

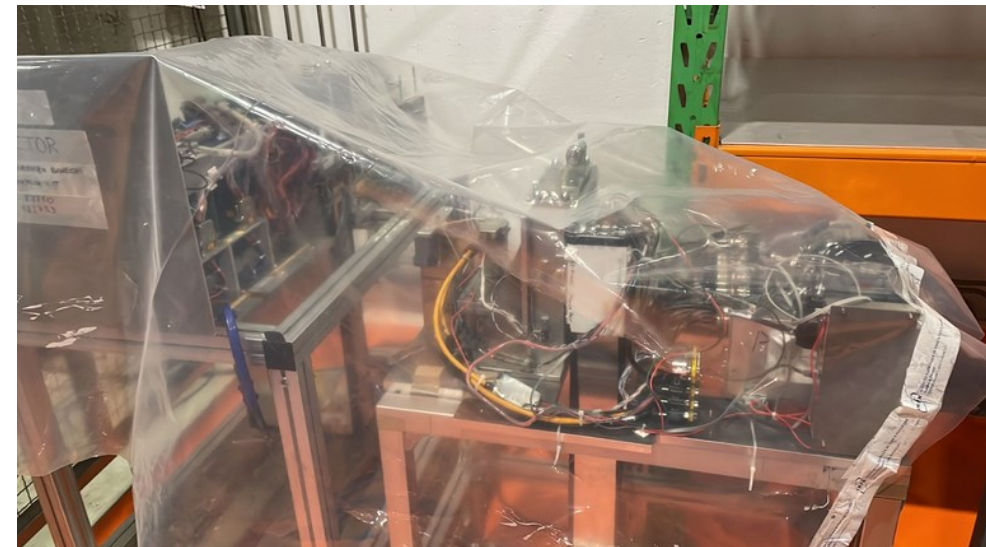
Preparation for the last LHCf run: p+O

Topics

- **Current situation of hardware**
 - Current location of detectors
 - Measurement of the detector's radioactivity and contacts with the RP team
 - Noise and delay lines (?)
 - Upgrade of the silicon MDAQ firmware
- **Barracks and infrastructures**
 - Missing stuff (?)
- **Beam crossing and parameters for the oxygen run**
 - 30/09: e-mail from Jorg Wenninger (Head of LHC beam operation)
 - 02/10: e-mail from LPC coordinators
- **Planning of the preparation activity**
 - December 2023
 - February 2024
 - May/June 2024
 - SPS beam test later in 2024
- **Schedule of installation and run**
 - LHCf and ATLAS / ZDC

Current location of Arm1&&Arm2

- CERN SPS experimental area



Contacts with RP (CERN radio protection team)

- June 2023

On 08-Jun-23 15:14, Frederic Lionel Aberle wrote:

Dear Lorenzo,

Thank you again for your patience, here are updated values

1. CR-128101 - LHCf Arm1 Detector: I couldn't detect levels of radioactivity anymore.
2. CR-002779 - LHCf arm2 front counter: same as CR-128101.
3. CR-002780 - LHCf ARM2 Calorimeter: I see a maximum dose rate of $0.3 \mu\text{Sv}\cdot\text{h}^{-1}$. This is rather low, but too high to be classified as non-radioactive.

Do you have an update about the future actions concerning the detectors?

Cheers, (natural background: $2.4 \text{ mSv/y} = 0.27 \mu\text{Sv/h}$)
Frederic


On 08-Jun-23 15:39, Frederic Lionel Aberle wrote:

Hello Lorenzo,

I see! From my side, there is no issue to leave the detector in EHN1, but I think M. Lazzaroni from BE-EA is always in need of space... So maybe it would be better to transfer it.


On the other hand, I see that building 6111 is non-designated, meaning that radioactive material should not be there (even if radiation levels are very low). But, depending on usage of building 6111, we could also propose to classify it as supervised area. Is there an office, or people working all day in this small building?

Cheers,
Frederic

From Frederic Lionel Aberle <frederic.aberle@cern.ch> 

To Bonechi Lorenzo 

6/20/2023, 1:49 PM

Cc Yann Pierre Pira <yann.pira@cern.ch> 

Subject **Re: Radiation measurements on LHCf detectors**

Dear Lorenzo,

Thank you for your feedback and for having investigated this possibility. For me, there is no problem to keep it in EHN1, but I am not the owner of the building 😊

I believe that, if needed, another storage space could be found in a dedicated supervised area, but if no one is asking you to move it, I would advise to leave the setup where it is 😊

Concerning the possibility to store it in building 6112 without classifying the local, I am afraid that it is not possible, since radioactive items should be stored in radiologically classified areas.

Cheers,
Frederic

Noise and delay lines – the story (1)

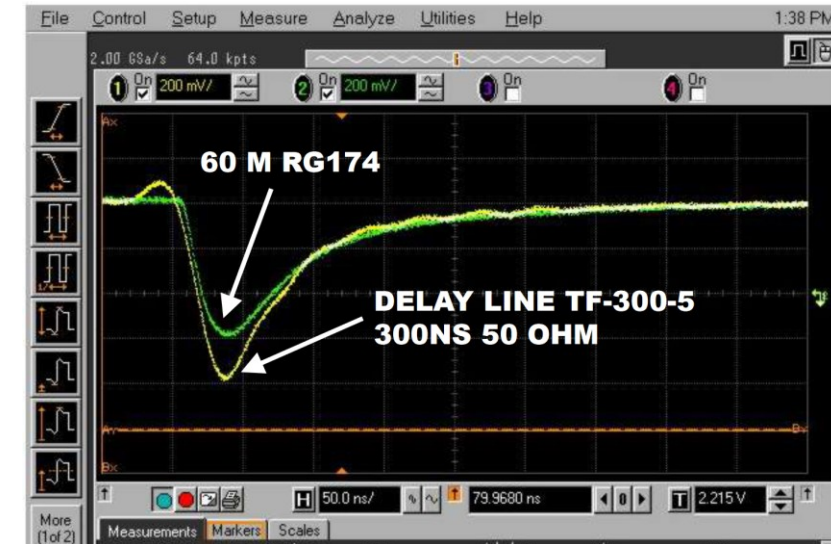
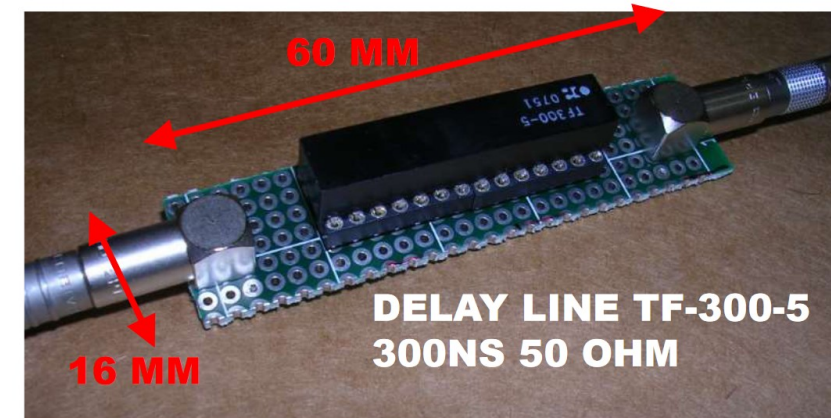
Delay lines originally used during data taking for p+Pb collision



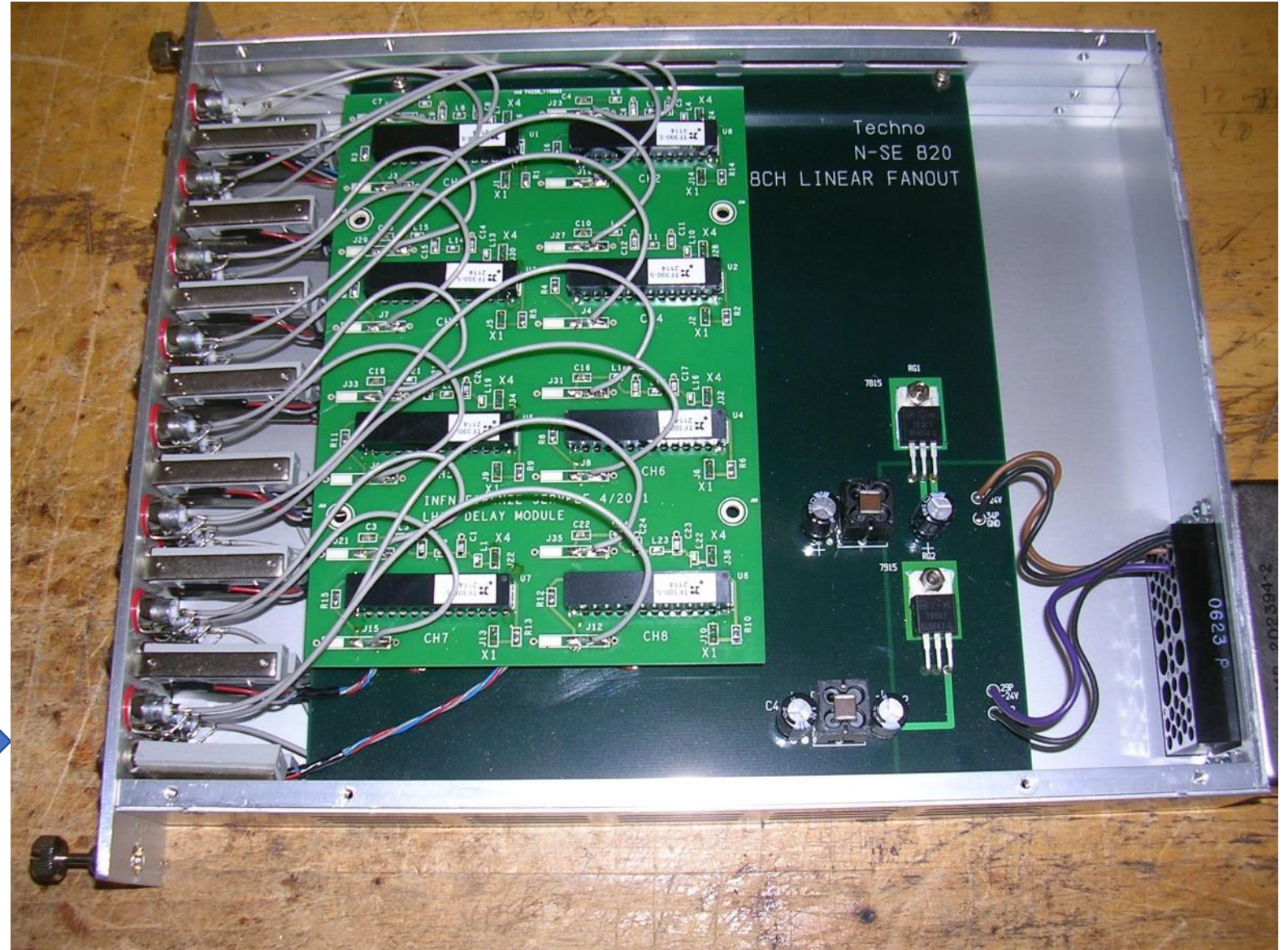
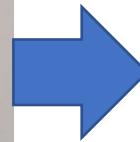
60 m long coax cable per delay line

NEW DELAY LINES

- Production of **72 analog delay lines** (~ 300 ns)
 - Necessary for implementing **optimized trigger schemes**
 - Avoid large delay boxes made with long cables due to limited space in the electronic racks in USA15
 - For last p+Pb we had free space (only the Arm2 system was used)
- Selected solution: **SINGLE CHIP ANALOG DELAY LINE**
 - very compact solution
 - less attenuation compared to coaxial cable, with the same delay
 - some oscillations typical of these devices
- Test of a 300 ns delay chip
 - Input signal digitized from real system and simulated by an Arbitrary Waveform Generator
 - Output signal have not been amplified



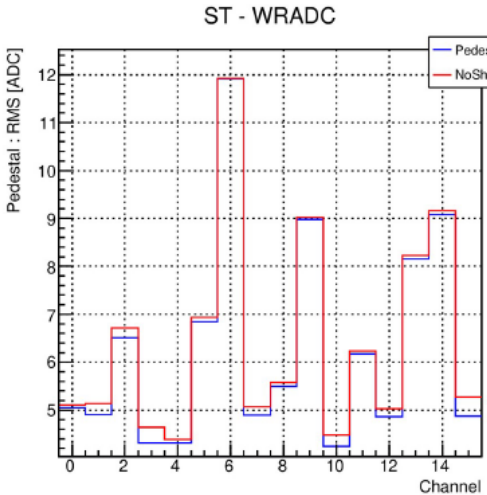
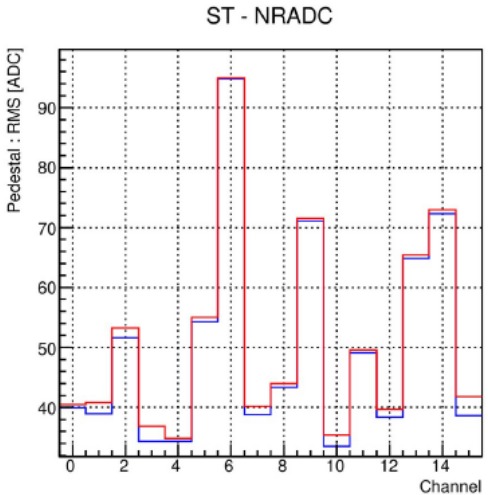
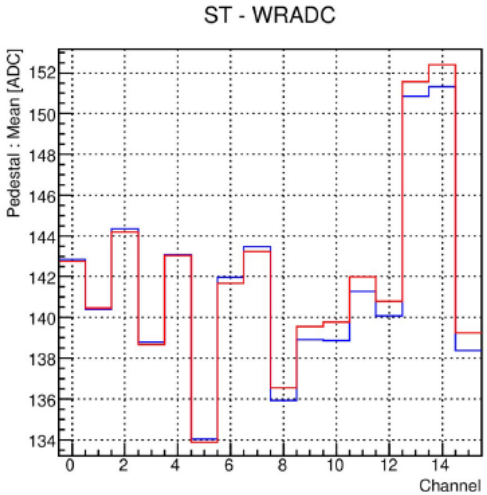
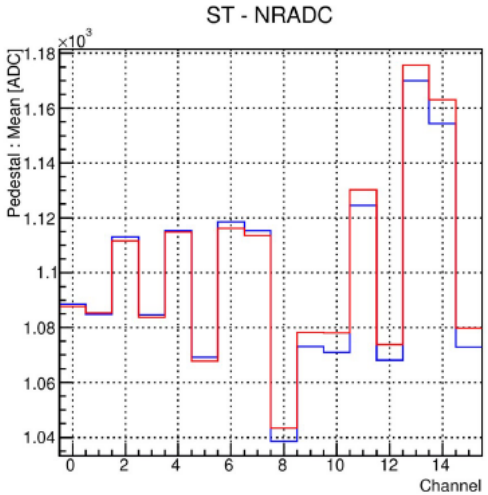
Noise and delay lines – the story (2)



Noise and delay lines – the current problem

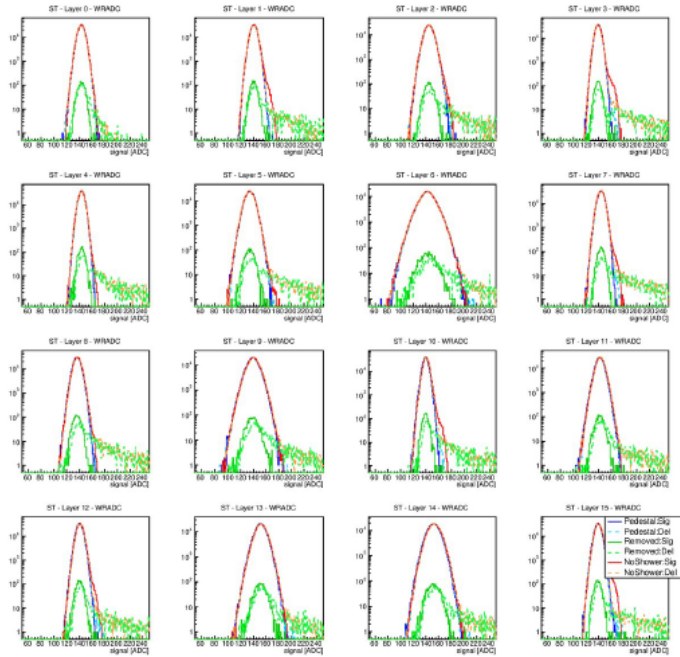
- The distortion of the signals downstream of these modules seems to require a longer integration windows that determines a larger noise (?)

Slide by E. Berti



GSO:Ped ST Summary

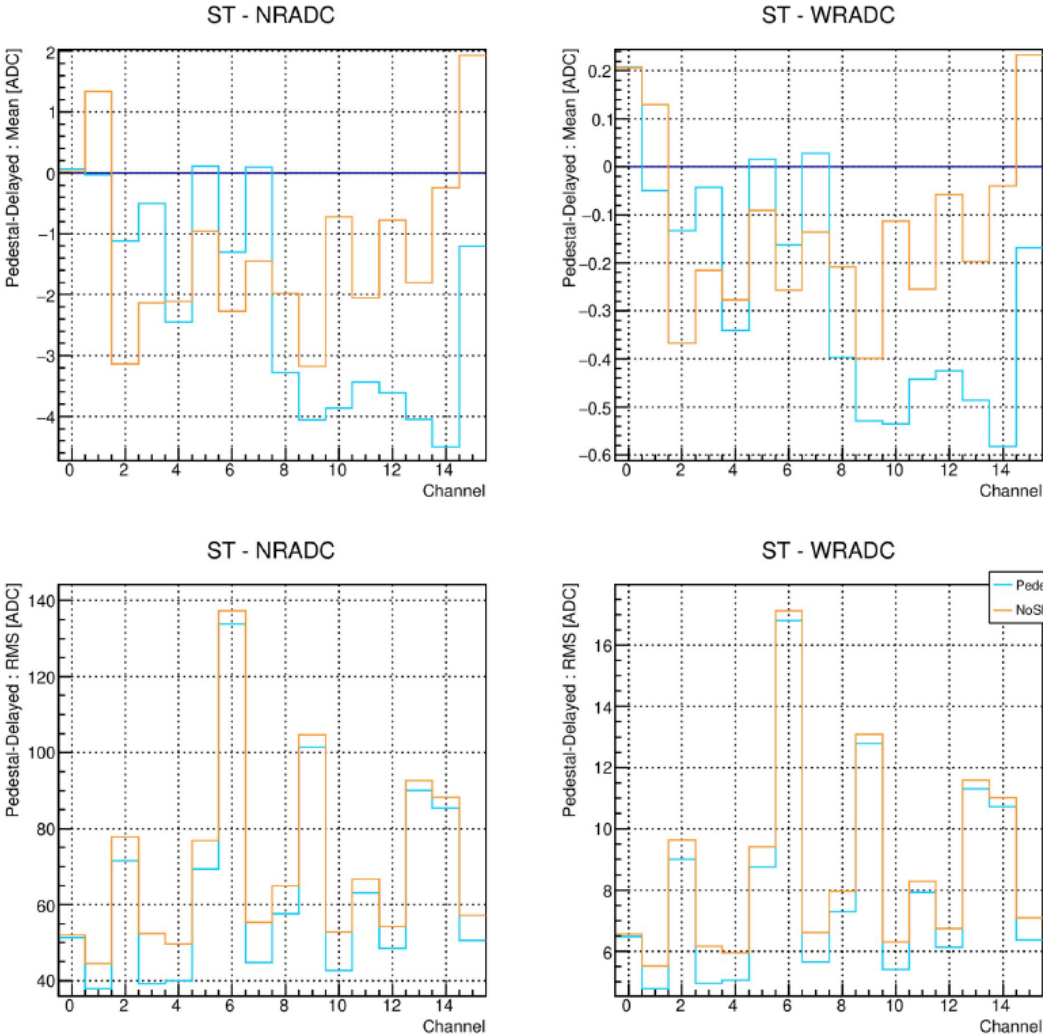
Larger RMS in NoShower events
due to low energy background



Noise and delay lines – the current problem

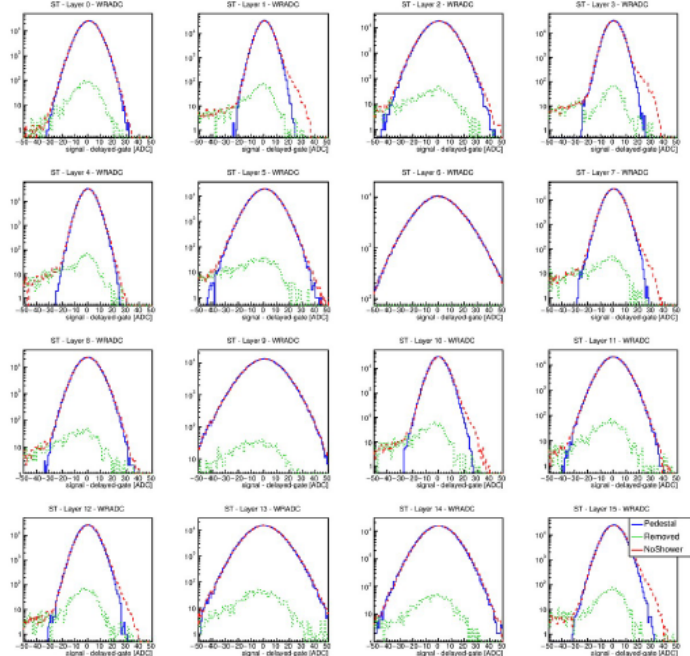
- The distortion of the signals downstream of these modules seems to require a longer integration windows that determines a larger noise (?)

Slide by E. Berti



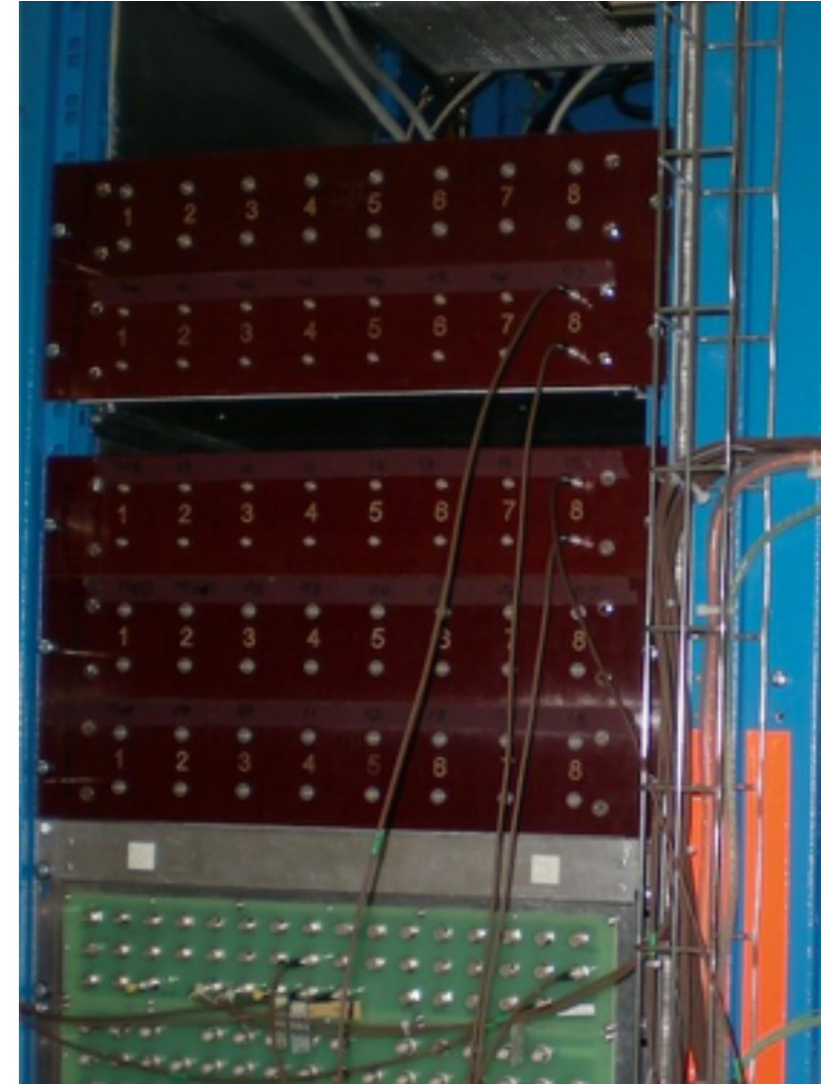
GSO:Ped-Del ST Summary

Larger RMS in NoShower events due to low energy background



Noise and delay lines – comments for 2024

- For the previous run (p+p 2022) it was not possible to install long delay lines made of coaxial cables both for the Arm1 and Arm2 detectors
 - Problem of space in the two LHCf racks in USA15
- In 2024 only the Arm2 detector will be installed at LHC
- It could be possible to go back to the original configuration
- To be discussed in details soon:
 - Is it useful to further investigate this problem?
 - Is it useful to involve the INFN Electronic Pool?
 - Should we recover the original configuration?
- Deadline for decision: before the end of October (?)
 - If required, in november or december we could go to CERN and collect the fanouts (to be modified or to be studied)



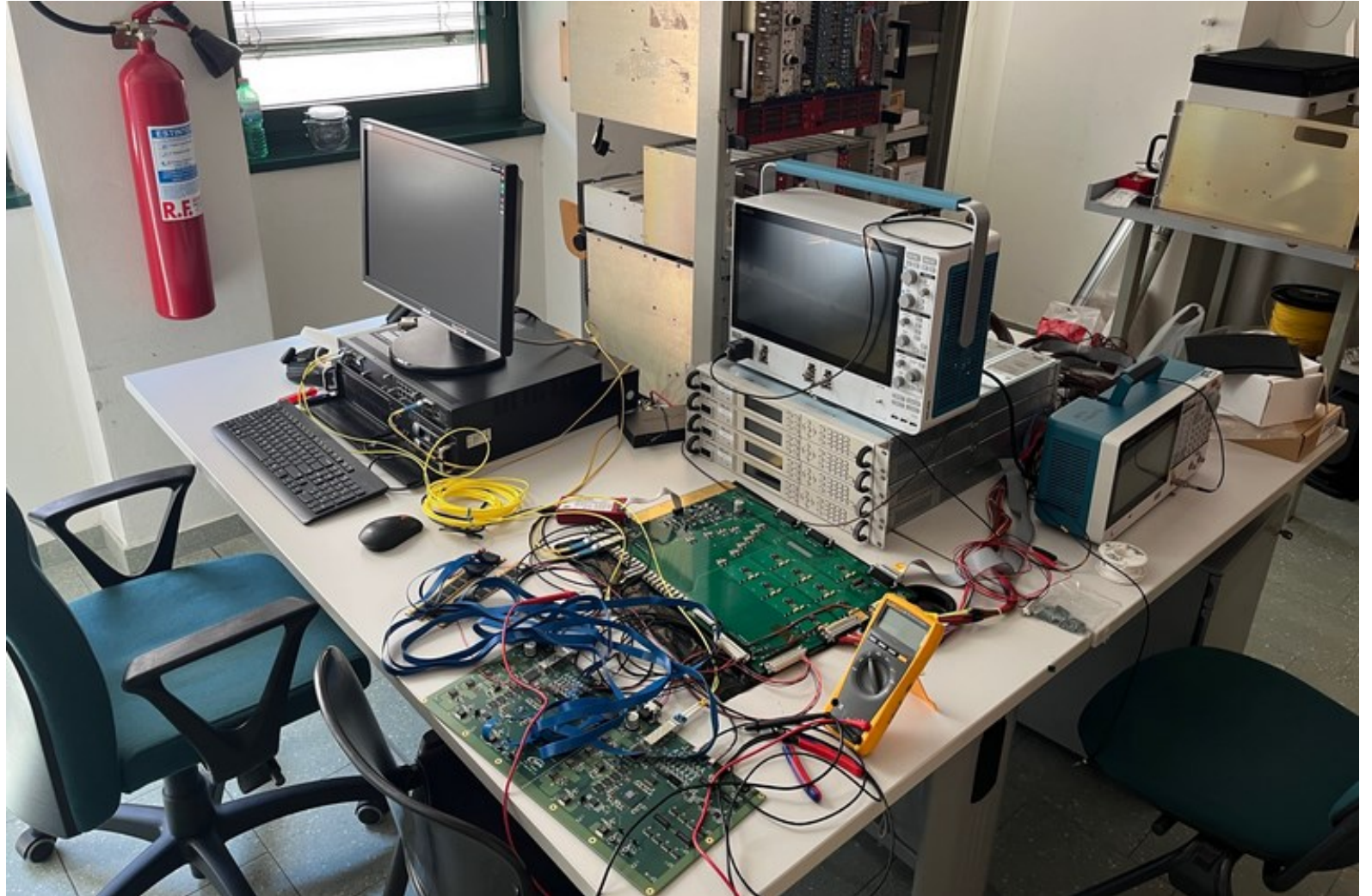
On-going work @ INFN Firenze

- Upgrade of the MDAQ firmware for the study of PACE3/silicon linearity/saturation

Main idea: provide the possibility to study the linearity of the PACE3 chips using their internal calibration system

Status: some details in the next presentation by Monica

Comment: this work is not strictly mandatory before the next run, but could be also completed later



Barracks and infrastructures

- Some info about CERN... already shown during a weekly meeting in July
- Additional comment: 3 bio-cells (safety masks) brought again to the CERN store in September by Monica for because they reached the foreseen 5-years expiration



Beam crossing and parameters for the Oxygen run

- Main issue: for 2024 LHC is planning to invert the beam crossing directions at IP1:
 - from downward going to upward going beams

Current beam crossing config





2024 beam crossing config




- This change should apply to the basic p+p run
- Special runs and ions should maintain the current ion configuration

Beam crossing and parameters for the Oxygen run

From Jorg Wenninger 

To Bonechi Lorenzo  9/30/2023, 7:05 PM

Cc Reyes Alemany Fernandez 

Subject **Re: Info for LHCf**

Hi Lorenzo,

1) Yes we will flip the xing angle sign for pp operation. But the oxygen configuration will most likely correspond to the current lead operation configuration and the xing can be choosen. **You just have to agree with ATLAS (and their ZDC in case it is used).**


2) For the moment, I think to remember that we plan to re-use the current lead configuration with beta* 0.5 m. We do have some issues with background in ALICE, but that does probably not apply to oxygen (TBC).


I CC Reyes for details on the parameters.

Cheers, Jorg

- I have not received any info from Reyes yet

Beam crossing and parameters for the Oxygen run

From Federico Alessio <Federico.Alessio@cern.ch> 

To Bonechi Lorenzo 

Subject Re: Decision on Triplet Inverted Polarity

10/2/2023, 11:08 AM

Purtroppo non ho ancora notizie o informazioni specifiche sull'Oxygen run. L'LHC si e' concentrata parecchio sul Lead e per il momento l'unica sicurezza e' che l'Oxygen run e' piu' o meno in weeks 24/25 (+/- 1 week) nella schedule del 2024 (injectors limitation).

Comunque al riguardo dei tre punti che hai menzionato.

- Il prossimo anno l'unico cambiamento al riguardo della direzione dei fasci a IP1 e' che il crossing angle in IP1 e' flippato a UP (rispetto a DOWN di adesso). Nessun cambio di polarita.. A prescindere da cio, l'agreement era che per le run speciali (lons appunto), si ritorna alla configurazione che abbiamo adesso (pre-2024). Jorg ha confermato che "it should be ok". Questo e' il massimo che abbiamo ottenuto da Jorg...
- punto 2: no. Non c'e' niente neanche di preliminare. Ma devo dire che la discussione e' sempre stata: OO e' uguale a PbPb... quindi mi aspetterei come baseline una configurazione identica a PbPb. Ma questa e' una mia opinione e non c'e' niente di ne' deciso ne' discusso.
- punto 3: credo si fara' prima OO, ma anche qui non abbiamo deciso. L'unico a cui potrebbe cambiare qualcosa e' LHCb, ma non credo che abbiamo una limitazione sull'ordine.

Appena sappiamo di piu, manderemo. Ma non credo che sara' prima di Dicembre/Gennaio.

A presto,
Federico.

Unfortunately I still have no news or specific information on the Oxygen run. The LHC has focused a lot on the Lead and for the moment the only certainty is that the Oxygen run is more or less in weeks 24/25 (+/- 1 week) in the 2024 schedule (injectors limitation).

Anyway regarding the three points you mentioned.

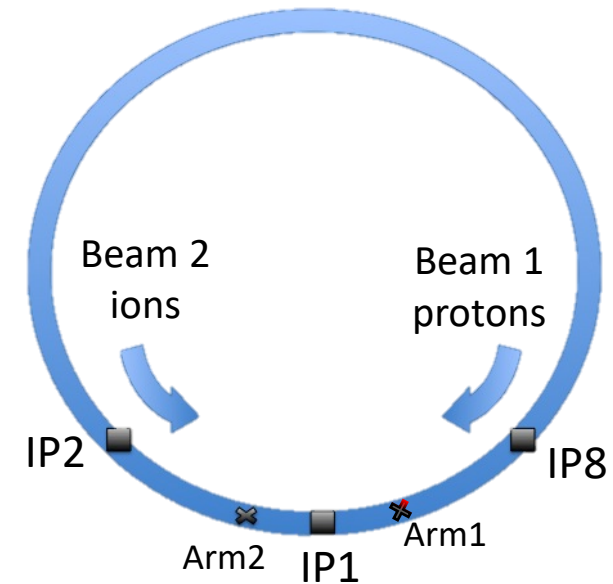
- Next year the only change regarding the beam direction issue at IP1 is that the crossing angle at IP1 is flipped to UP (compared to DOWN now). No change of polarity. Regardless, the agreement was that for the special runs (lons precisely), we return to the configuration we have now (pre-2024). Jorg confirmed that "it should be ok". This is the best we got from Jorg...
- Point 2: no. There's nothing even preliminary. But I have to say that the discussion has always been: OO is the same as PbPb... so I would expect a configuration identical to PbPb as a baseline. But this is my opinion and nothing has been decided or discussed.
- Point 3: I think OO will be done first, but we haven't decided here either. The only one where something could change is LHCb, but I don't think we have a limitation on the order.
- As soon as we know more, we will send. But I don't think it will be before December/January.

Beam crossing and parameters for the Oxygen run → the LHCf requests (just for reference)

Presentation of proposal, CERN - LHCC - 28 Feb 2019

p+O at $\sqrt{s_{NN}}$ 9.9 TeV

- Requests for an eventual LHCf run with light ions
 - Usual low luminosity / low pile-up special run
 - Max luminosity $\sim 10^{28}$
 - $L=5 \times 10^{27}$ @ full rate $\rightarrow 16 \text{ h} \times 2$
 - $L=10^{28}$ @ full rate $\rightarrow 10 \text{ h} \times 2$
 - $N_b \sim 40$ (separated $> 2 \mu\text{s}$ due to slow amplifier)
 - $\mu \sim 0.01$ (no capability to identify pile-up)
 - **Beam crossing:** vertical with downward going beams



Beam crossing and parameters for the Oxygen run → the LHCf requests (just for reference)

Presentation a LPC meeting 14 Jun 2021

Beam parameters for the LHCf run with $p + O$ collisions at $\sqrt{s_{NN}} = 9.9$ TeV	
Parameter	Value
Bunches per beam	best: 43
Minimum bunch spacing (ns) $\mu\text{s}!!$	best: 2 (≥ 0.2)
Luminosity ($\text{cm}^{-2}\text{s}^{-1}$)	$\lesssim 1 \times 10^{28}$
Inelastic cross-sections QCD/UPC (b)	0.5/0.005
μ (average n. of collisions per BC)	$\lesssim 0.01$
Beam crossing	vertical, downward
Beam crossing angle (μrad)	best: 290 (total)
β^* (m)	best: ~ 10 ($\gtrsim 1$)

Run parameters for the LHCf minimum physics program with $p + O$ collisions at $\sqrt{s_{NN}} = 9.9$ TeV	
Parameter	Value
Number of $p + O$ collisions (one detector position)	$\sim 3.5 \times 10^8$
Integrated luminosity (nb^{-1} , one detector position)	~ 0.7
Collision rate at IP1 (kHz)	~ 5
Arm1/Arm2 total acceptance	~ 0.08
Hit rate on Arm1/Arm2 (kHz)	~ 0.4
Max DAQ rate (kHz, including dead time)	~ 0.33
Net operation time at max rate (h)	~ 40
Total number of collected type I and II π^0 events	$\sim 4 \times 10^5$

- **Bunch spacing:** best $2\mu\text{s}$ (acceptable > 200 ns)
- **Lumi:** low (standard LHCf run), $1 \times 10^{28} \text{ cm}^{-2} \text{ s}^{-1}$
- **Pile-up:** low, ~ 0.01 (\rightarrow no large effect with $\mu = 0.02$)
- **Beam crossing:** vertical with downward going beams
- Large β^* (> 10 m) to minimize event by event variations of the beam center (few mm at TAN)
- **Basic physics program:** 1.5 nb^{-1} , 40 h approximately
 - High statistics seems to be difficult (too low luminosity necessary to reduce the pile-up)
- **Detector installation:** Arm1+Arm2 or only Arm2
- **Number of bunches:** for $> 2\mu\text{s}$ bunch spacing, but up to 500 acceptable (previous modification of DAQ setup in USA15; slightly increased electr. noise)

180 ns bunch spacing (confirmed?)

Plans for next main activities at/for CERN (I)

- 2023
 - Buy the CPU server to be used for on-line monitoring during 2024 LHCf special run with p+O collisions
 - Depending on the decision for the delay lines:
 - Collect the NIM fanouts at CERN
 - Recover the original configuration of these modules
 - Depending on the status of upgrade of silicon MDAQ:
 - Upload of the new MDAQ firmware on all MDAQ boards at CERN
 - Only if safe for the 2024 run
 - Better to be done before Feb 2024 or after the June 2024 run

Plans for next main activities at/for CERN (II)

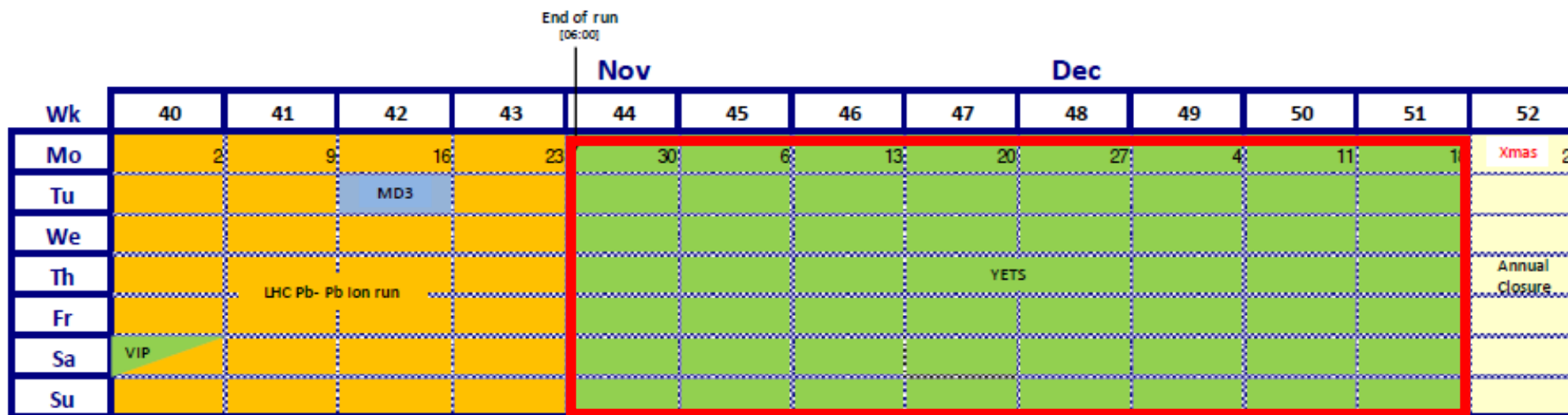
- 2024 – February
 - Rental of electronic modules at the CERN electronic pool
 - Preparation of DAQ in USA15
 - Preliminary test of Arm2 in USA15
 - Preliminary test of Arm2 in the LHC tunnel
- 2024 – June
 - Installation of Arm2 in LHC
 - Data taking for the special run p+O
- 2024 – September or October
 - New beam test at SPS for calibration

Plans for next main activities at/for CERN (III)

RS

August 22, 2023
ver. 1.4

LHC Schedule 2023
 Version 1.0 was approved at the Research Board of 7 December 2022



- Technical Stop
- Machine development (incl. floating)
- HW Commissioning, Powering Tests, Magnet Training
- Scrubbing
- Machine check out
- Pb - Pb Ion physics run
- Recommissioning with beam
- Pb Ion or p - p reference setting up
- Interleaved commissioning & intensity ramp up
- p - p reference run
- Proton physics run
- Special physics runs (place holders)
- LINAC 3 Pb oven re-fill
- SPS HiRadMat Run & reserve (08:00 - 24:00)

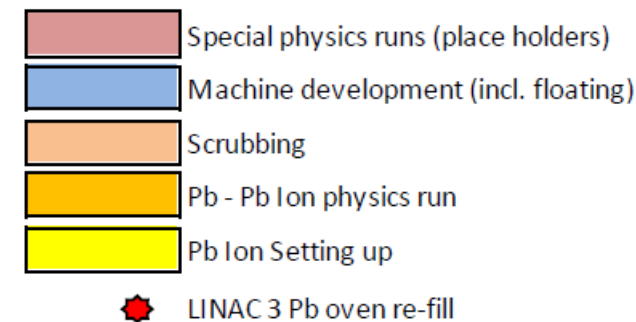
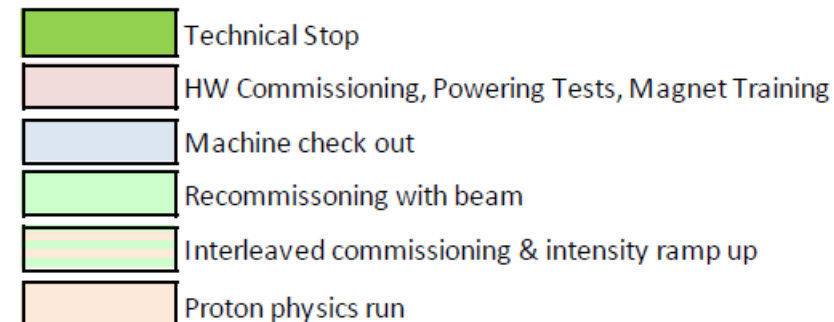
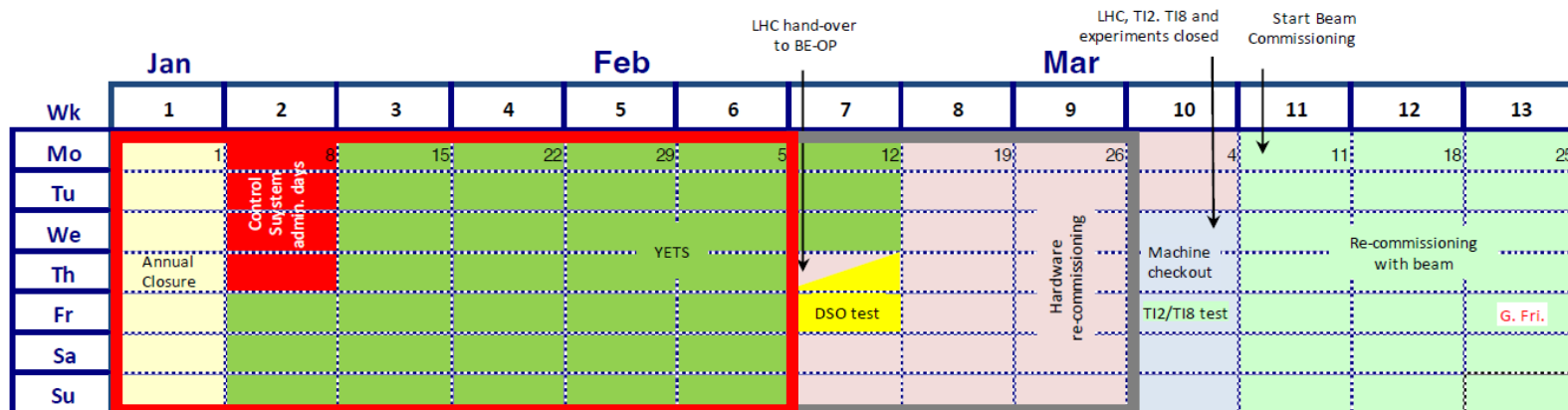
Plans for next main activities at/for CERN (IV)

RS

August 24, 2023

ver. 0.5

DRAFT LHC Schedule 2024 PROPOSAL
Energy cost optimised



Preliminary test of Arm2 in USA15

- Important to check the whole silicon DAQ system
- For testing the stand-alone silicon system in USA15, 1-2 days are required
- It is maybe possible also to test the whole detector
- We have to prepare a request to be submitted to the relevant teams
- This work must to be allowed
 - By who? It depends on the responsible team
 - Then we have to prepare the necessary IMPACT



Preliminary test of Arm2 in the LHC tunnel

- Important to check the status of cables and fibers arriving to TAN
- For testing the silicon system alone in the tunnel, 1-2 days are required
- It is maybe possible also to test the whole detector+DAQ
- We have to prepare a request to be submitted to the relevant teams
- This work must to be allowed
 - By who? It depends on the responsible team
 - Then we have to prepare the necessary IMPACT



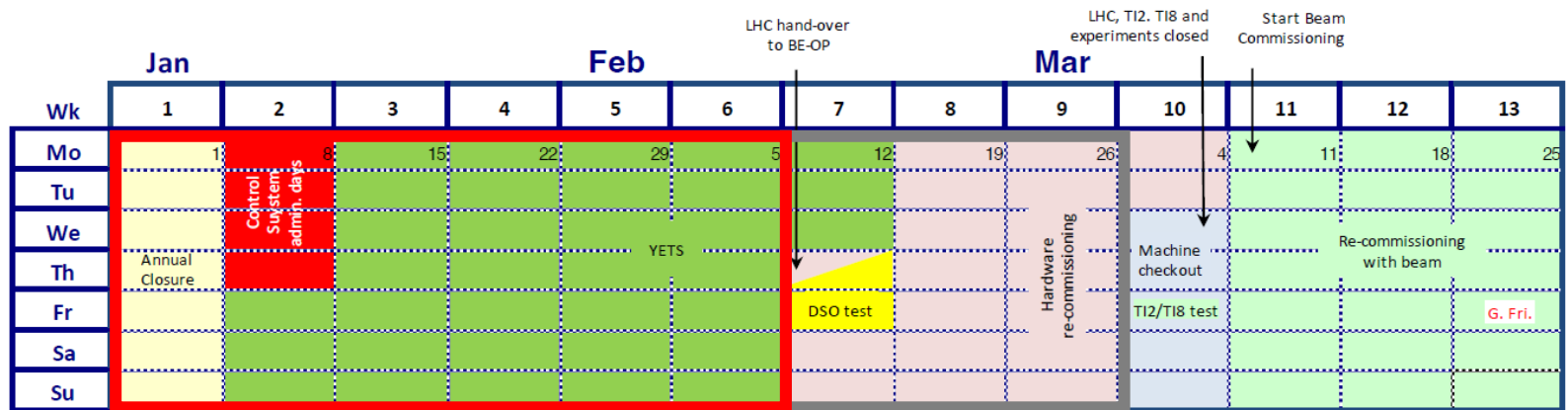
Plans for next main activities at/for CERN (V)

RS

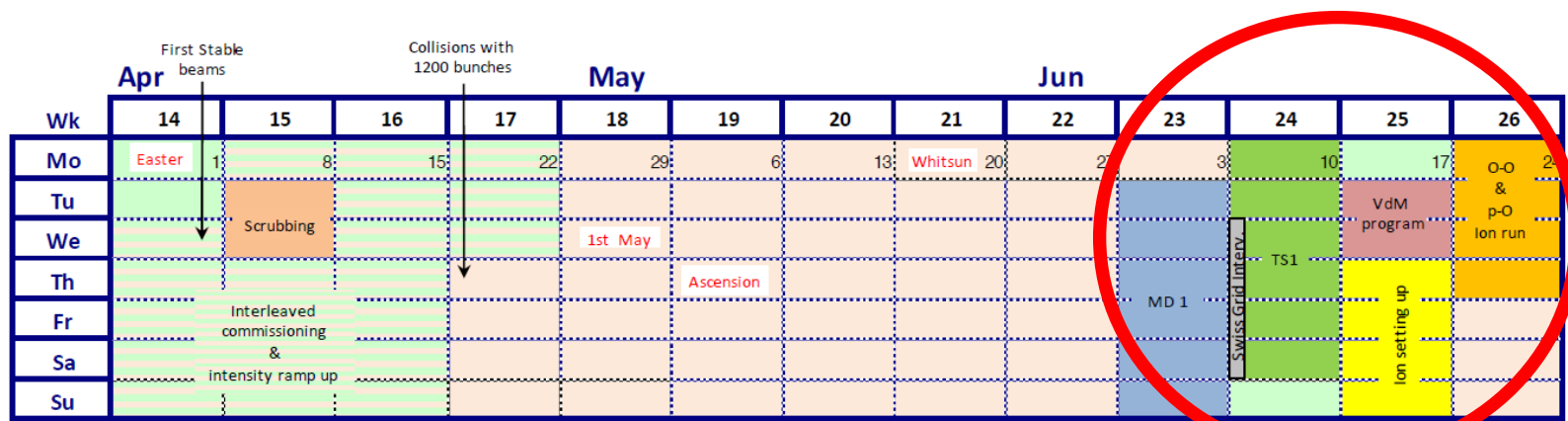
August 24, 2023

ver. 0.5

DRAFT LHC Schedule 2024 PROPOSAL
Energy cost optimised



- Technical Stop
- HW Commissioning, Powering Tests, Magnet Training
- Machine check out
- Recommissioning with beam
- Interleaved commissioning & intensity ramp up
- Proton physics run



- Special physics runs (place holders)
- Machine development (incl. floating)
- Scrubbing
- Pb - Pb Ion physics run
- Pb Ion Setting up
- LINAC 3 Pb oven re-fill

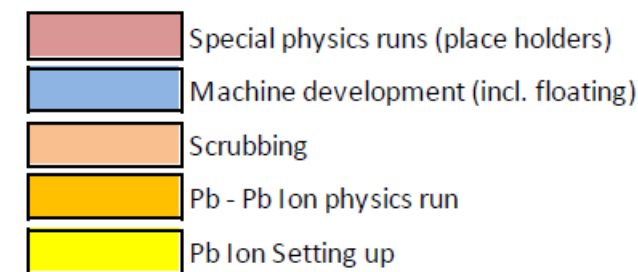
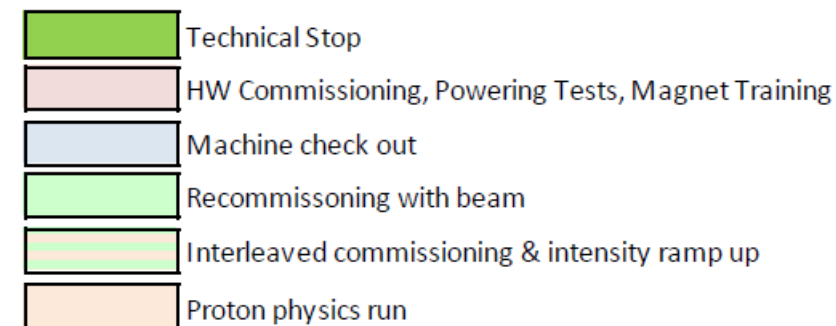
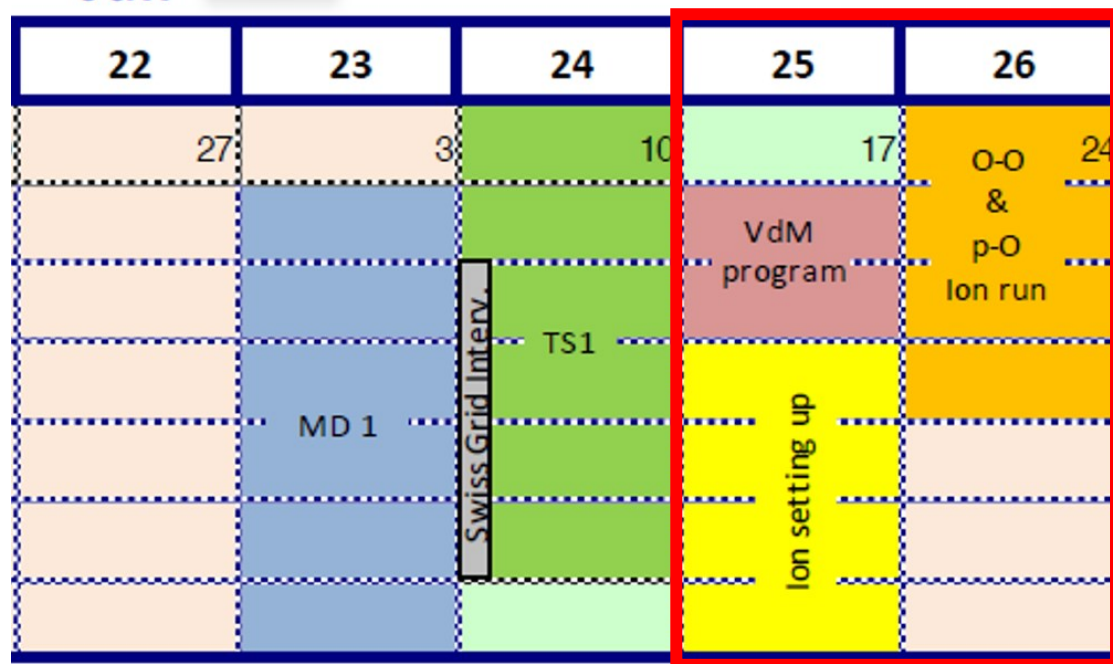
Plans for next main activities at/for CERN (VI)

2024

Installation and run

Jun

Saved to this PC



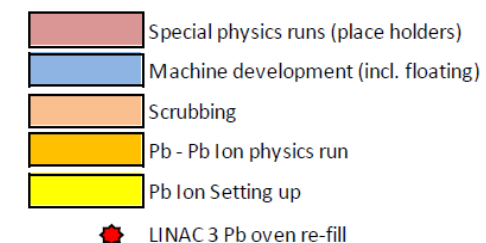
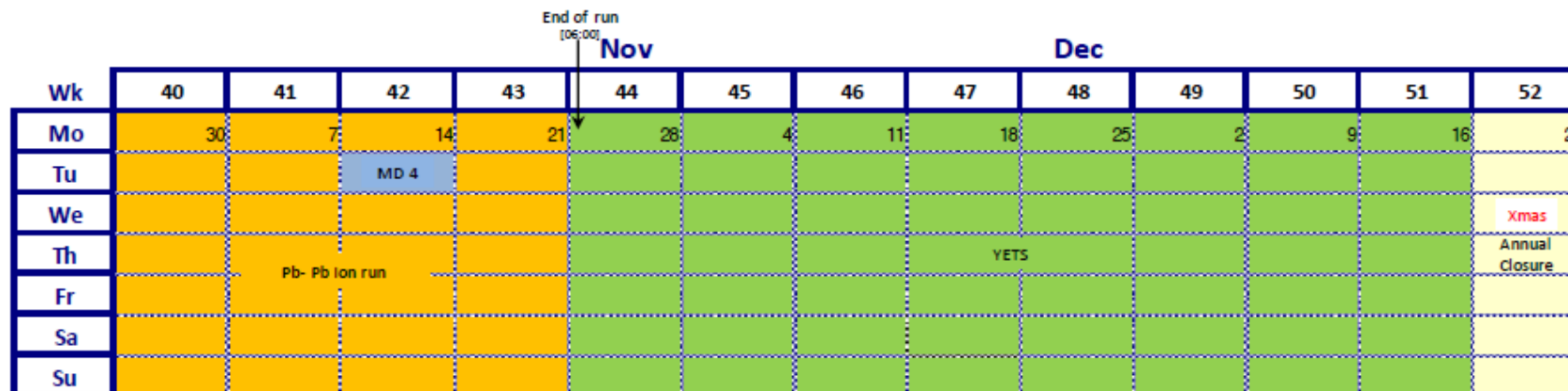
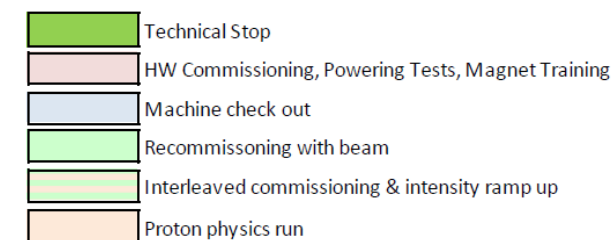
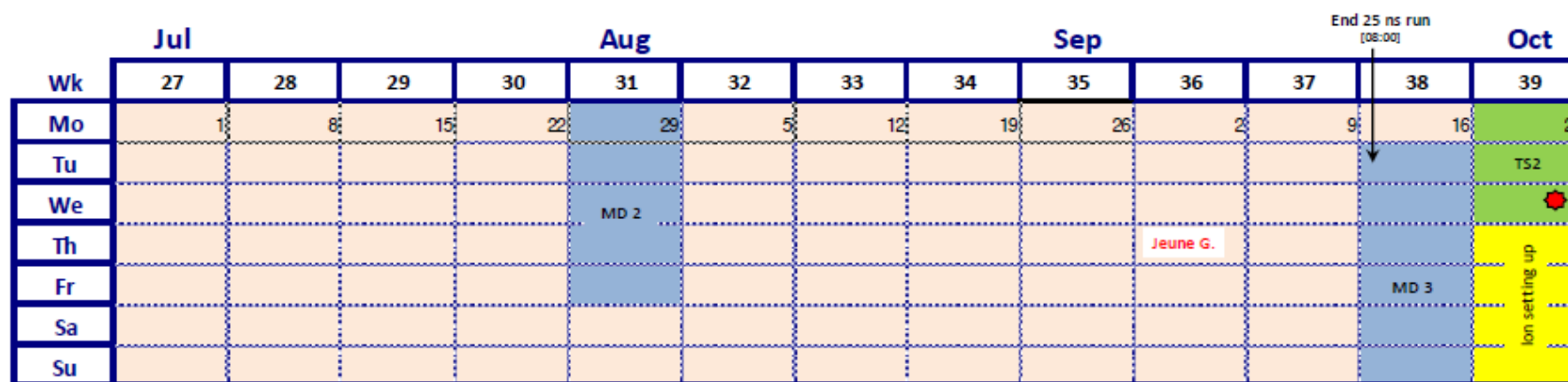
LINAC 3 Pb oven re-fill

- Mostly depends on and agreement to be taken with ATLAS and ZDC
- If p+O comes before O+O we would install in TS1
- If O+O comes before p+O we should install between in between

Plans for next main activities at/for CERN (VII)

NEW SPS beam test (?)

2024



Schedule: install/run/uninstall

- We should fix the **LHCf preferred scheme**
- We should **discuss it with ATLAS and ZDC**
 - find an agreement with ATLAS and ZDC
- In both cases ($p0 \rightarrow 00$ or $00 \rightarrow p0$) there are some complications
 1. In case $p0 \rightarrow 00$ we can install in TS1, but we have to uninstall in the middle of the two runs
 2. In case $00 \rightarrow p0$ we have to install in the middle of the two runs, but I think we are free to uninstall just after the run or later

Conclusions...

- | | |
|---|---|
| <ul style="list-style-type: none">• Current situation of hardware | Good! |
| <ul style="list-style-type: none">• Current location of detectors | SPS experimental area |
| <ul style="list-style-type: none">• Measurement of the detector's radioactivity and contacts with the RP team | Am2 still active; new measurement under discussion |
| <ul style="list-style-type: none">• Noise and delay lines (?) | To be decided: cables or circuits? |
| <ul style="list-style-type: none">• Upgrade of the MDAQ firmware | On-going |
| <ul style="list-style-type: none">• Barracks and infrastructures | To be prepared |
| <ul style="list-style-type: none">• Missing stuff (?) | |
| <ul style="list-style-type: none">• Beam crossing and parameters for the oxygen run | Still not fixed (no info for oxygen on LPC's page) |
| <ul style="list-style-type: none">• 30/09: e-mail from Jorg Wenninger (Head of LHC beam operation) | Same beam crossing config. Should be possible |
| <ul style="list-style-type: none">• 02/10: e-mail from LPC coordinators | Beam parameters are not fixed yet |
| | Beta* should be 0.5 m |
| <ul style="list-style-type: none">• Planning of the preparation activity | Several time slot for the different operations |
| <ul style="list-style-type: none">• December 2023 | We must get an agreement with ATLAS |
| <ul style="list-style-type: none">• February 2024 | We must inform LHC relevant team(s) |
| <ul style="list-style-type: none">• May/June 2024 | |
| <ul style="list-style-type: none">• Schedule of installation and run | Still unknown the sequence of pO and OO |
| <ul style="list-style-type: none">• LHCf and ATLAS / ZDC | It depends mainly on LHCf/ATLAS ZDC request |

ありがとうございました for the
organization of this meeting in Nagoya
and for our long and successful collaboration

