• ISCC 92 November 2021 Coordinator’s report

- Schedule 2021
- Draft planning 2022
- Access to cern
- Around the hall
- Training

2021 Beam requests and schedule

- ~676 shifts requested
- Low energy Physics 21 June
- HIE ISOLDE: stable July 7; physics in W30
- Lack of ventilation in Class A labs, UC units were “predicted in 2020”
- Combine with some used targets from 2018
- Caused some issues with mass markers/outgassing
- Travel has still been very difficult for many countries (see access section later)
- Inevitable bias to local groups (or those able to run remotely)

Row Labels	Count of Experiment	Sum of Requested shifts
Actar	2	12
COLLAPS	2	40
Corset/XT03	1	12
CRIS	5	72
IDS	7	44
IDS	5	50,5
IDS fast timing	6	25,001
IDS Vandle	1	15
IDS/TISD	1	2
ISOLTRAP	3	36
ISS	7	117
LA1 Bordeaux	1	12
Magnetic moments	2	8
MIRACLS	1	7
SSP	20	53
TAS	3	19
Thorium clock	2	11
TISD/ISOLTRAP	4	60
VITO	4	17
VITO	1	0
Wisard	1	24
Edinbugh setup	1	21
Gandalph	1	6
TISD	1	6
GLM	2	6
Grand Total	**84**	**675,501**

ISOLDE Schedule 2021: weeks 25 - 46

GPS schedule 2021

June		July				August					September				October				November		
25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
21	#730 Ti 28	5	12	19	26	#711 UC 2	9	16	23	30	#711 UC Ta 6	13	20	27	4	11	#732 LaC 18	25	1	8	15
IS668/Colls		EC-SLI			(TBC) Colls			#567 Sn-VD5	#709 UC			#734 UC VD7				#534 Sn VD5			IS675	IS668	
		IS668	colls/TISD			COLLAPS			LA1	(TBC) Collections	jeune G	Technical Stop	IS689 212Rn @ 7.4MeV/u				IS673 (TISD)		#627 Ta	(nights)	
	LA1	#xxx UC					COLLAPS	IS647			LA1			XXX LIST	TISD (LIST)	IS647	#739 ZrO Ta				Winter Physics period
	IS527			TISD		Stable + physics (if ready)	IS529	IS652 IS679	IS665		EC-SLI IS658					IS652 IS679		IS675		(TBC) IS627	
Surface	37K	RILIS: Mg	Surface			RILIS: Ca	RILIS: Ca	111Cd	RILIS : Au	RILIS : Au	RILIS : Ac		212Rn		RILIS: TBC	111Cd	RILIS: Sb/Sn(?)	RILIS: Zn	RILIS: Zn	RILIS: Dy/Sc(?)	

ROC run not successful

Disappointing LIST run

In general, protons have been pretty reliable….

HRS schedule 2021

June		July				August					September				October				November		
25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
21	28	5	12	IS622 19	#717 UC 26	2	9	16	23	30	6	#733 YO Ta 13	20	27	4	11	#740 UC Ta 18	25	1	8	15
			#653 UC n							#730 Ti	IS666	Technical Stop							TBC UC/Ti		
CRIS		IS666 (sharing with GPS)		IS666 (nights)	IS680 30Mg @ >7.5MeV/u		#732 LaC	ISOLTRAP		(if ready) VITO stable or RIB	jeune G Possible sharing with GPS	ISOLTRAP	#735 UC n	COLLAPS	#738 CaO VD7	IS678 (Wisard)	CRIS		IS666	XT03 ACTAR >7.5MeV/u	Winter Physics period
IS660			IS622					IS661				IS625		IS667			IS663			IS581	
RILIS: Ag		26Na	RILIS: Cu	26Na	RILIS: Mg	RILIS: Mg		RILIS: In		26Na /37K	26Na /37K	RILIS: Zn		RILIS: Te		32Ar	RaF		26Na/37K	209Fr/227Fr	

Beamgates not operating to ISOLTRAP requirements

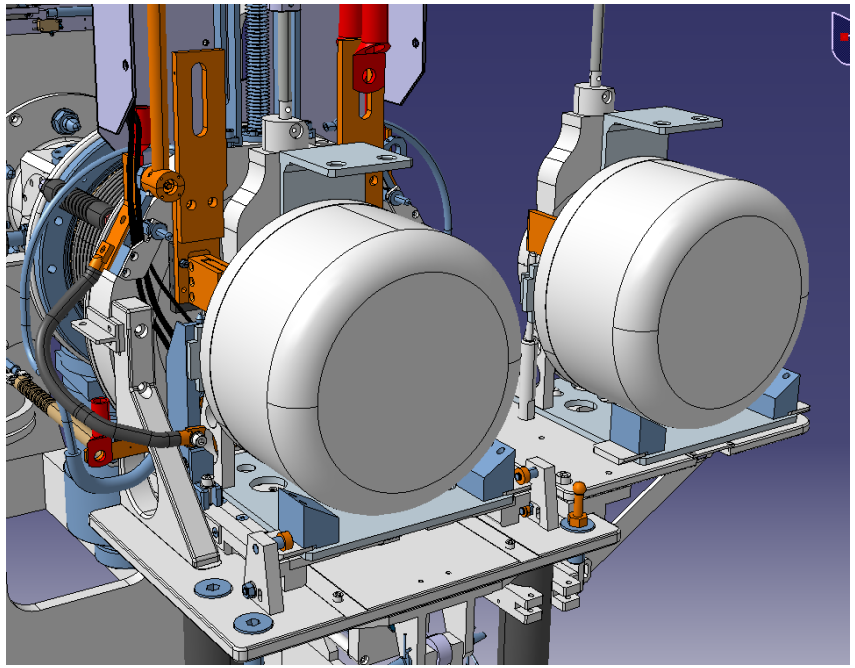
IS701: Pb

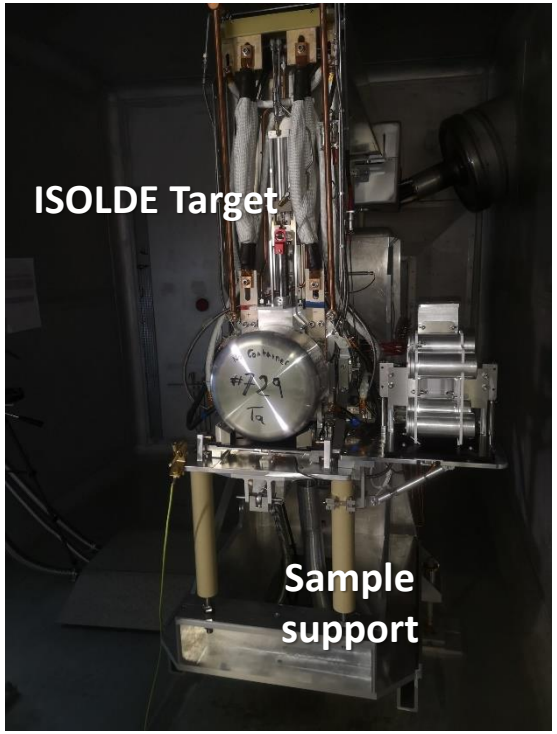
Start of protons for physics: 21 June
End of protons for physics 15 November

Target change	CERN holiday	Setting up/proton scan/yield	Physics HPS	Physics GRS	RILIS run

KJ: 25.08.21

New GPS irradiation station: now ready for testing





ISOLDE Week 45 2021			RILIS	GPS	HRS	CA0	MEDICIS	GPS IS	p's	Visits	other
Monday	08/11/2021	AM	RILIS: Dy (GPS) RILIS: Ac (HRS)		#711 UC	HRS	0900 #723M to MEDICIS	#635 UC (TBC)			
		PM		Installation of target on irradation station	stable setup	HRS					
		night		IS688	Stable to LA1 if possible	HRS			NORMGPS		
Tuesday	09/11/2021	AM			IS658	HRS			NORMHRS		INTC Open Session
		PM			IS658	HRS			NORMHRS		
		night		IS688		HRS			NORMGPS		
Wednesday	10/11/2021	AM				HRS			NORMHRS		INTC closed session. NO protons during day…
		PM			Transmission to XT03	HRS					
		night		IS688	IS581 tests (if ready)	HRS			NORMHRS		
Thursday	11/11/2021	AM			IS581	HRS	(TBC) #734 UC VD7 indirect irradiation		NORMHRS	1100 STFC visit to ISOLDE	
		PM			IS581	HRS			NORMHRS		
		night		IS688	IS581	HRS			shared		
Friday	12/11/2021	AM			IS581	HRS		#635 removed?	NORMHRS		
		PM			IS581	HRS			NORMHRS		
		night			IS581	HRS			NORMHRS		
Saturday	13/11/2021	AM	RILIS: Sc	IS627 (GLM) (without p+)	IS581	HRS			NORMHRS		
		PM		IS627 (GLM) (without p+)	IS581	HRS			NORMHRS		
		night			IS581	HRS			NORMHRS		
Sunday	14/11/2021	AM		IS627 (GLM) (without p+)	IS581	HRS			NORMHRS		
		PM		IS627 (GLM) (without p+)	IS581	HRS			NORMHRS		
		night			IS581	HRS			NORMHRS		
Monday	15/11/2021	AM			IS581		(TBC) #734 UC VD7 to GPS		NORMHRS		
		PM		Protons off at 0600. End of online period 2021. Preparations begin for ISOLDE winter physics.							
		night									

Summary of week: Quite a busy week before protons end for 2021. GPS will continue with Tb collections overnight until Thursday morning. (sharing with HRS users as required). HRS setup for Fr and Ac beams from Monday onwards. Ac to LA2 for IS658 if possible on Tuesday to confirm some transitions related to earlier run in September. ACTAR will take Fr beams for last 4 days of protons to XT03. 209Fr and 227Fr @ >7.5MeV/u. FIrst week using the new GPS irradiation station.

GPS: Used target #627 Ta for Dy/Tb collections. Setup to GLM. HV = 30kV. Collections of 149Tb overnight for shipping early each morning. Sc extraction without protons on final weekend.

HRS: #711 UC for AC and Fr beams. Setup at 30kV in bunched mode. Some shots of Ac to LA1 on Tuesday, else priority to ACTAR run on XT03. Stable setup with 238U.

Protons: NO protons expected during day on Monday 8 November. Rest of the week NORMGPS and NORMHRS will be in demand up to 2uA until end of proton run on 15 November. NO protons during Wednesday daytime for intervention on Linac4.

Operations responsible: Alberto (167538) till Tuesday 9th November. Erwin (164585) till Tuesday 16th November.

For more details about visits: https://publicoutreach.cern.ch/outreach/panel#agenda/today

ISOLDE Daily meeting: 09:15 Monday; 08:45 Tue-Fri via Zoom: https://cern.zoom.us/j/98894210347?pwd=WUtSMlFKbkVicWVkKytNOG5nMFNFdz09

Final weekly schedule of the online period

- Quite busy as expected
- Inauguration of the new GPS irradiation station: another column for the planning!
- Use of MEDICIS for winter physics irradiation

- Growing need to have more straightforward visibility of protons taken on target depending on which station is receiving protons.

- Target exchanges/movements becoming more common. Quite some problems this year which will hopefully be ironed out after the YETS.

ISOLDE 2021 schedule: end of year including winter physics

GPS

November				December	
44	45	46	47	48	49
1	8	15	TBC 22	TBC 29	6
IS675	IS688	#734 UC VD7		TBC 7Be for IS586	
#627 Ta	(nights)			TBC	
			TBC LIST TISD		
	(TBC) IS627	IS691		TBC Ag for IS672	
RILIS: Zn	RILIS: Dy/Sc(?)	Xe isotopes	TISD	RILIS: Be/Ag	

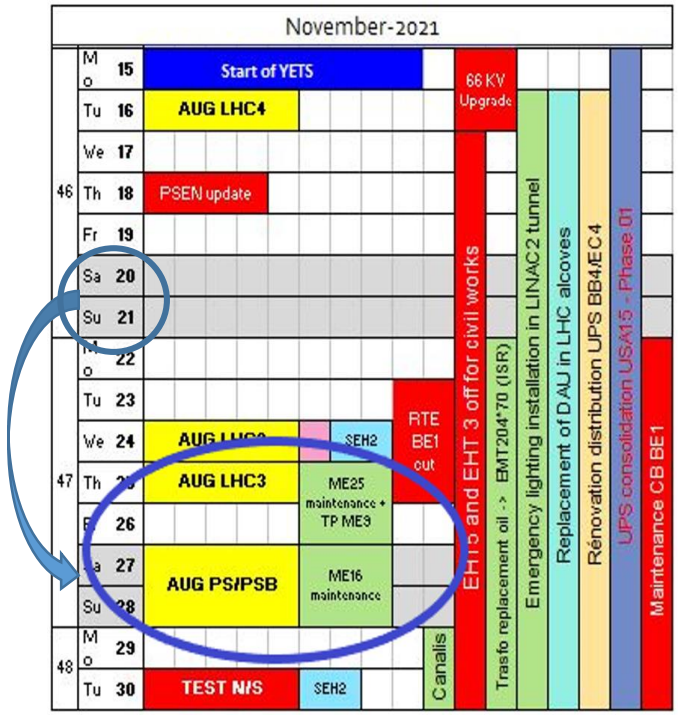
HRS

November				December	
44	45	46	47	48	49
1	8	15	22	29	6
TBC UC/Ti	IS658				
		#740 UC W		IS663	
				(TBC)	
IS666	IS581	IS663	IS663	MIRACLS Test	
26Na/37K	209Fr/227Fr	RaF isotopes			
	RILIS: Ac				

Protons finish on 15 November @ 0600 in W46.
IS691 and IS663 are scheduled for winter physics.
Remaining runs on GPS need to be confirmed. Dependent on irradiation possibilities and target availability
Note that interruptions due to electrical tests are expected during winter physics period.

Target change | CERN holiday | Setting up/proton scan/yield | Physics HPS | Physics GRS | RILIS run

KJ: 12.10.21



Note that AUG and network switching will affect the winter runs, esp the long CRIS RaF

Row Labels	Sum of Scheduled 2021	Sum of Delivered 2021
biophysics		
COLLAPS	37	17
Collections: 108Ag		
Collections: 163Ho	2	
CRIS	70,5	25
Gandalph		
Gandalph/CRIS		
HIE ISOLDE	56	50
IDS	21	14
IDS/ISOLTRAP		
IDS/VANDLE		
in-source / IDS		
ISOLTRAP	27	7
Medical physics	13,5	1
MIRACLS		
Nuclear masses		
SSP	31,5	32,5
TAS		
TISD		
TISD/IDS		
Travelling Setup	14	14
Travelling Setup;		
ECSLI	11	11
VITO	22	12
Windmill/IDS		
WISARD	14	10
Grand Total	319,5	193,5

Preliminary overview of running period 2021

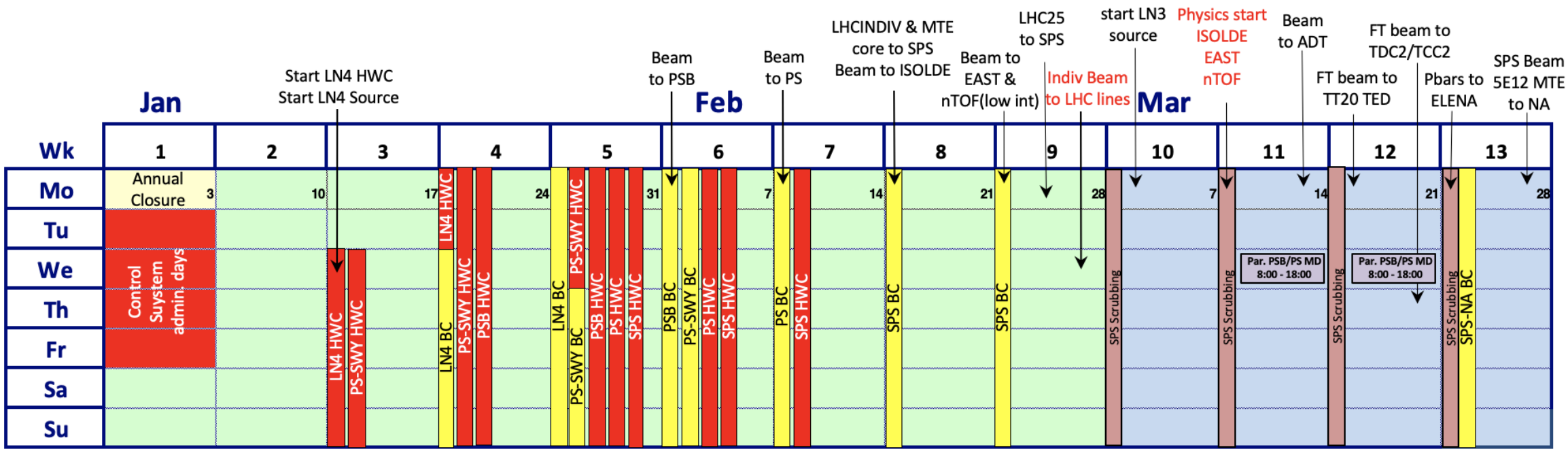
So far around 200 radioactive shifts have been delivered

23 experiments ran/scheduled in 2021

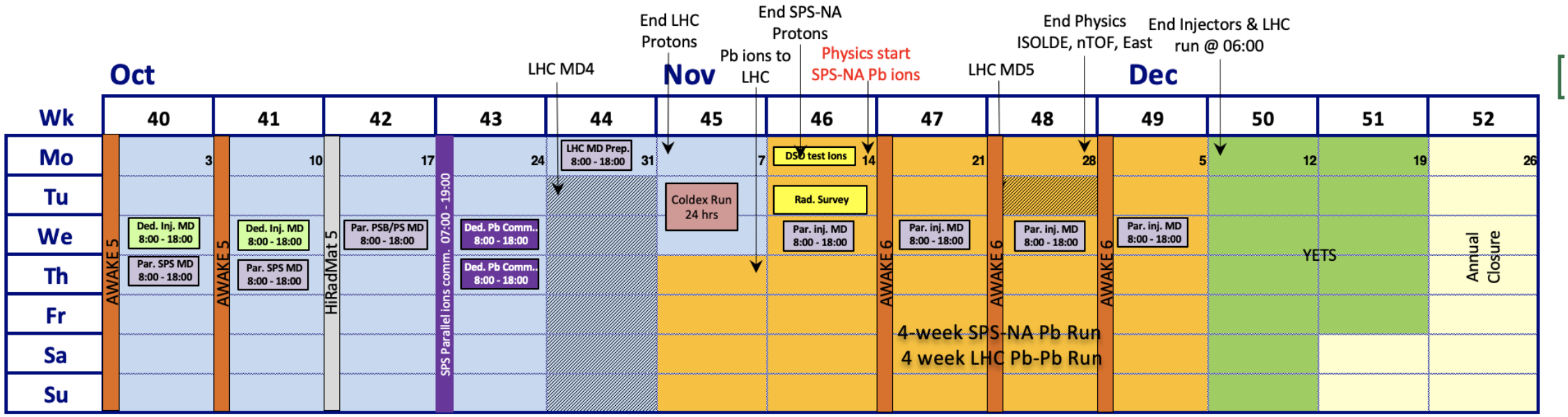
Fewer than other years, partly because some groups ran several times, also due to covid situation favouring the locals.

Draft schedule for 2022

- Wk1: Control system administration days – *starts on last day of annual closure*
- Wk3: Start of Linac 4 source and injectors complex re-commissioning
- Wk9: LHCProbe/Pilot/INDIV ready for LHC
- Wk10 – 13: SPS scrubbing
- **Wk11: Physics start ISOLDE, nTOF and East Area – *preceded by 2 weeks setting-up***
- Wk11 and Wk 12: Parallel MD for PSB and PS on Wednesday
- Wk13: Start 2-week beam commissioning SPS-NA – *interleaved with scrubbing during nights*

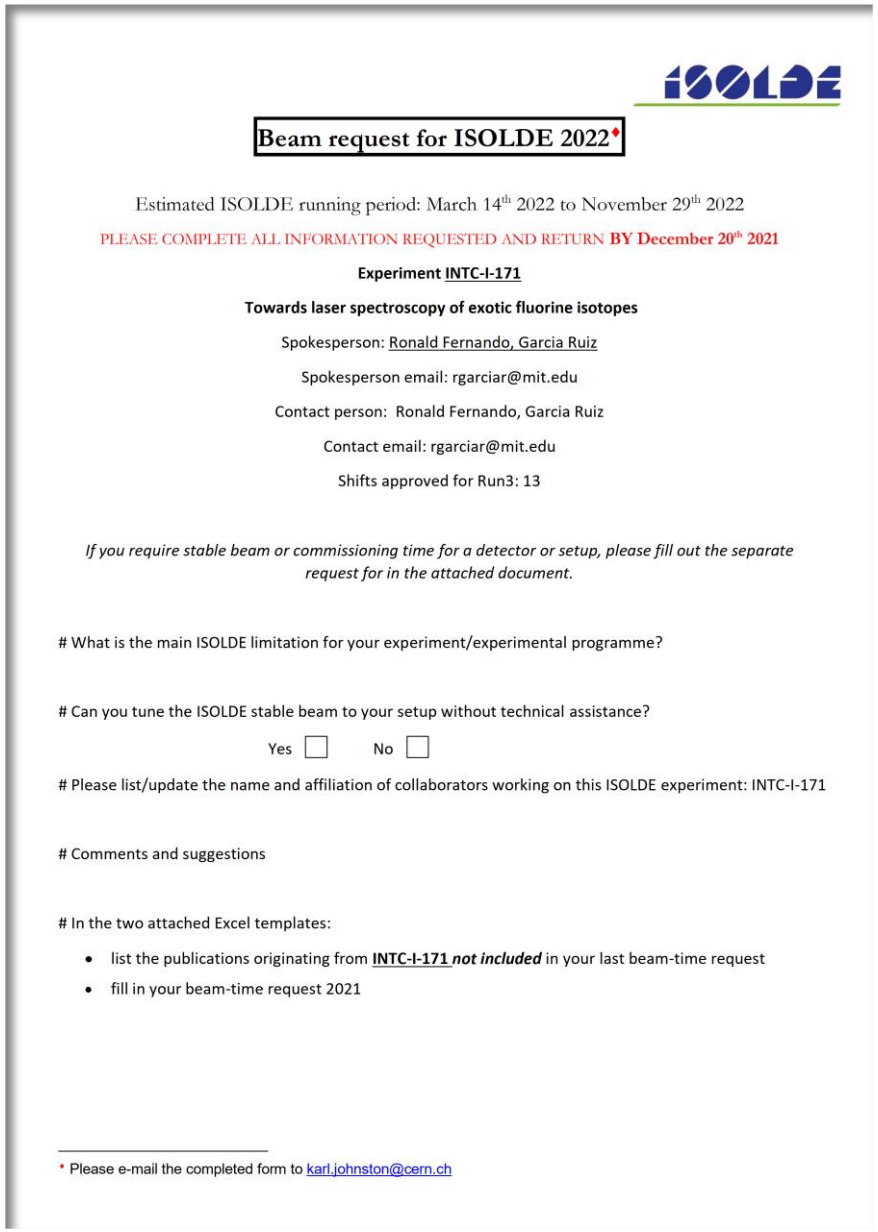


Draft schedule 2022: end of year



- Wk46: End SPS-NA protons and start SPS-NA Pb ions physics – *4 weeks Pb ions run*
- Wk47+48+49: AWAKE run 6
- **Wk48: End protons physics for ISOLDE, nTOF and PS-EA – *cool-down in view of YETS***
- Wk48: LHC MD block 5 (ions)
- Wk50: Mon.12 December @ 06:00 stop off all beams
- 2 dedicated MD blocks, 7 parallel MD blocks and 1 LHC MD preparation block

Extremely long year: 259 days for physics
However, note that HIE ISOLDE only starting around 20th July at current estimations : only ~132 days available…
Dates still to be confirmed at research board in December



ISOLDE

Beam request for ISOLDE 2022♦

Estimated ISOLDE running period: March 14th 2022 to November 29th 2022

PLEASE COMPLETE ALL INFORMATION REQUESTED AND RETURN **BY December 20th 2021**

Experiment INTC-I-171

Towards laser spectroscopy of exotic fluorine isotopes

Spokesperson: Ronald Fernando, Garcia Ruiz

Spokesperson email: rgarciar@mit.edu

Contact person: Ronald Fernando, Garcia Ruiz

Contact email: rgarciar@mit.edu

Shifts approved for Run3: 13

If you require stable beam or commissioning time for a detector or setup, please fill out the separate request for in the attached document.

What is the main ISOLDE limitation for your experiment/experimental programme?

Can you tune the ISOLDE stable beam to your setup without technical assistance?

Yes ☐ No ☐

Please list/update the name and affiliation of collaborators working on this ISOLDE experiment: INTC-I-171

Comments and suggestions

In the two attached Excel templates:

- list the publications originating from **INTC-I-171** ***not included*** in your last beam-time request
- fill in your beam-time request 2021

♦ Please e-mail the completed form to karl.johnston@cern.ch

Beam requests for 2022

- Ready to be sent out, this weekend
- To be returned before Christmas, 17th Dec
- Earlier than usual, but need to prepare targets for 2022.
- Also useful to know plans of some collaborations in particular Miniball.
- Spokespersons will be contacted later in 2022 to see if availabilties are still valid.

Row Labels	Sum of Shifts remaining for Run3	Sum of Shifts remaining after 2021 till end of Run3
biophysics	**9,5**	**9,5**
N/A	9,5	9,5
COLLAPS	**56**	**39**
N/A	56	39
Collections: 108Ag	**30**	**30**
N/A	30	30
Collections: 163Ho	**6**	**6**
N/A	6	6
CRIS	**115,5**	**90,5**
N/A	115,5	90,5
Gandalph	**8**	**8**
N/A	8	8
Gandalph/CRIS	**6**	**6**
N/A	6	6
HIE ISOLDE	**550**	**500**
ISS	147	97
Miniball	275	275
Prototype	0	0
SEC	23	23
XT03	23	23
XT03: Actar	28	28
XT03: Corset	12	12
XT03: Edinburgh	42	42
IDS	**107**	**93**
N/A	107	93
IDS/ISOLTRAP	**6**	**6**
N/A	6	6
IDS/VANDLE	**18**	**18**
N/A	18	18
in-source / IDS	**10**	**10**
N/A	10	10
ISOLTRAP	**42**	**35**
N/A	42	35
Medical physics	**16**	**15**
N/A	16	15
MIRACLS	**17**	**17**
N/A	17	17
Nuclear masses	**8**	**8**
N/A	8	8
SSP	**136**	**103,5**
N/A	136	103,5
TAS	**39**	**39**
N/A	39	39
TISD	**20**	**20**
N/A	20	20
TISD/IDS	**9**	**9**
N/A	9	9
Travelling Setup	**24**	**10**
N/A	24	10
Travelling Setup; ECSLI	**11**	**0**
N/A	11	0
VITO	**29**	**17**
N/A	29	17
Windmill/IDS	**22,5**	**22,5**
N/A	22,5	22,5
WISARD	**24**	**14**
N/A	24	14
Grand Total	**1319,5**	**1126**

Shift backlog before next week's INTC

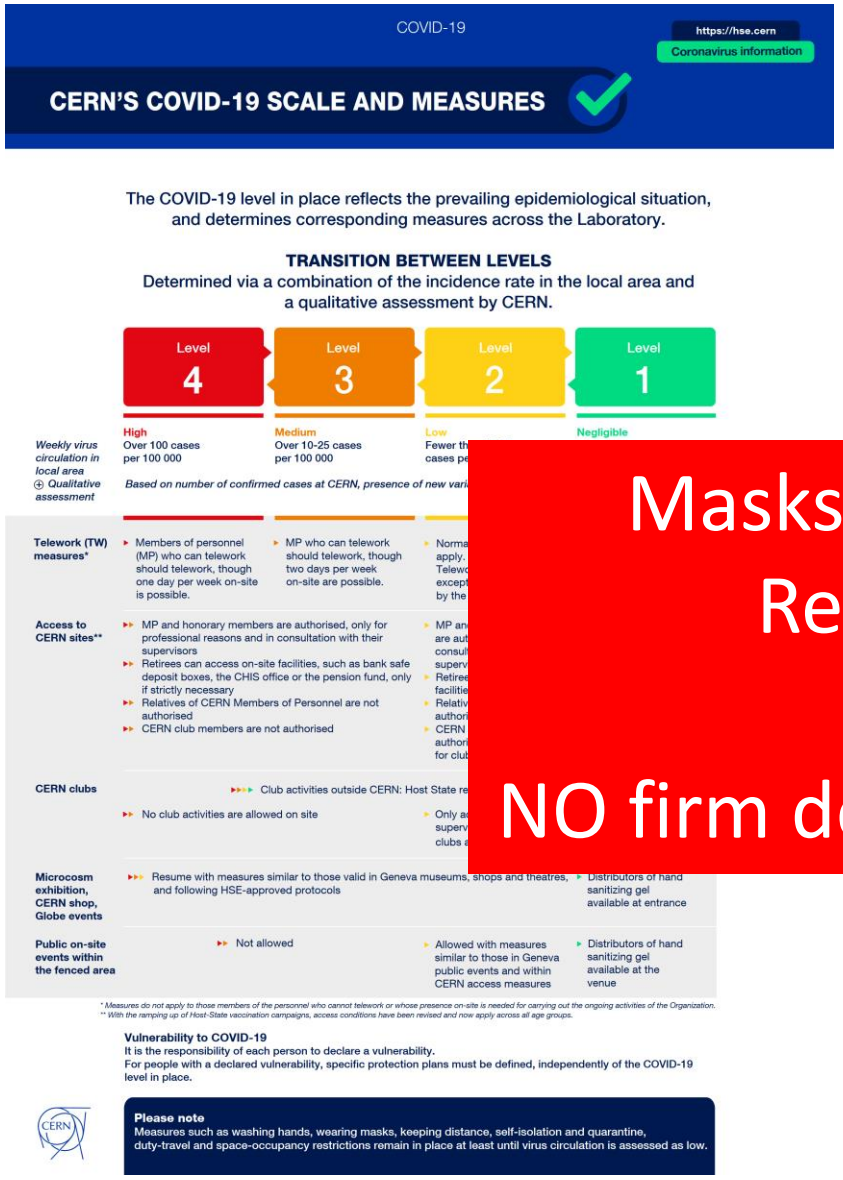
Row Labels	Count of Exp. no.	Sum of Shifts remaining after 2021 till end of Run3	Sum of Shifts remaining for Run3
INTC 63	34	470	485
INTC 64	18	201	285.5
INTC 65	14	182	245
INTC 66	16	139	153
INTC 67	11	134	151
Grand Total	**93**	**1126**	**1319.5**

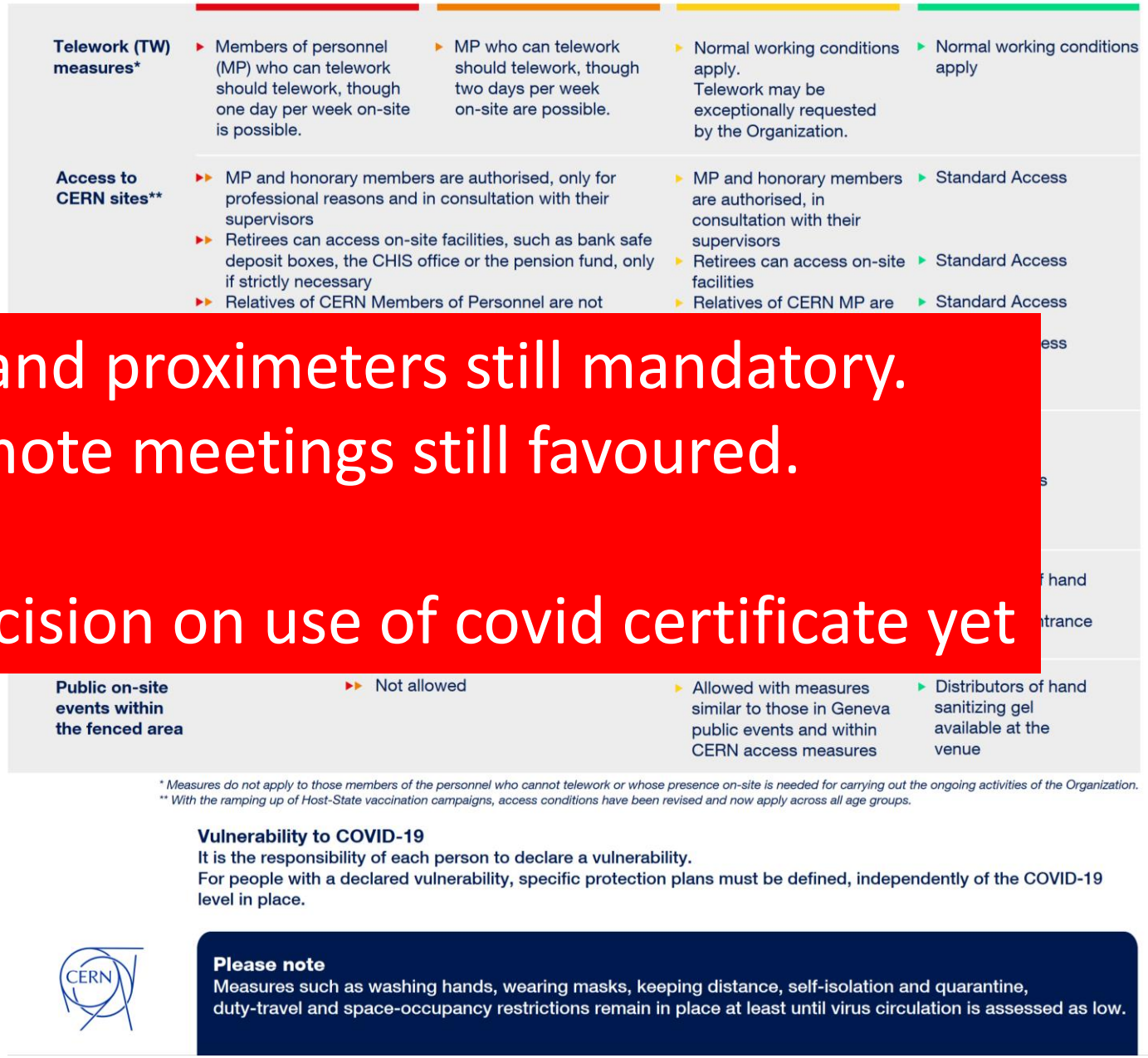
Next week's INTC

Open session 9 November
Closed session 10 November
Agenda here: https://indico.cern.ch/event/1085117/

Row Labels	Count of Title	Sum of Shifts requested
Addendum	**1**	**0**
nTOF	**1**	**0**
Letter of intent	**4**	**11**
ISOLDE	**3**	**11**
TISD	2	6
TISD/HIE	1	5
nTOF	**1**	**0**
Proposal	**6**	**118**
ISOLDE	**6**	**118**
Decay spectroscopy	2	39
Laser spectroscopy	1	29
Total absorption spectroscopy	1	14
HIE ISOLDE/ISS	1	24
IDS	1	12
(blank)		
Grand Total	**11**	**129**

CERN currently in level orange





Masks and proximeters still mandatory.

Remote meetings still favoured.

NO firm decision on use of covid certificate yet

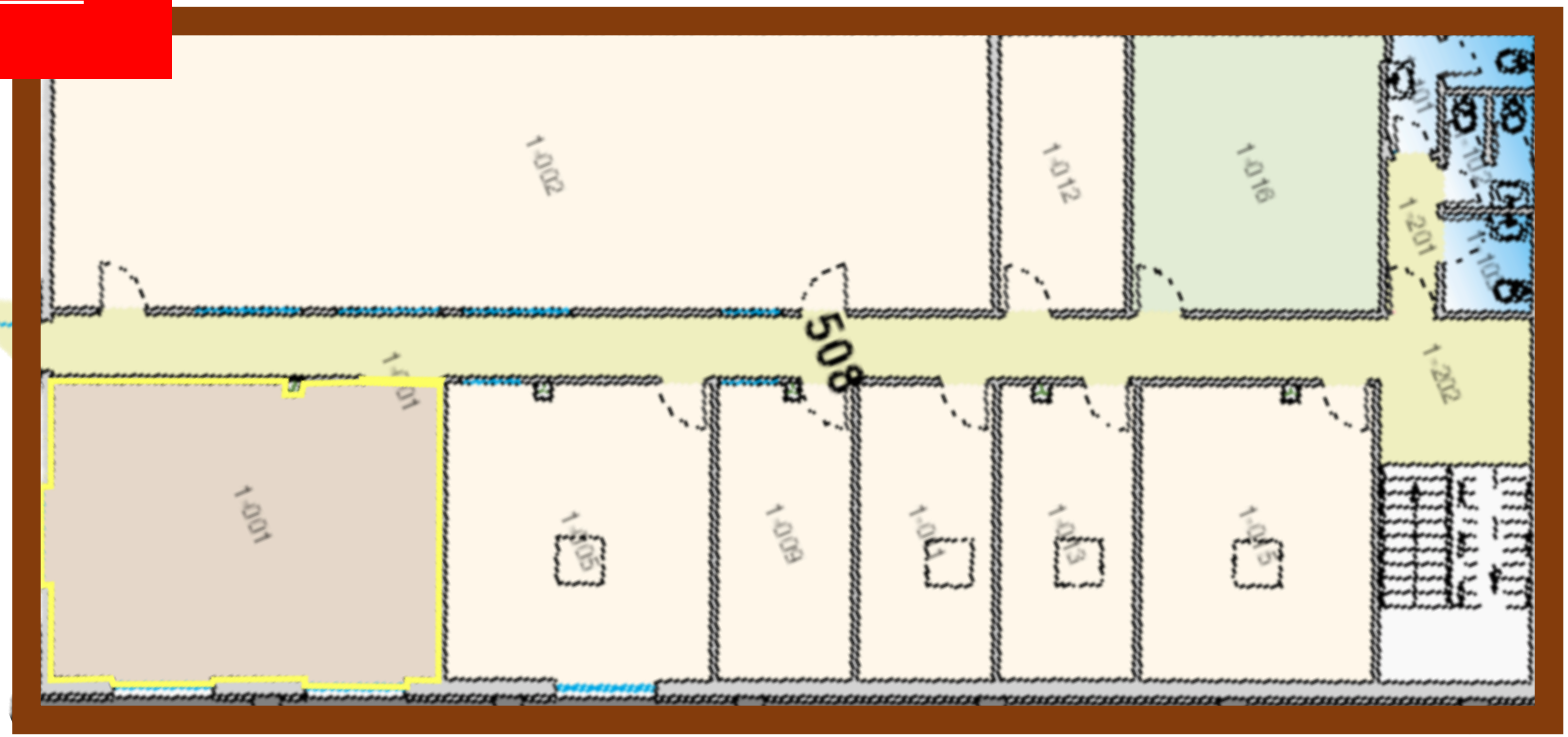
Hse.cern

Restrictions on number of people **remain**

(has become challenging to manage groups in recent weeks….)

- 1-002 → Control room (291 m^3)
- 170 m^3/h
- 6 people

- 1-016 → Kitchen (77 m^3)
- Vent?
- 4 people



- 1-001 → Visitors room (130 m^3)
- 310 m^3/
- 6 people

- 1-015 → RILIS DAQ (76 m^3)
- 196 m^3/h
- 4 people

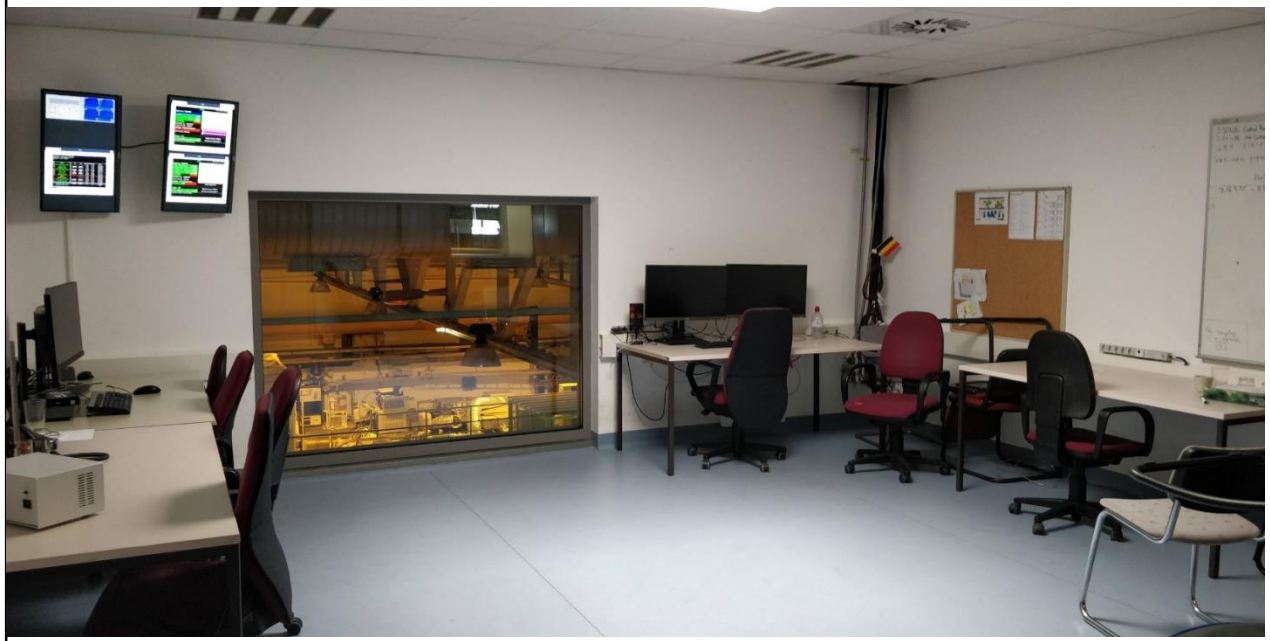
- 1-005 → ISOLDE DAQ (87 m^3)
- 232 m^3/h
- 4 people

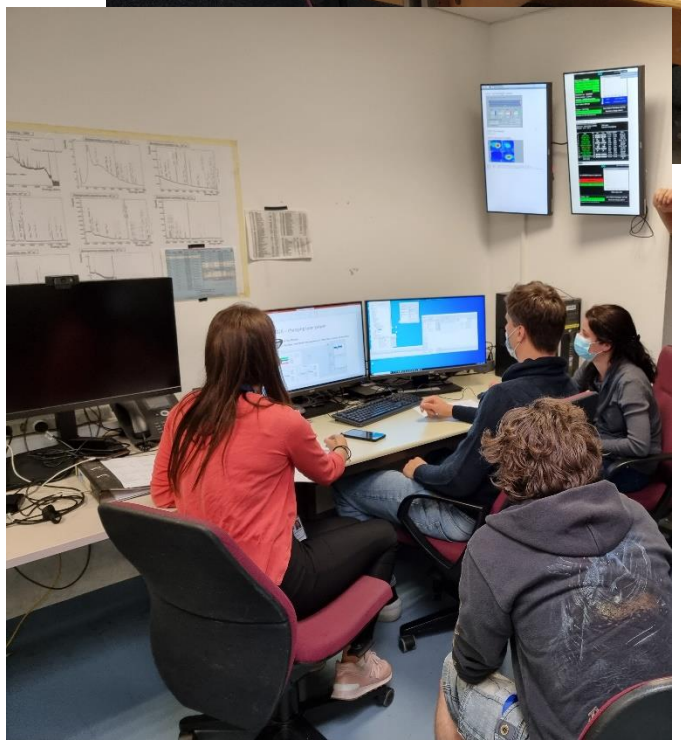
- 1-009 → ISOLTRAP DAQ (44 m^3)
- 176 m^3/h
- 2 people

- 1-011 → xx (44 m^3)
- Vent?
- 4 people

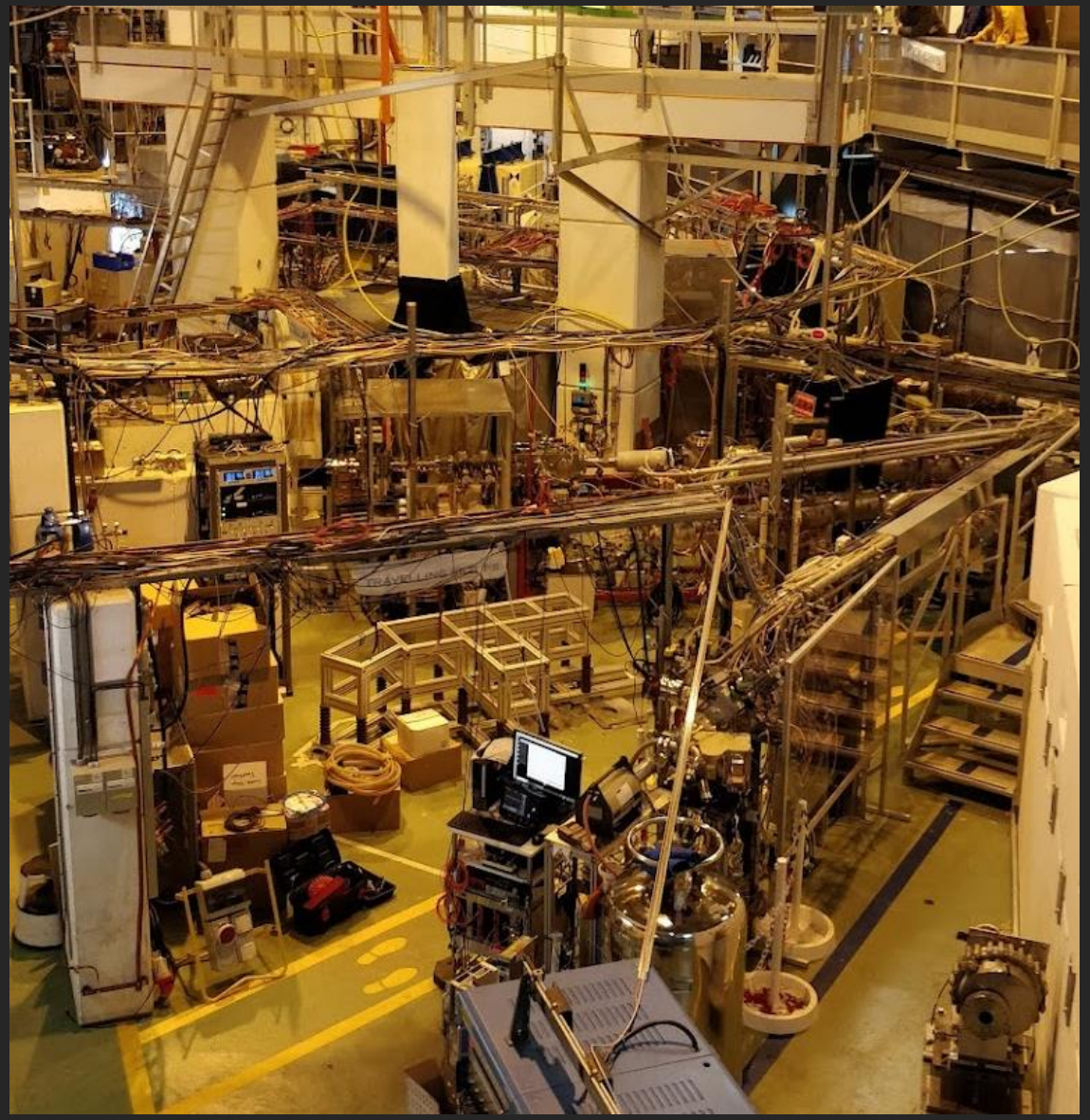
- 1-013 → xx (42 m^3)
- Vent?
- 2 people

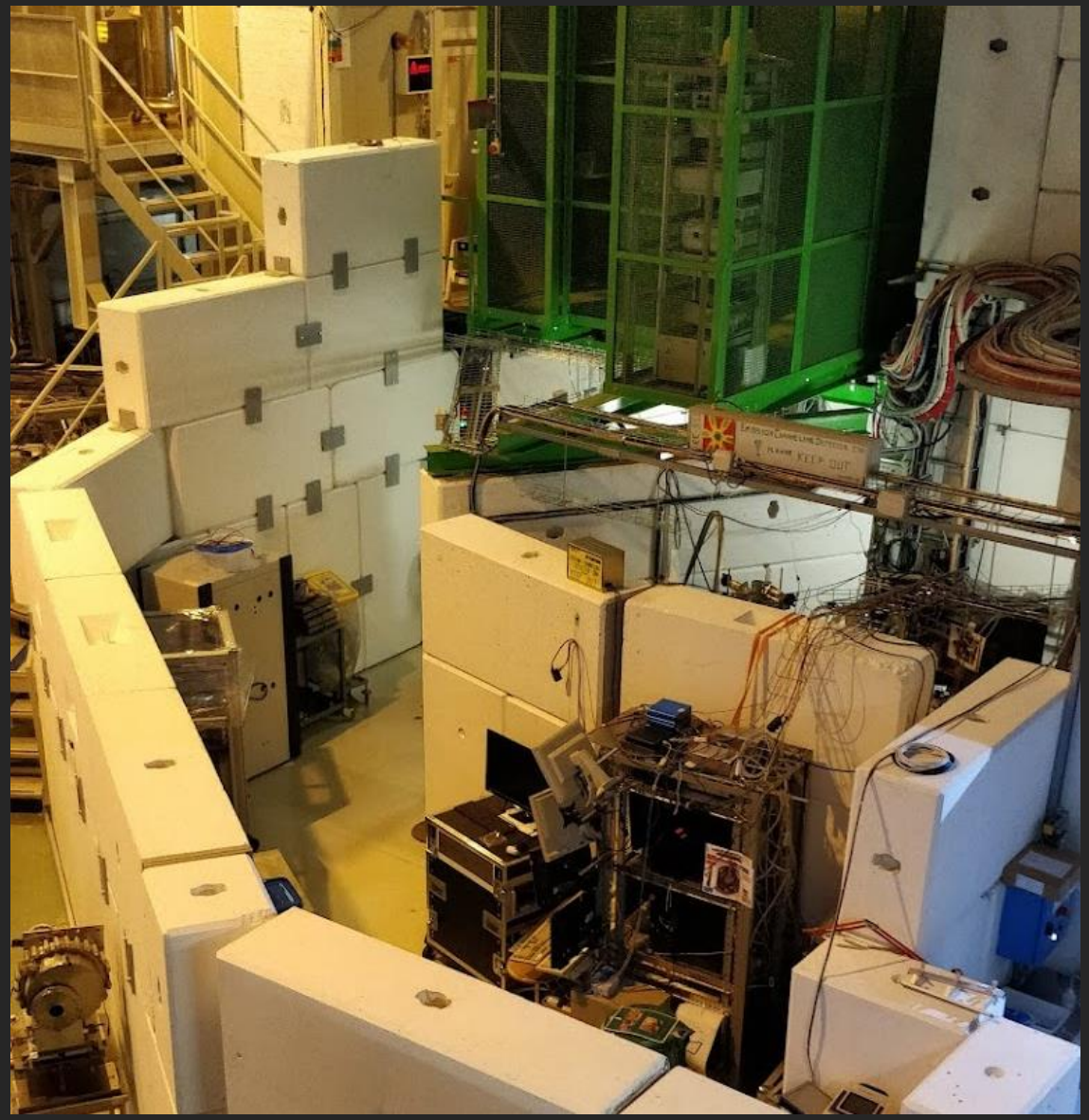
Use old control room, DAQ and visitors space more optimally to allow for more distancing/zoom conferencing

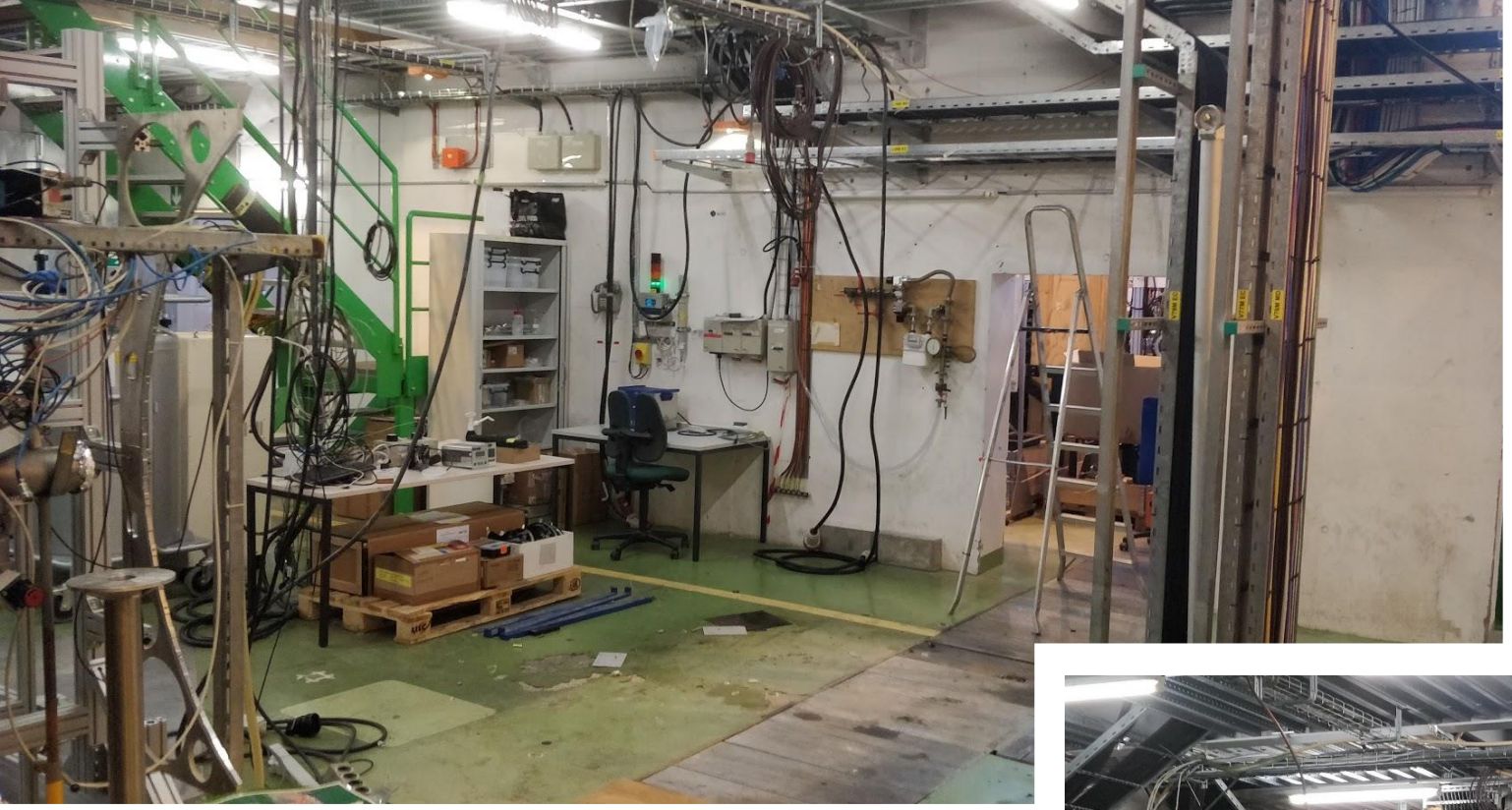




With OP, additional control terminals…OP working on means to allow monitoring e.g. for advanced users at home/office

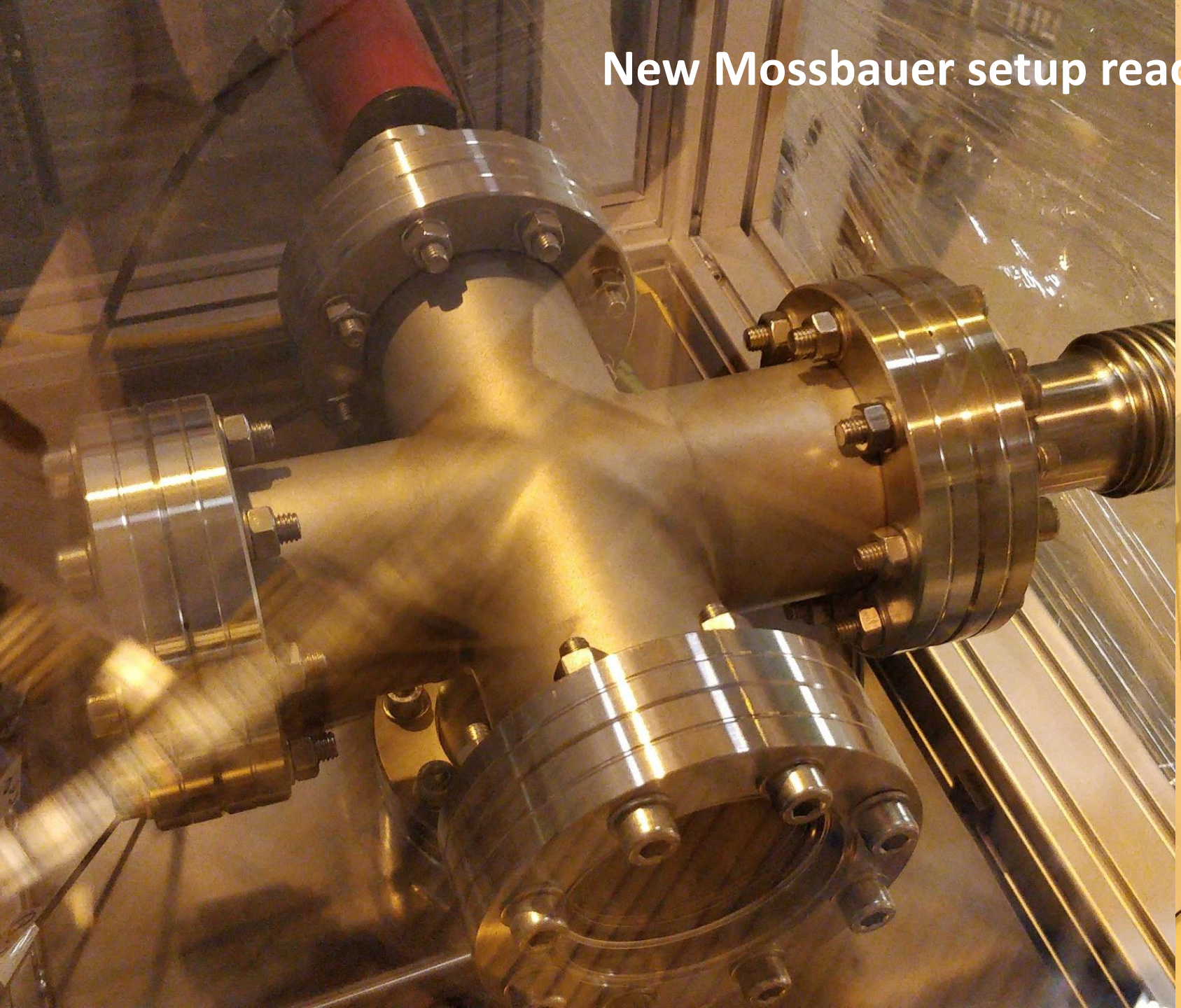




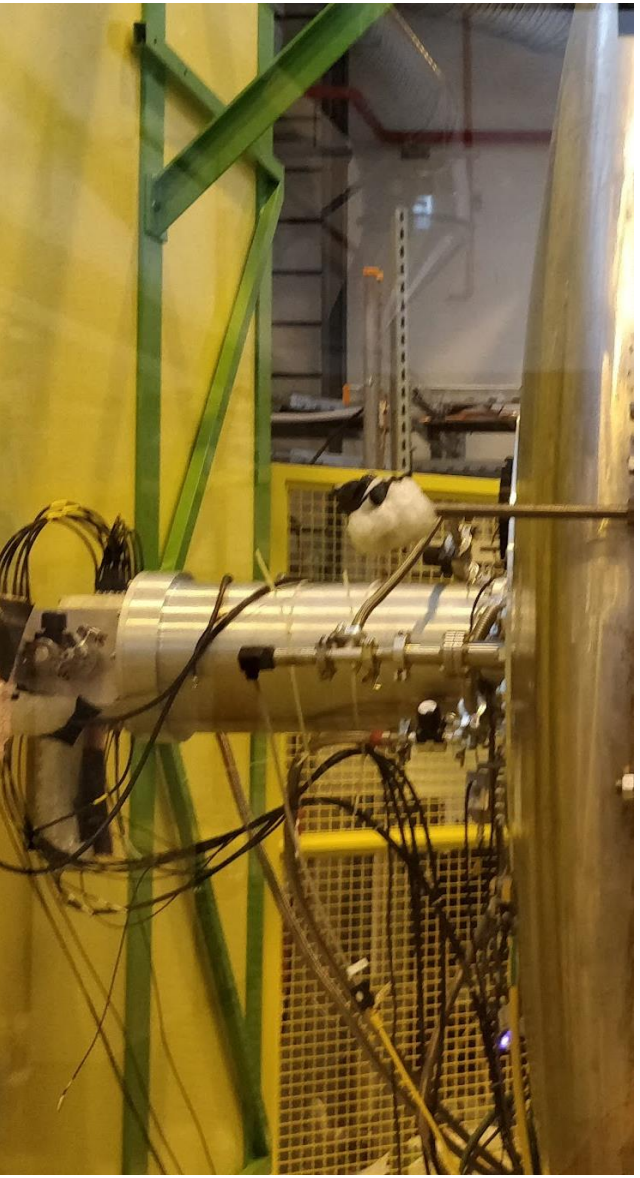


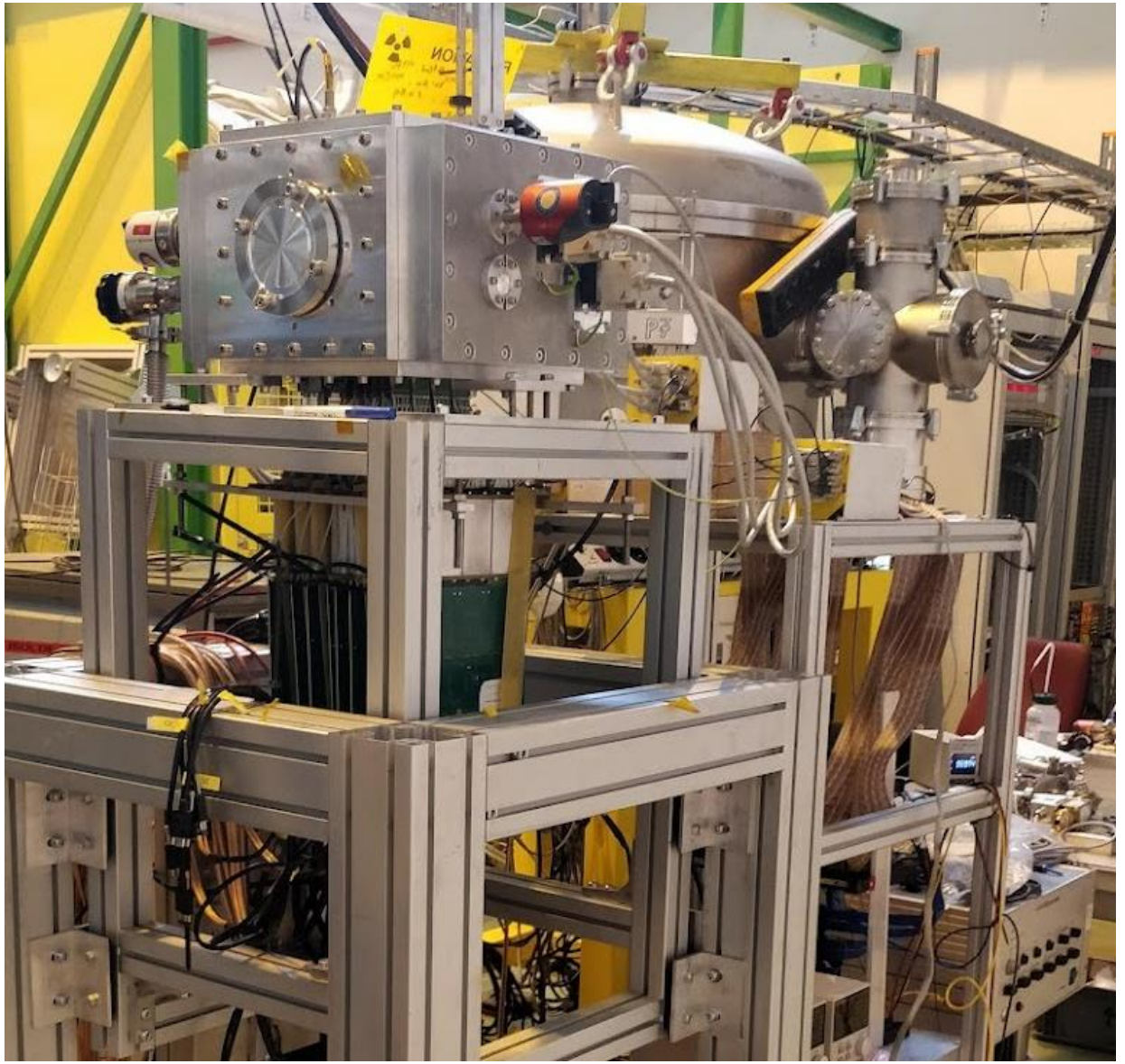
MIRACLS installation in old NICOLE area

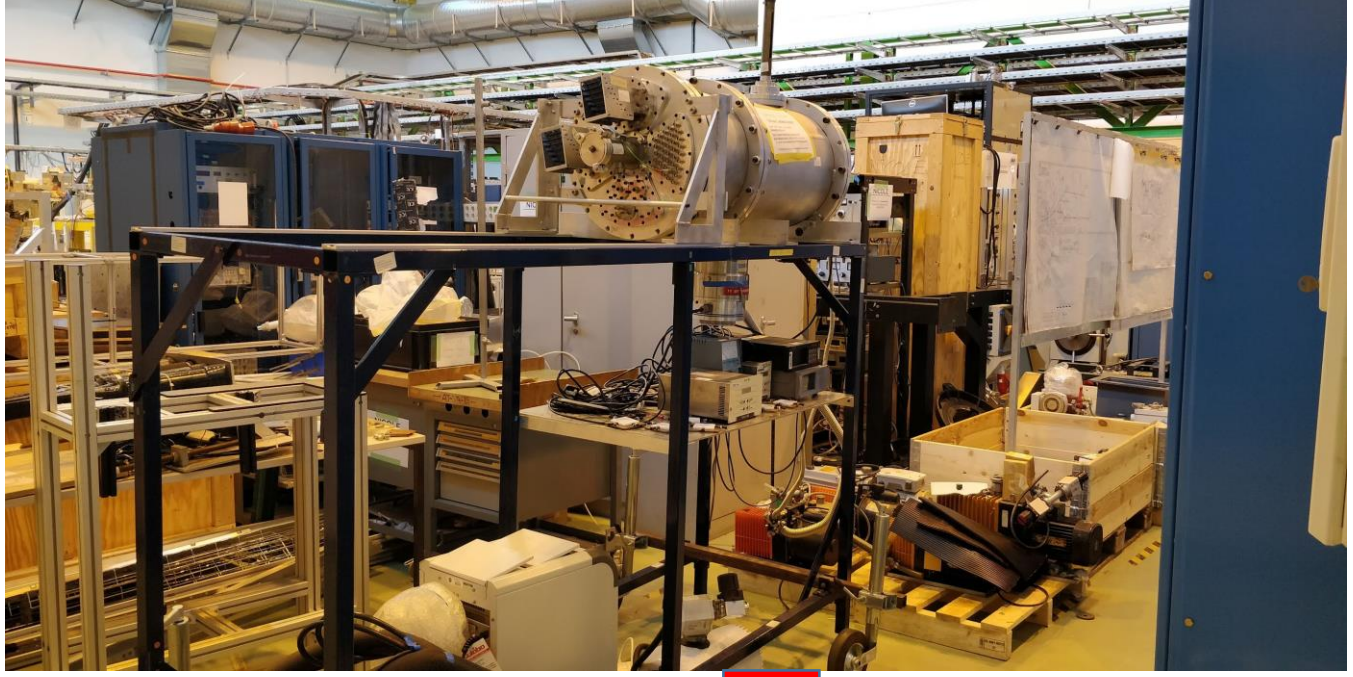
New Mossbauer setup ready for commissioning

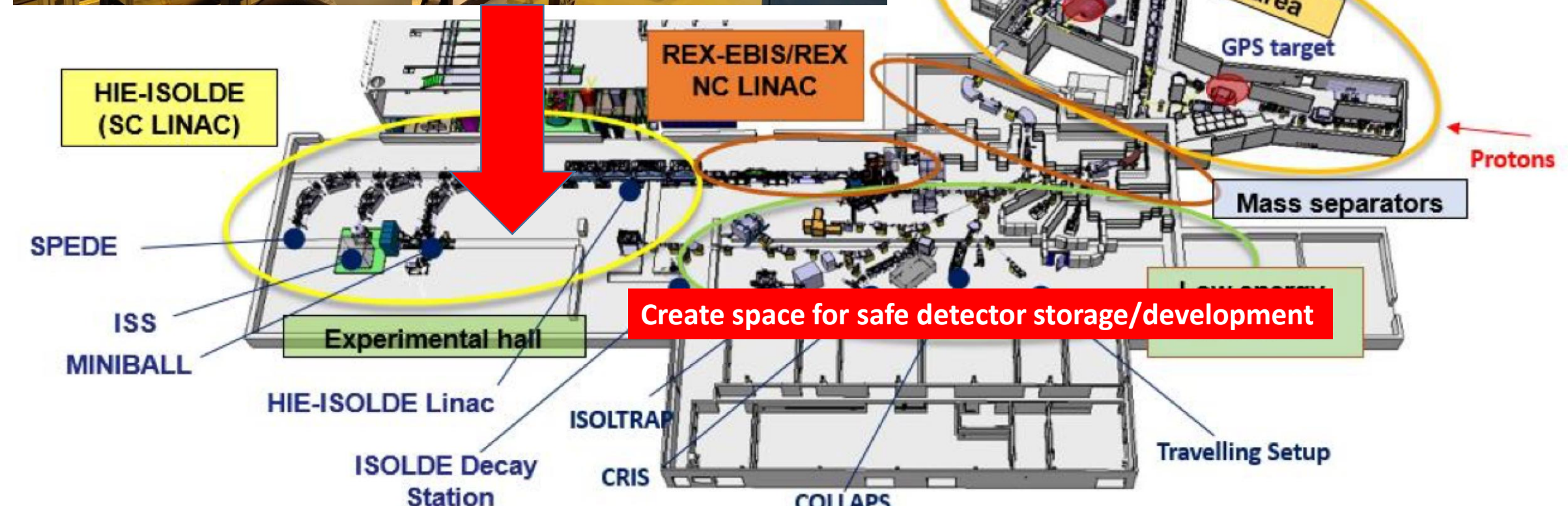


HIE ISOLDE: ionisation chamber and ACTAR








Class A labs
MEDICIS
HRS target
Target area
GPS target
Protons
REX-EBIS/REX
NC LINAC
HIE-ISOLDE
(SC LINAC)
Mass separators
SPEDE
ISS
MINIBALL
Experimental hall
Create space for safe detector storage/development
HIE-ISOLDE Linac
ISOLTRAP
ISOLDE Decay
Station
CRIS
Travelling Setup


THIS WAY UP

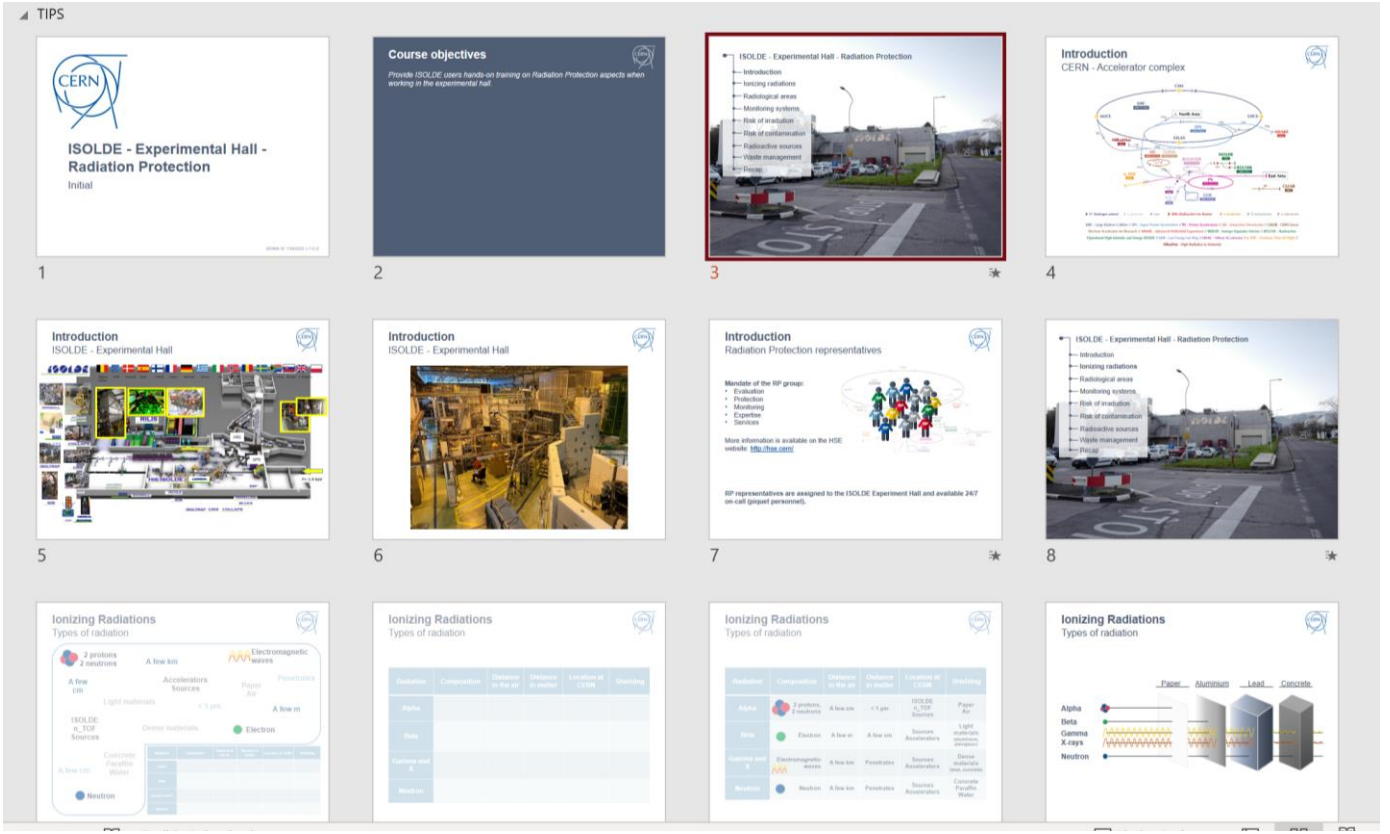
Training

In addition to the (ever-growing) number of online courses…

Hands-on RP and Electrical training

New from next week:

- dedicated weekly sessions of RP hands-on course. Local trainer (!) so scheduling should be easier for this course.
- New EP-wide electrical course for all users/staff who need to work in an experimental area.
- Both will take place on Tuesday but time has increased:
  - EP course 0830 till 1230
  - RP course 1400 till 1630



In LMS:

ISOLDE - Experimental Hall - Radiation Protection - Handling (Covid-19)

Electrical Safety - Working in EP experiments

Scheduling of safety courses has not been as straightforward as expected, limited numbers due to covid/unexpected cancellations and EP electrical course not yet available every week. *Ad hoc* sessions are available but not desired.

EDMS No: 2539300 v.1.0.0

HSE
Occupational Health & Safety
and Environmental Protection Unit

MEMORANDUM

Date : **2 June 2021**

To : Department Heads, Technical Coordinators of Large Experiments
Cc : HSE-TMB, DSOs / LEXGLIMOSes + deputies
From : Safety Training section (HSE-TS-ST)
Via : Angela GOEHRING-CRINON (HSE-TS, Group Leader)
Subject : Safety Training programme "Electrical Safety - Working in EP experiments"

CERN Safety Training, in collaboration with CERN experts in electrical safety and representatives from the EP Department, has designed a new training course for physicists, engineers and technicians who will carry out a limited number of electrical tasks in CERN experimental areas, workshops and laboratories.

The aim of the course, titled "**Electrical Safety - Working in EP experiments**", is to raise awareness of the persons concerned regarding the specific risks that are present in the above-mentioned installations and the associated mitigation measures and procedures.

The course only covers electrical and mechanical tasks listed below. Any task exceeding the scope of those mentioned below require specific electrical training and authorisations according to Safety Code C1[1].

Electrical tasks

- Connection, disconnection and operation of equipment at plug sockets up to 63A.
- Install and operate standardised rack mounted electrical equipment in relation to experimental apparatus at CERN within existing racks and the connection of modules and modular power supplies with standardised connectors.
- Performance of localised lock-out/tag-out for your own work and for equipment under your responsibility, where the point of isolation is a plug and socket outlet.
- Cable installation and termination in an electrical environment, up to 6 mm^2 for signal cabling and power distribution, and up to 16 mm^2 for earthing.
- Repair and removal operations on experimental apparatus, when the equipment is disconnected and unplugged. If the operation requires the removal of any housing or protective screens these must be replaced before the equipment is re-powered.
- Measurements on live equipment, which may only be taken in the course of normal operation as part of a written and verified operational procedure and risk assessment.

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[1] Link

Also causing issues....

HSE
Occupational Health & Safety
and Environmental Protection Unit

EDMS No: 2539300 v.1.0.0

MEMORANDUM

Annex 1
Authorisation to carry out specific activities in CERN experimental areas

This authorisation is prerequisite for Associated Members of the Personnel (MPAs[1]) with status USER to carry out certain electrical and mechanical tasks in experimental areas at CERN. It must be signed by the authorized representative of the home institution[2].

I, the undersigned, herewith certify that the MPA identified hereafter

Cern ID of MPA (if already attributed): _____
Name (as in passport): _____
First name(s): _____
Date of birth (dd/mm/yyyy): _____
Name of home institution: _____
Country: _____

is employed by us and that, subject to the successful completion of the CERN Safety Training course "Electrical Safety - Working at EP Experiments"[3] by said MPA, he/she is authorised to carry out the following electrical and/or mechanical tasks at CERN.[4]

Electrical tasks

☐ Connection, disconnection and operation of equipment at plug sockets up to 63 A.

☐ Install and operate standardised rack mounted electrical equipment in relation to experimental apparatus at CERN within existing racks and the connection of modules and modular power supplies with standardised connectors.

☐ Performance of localised lock-out/tag-out for your own work and for equipment under your responsibility, where the point of isolation is a plug and socket outlet.

☐ Cable installation and termination in an electrical environment, up to 6 mm^2 for signal cabling and power distribution, and up to 16 mm^2 for earthing.

☐ Repair and removal operations on experimental apparatus, when the equipment is disconnected and unplugged. If the operation requires the removal of any housing or protective screens these must be replaced before the equipment is re-powered.

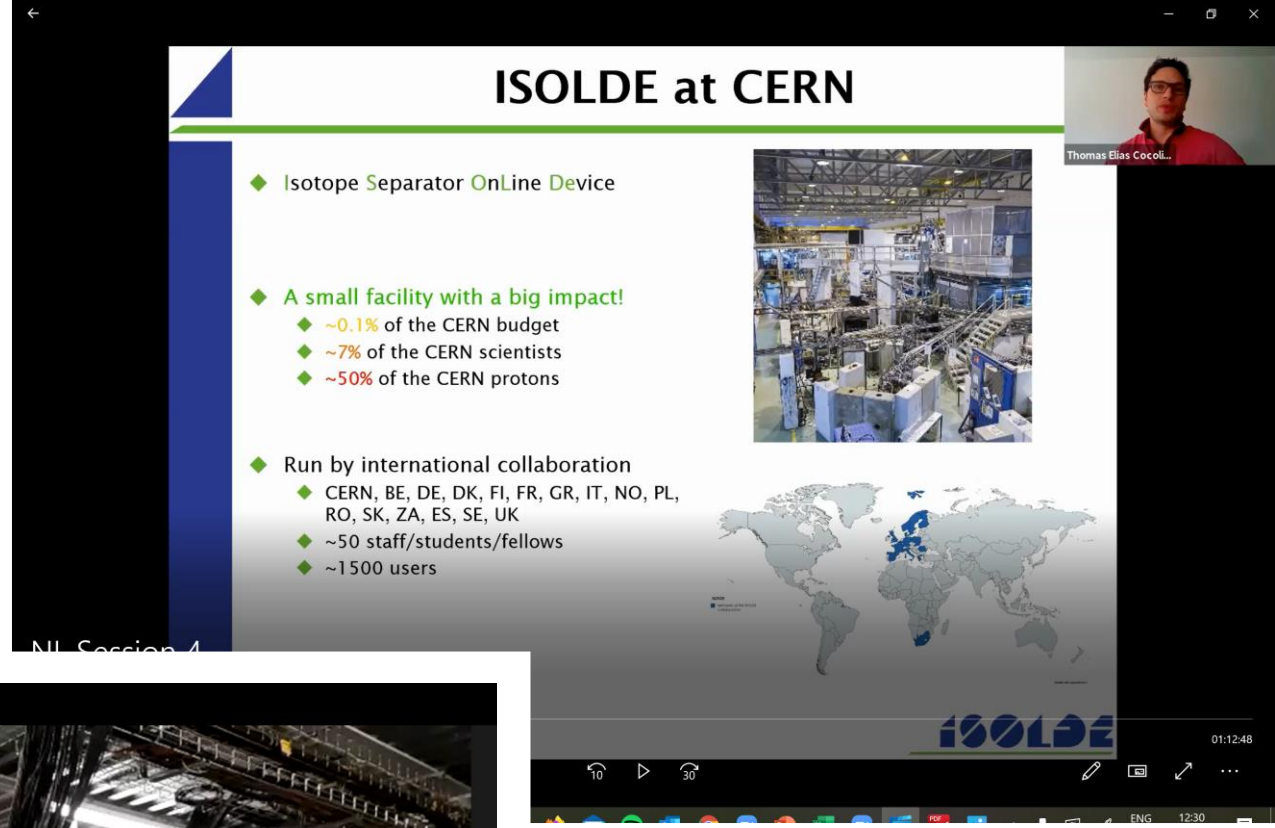
---

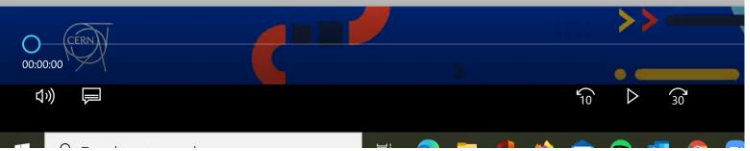
[1] The Associated Members of the Personnel are defined in CERNs Staff Rules and Regulations and the corresponding Administrative Circulars and include users, cooperation associates and visiting scientists.
[2] Normally the team leader should sign the form as authorized representative.
[3] Link to Safety Training catalogue, Electrical Safety domain.
[4] Please indicate the tasks concerned.

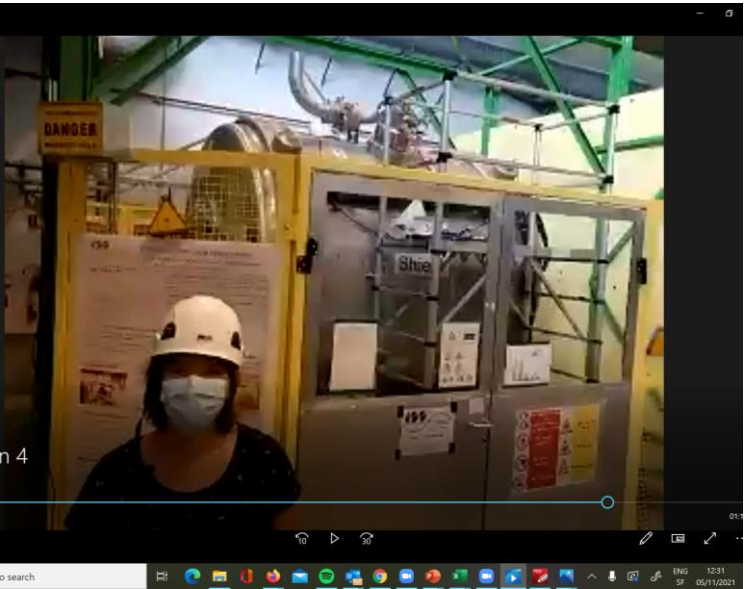
Virtual visits now possible…

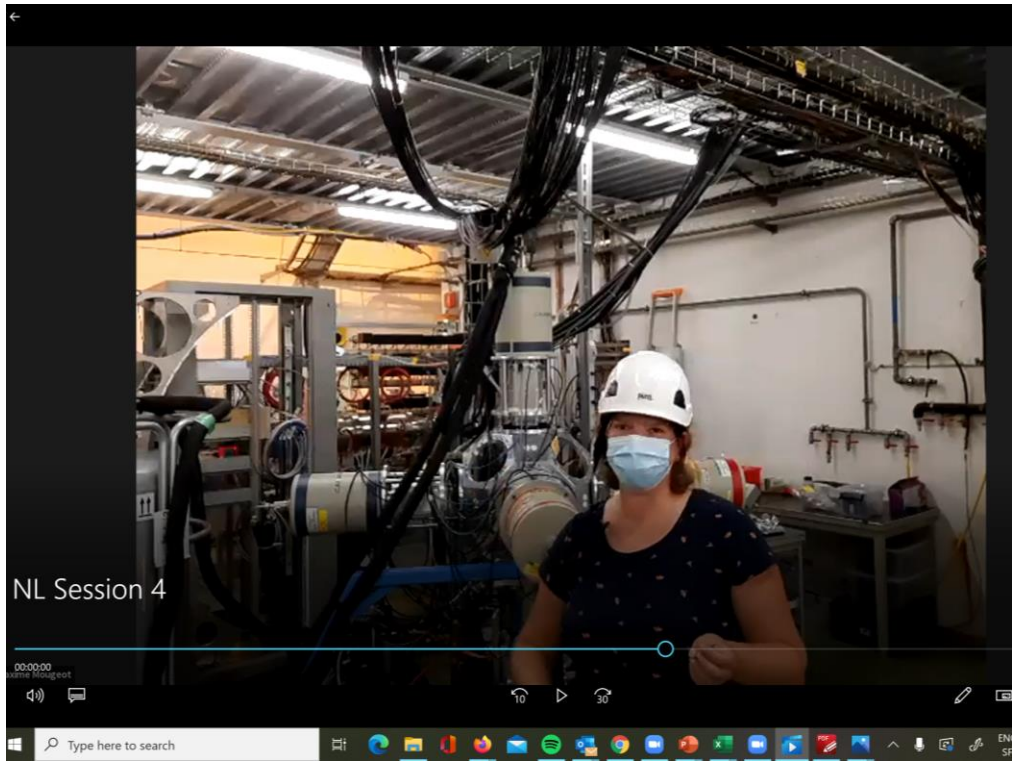
2021 Belgian High-School
Students Internship Programme

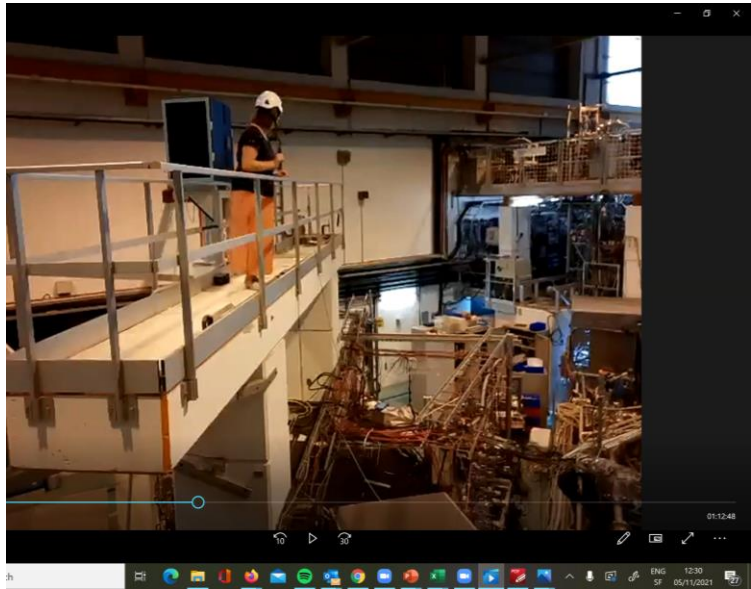
25 september 2021
Virtuele ontdekkingsdag van CERN











Some recent publications…

nature physics

LETTERS

https://doi.org/10.1038/s41567-021-01326-9

Check for updates

OPEN

Mass measurements of $^{99-101}$In challenge ab initio nuclear theory of the nuclide ^{100}Sn

M. Mougeot[1,2], D. Atanasov[2], J. Karthein[1,2,17], R. N. Wolf[3], P. Ascher[4], K. Blaum[1], K. Chrysalidis[2], G. Hagen[5,6], J. D. Holt[7,8], W. J. Huang[1,18], G. R. Jansen[9], I. Kulikov[10], Yu. A. Litvinov[10], D. Lunney[11], V. Manea[2,11], T. Miyagi[7], T. Papenbrock[5,6], L. Schweikhard[12], A. Schwenk[1,13,14], T. Steinsberger[1], S. R. Stroberg[15], Z. H. Sun[5,6], A. Welker[2], F. Wienholtz[2,12,13], S. G. Wilkins[2] and K. Zuber[16]

The tin isotope ^{100}Sn is of singular interest for nuclear structure due to its closed-shell proton and neutron configurations. It is also the heaviest nucleus comprising protons and neutrons in equal numbers—a feature that enhances the contribution of the short-range proton–neutron pairing interaction and strongly influences its decay via the weak interaction. Decay studies in the region of ^{100}Sn have attempted to prove its doubly magic character[1] but few have studied it from an ab initio theoretical perspective[2,3], and none of these has addressed the odd-proton neighbours, which are inherently more difficult to describe but crucial for a complete test of nuclear forces. Here we present direct mass measurements of the exotic odd-proton nuclide ^{100}In, the beta-decay daughter of ^{100}Sn, and of ^{99}In, with one proton less than ^{100}Sn. We use advanced mass spectrometry techniques to measure ^{99}In, which is produced at a rate of only a few ions per second, and to resolve the ground and isomeric states in ^{101}In. The experimental results are compared with ab initio many-body calculations. The 100-fold improvement in precision of the ^{100}In mass value highlights a discrepancy in the atomic-mass values of ^{100}Sn deduced from recent beta-decay results[4,5].

The nuclear landscape is shaped by the underlying strong, weak and electromagnetic forces. The most salient features are the pillars of enhanced differential binding energy associated with closed-shell configurations, the best example of which is $Z=50$ (tin), featuring the largest number of β-stable isotopes (10) of all elements. These nuclides lie between the closed neutron shells $N=50$ and 82, conferring particular importance to the nuclides ^{100}Sn and ^{132}Sn. The neutron-rich ^{132}Sn can be synthesized in comfortable quantities[6]. This is not so for ^{100}Sn, forming the limit of proton stability due to its extreme neutron deficiency, only just staving off the Coulomb repulsion of the 50 protons. This rare combination of like closed shells causes ^{100}Sn to have one of the strongest beta transitions and makes it the heaviest self-conjugate nucleus on the nuclear chart.

Nuclei in the immediate vicinity of ^{100}Sn offer important insight for understanding the single-neutron and proton states in this region and constitute an excellent proxy for the study of ^{100}Sn itself. However, experiments have so far only been feasible with in-beam gamma-ray spectroscopy at fragmentation facilities[4,5,7–10]. By direct determination of the nuclear binding energy, high-precision atomic-mass measurements provide a crucial model-independent probe of the structural evolution of exotic nuclei. Precision mass measurements are traditionally performed at isotope separation online (ISOL) facilities; however, the production of medium-mass, neutron-deficient nuclides at such facilities is prohibitively difficult, explaining the lack of accurate mass values in the region. Measurements performed at the FRS Ion Catcher at GSI[11] and the Cooler-Storage experimental Ring (CSRe) in Langzhou[12] (both high-energy, heavy-ion fragmentation facilities) recently extended direct mass measurements to the ^{101}In ground and isomeric states. However, the ^{100}In mass value is still constrained 63% indirectly through its beta-decay link to ^{100}Cd (ref. [13]).

Thus, the first experimental challenge overcome in this work was the production and separation of the successfully studied ^{99,100,101g,101m}In states. A detailed schematic of the necessary stages, from radioactive ion beam production to beam purification, preparation and measurement, is shown in Fig. 1. The exotic indium isotopes were produced at the Isotope Separator On Line Device (ISOLDE) located at CERN. A 1.4 GeV proton beam impinged on a thick lanthanum carbide target, producing a swath of neutron-deficient radioactive species of various chemical elements. After diffusion from the heated target, the indium atoms of interest were selectively ionized using a two-step resonance laser ionization scheme provided by the ISOLDE Resonant Ionization Laser Ion Source (RILIS)[14]. The ion beam was extracted from the source and accelerated to an energy of 40 keV. The mass number ($A=Z+N$) of interest was selected using ISOLDE's high-resolution dipole mass separator and delivered to the ISOLTRAP online mass spectrometer[15].

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Large Shape Staggering in Neutron-Deficient Bi Isotopes

A. Barzakh[1,*], A. N. Andreyev[2,3], C. Raison[2], J. G. Cubiss[2], P. Van Duppen[4], S. Péru[5], S. Hilaire[5], S. Goriely[6], B. Andel[7], S. Antalic[7], M. Al Monthery[2], J. C. Berengut[8], J. Bieroń[9], M. L. Bissell[10], A. Borschevsky[11], K. Chrysalidis[12,13], T. E. Cocolios[4], T. Day Goodacre[14,12,10], J.-P. Dognon[15], M. Elantkowska[16], E. Eliav[17], G. J. Farooq-Smith[4,†], D. V. Fedorov[1], V. N. Fedosseev[12], L. P. Gaffney[18,‡], R. F. Garcia Ruiz[10,§], M. Godefroid[19], C. Granados[12,4], R. D. Harding[2,12], R. Heinke[13,‖], M. Huyse[4], J. Karls[12,20], P. Larmonier[12], J. G. Li (李冀光)[21], K. M. Lynch[12], D. E. Maison[1,22], B. A. Marsh[12], P. Molkanov[1], P. Mosat[7], A. V. Oleynichenko[1,23], V. Panteleev[1], P. Pyykkö[24], M. L. Reitsma[11], K. Rezynkina[4], R. E. Rossel[12], S. Rothe[12], J. Ruczkowski[16], S. Schiffmann[19], C. Seiffert[12], M. D. Seliverstov[1], S. Sels[4,‖], L. V. Skripnikov[1,22], M. Stryjczyk[4,25], D. Studer[13], M. Verlinde[4], S. Wilman[16] and A. V. Zaitsevskii[1,23]

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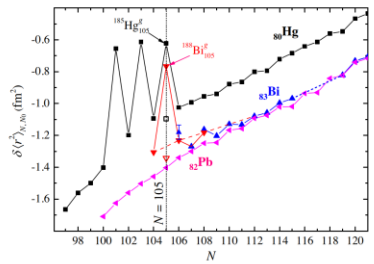

FIG. 2. Changes in the mean-square charge radii for Bi (downward triangles, present work; upward triangles, Refs. [27,55,56]), Pb (leftward triangles, Refs. [5,57,58]), and Hg (squares, Refs. [10–12]) isotopes. Full and hollow symbols label the gs's and isomers, respectively. Data for each chain are shifted along the Y axis to improve visibility. Red dashed line connects the data for the even-N $9/2^-$ Bi gs's to demonstrate deviation from the Pb trend.

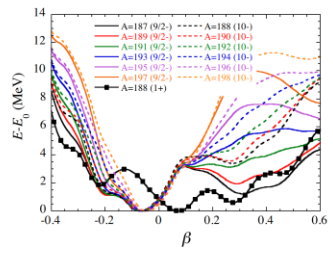

FIG. 3. HFB PESs obtained by blocking the first $9/2^-$ qp in odd-A bismuth isotopes (solid lines), 10^- in even-A ones (dashed lines), and 1^+ in ^{188}Bi (squares). E_0 is the minimal energy of the corresponding PES. For each PES, at least one of the minima has a magnetic moment compatible with experimental data. For $9/2^-$ and 10^- states it is a minimum at $\beta\approx-0.07$, whereas for 1^+ state in ^{188}Bi it is a minimum at $\beta\approx+0.28$.

The further selection of the proper states was made by constraining the calculated magnetic moment to the exper-

Laser Spectroscopy of Neutron-Rich ^{207,208}Hg Isotopes: Illuminating the Kink and Odd-Even Staggering in Charge Radii across the $N=126$ Shell Closure

T. Day Goodacre[1,2,3,*], A. V. Afanasjev[4], A. E. Barzakh[5], B. A. Marsh[2], S. Sels[2,6], P. Ring[7], H. Nakada[8], A. N. Andreyev[9,10], P. Van Duppen[6], N. A. Althubiti[1,11], B. Andel[6,12], D. Atanasov[13,†], J. Billowes[1], K. Blaum[13], T. E. Cocolios[1,6], J. G. Cubiss[9], G. J. Farooq-Smith[1,6], D. V. Fedorov[5], V. N. Fedosseev[2], K. T. Flanagan[1,14], L. P. Gaffney[6,15,‡], L. Ghys[6,16], M. Huyse[6], S. Kreim[13,2], D. Lunney[17,§], K. M. Lynch[1,2], V. Manea[13,§], Y. Martinez Palenzuela[6,2], P. L. Molkanov[5], M. Rosenbusch[18,‖], R. E. Rossel[2,19], S. Rothe[2], L. Schweikhard[18], M. D. Seliverstov[5], P. Spagnoletti[15], C. Van Beveren[6], M. Veinhard[2], E. Verstraelen[6], A. Welker[2,20], K. Wendt[19], F. Wienholtz[2,18,¶], R. N. Wolf[13,18,**], A. Zadvornaya[6] and K. Zuber[20]

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The mean-square charge radii of ^{207,208}Hg ($Z=80$, $N=127$, 128) have been studied for the first time