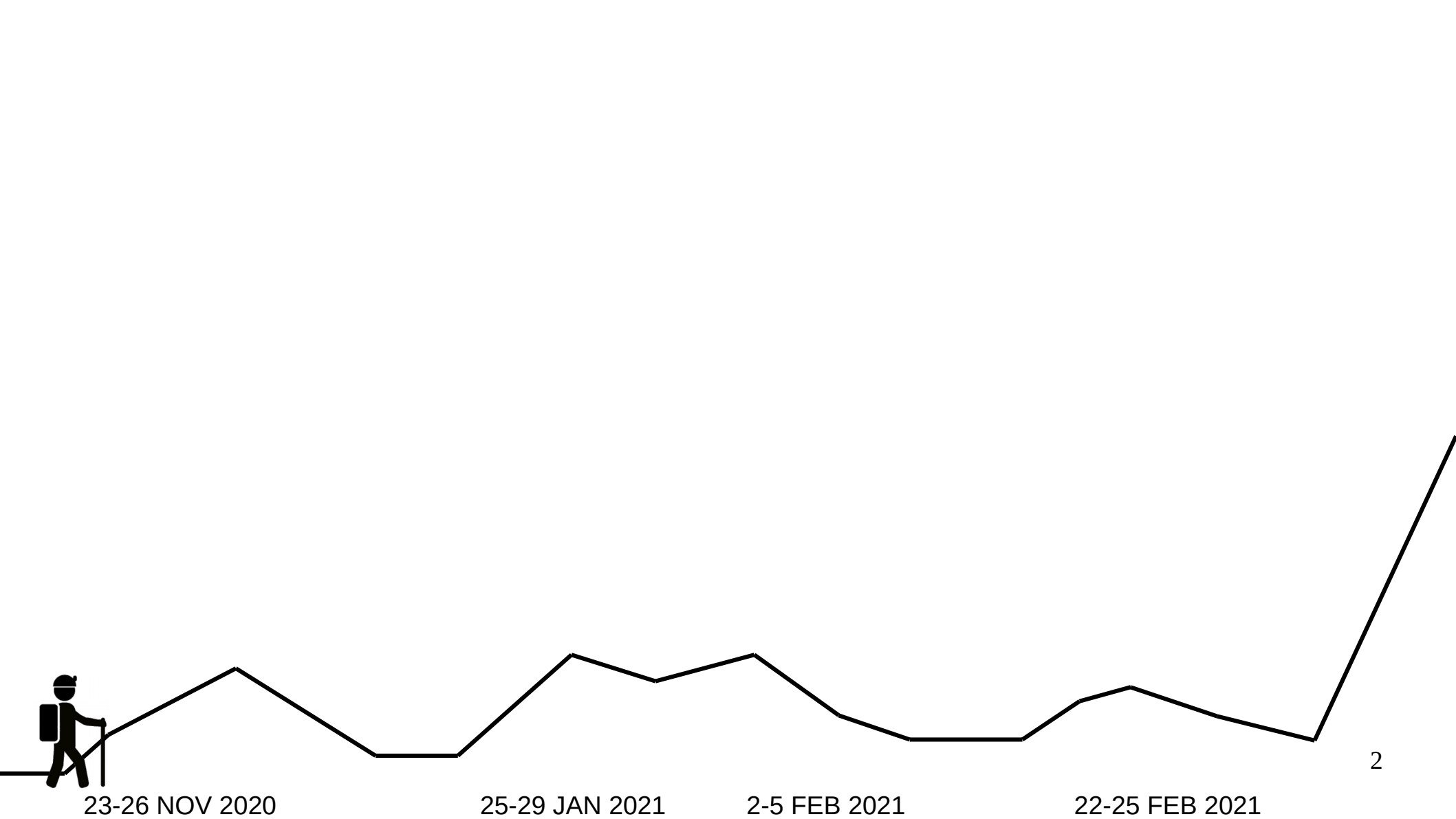


L3 Tests

Ilaria and Riccardo
on behalf of the working group

BESIII Italia
Marzo 2021





23-26 NOV 2020

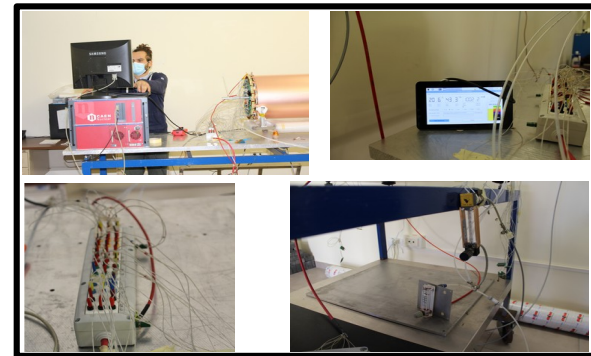
25-29 JAN 2021

2-5 FEB 2021

22-25 FEB 2021

2

Setup Preparation



Ar CO₂ (premixed at the beginning, now with separate bottles)

1. Without the detector
2. With the detector → identified a ~30% leakage
→ Continued with the electrical tests anyway

• Gas Line

1. Test the HV distribution w/o detector
2. Cabling

• HV Chain

• C&R Measurements

1. Same GEMs (Macro/micro) $\mu \approx 373$ pF
2. Facing GEMs (Transfer) $\mu \approx 520$ pF
3. 2 micros to be further investigated

• Anode and Ground

1. Caps on the Anode tails
2. HV Reference to GND plane

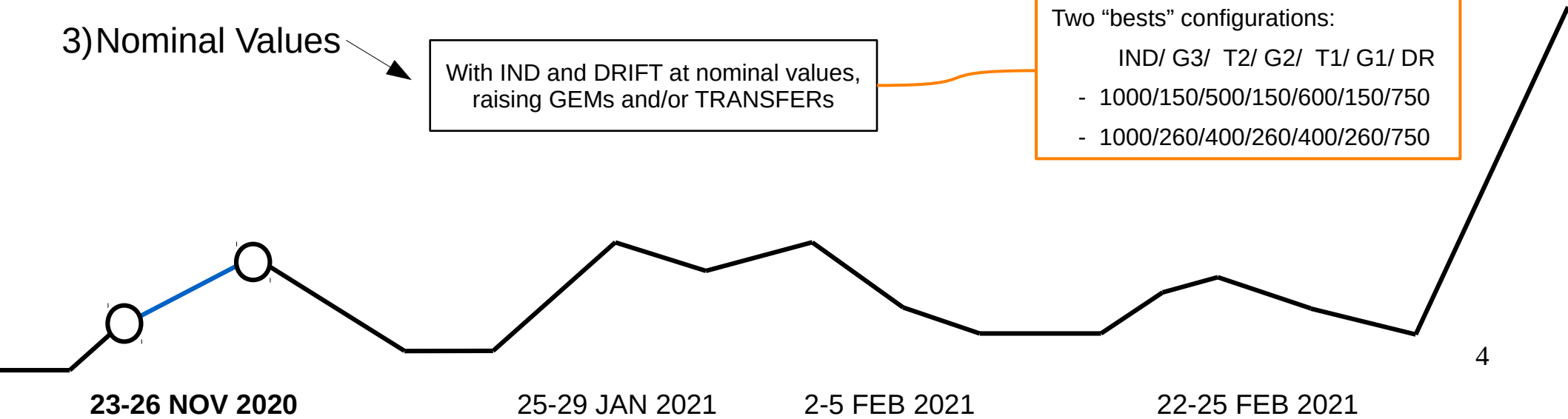
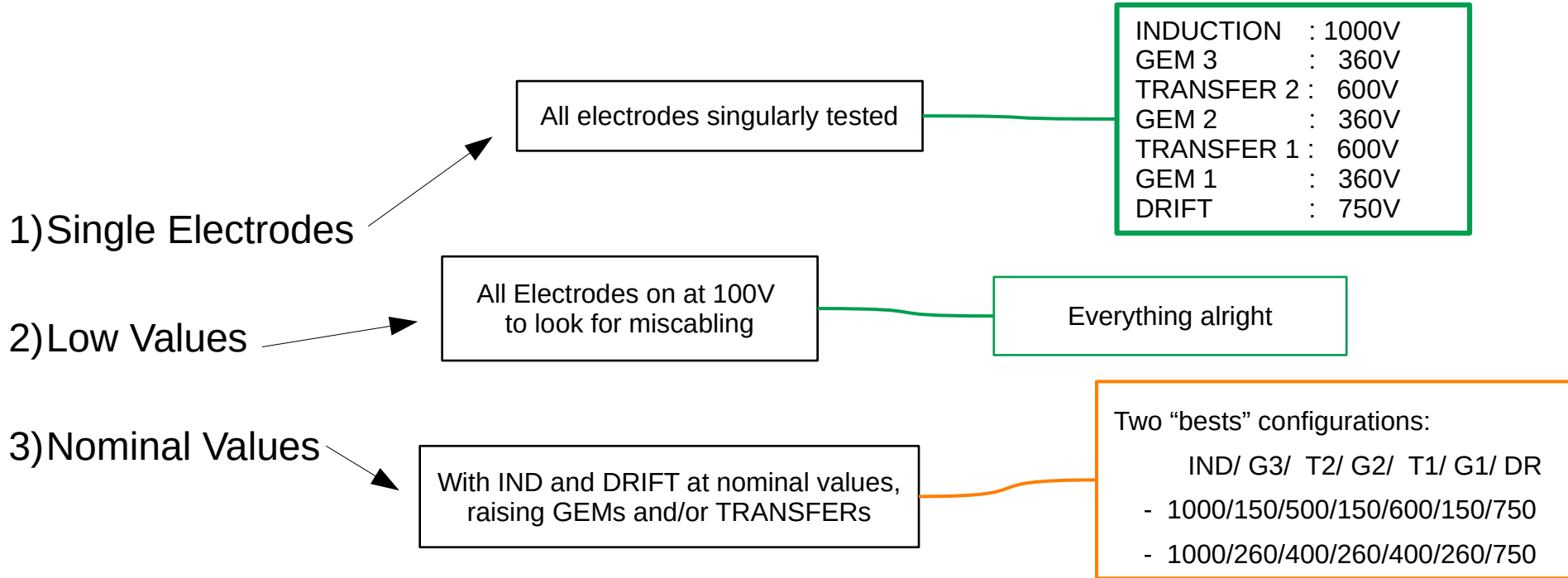
23-26 NOV 2020

25-29 JAN 2021

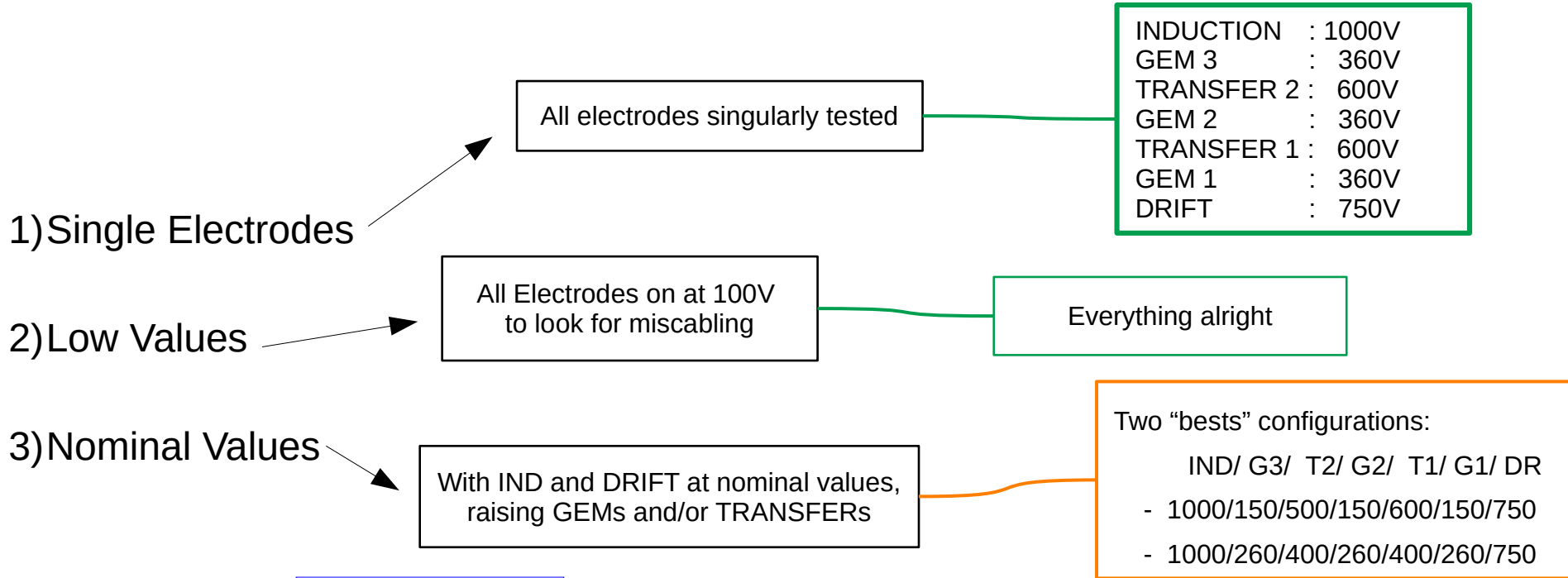
2-5 FEB 2021

22-25 FEB 2021

First Power ON

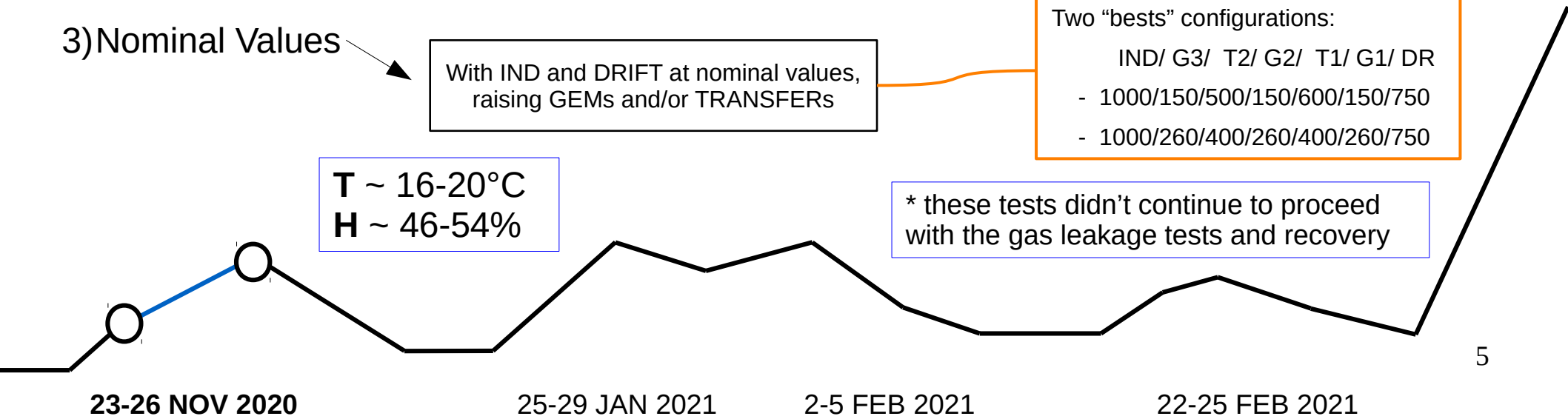


First Power ON



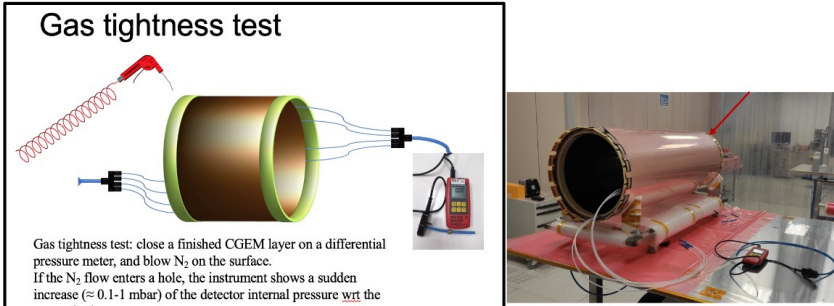
T ~ 16-20°C
H ~ 46-54%

* these tests didn't continue to proceed with the gas leakage tests and recovery



Test GAS

Gas tightness test



Gas tightness test: close a finished CGEM layer on a differential pressure meter, and blow N₂ on the surface. If the N₂ flow enters a hole, the instrument shows a sudden increase ($\approx 0.1-1$ mbar) of the detector internal pressure wrt the atmospheric one.

by: Sandro C.

The first test showed a leakage

- glue sealing
- Following test showed no leakage

Monica's presentation

Nuovi test di tenuta gas in camera pulita

- Durante i test di validazione si inizia ad evidenziare una **notevole perdita di gas** (non presente all'uscita della camera pulita) di circa **30%**
- I primi di dicembre si fa upgrade del sistema di gas: flussimetri massivi in ingresso e misuratore di flusso in uscita (prestato da G.Bencivenni)
- si riporta in camera pulita assieme a sistema di gas e si cominciano ricerche di fughe (con metodo sovrappressione) e **sigillature a più riprese**:
 - perdite nei fori di spina (1,2)
 - man mano che si chiudono fori se ne trovano altri più piccoli non evidenziabili prima, nel contorno degli anelli (3), [essendo più stretti di L2 e L1, fanno meno tenuta gas nella zona in cui gli elettrodi sono incollati sugli anelli]
 - il gas filtra attraverso i fori di spina e trova strada all'interno dell'anello esterno dell'anodo
- si controlla ogni volta la perdita totale flussando con N₂, flussimetri massivi in ingresso e misuratore di flusso in uscita
- si arriva ad un **perdita finale dell'8%** ritenuta tollerabile



23-26 NOV 2020

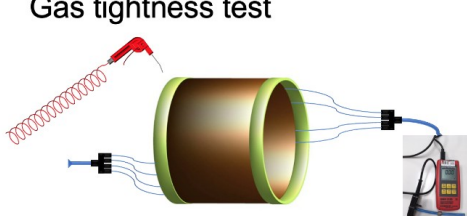
25-29 JAN 2021

2-5 FEB 2021

22-25 FEB 2021

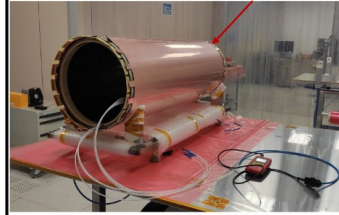
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Monica's presentation

- Ar CO₂ (premixed at the beginning, now with separate bottles)
- L3's volume ~12 l
- L1 & L2 passed the first checks without *big* leakages

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- si arriva ad un **perdita finale dell'8%** ritenuta tollerabile ✓

23-26 NOV 2020

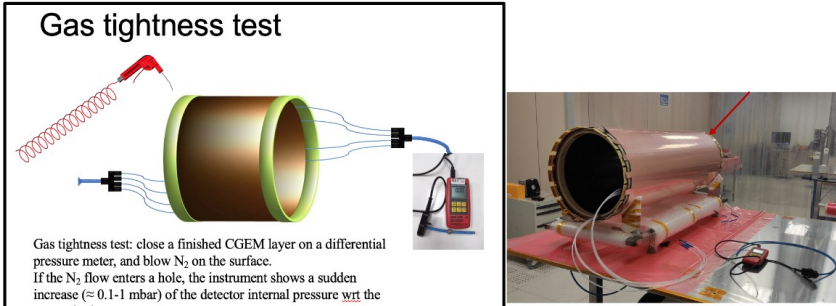
25-29 JAN 2021

2-5 FEB 2021

22-25 FEB 2021

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- si arriva ad un **perdita finale dell'8%** ritenuta tollerabile ✓

L3 suffered a hit before gluing

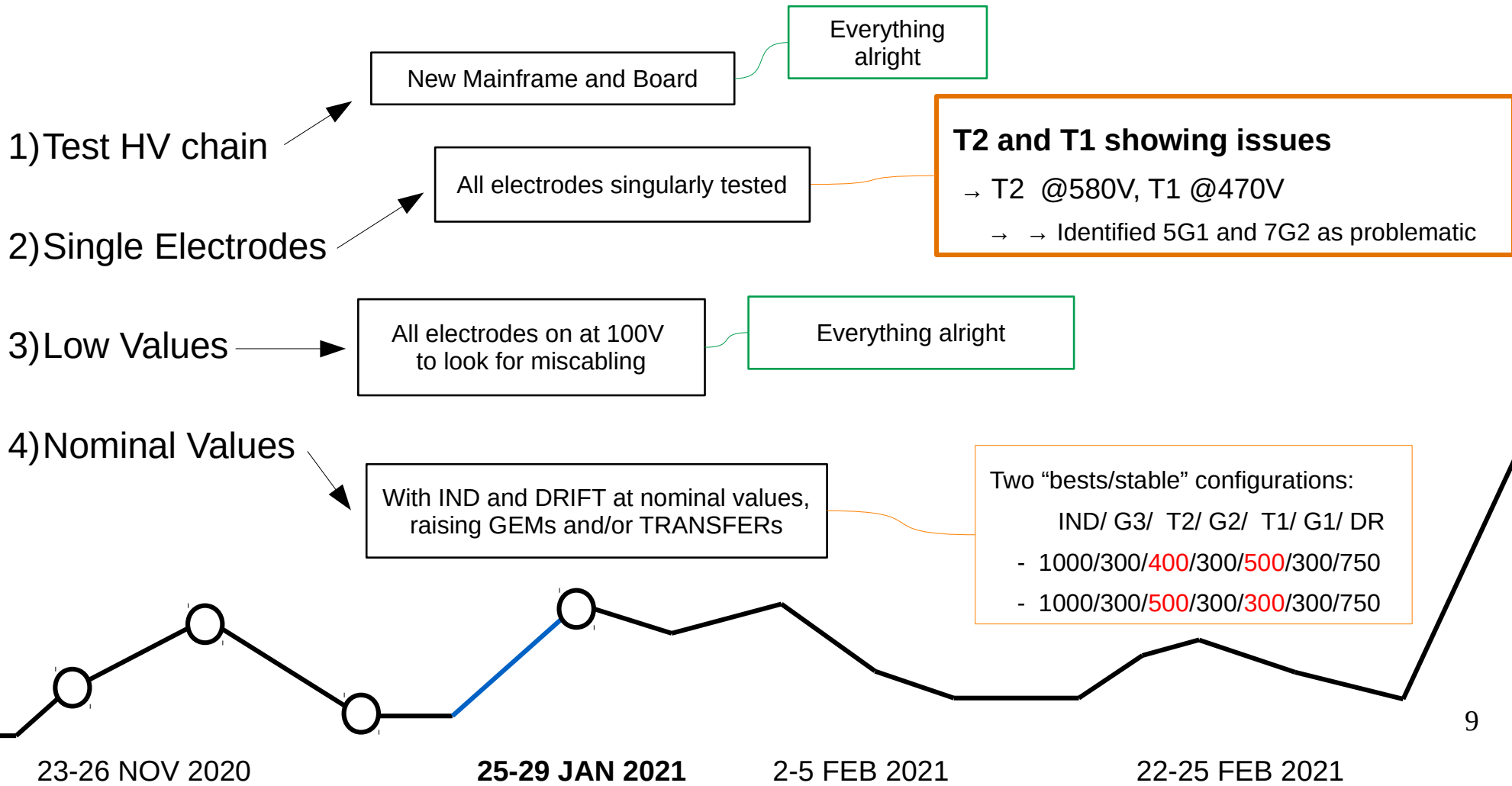
23-26 NOV 2020

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2-5 FEB 2021

22-25 FEB 2021

Second Power ON



Second Power ON

T ~ 13-25°C
H ~ 23-40%

1) Test HV chain

New Mainframe and Board

Everything alright

2) Single Electrodes

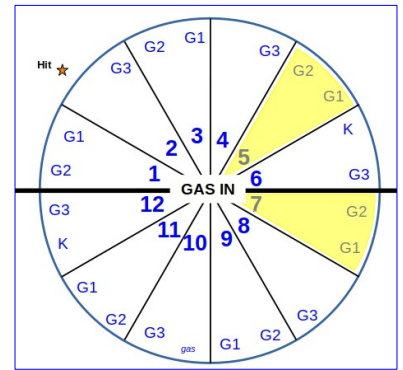
All electrodes singularly tested

T2 and T1 showing issues
→ T2 @580V, T1 @470V
→ → Identified 5G1 and 7G2 as problematic

3) Low Values

All electrodes on at 100V to look for miscabling

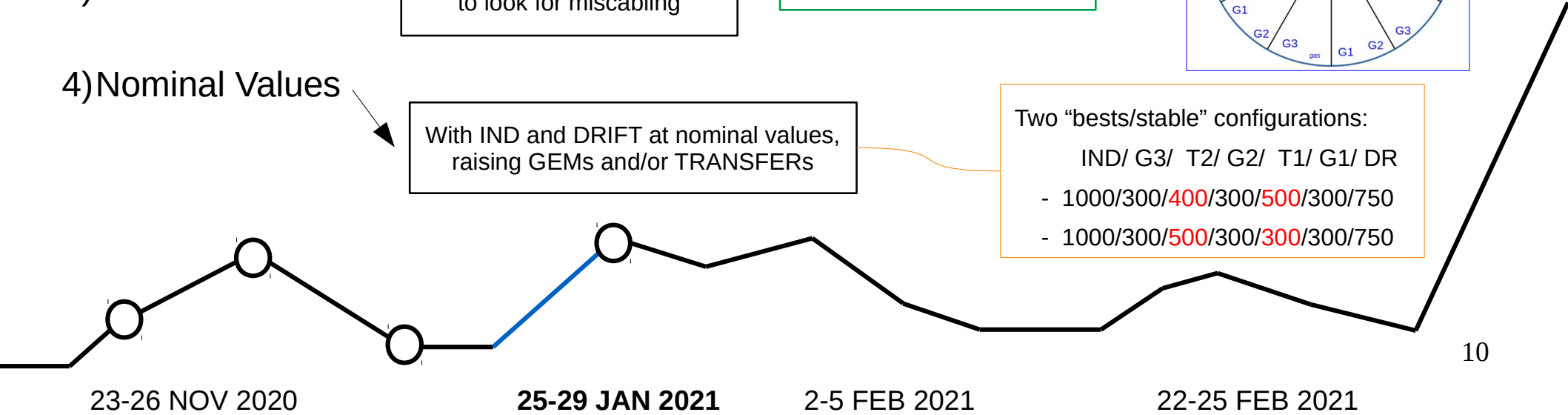
Everything alright



4) Nominal Values

With IND and DRIFT at nominal values, raising GEMs and/or TRANSFERS

Two "bests/stable" configurations:
IND/ G3/ T2/ G2/ T1/ G1/ DR
- 1000/300/400/300/500/300/750
- 1000/300/500/300/300/300/750



Tests

Looking for miscabling

Grounding

HV chain checks

Gas test

Gas checks

Megger Test

T2 and T1 showing issues

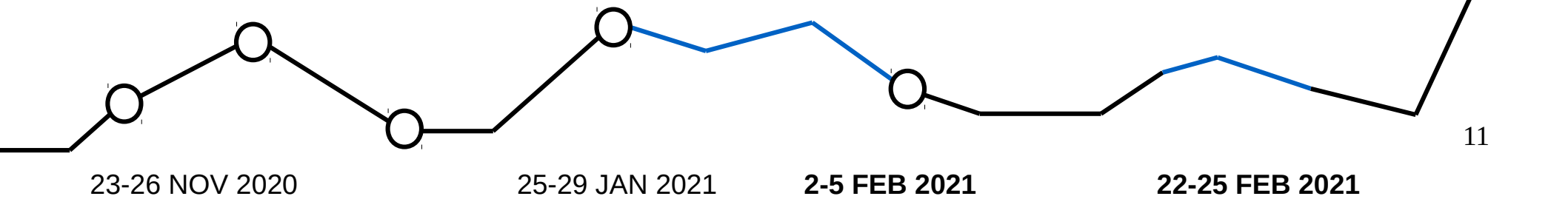
→ T2 @580V, T1 @470V

→ → Identified 5G1 and 7G2 as problematic

Mechanical test (FE)

Macro's mapping

Searching for working configuration



Tests

Looking for miscabling

Grounding

T2 and T1 showing issues

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HV chain checks

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Gas checks

Megger Test

Mechanical test (FE)

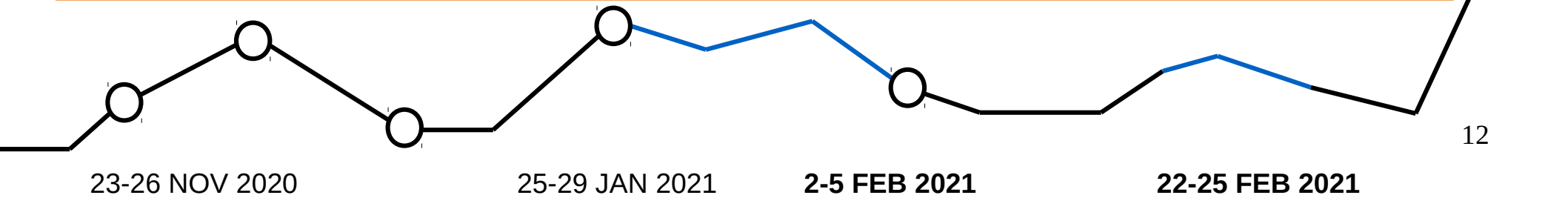
Macro's mapping

Searching for working configuration

Lots of cables and connections.

The HV chain was tested to validate the distribution more than once.

Only once (last week) we found an inversion that was promptly corrected.



Tests

Looking for miscabling

Grounding

T2 and T1 showing issues

→ T2 @580V, T1 @470V

→ → Identified 5G1 and 7G2 as problematic

HV chain checks

Gas test

Gas checks

Megger Test

Mechanical test (FE)

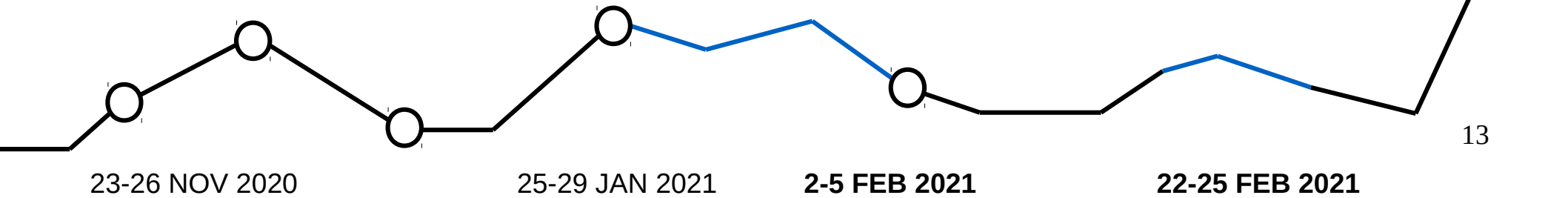
Macro's mapping

Searching for working configuration

The gas line have been checked multiple times.

Only once it seemed to have another leakage, but it was a false alarm.

Different **gas fluxes** have been tested. One test was performed also **switching IN/OUT** at the detector



Tests

Looking for miscabling

Grounding

HV chain checks

Gas test

Gas checks

Megger Test

T2 and T1 showing issues

→ T2 @580V, T1 @470V

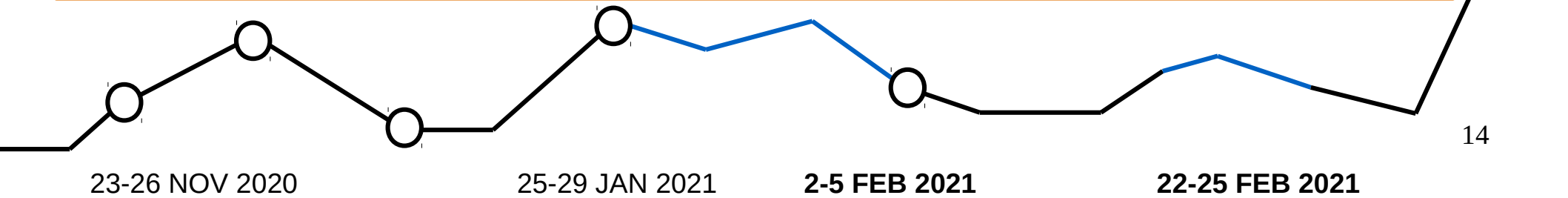
→ → Identified 5G1 and 7G2 as problematic

Mechanical test (FE)

Macro's mapping

Searching for working configuration

The Megger have been used on the two problematic sectors but no issues were found.



Tests

Looking for miscabling

Grounding

T2 and T1 showing issues

→ T2 @580V, T1 @470V

→ → Identified 5G1 and 7G2 as problematic

HV chain checks

Gas test

Gas checks

Megger Test

Mechanical test (FE)

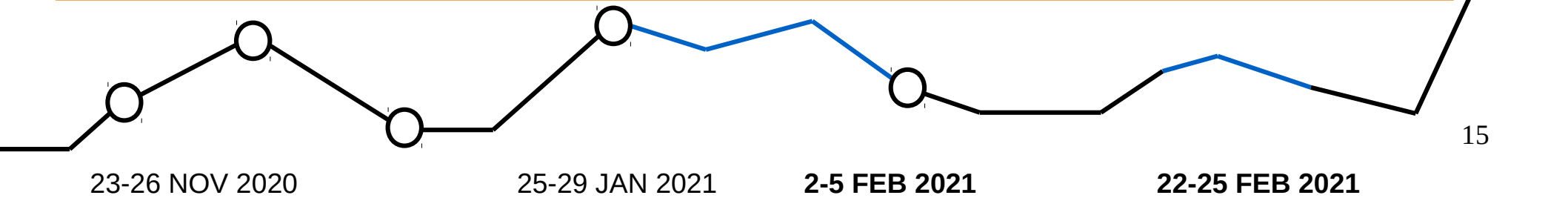
Macro's mapping

Searching for working configuration

The grounding were improved several times.

The ground plane and the Faraday cage are now connected together.

They are used as HV reference and are connected to the chassis with a 10MΩ resistance.



Tests

Looking for miscabling

Grounding

T2 and T1 showing issues

→ T2 @580V, T1 @470V

→ → Identified 5G1 and 7G2 as problematic

HV chain checks

Gas test

Gas checks

Megger Test

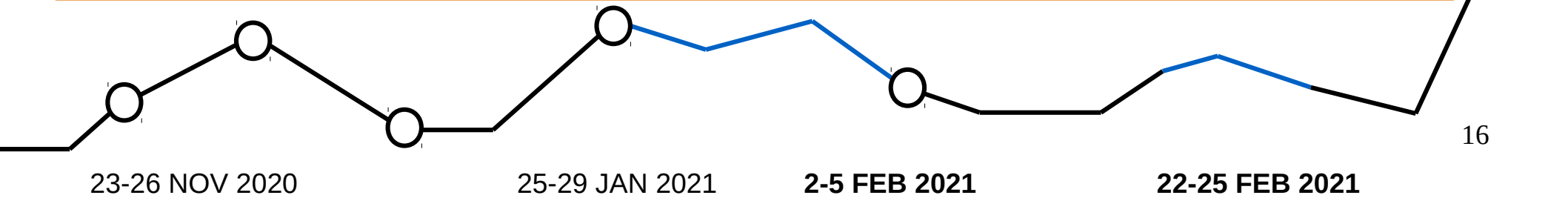
Mechanical test (FE)

Macro's mapping

Searching for working configuration

To register the maximum value for each gap and each sector.

Starting from the naked layer, we re-cabled one macro at time, one GEM at time, and powered the transfers up to 700V. The tests confirmed the issued on 7G2 (max 550V) and 5G1 (max 690V).



Tests

Looking for miscabling

Grounding

T2 and T1 showing issues

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HV chain checks

Gas test

Gas checks

Megger Test

Mechanical test (FE)

Macro's mapping

Searching for working configuration

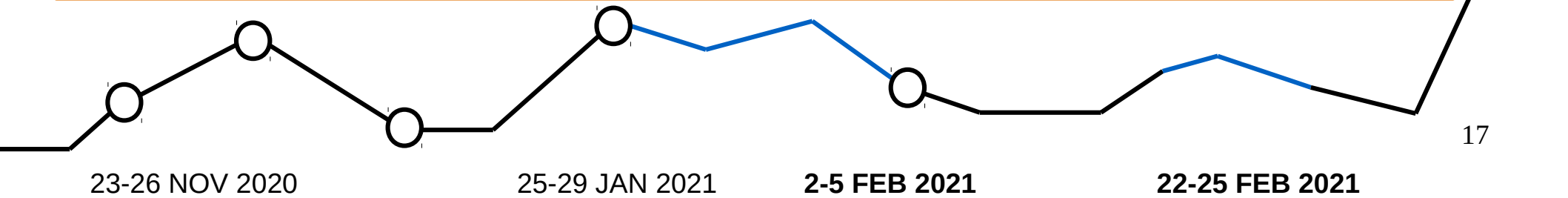
To understand the possible effects of the impact on the detector. In Ferrara we have only the anode and the GEM3.

Tested at different heights over a M8 to see when G3 is affected.

>5cm fall, the fiber is punctured;

>10cm fall, the GEM is touched.

Trying to understand the force of the impact with a load cell.



Tests

Looking for miscabling

Grounding

HV chain checks

Gas test

Gas checks

Megger Test

T2 and T1 showing issues

→ T2 @580V, T1 @470V

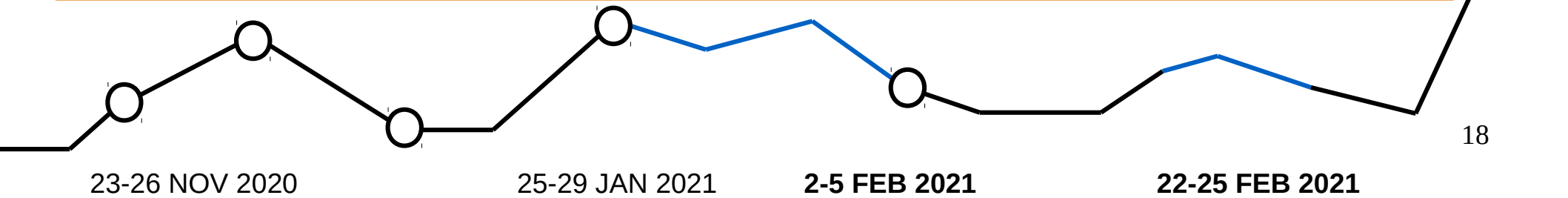
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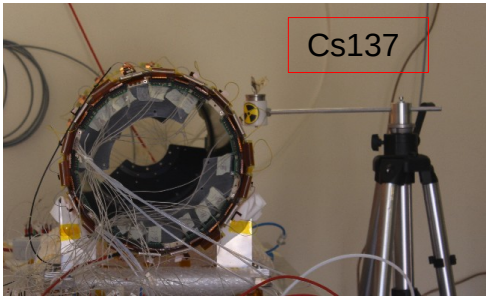
Mechanical test (FE)

Macro's mapping

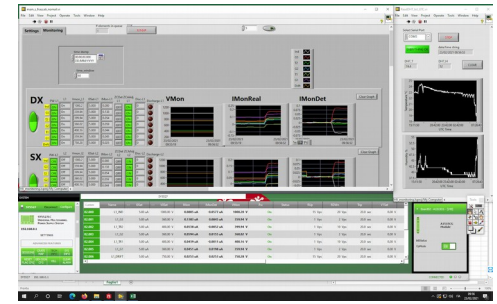
Searching for working configuration

All the rest of the time (mostly remotely) we worked to find a stable condition with HV values as close as possible to the nominal values.





Source Tests

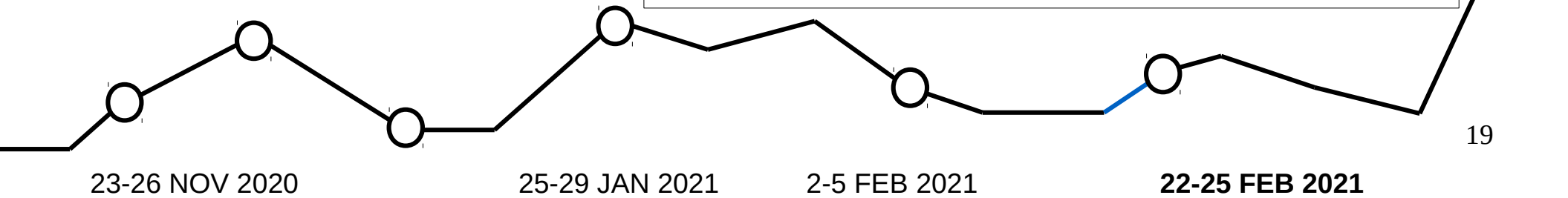


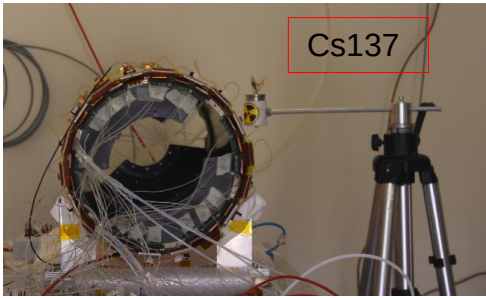
- Source pointing/emitting toward the floor
- Good sectors close to the source
- Nothing inside the detector

- Induced difference in current:
G3 IDet ~ 80nA
- Few discharges during operations
- IND, GEMs, DRIFT at nominal values:
1000V, 360V, 750V
- T~ 19°C, H ~ 50% (stable during this test)

Test of different configurations, measuring G3's I Det:

- all connected (L3 all) and w/o 2 sectors (L3 cut)
 - with all the sectors connected
 - without the full problematic sector
(7 and 5, no G1, G2 and G3)
- T2 and T1 at different values
 - 400V – 400V minimal efficient value
 - 450V – 550V maximum values reached
 - 600V – 600V nominal values
- only 3 good sectors connected; Source outside/inside L3
 - 9, 10 and 11
 - close to the source if placed as in the picture
 - for the test “inside” we rotated the detector to have these sectors right below the source

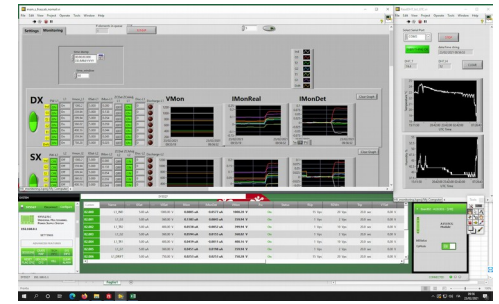




Source Tests

Test of different configurations, measuring G3's I Det:

- all connected (L3 all) and w/o 2 sectors (L3 cut)
- T2 and T1 at different values
- only 3 good sectors connected; Source outside/inside L3



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- Nothing inside the detector

- Induced difference in current:
G3 IDet ~ 80nA
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- IND, GEMs, DRIFT at nominal values:
1000V, 360V, 750V
- T~ 19°C, H ~ 50% (stable during this test)

T2 [V]	T1 [V]	I Det [uA]: L3 ALL	I Det [uA]: L3 CUT	I Det [uA]: EXT	I Det [uA]: INT
400	400	85	86	X	X
450	550	130	103	X	X
600	600	X	120	90	140



No differences, the source was not close to the problematic sectors



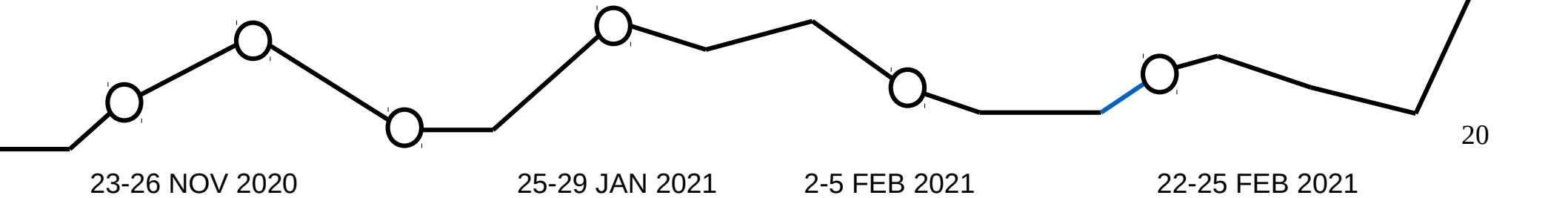
~20% difference, pro L3 all



L3 cut gains performance with higher HV



Source from inside is better, to be considered for future tests



Now

Remotely testing HV configurations
With local check on the detector

T2 and T1 showing issues
→ T2 @580V, T1 @470V
→ → Identified 5G1 and 7G2

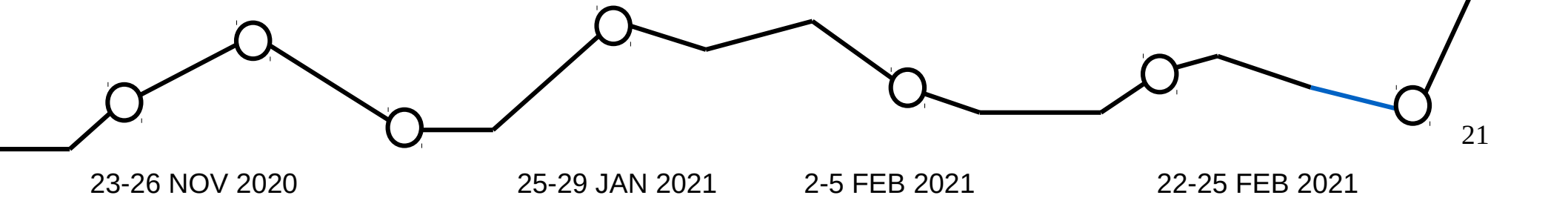
2 micros disconnected:
→ 10G1m10
→ 7G1m17

With IND and DRIFT at nominal values, raising GEMs and/or TRANSFERS

Some configurations tested: @3MAR2021

- 1100/300/400/300/550/300/750
- 1000/300/400/300/500/300/750

These days the transfer won't raise above these values, even if in the past they reached higher values.



Next

- X-Ray measurements

- CT scan

- Transport

- Source Test

- Look inside the detector
- Before AND After the trip

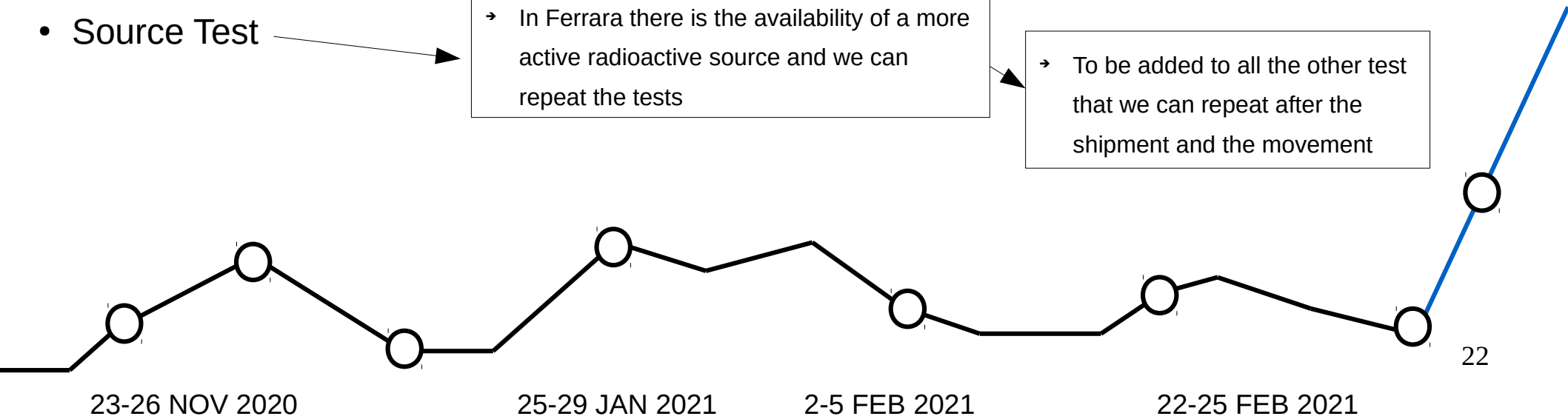
- CT scan in Modena probably
- Still investigating the possibilities to perform a measurement before moving it

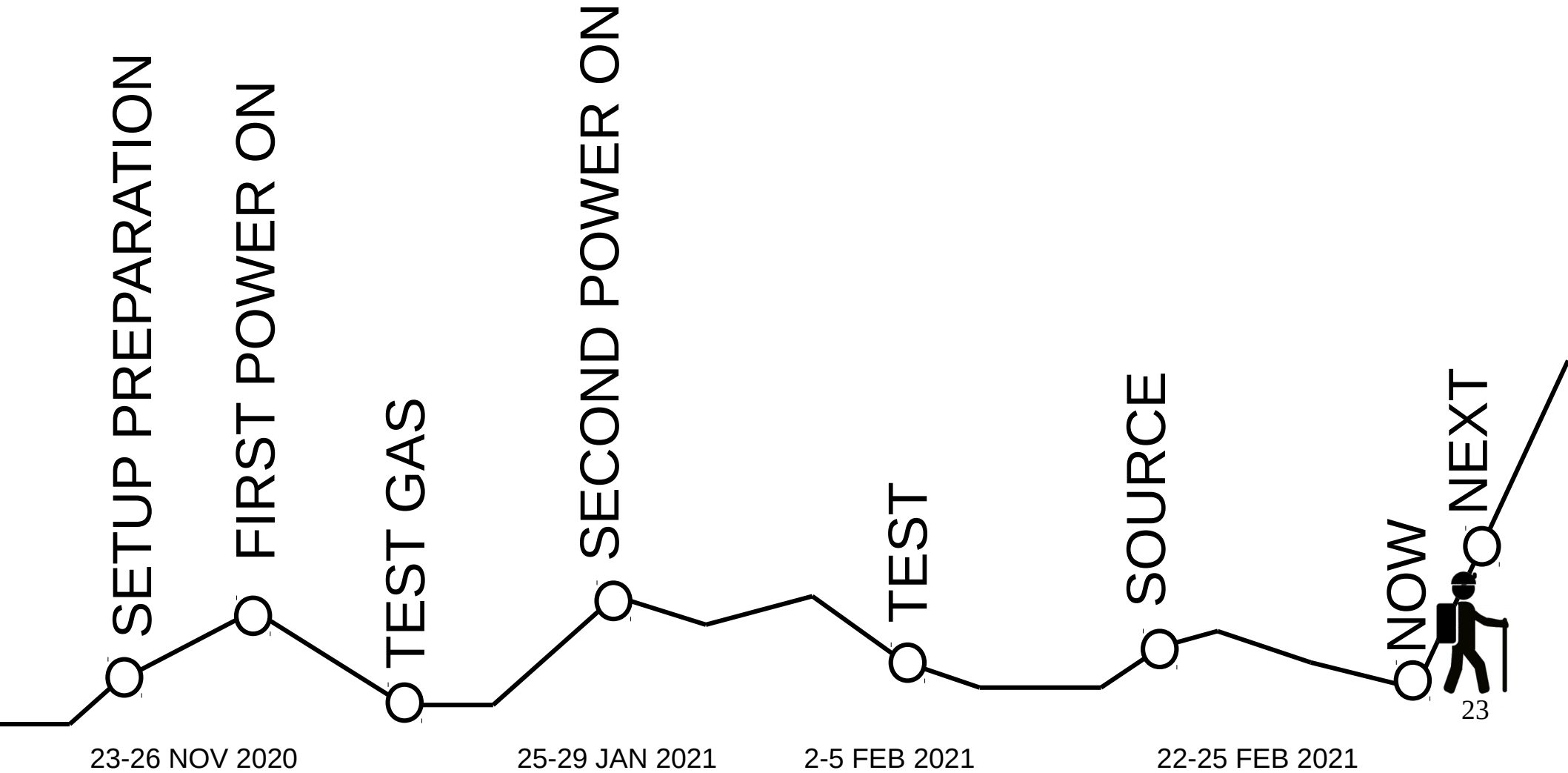
- Test it in Italy since we can still not move

- Again with Montenovi, on wheels

- In Ferrara there is the availability of a more active radioactive source and we can repeat the tests

- To be added to all the other test that we can repeat after the shipment and the movement





Thank You

