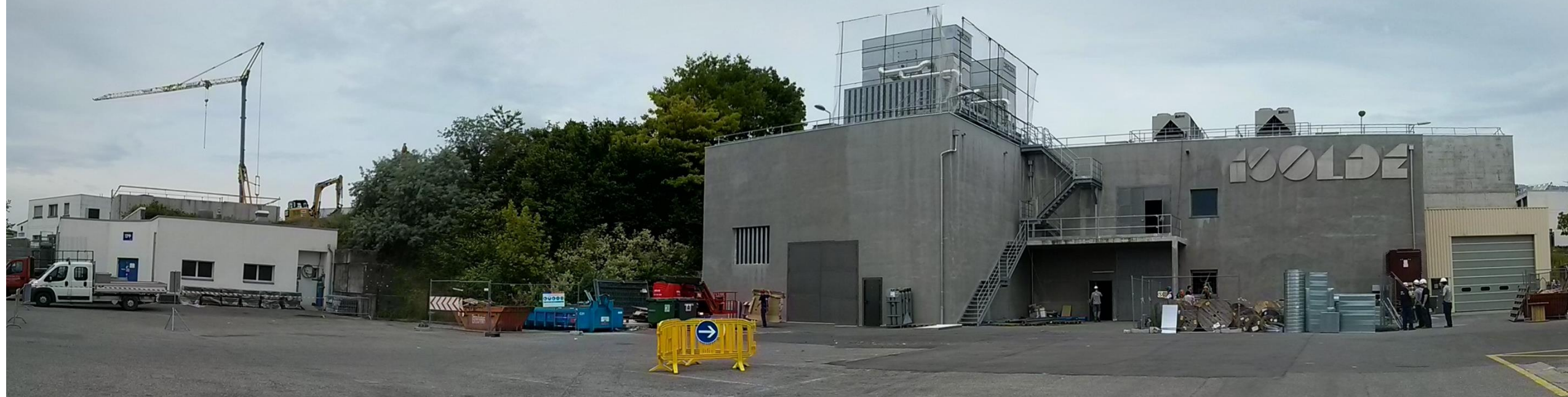


ISOLDE physics coordinator report: INTC 27th June 2018

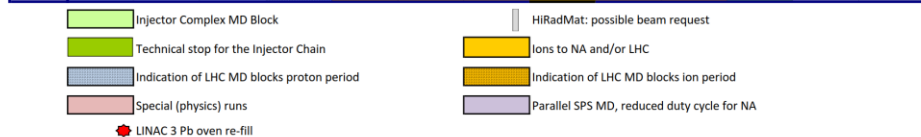
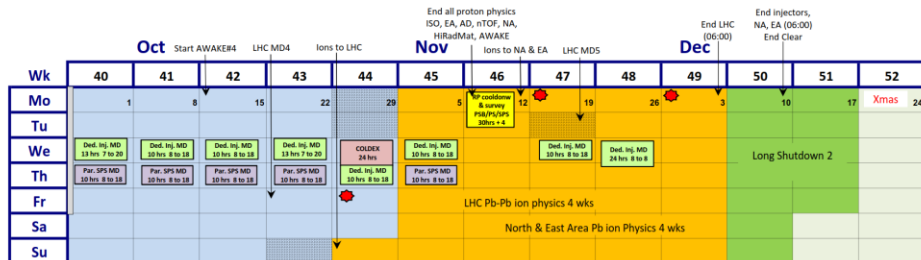
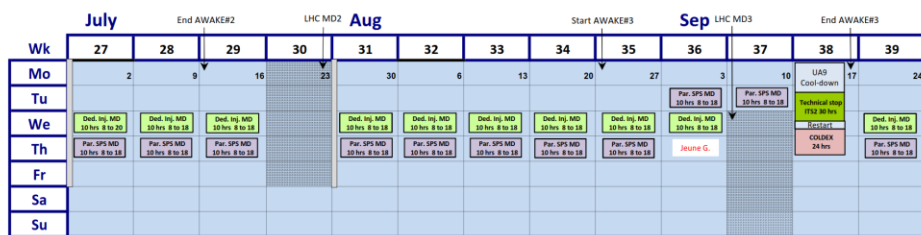
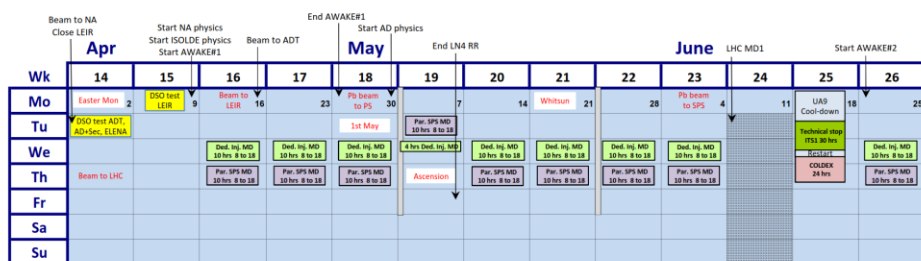
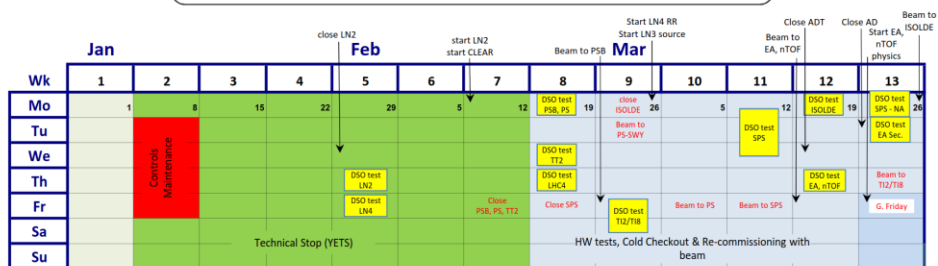
Karl Johnston



- Planning for 2018
- Schedule so far: preparation for HIE-ISOLDE and end of year
- Safety/training
- ISOLDE Technicians

Injector Accelerator Schedule 2018

Approved by Research board on 06.12.2017



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

217 days for physics (compared to 224 in 2017)

HIE ISOLDE on track for physics the week of July 9.

This leads to ~ 126 days available for HIE ISOLDE, compared to 150 in 2017. (at least with protons)

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

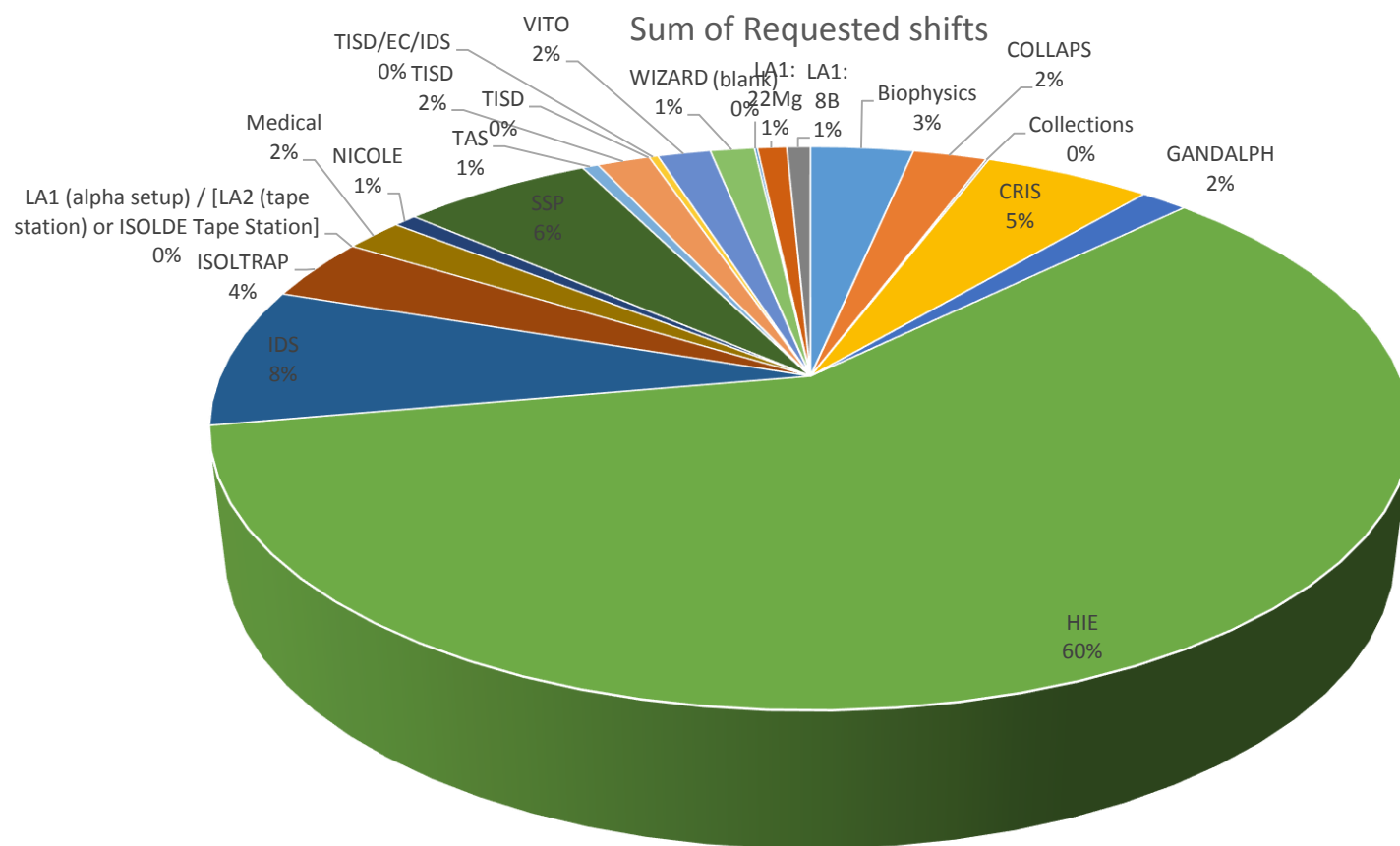
Interleave HIE and LE runs as in 2017.

Strategy for HIE: 4CMS so optimized for reactions.

10MeV/u only available for lighter masses ~ 7.4MeV/u for mid/heavy: consequences for reaction runs.

Starting with CE then switch to T-Rex; XT03 and ISS to be accommodated.











Summary of beam requests 2018










Row Labels	Sum of Requested shifts
Biophysics	35
COLLAPS	25
Collections	1
CRIS	57
GANDALPH	16
HIE	629.5
IDS	84.501
ISOLTRAP	38
Medical	20
NICOLE	8
SSP	65
TAS	5.5
TISD	18
TISD	0
TISD/EC/IDS	3
VITO	18
WIZARD	15
(blank)	1
LA1: 22Mg	10
LA1: 8B	8
Grand Total	1057.501

ISOLDE Schedule 2018: weeks 15 – 34

GPS schedule 2018

	April				May				June				July					August			
WK	14	15	16	17	18	19	20	21	22	23	24	25	27	28	29	30	31	32	33	34	
MO	2	9	16	#534/567 Sn VDS 23	30	7	MD: FTS 14	21	28	 4	11	18	25	2	9	16	23	30	6	13	20
TU			TISD		May-01		MD:FTS			IS610		Tech Stop	Medical isotopes					#650 M WCNT			
WE			TISD		#599 Ti foils	IS634					ISBM	#655 Ta - W	UC VD7			ThC VD7					
TH		#513/ #650		IS611 IS640 IS647 IS652 IS653		Ascension					²² Mg to LA1		IS528 IS638						XT03	(tbc)	
FR							#653 UC - Ta n			#634 LIST					IS644: 4.8MeV/ u (IS506)		IS552: 4.1MeV/ u		IS616: 4.5MeV/ u		
SA																					
SU			IS633					IS622			IS614	IS528									
			8B: IDS	111Cd		RILIS: Mg		RILIS: Cu		RILIS: In	RILIS: Mg	RILIS: Dy	RILIS: Dy		96Kr / 212Rn		22x Rn		8B		
												(night-time)									

HRS schedule 2018

April				Challenging runs				June						July					August			
WK	14	15	16					20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
MO	2	9	16		#618 UC - Ta/W 14	21	28	4	11	18	25	#652 UC Ta (+CF4) 2	9	16	23	30	6	13	20			
TU					May-01			#626 Ta - W	TBC	Tech Stop												
WE	#640 LaC - n				TISD						Machine development			UC W (+CF4)								
TH											Machine development	IS650			IS552	LaC		LaC				
FR			#627 Ta - W				#654 UC - W					IS637			IS553: 4.1MeV/ u							
SA												IS608										
SU		IS639			IS532	IS623	IS642	IS645		IS620	IS649						IS562: 4.4MeV/ u		IS613			
	HT tests	In RILIS		Sc RILIS	RILIS test	70Br	26Na	K beams	Sc RILIS			RILIS: Bi		22xRa/142Ba		Sn RILIS		Sn RILIS				
				In RILIS	Ge 34S																	



Target
change

CERN
holiday

Setting
up/proton
scan/yield

Physics
GPS

Physics
HRS

RILIS
run

Week 24 2018			RILIS	GPS	HRS	CA0	p's	MEDICIS	Visits	other
Monday	6/11/2018	AM	RILIS: Sc	LIST/separator setup	IS649	HRS	NORMHRS	#626M (Ta): move to irradiation point (PM)		
		PM		LIST/separator setup	IS649	HRS	NORMHRS			
		night			IS649	HRS	NORMHRS			
Tuesday	6/12/2018	AM		LIST/separator setup	IS649	HRS	NORMHRS	#626M to exchange point	14:00 Swedish students	
		PM		LIST/separator setup	#661 (if ready)	GPS				
		night		Stable beam to LA1		GPS				
Wednesday	6/13/2018	AM		Proton scan TISD	setup of HRS through cooler (Tim/Stuart/Annie)	GPS	NORMGPS			
		PM		TISD		GPS	NORMGPS			
		night		Stable beam to LA1		GPS	NORMGPS			
Thursday	6/14/2018	AM		TISD		GPS	NORMGPS			
		PM		IS614		GPS	NORMGPS			
		night		IS614		GPS	NORMGPS			
Friday	6/15/2018	AM		IS614		GPS	NORMGPS			
		PM		IS614		GPS	NORMGPS			
		night		IS614		GPS	NORMGPS			
Saturday	6/16/2018	AM	RILIS: Mg	IS614		GPS	NORMGPS			
		PM		IS614		GPS	NORMGPS			
		night		IS614		GPS	NORMGPS			
Sunday	6/17/2018	AM		IS614		GPS	NORMGPS			
		PM		IS614		GPS	NORMGPS			
		night		IS614		GPS	NORMGPS			
Monday	6/18/2018	AM		IS614		GPS	NORMGPS			
		PM		(tbc) protons off at 1600 for TS		GPS	NORMGPS			
		night				GPS	NORMGPS			

Summary of week: COLLAPS finish with Sc on HRS on Tuesday morning. Setup for Mg run using LIST then begins. TISD will make extensive tests. Stable beam to LA1 either Tuesday night or Wednesday. Proton scan Wednesday if ready. Yield checks on Mg once lasers ready. Beam to experiment on Thursday afternoon/evening. On Monday 11th June, the MEDICIS target will be put on the irradiation point for irradiation overnight. Technical stop on 19th June. Protons will be turned off on 1600 Monday 18 June (tbc at next week's FOM).

(GPS): #660 SiC LIST for Mg beams to LA1. Setup at 50-60kV. Isotope for the experiment: 22Mg. **Responsible for target:** Reinhard and TISD group.

(HRS): #626 Ta - W for Sc beams to COLLAPS. HT = 50kV. RFQ in bunching mode. #661 VD5 target for RFQ tests.

Responsible for the target #626: David and Sebastian. **Responsible for target: #661** Tim/Stuart/Annie

Protons: NORMHRS till Tuesday morning. NORMGPS from Wednesday

Operations responsible: Emanuele (167813) until 12th June Alberto (167538) afterwards.

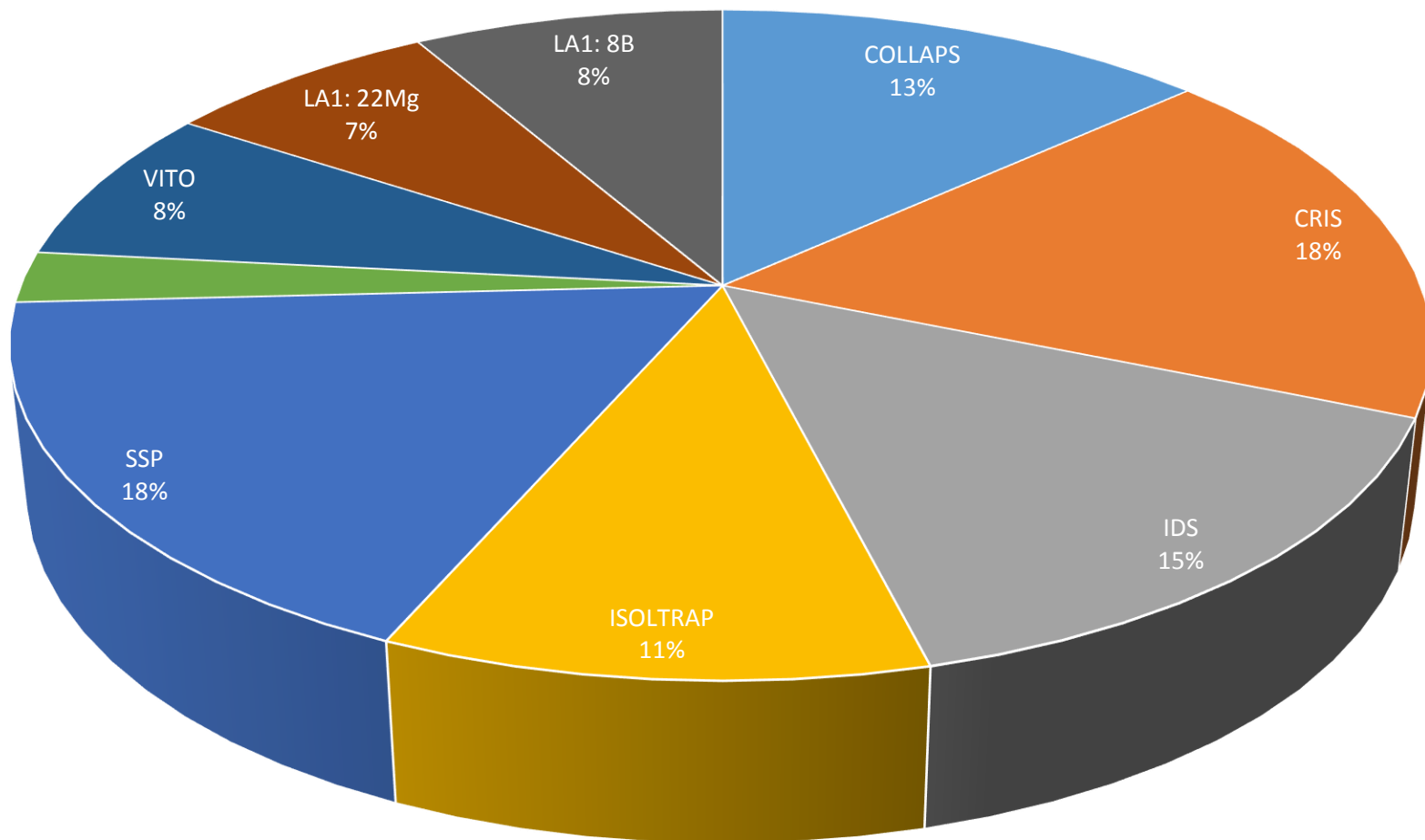
For more details about visits: <https://espace.cern.ch/isolde-visits-info/Lists/Calendar/calendar.aspx>

New column to the weekly planning: MEDICIS.

So far no consequence on ISOLDE programme.

MEDICIS station possibly available for offline irradiation of ISOLDE targets in Autumn

New ISOLDE Schedule “TAC” (Technical advisory committee). Similar to what takes place before INTC but for the schedule to avoid surprises, discuss yields, targets impurities, feasibilities etc. (start-up meetings often too close to the beamtime to make changes).



Currently on day 80

~ 163 number of shifts so far
(excluding current medical run...)

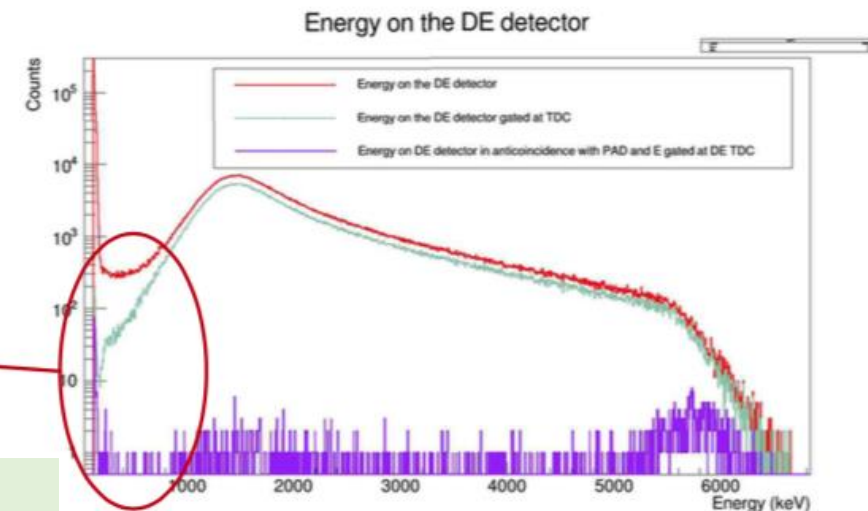
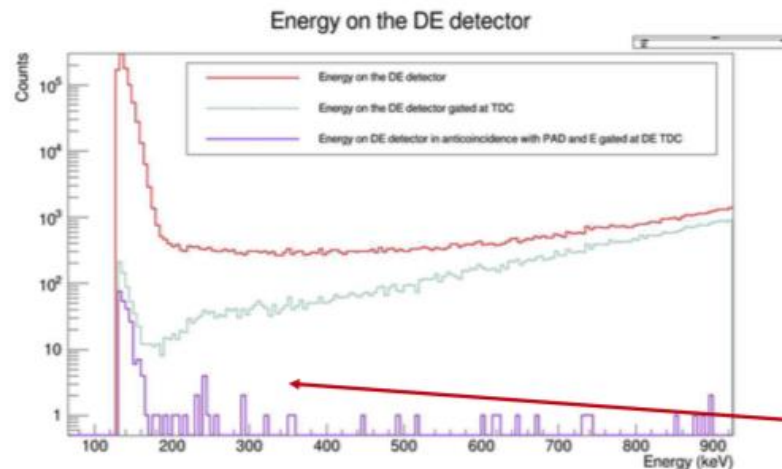
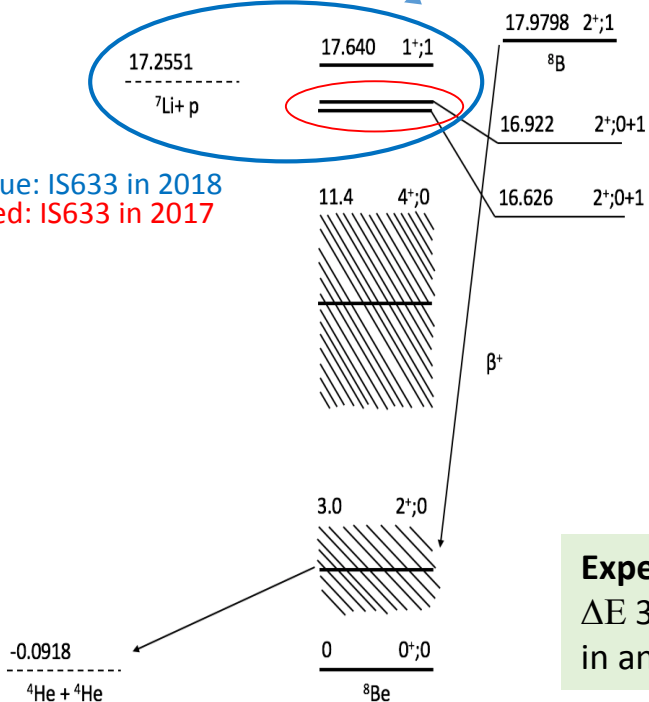
18 experiments

ISSUES: Autotune: currently
working on a new CERN supported
programme and investigating Tim's
programme.

Observations: Machine performing
even in spite of late start-up (later
arrival of water than 2017)
compressed cold check
out...protons were available before
ISOLDE was able to take them....

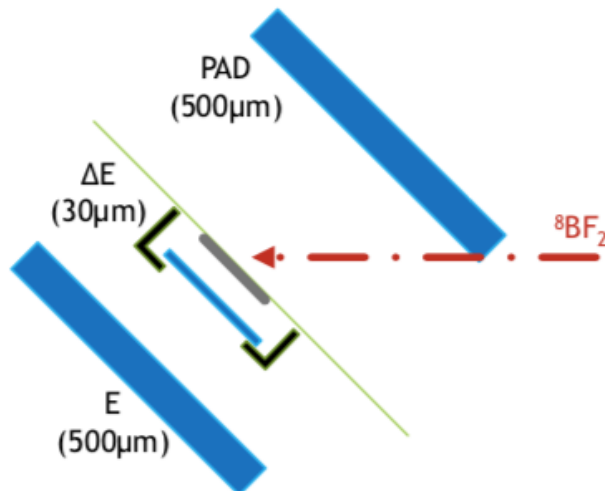
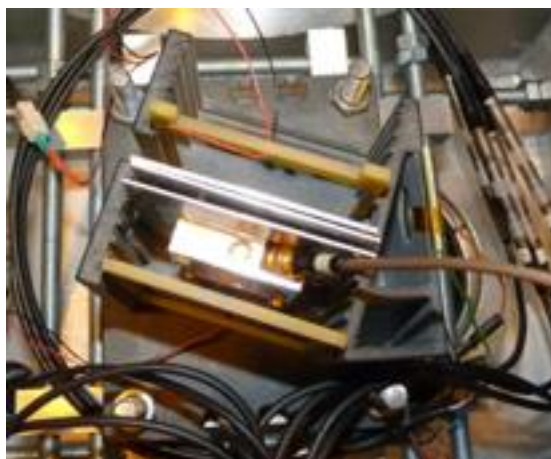
IS633: Electron capture of ^8B into the highly excited states of ^8Be 2018; determining the branching ratio to the state at 17.64 MeV $\rightarrow 7\text{Li}+p$

Blue: IS633 in 2018
Red: IS633 in 2017



Experimental set-up at La1:

ΔE 30 μm thick, 20mm² Si detector to detect the 330 KeV proton in anti-coincidence with two 5x5cm² Si-PAD



The main decay of ^8B is $\beta \rightarrow \alpha + \alpha$, determining the branching ratio depends on the overall statics obtained. We had very good yield 1E5 $^8\text{B}/\mu\text{C}$; with 70% of the data analysed we have 3.64E^8 events in $\Delta E + \text{PAD}$ coincidence

The task is to have the region of 300KeV clean enough in order to give an experimental limit on the branching ratio to the 17.25 MeV level.

The theoretical upper limit is $2.3 \cdot 10^{-8}$ [3] was calculated factorizing the wave function as a proton halo.

Thesis: Silvia Viñals i Onses
Many thanks to Olof Tengblad

Spring 2018 at



Ge ($Z = 32$) isotopes across the $N=40$ subshell closure

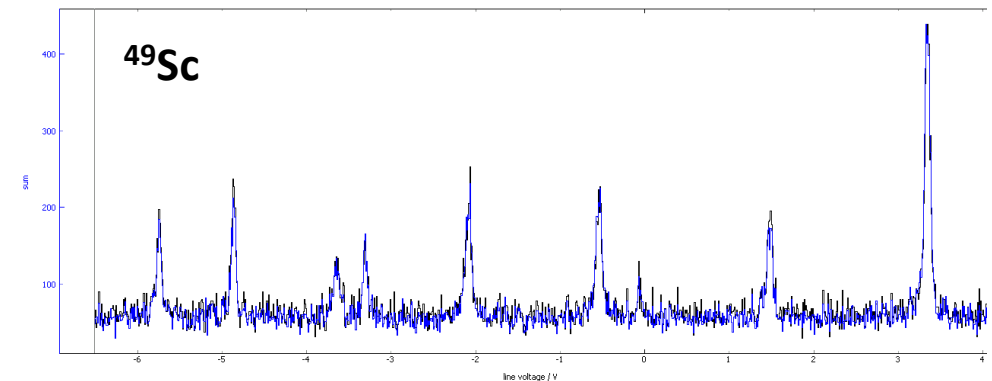
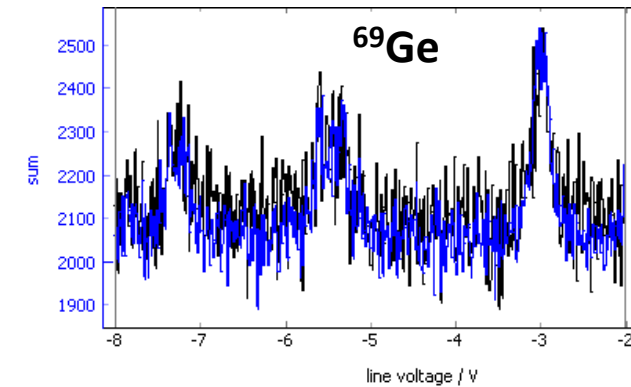
- $^{68-74}\text{Ge}$ ($N = 36 - 42$)
 - ✓ Part of physics goal was reached
 - ☹ $^{65-67,75-76}\text{Ge}$ and isomers in $^{71,73}\text{Ge}$ out of reach
- First use of new laser frequency mixing unit

BUT ...

- Overwhelming amount of contamination
 - nA of beam at some masses (luckily decreased over time)
- No Ge mass marker (in combination with large contamination) slowed down setting up COLLAPS

Sc ($Z = 21$) isotopes across $N=28$

- $^{44-50}\text{Sc}$ ($N = 23 - 29$)
 - ✓ Main physics goal reached
 - Only partial spectrum of ^{50}Sc
- Smooth ISOLDE operation



Generally

- Continuous AC problems in laser lab
- Frequent tripping of power supplies at ISOLDE make long scans even more difficult!

Many thanks to Hanne Heylen

Study of neutron-rich K isotopes at CRIS IS620

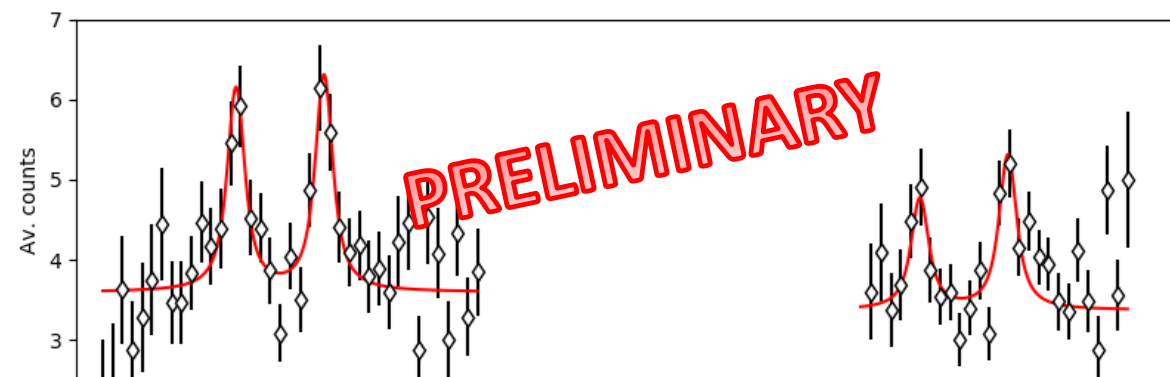
Goal of the experiment

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

Results

- ❖ Hyperfine structure of $^{38,41,42,47-51}\text{K}$ using ion detection
- ❖ Due to high (stable) contamination at mass 52, 53 ion detection was not possible at these masses
- ❖ Beta detection of resonantly laser ionized isotopes enabled the measurement of ^{52}K
- ✓ First use of beta detection at CRIS
- ❖ ^{52}K (N=33) is an excellent laboratory to investigate the N=32 shell closure
- ❖ Hyperfine structure of ^{53}K was not obtained

Many thanks to Agi Koszorus



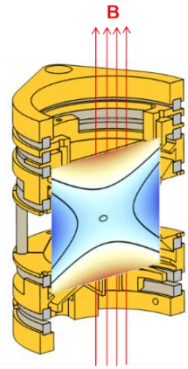
Hyperfine structure of ^{52}K obtained by detecting the beta decay of resonantly ionized ^{52}K isotopes

Contamination @ mass 52	$\sim 10^7$ ions/s
^{52}K yields	~ 300 ions/s

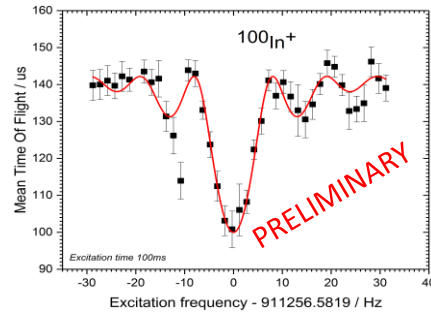


ISOLTRAP : experimental campaigns in 2018

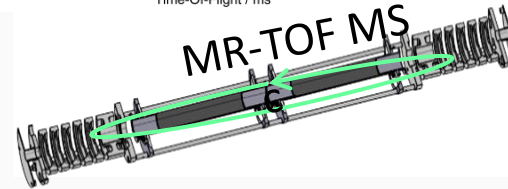
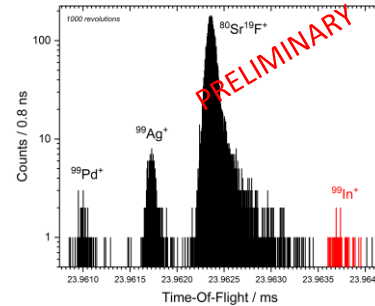
April 2018 – LaC_x + RILIS: high-quality Indium beams.



Precision
Penning trap

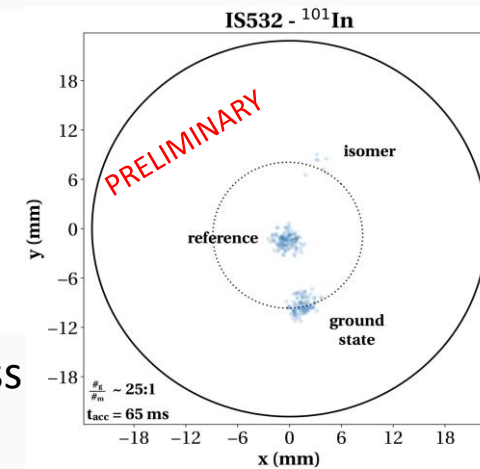


Penning trap measurements improve the mass uncertainty of ^{100}In by a factor 100.



MR-TOF MS allows first mass measurement of ^{99}In

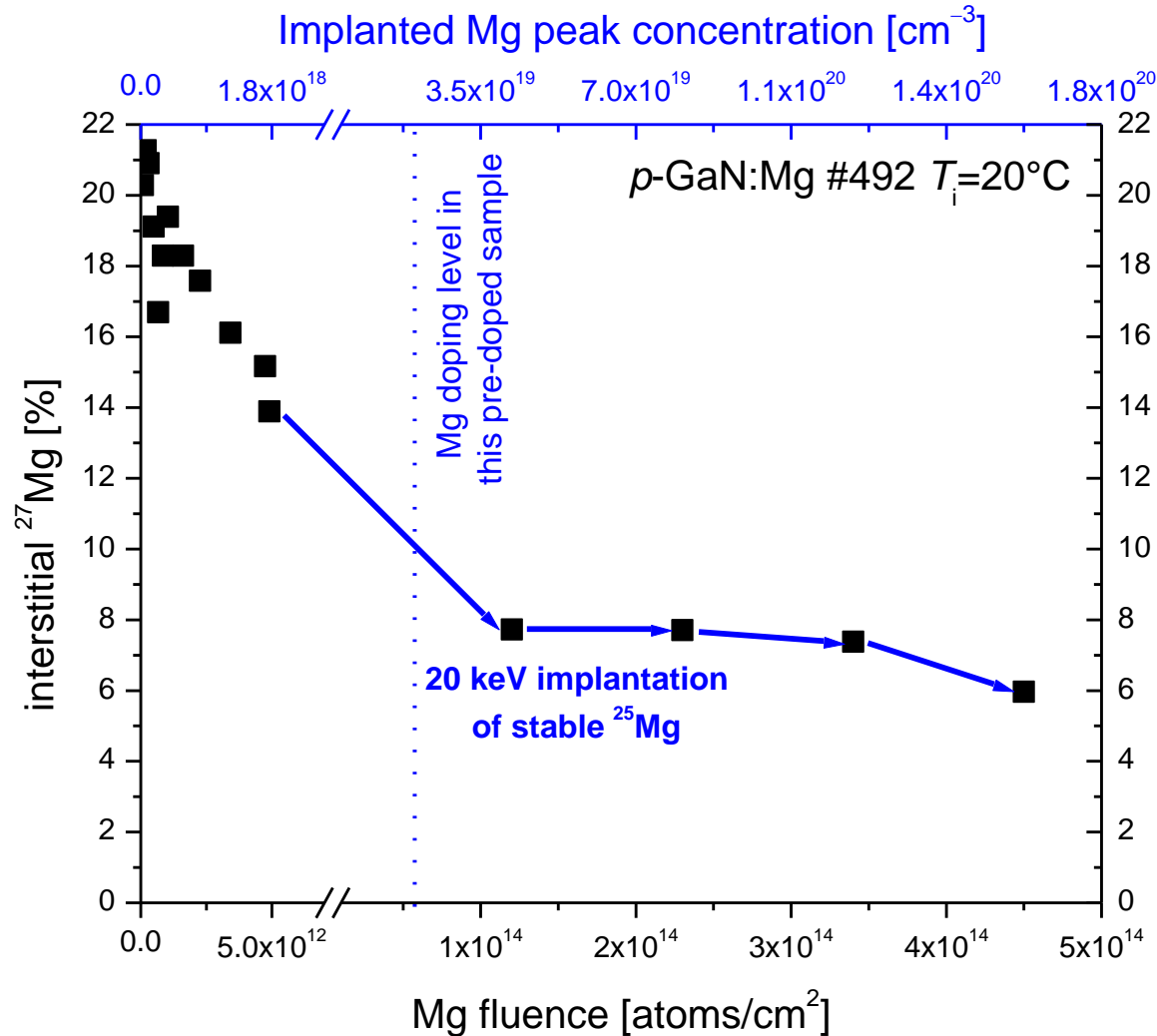
PI-ICR technique allows first mass measurement of $^{101}\text{In}_{g,m}$.



- $^{52-55}\text{Sc}$ run (RILIS+Ta-foil target)
 - Confirms that neutron rich Sc up to $A=52$ are produced 😊
 - Stable Ti-V-Cr isobaric contamination too strong ☹️
 - Impossible to measure the Sc isotopes of interest
 - Run redirected to In 😊😊😊
- ^{70}Br Q_{ec} value : Mai 2018
 - lower production rate and higher than expected contamination ☹️

Many thanks to Maxime Meugeot

IS634: Exploring the limits of p -type doping in GaN



- **Aim of 2018 beam time:** explore lattice location (substitutional vs interstitial) of ion implanted Mg in GaN **at technologically relevant doping levels**
- 20 kV operation of GPS
- Interstitial Mg undergoes a fast drop within fluence range up to 1x10¹³ cm⁻²
- Even for Mg fluences as high as 5x10¹⁴ cm⁻², i.e. [Mg] ~1.6x10²⁰ cm⁻³ = 0.3%, interstitial Mg does not reappear, ~93% of Mg continues to be implanted into Ga sites



Many thanks to Uli Wahl

First ^{111}Cd PAC measurements of free molecules (IS640), here CdI_2

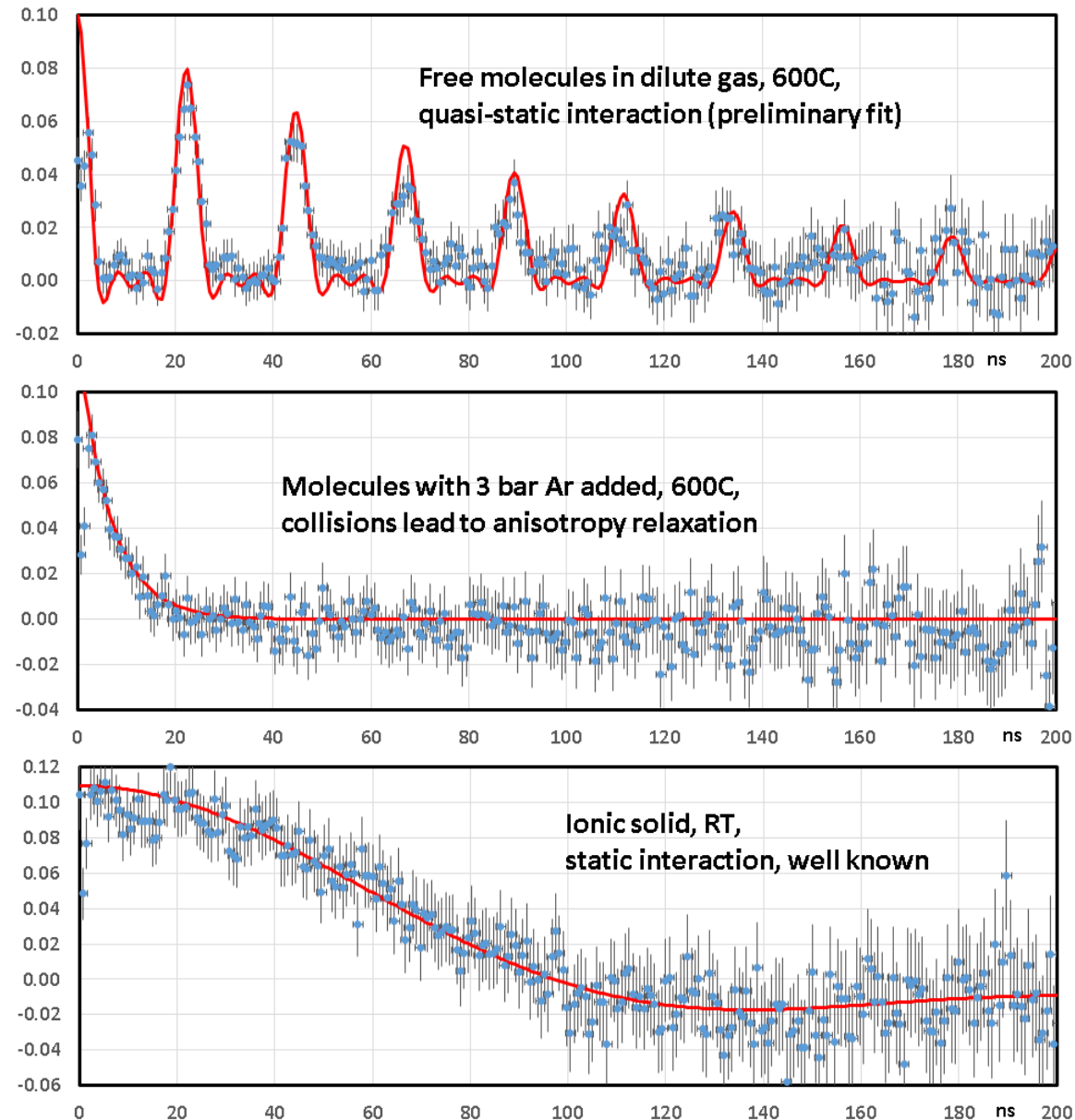
The problem: Measure quadrupole interaction in free molecules to determine Q for ^{111}Cd (and ^{199}Hg)

The concept: Freely rotating linear molecules have the rotation axis J perpendicular to the molecule, thus the EFG along J is (minus) half the molecular one

The task: *Produce highly dilute samples so that collisions do not change the orientation of J during the measuring time, typically 100ns*

The status: Concept has been confirmed for Hg halides last year. Now high precision data for CdI_2 (less precise for CdCl_2 and CdBr_2)

The next step: Quantum chemistry calculations (in progress)



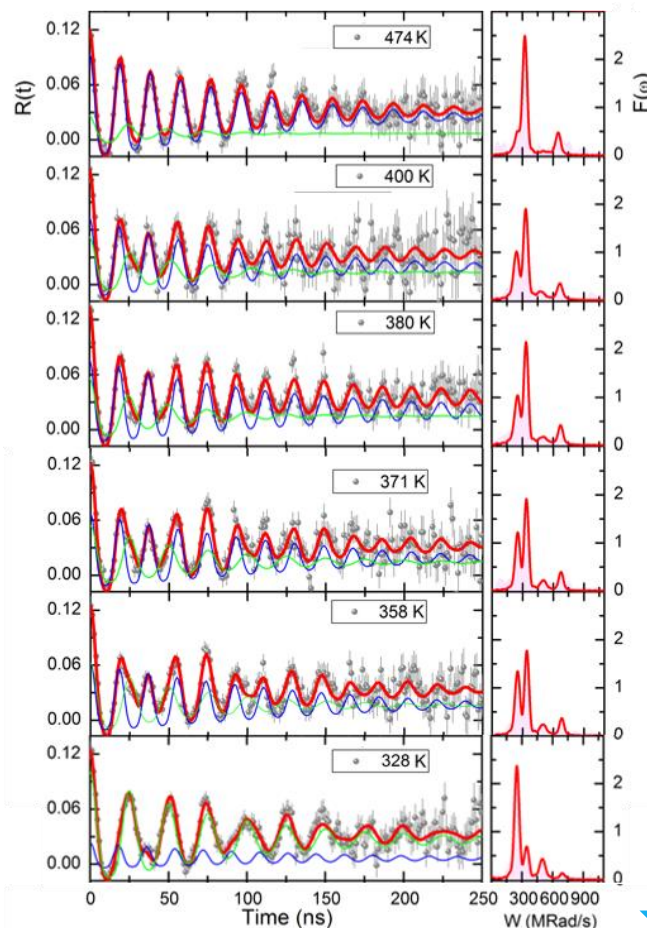
Many thanks to Heinz Haas

IS647 - PAC studies in $\text{Ca}_3\text{Mn}_2\text{O}_7$ naturally layered perovskite

Hybrid Improper Ferroelectric

$^{111}\text{mCd}/\text{Cd}$ PAC at CERN-ISOLDE (May 2018)

Orthorhombic
 $Acaa$ – non polar



Orthorhombic
 $A2_1am$ – polar

NON LOCAL METHODS say:

Is there a negative thermal expansion (NTE) and/or soft mode?

YES

Where? In the High T $Acaa$ non polar or Low T $A2_1am$ polar phase?

$Acaa$ non polar phase

Is phase coexistence indeed needed to see NTE and/or soft mode

YES

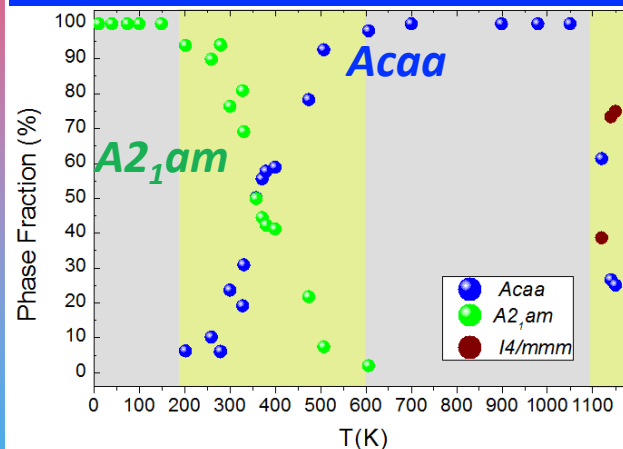
We say: PAC / DFT results

IT IS POSSIBLE

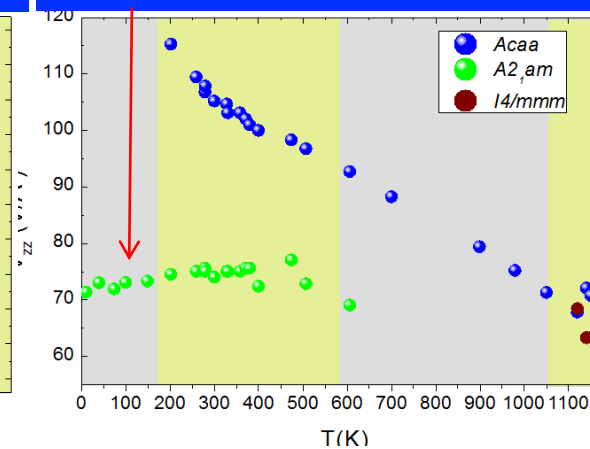
Low T $A2_1am$

SEEMS NOT !!

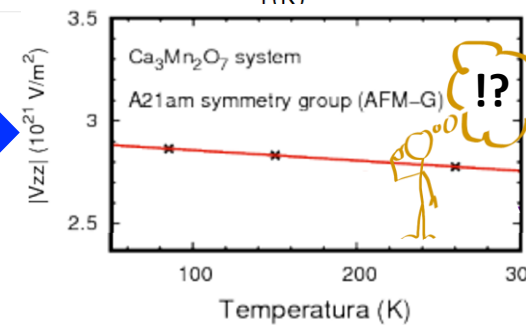
Phase Coexistence & Transitions



$A2_1am$ atypical V_{zz} negative thermal dependency



DFT $A2_1am$ V_{zz} thermal dependency calculations using the high-resolution synchrotron X-ray diffraction data from PRL 114, 035701, 2015



Also good data from new Brazilian collaboration (proposal at last INTC)

Many thanks to Dina Lopes

Draft planning (from October onwards very much a draft....do not get excited/emotional yet...).

August				September				October					November			
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	
6	13	20	27	3	10	17	24	1	8	15	22	29	2	5	12	
#650 MWCNT			11Be for XT03 + EC + colls			tech stop	Pb or Sn	ISS Hg run(enough energy?)				CaO?				
					Mossbauer (57Mn) + EC		Stagiso run		negative run		Ta	9Li?	WISARD?			
	IS616: 4.5MeV/u	(tbc)		UC Ta												
		uc														
	8B															

Mixture of T-REX/ISS and XT03 for HIE ISOLDE: try to maximize range of HiE ISOLDE experiments. Interleaving low energy and negative runs (last year before 2022). Also quite a few setups coming together at end of year...

After protons finish on Nov 12th: 7Be to XT03 (if target available); 44Ti to XT03 (Edinburgh); RaF to CRIS.

August				September				October				November					
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47		
6	13	20	27	3	10	17	24	1	8	15	22	29	2	5	12		
				134Sn for TREX: IS654		28Mg for TREX + ISS	28Mg for TREX + ISS					COLLAPS Sn (II)	94Rb for Miniball and XT03? Else MB C- REX.				
					SiC												
IS562: 4.4MeV/u	LaC								UC n	COLLAPS: Sn (I)	IS595 132Sn + 34S	UC n					
Sn RILIS		Sn RILIS															

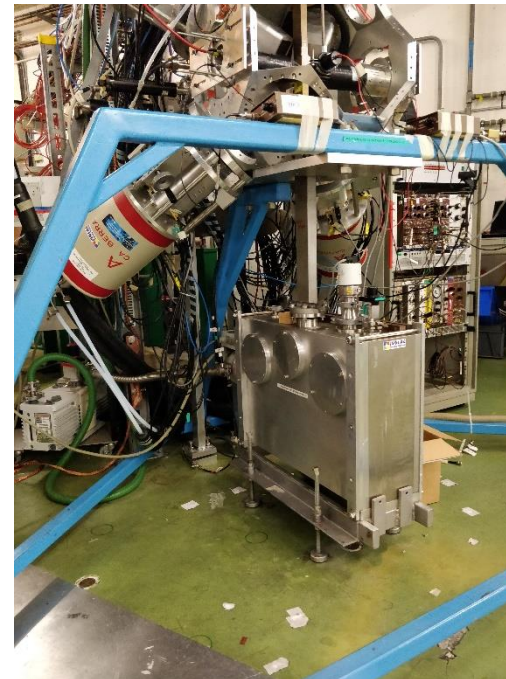
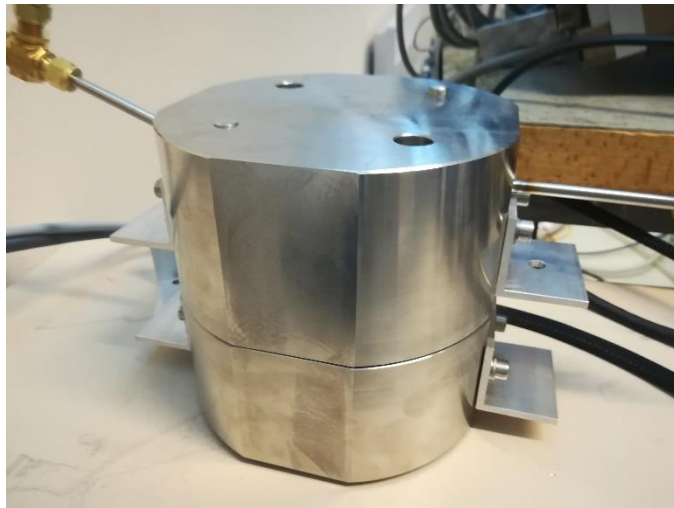
EP technicians

Antonio Goncalves and Francois Garnier: supported by the ISOLDE collaboration.

Available for jobs for users to assist experiment: especially mechanical work.

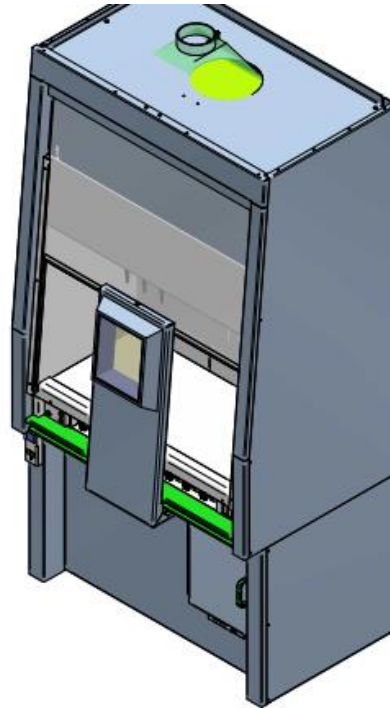
Work carried out for MIRACLIS, IDS, HIE-ISOLDE, VITO, biophysics and others.

Day to day presence in the hall could be increased, otherwise very positive feedback.



Safety: Ergonomics around GLM/GHM area

New working group to optimise the space. New shielded fume cupboard ordered (paid by EP)



Training etc

Hands on courses: electrical awareness and RP

Online courses: safety at CERN, RP supervised area

Expiration date for hands on courses: appears to be a mistake, but still needs to be reset....

Backup solution being sought in case of problems with the trainer (coming from Belgium: strikes etc).

Refreshing courses: new approach during LS2, currently being finalized. More frequent.