

LINAC & BTF

L.Foggetta on the behalf of

LINAC/BTF Group


Researchers (5):

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D. Di Giovenale, C. Di Giulio,
L. G. Foggetta
(Oct 2020)***

(From 17/11/2020 up to May 2021)




Technicians (6):

***R. Ceccarelli, A. Cecchinelli,
G. Piermarini, A.L. Rossi,
S. Strabioli, R. Zarlenga
Retired: M. Belli, R. Clementi***

 = H24/7 DUTY

Scientific and technical FTE distribution:

Act. related to LNF ACC. Facilities for maintenance/development/shift

-  + TEX +  +  = **1,8 Scient's + 5 Technic's**

Act. related to BTF USERS and BTF maintenance/development/shift

-  +  + UA9@BTF = **1,1 + 0**

Act. related to LINAC/BTF usage for LNF internal project

- ERAD = **1 + 1**

OTHER LNF PROJECT

- CNS5(SINGULARITY, TUAREG...)+EUPRAXIA+SABINA = **1.1 + 0**

BRIEF ACTIVITIES SUMMARY

What we got from last SciCom

| | |
|---|----------------------------------|
| LINAC (Maintenance, Power-up, KlyC Conditioning, Beam tune) | 08 Jun 20 -> 02 Jul 20 |
| PADME Tech-RUN2 (in time, as planned) | 03 Jul -> 07 Aug |
| LINAC (Maintenance, Power up) | 08 Aug -> 19 Sep |
| PADME Scient-RUN2 (delayed due to LNF power plant shutdown) | 20 Sep -> 01 Dec |
| BTF Beam Trial ERAD (conditioned primary, 20ns, 100MeV) | 02 Dec -> 03 Dec |
| BTF (Experimental area and Vacuum change for user run) | 04 Dec -> 23 Dec |
| LINAC (Main Vacuum upgrade, Kly ModC broken window fixing, Main Maintenance) | 04 Dec 20 -> 11 Jan 21 |
| LINAC (Power up for BTF/DAFNE, KlyC conditioning, shutdown for LNF power plant shutdown) | 12 Jan 21 -> UP TO NOW |
| BTF USER RUN (SHIP run opportunistic run) | 20 Jan -> 23 Jan |
| BTF DIAGNOSTIC (diagnostic upgrade and sub elements tests before shutdown) | 25 Jan -> 07 Feb |

No days lost

BTF 2 installation started on: 08/02/21

BTF

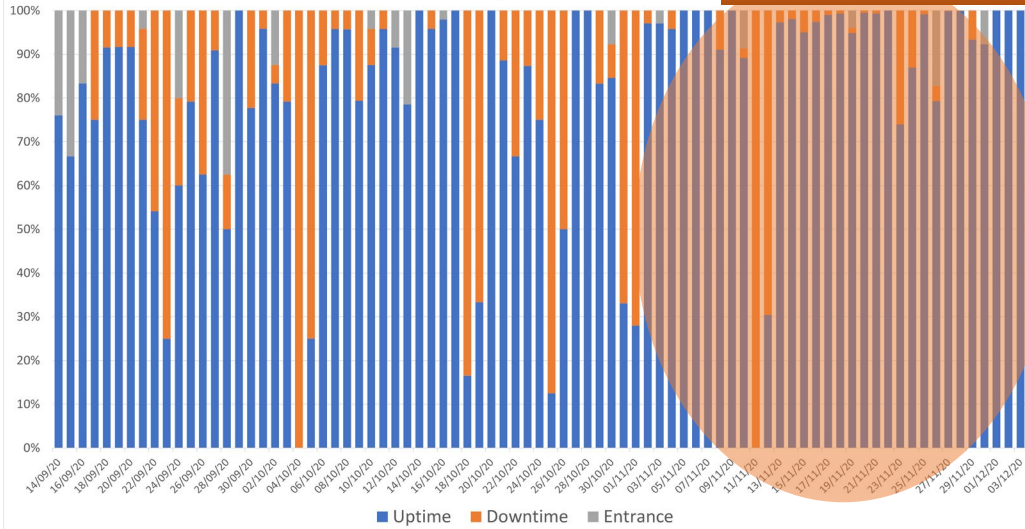
EXPERIMENTAL ACTIVITIES

PADME SCIENT - RUN 2 - CONCLUSIONS

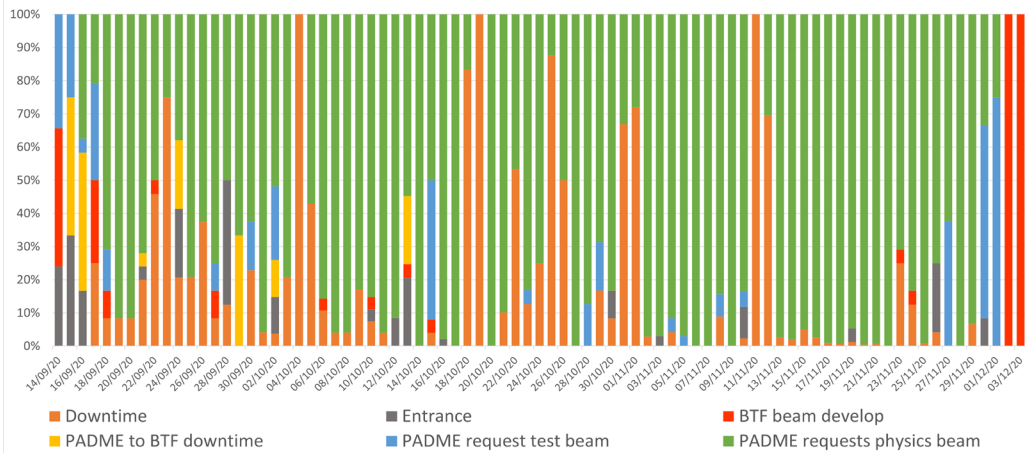
Sci-Run2 ends on 01/12/2020

Last month uptime = 0.93 (two days stop)

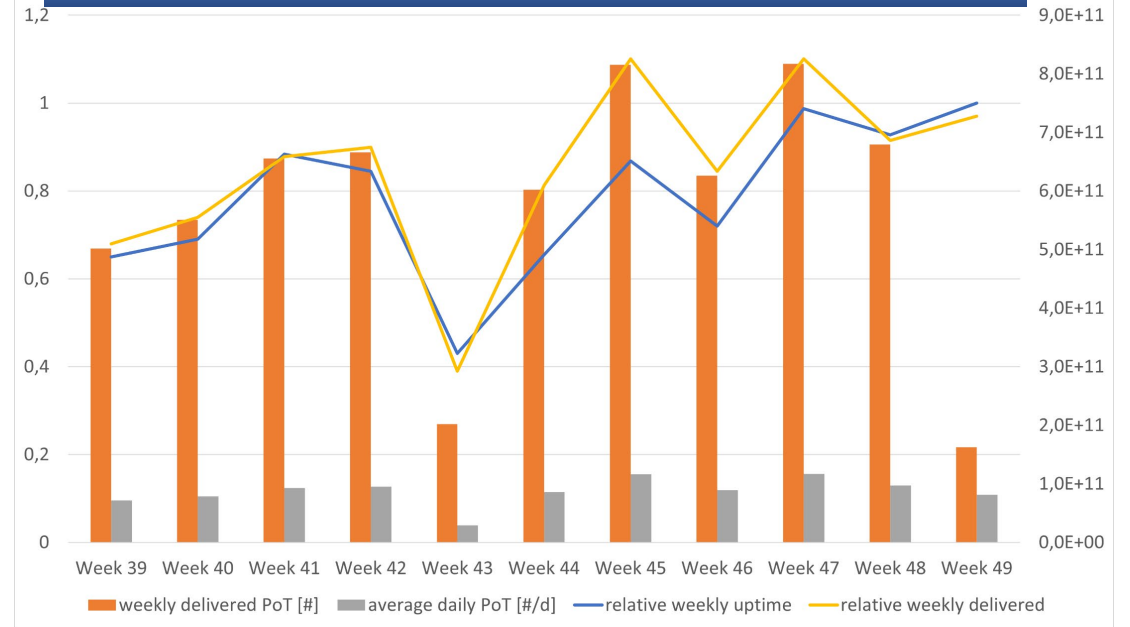
BTF performance sheet



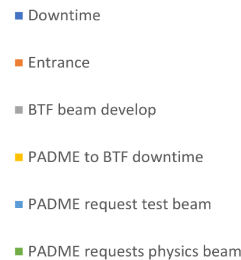
BTF activities sheet



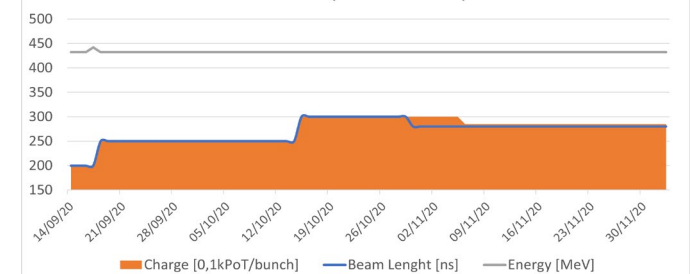
Good agreement w PADME integrated lumi



Sci. Run 2 activities



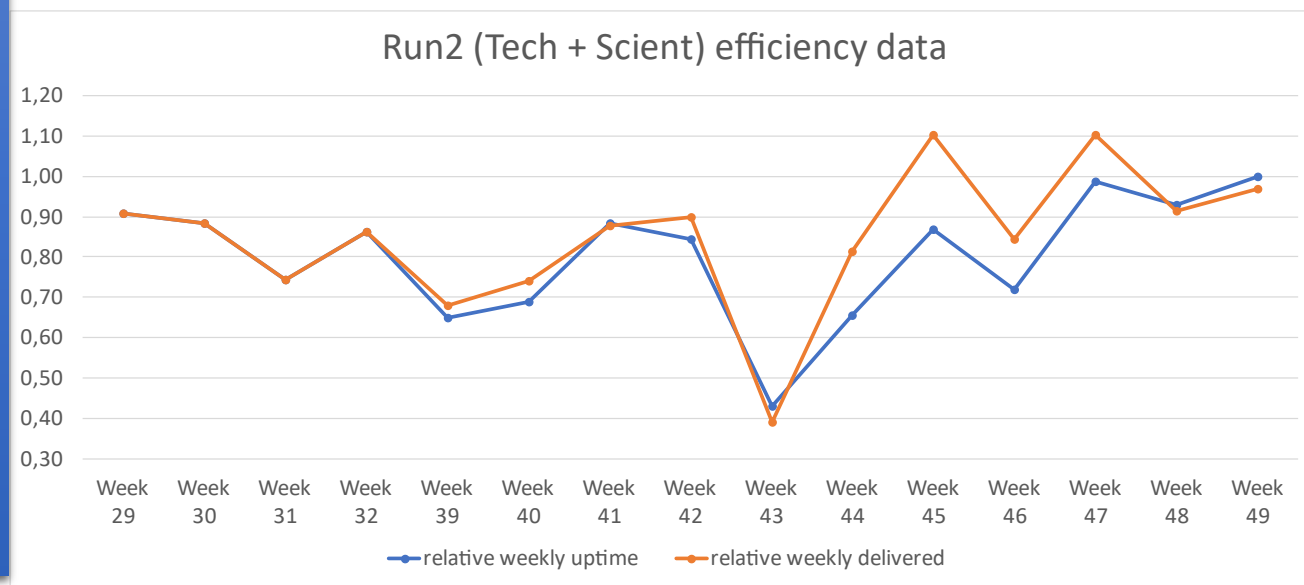
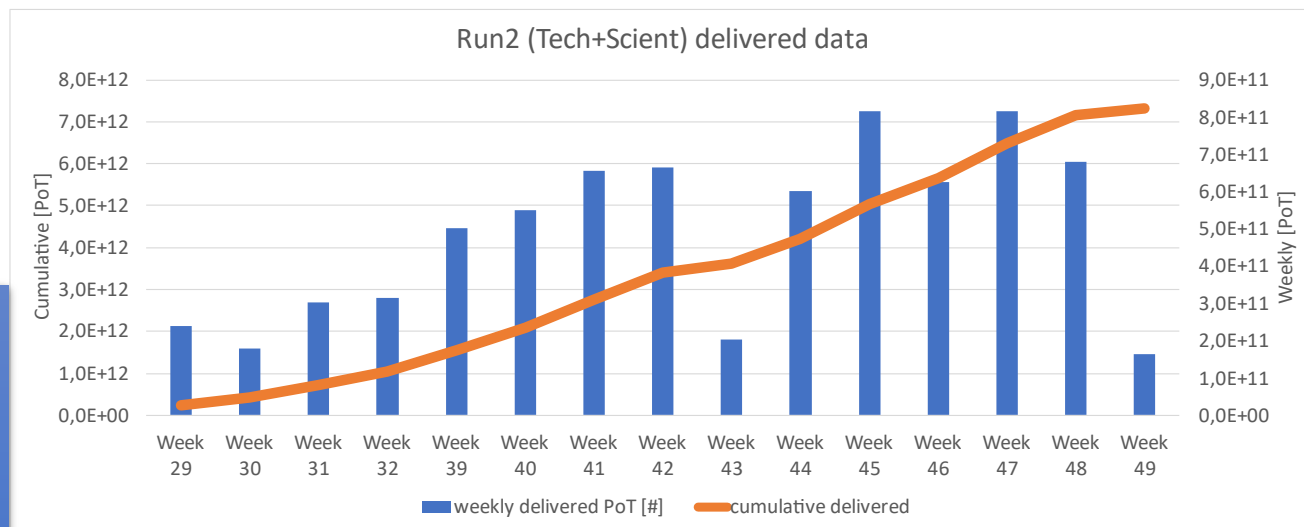
PADME steady state beam specs



PADME RUNS - OVERALL DATA

| Item | RUN2 Tech | RUN2 Scient | Overall |
|---------------------------|-----------|-------------|----------|
| relative weekly uptime | 0,85 | 0,80 | 0,81 |
| weekly delivered PoT [#] | 1,04E+12 | 6,28E+12 | 7,32E+12 |
| average daily PoT [# /d] | 4,50E+10 | 8,68E+10 | |
| relative weekly delivered | 0,85 | 0,85 | 0,85 |

- Congratulation to the PADME collaboration
 - Difficult times leads to better collaboration, we enjoy these very good results and the time we spent together
- **Errors less than 10%**
- **Beam stability** (physics parameters) **good** (see Piperno presentation)
- **LINAC performances increases** during RUN2
 - **Beam flat pulse lenght** over 320ns
 - **Down to Single particle primary beam**
 - Fault frequency lowered
 - LINAC diagnostics increases:
 - Sensibility and Logging data via MemCached



BTF BEAM 150 MEV IRRAD

REGIONAL FUND

AIMS:

The general aim of the project is the use of electron sources, available at the INFN-LNF to measure the behavior and resistance of electronic components intended to be subjected to radiation in the aerospace environment.

The values and results acquired with these measurements will be compared with homologous measurements performed with photons in order to define comparative resistance thresholds and related indicators.

ERAD @ BTF

Lucia Sabbatini, Bruno Buonomo

INFN TEAM : Bruno Buonomo, Luca Foggetta, Claudio Di Giulio,
Domenico Di Giovenale, Fabio Cardelli



eRAD
Test di resistenza alle radiazioni per componenti
aerospaziali

Started 11/06/2020 Duration 2 years

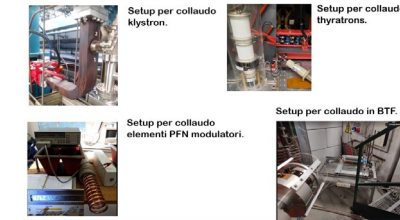
- Status of the project month 14/22
- 2 Deliverable done
- Beam time request ~ 3 months high intensity beam @ BTF
- LINAC Measurements time request ~1 month, on the next July



TOTAL FTE involved in the project
(0.2+0.3+0.3+0.4+0.4+0.2+0.2 =2 FTE)
(thanks to C. Conti, S. Silvi, L. Sabbatini)

| Bando Regione Lazio n° POR FESR LAZIO 2014-2020 "Progetti Strategici" | |
|---|---|
| eRAD | |
| Test di resistenza alle radiazioni per componenti aerospaziali | |
| DELIVERABLE REPORT | |
| MANUALE DEI REQUISITI OPERATIVI | |
| D1.1 | |
| Documento N.: | ERAD-2020-D1.1 |
| Data di consegna: | Da Mese 5 (Nov. 2020) a Mese 8 (Feb. 2021) |
| Data: | 12/01/2021 |
| Work package: | WP1: Studio requisiti di prova e definizione protocolli |
| Lead beneficiary: | eRAD Teams |
| Document status: | 12/01/2021 |

WP4 Setup collaudi LINAC-BTF



| Bando Regione Lazio n° POR FESR LAZIO 2014-2020 "Progetti Strategici" | |
|---|---|
| eRAD | |
| Test di resistenza alle radiazioni per componenti aerospaziali | |
| DELIVERABLE REPORT | |
| RAPPORTO DI PROVA LINAC-BTF | |
| D4.1 | |
| Documento N.: | ERAD-2020-D4.1 |
| Data di consegna: | A Mese 8 (Feb. 2021) |
| Data: | 26/02/2021 |
| Work package: | WP1: Rapporto di prova LINAC-BTF |
| Lead beneficiary: | eRAD Teams |
| Document status: | 12/01/2021 |
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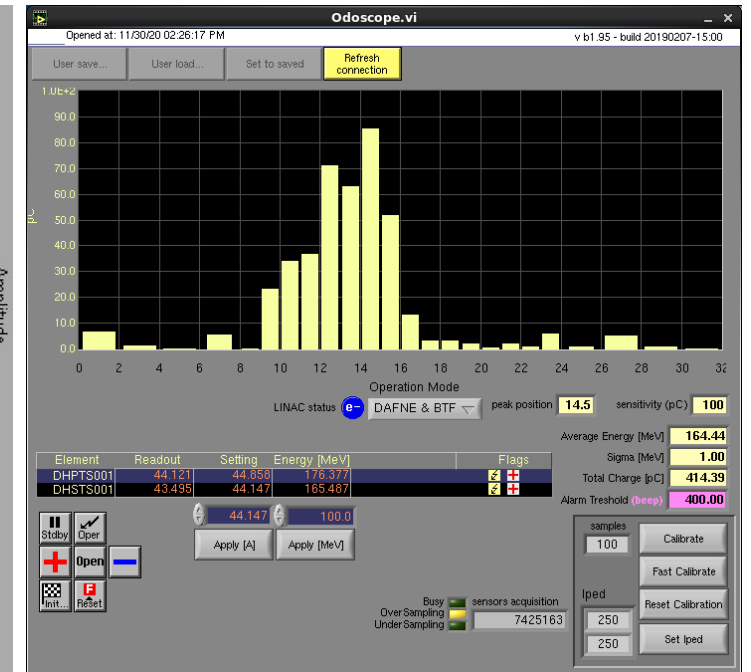
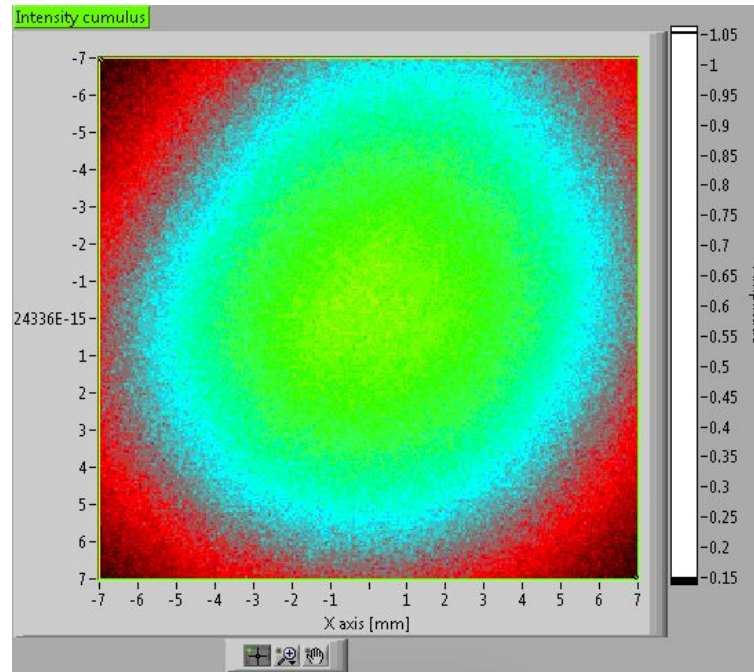
BTF BEAM 150 MEV DEVELOPMENT

BTF for SPACE related RAD hardness test

- Goal to achieve 150MeV primary beam
- 20->100ns beam pulse time
- Shot over 10^6 -> 10^{10} electron per bunch
- Narrow energy spread
- Broad X/Y dimensions ($\sim \text{cm}^2$)
- Overall tolerance on 10%

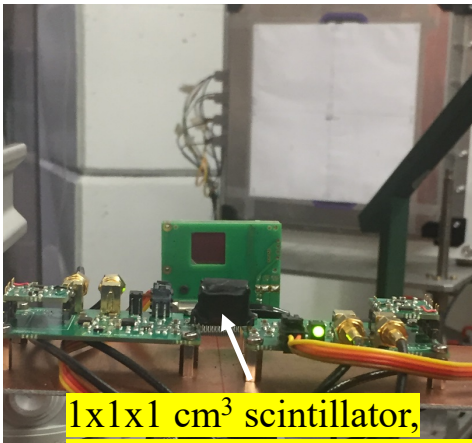
First trials on DEC-2020:

- 164 MeV achieved
- 20ns pulse time
- Test on lower charge due to FitPIX saturation (but well under charge limits)
- Counter phased modulators
- Energy spread less than 1%

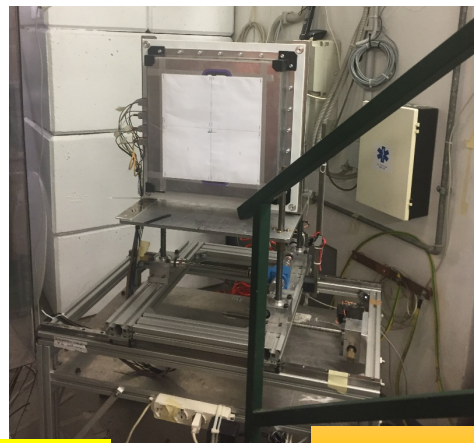


EXTERNAL EXPERIMENTAL RUN

- **Panel Selection for single shot** (5 days) availability programmed in December, run in January, with one 2019 delayed team
 - Restriction to only INFN-LNF people
 - Needs of a new remote movable platform due to very narrow exp. space (straight line at BTF1)
 - Hard shaped timing and go-nogo alert of just one week (LINAC restarting & conditioning, Mains shutdown start days...)
 - Low intensity secondary beam with DAFNE specs
- Only one survived this hard selection then assigned to SHIP (G. Lanfranchi et al.)
 - Due to mains shutdown earlier than expected => rush to gain one week => we got it (all)

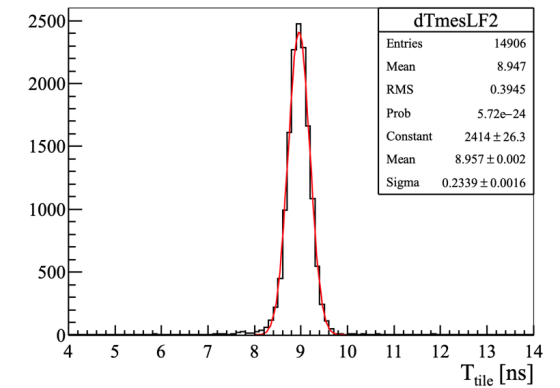
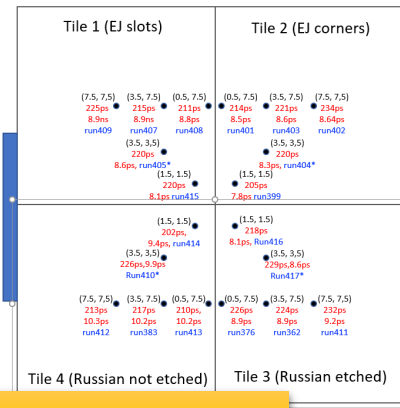


1x1x1 cm³ scintillator,
read out by 2 sipm at two opposite sides



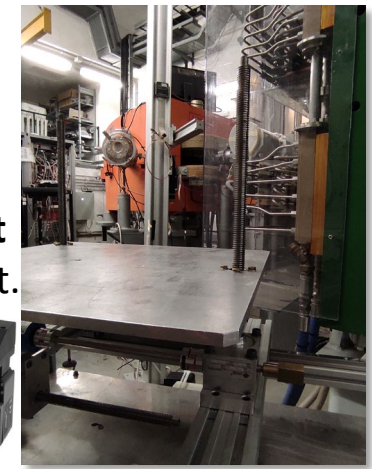
Courtesy of SHIP group

Scan results: time resolution and time average



Once subtracted trigger time jitter: time resolution ~ 210 ps

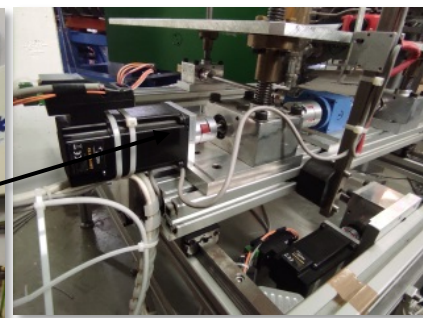
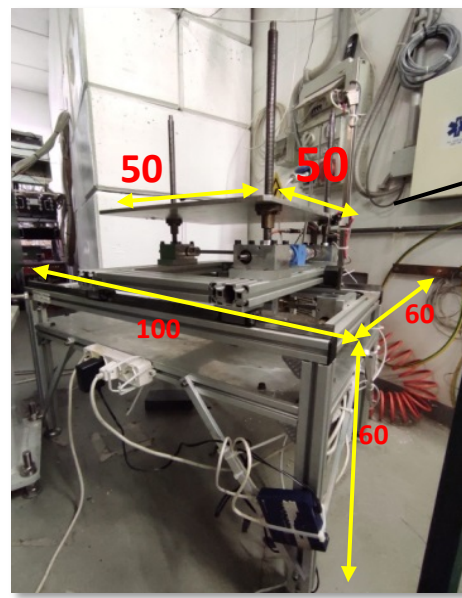
NEW REMOTE TABLE (AND THE OLD ONE)



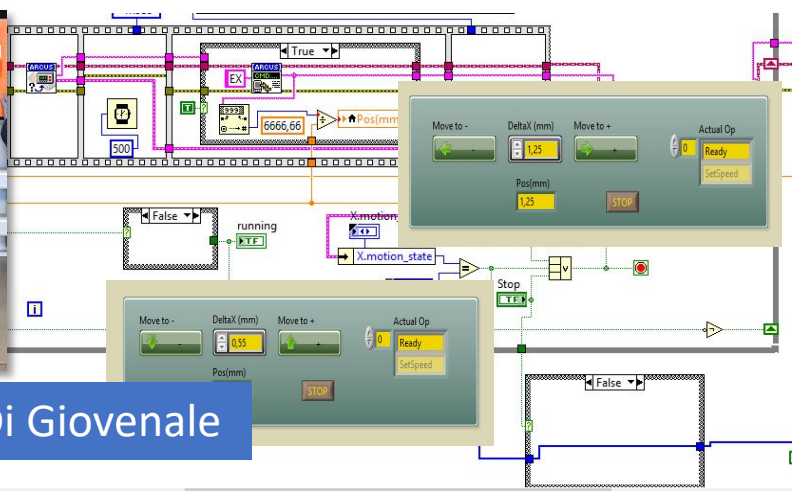
Using SHIP collaboration experience, to fit in new EH and ERAD project DMX-ETH integrated stepper controller + driver + motor motion product.

Communication and control of the DMX-ETH:

- is established over Ethernet via TCP/IP protocol
- using software developed in LabView.



Gear ratio 20:1 \Rightarrow **Linear displ.: 150 μ m/rev**
 Screw step 3mm
 1000 counts/rev incremental stepper and encoder
 Resolution \Rightarrow **0.15 μ m/step (Theoretical)**
20 μ m (actual)
 Max Load: **60kg**
 Status = **Ready**



D. Di Giovenale

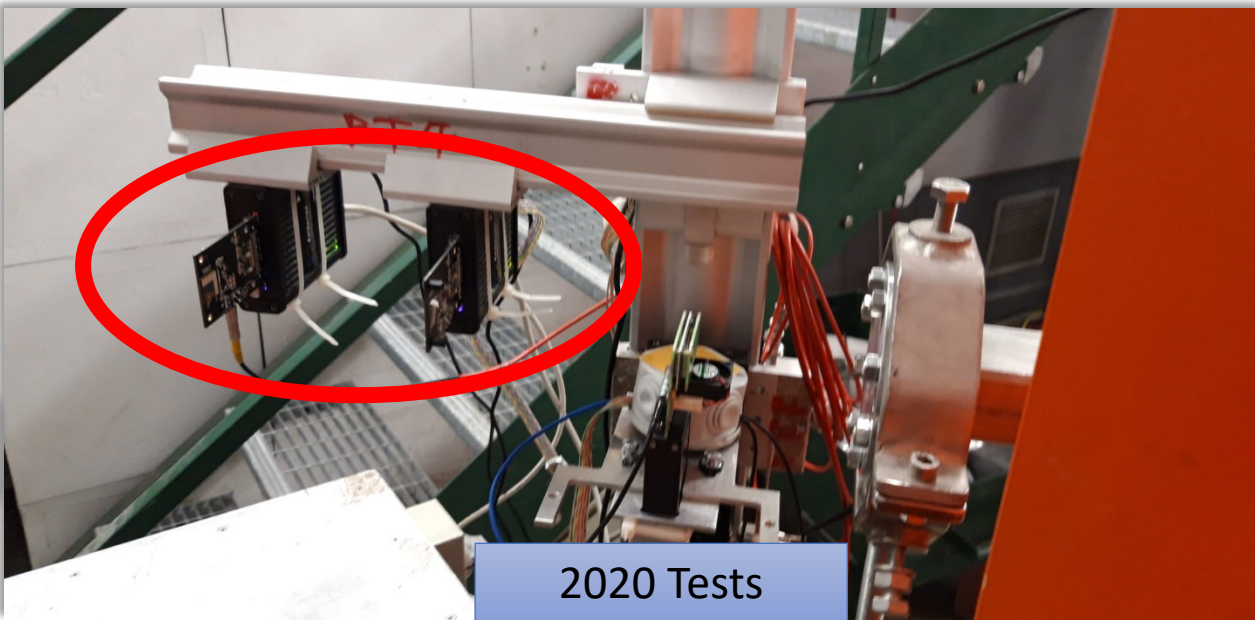


The old remote table is under development to fit in the new spaces
 Upgraded by LINAC service and Research Division (Thanks to G. Mazzitelli)

Resolution \Rightarrow **1 μ m/step (Theoretical)**
5 μ m (actual)
 Max Load: **200kg**
 Status = **Ready in 3 weeks**

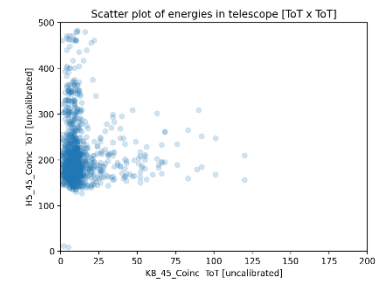
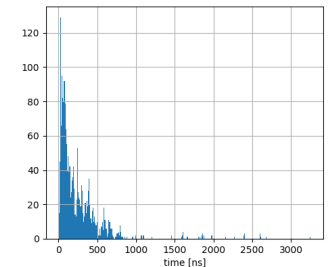
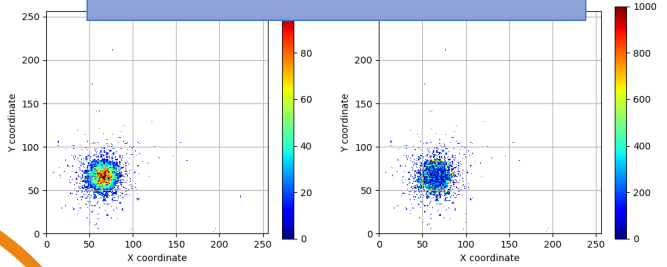
KATHERINE = Ethernet Embedded Readout Interface for Timepix3

- RJ45 plug – 1Gbit interface
 - No needs of standalone PC
- Easy included in BTF virtual machine environment
- Test Beam with native software
- Actually trials on BTF DAQ
- Debugging a BTF solution for compact and portable tracker

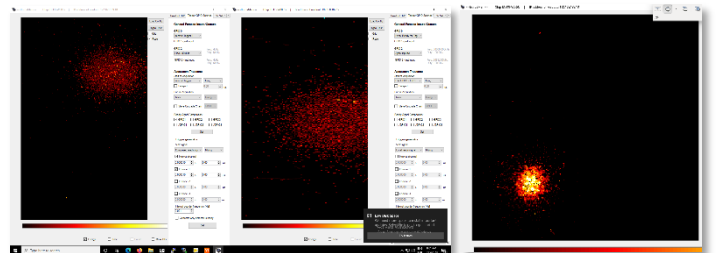
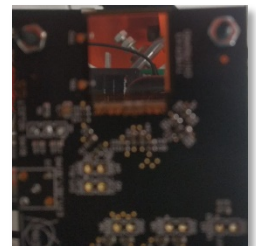


2020 Tests

BTF 450MeV beam



After SHIP testbeam waiting a new version of **dual KATHERINE**
 After two weeks of customs delay the parcel was lost in other stocks
 So starting BTF2 installation
 => shutdown the BTF facility



BTF UPGRADE

BTF2 ACTIVITIES SUMMARY

BTF 2 installation start and commissioning

- Magnet and vacuum deploy, align and final pumping
- Subsystem setup (PS&Vacuum Interlocks, Movements, Power, Fluids...)
- Magnets&Fluids&Interlocks Check and Commissioning
- Safety installation and commissioning
- DCS test and commissioning
- Final Civil works (BTFEH1, BTFEH2, external shielding)

08/02/21 -> up to now

08 Feb -> 16 Apr



12 Mar -> 8 Apr



9 Apr -> 16 Apr



6 Apr -> Up to now (est. 2w end)

16 Apr -> 30 Apr



4 May -> up to now (est. 3d end)

First beam trials expected on the second part of May 21

BTF2 COMMISSIONING – INSTALLATION RULES

COVID rule implementation - thanks to LNF Director and Sandro Vescovi (LNF - RSPP)

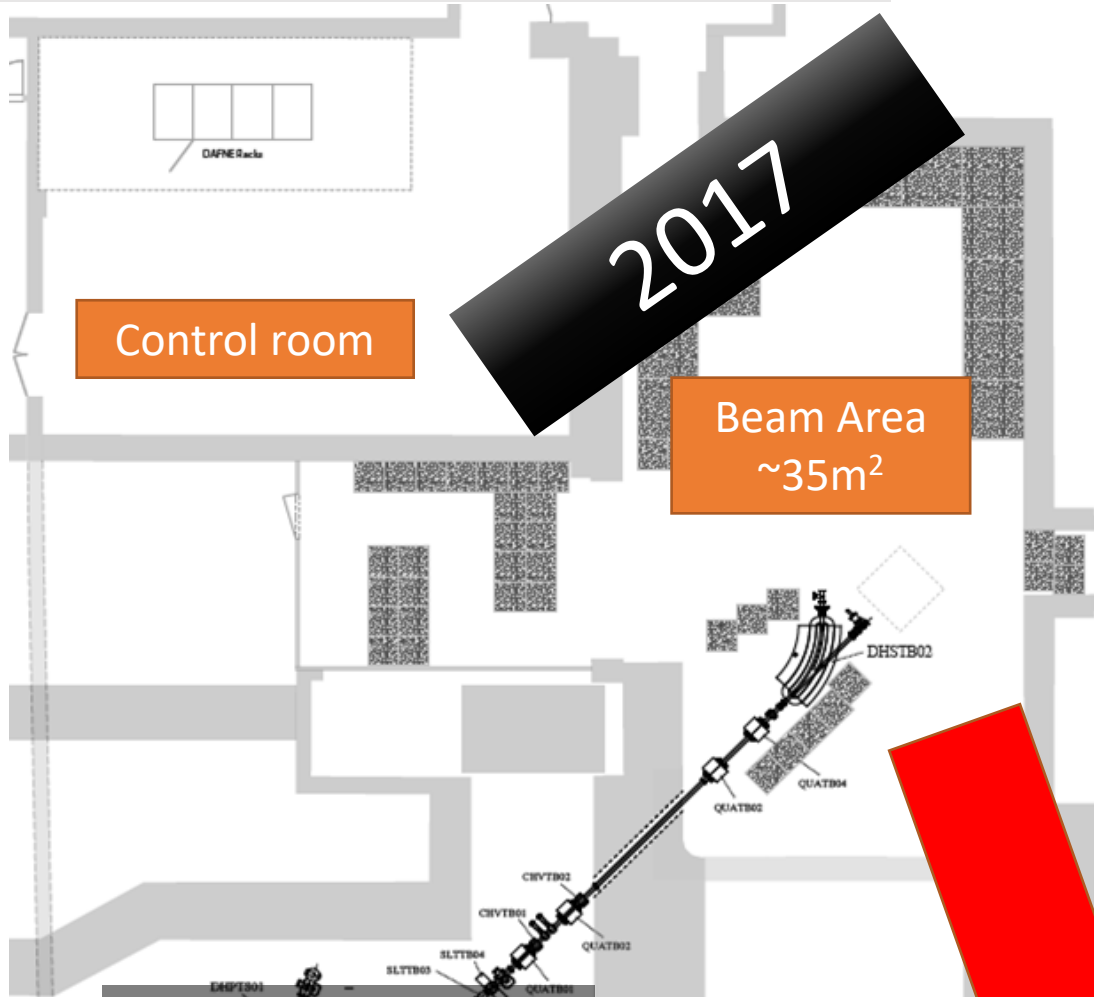
- Increased level of security due to closer space, people involved, many hours of closed contact: slowing installation timing but huge safety margin
- Just one BTF jolly to overlap work commissioning
- Strict timing and working bubbles rules:
 - One LNF service per day per area, no different LNF service overlapping
 - no superposition with external workers
 - Very hard to implement since almost all the people involved are DAFNE shifters
- Correct preparation of interventions by identifying first and second levels workouts:
 - In case of impossibility to execute the first level, the second overlaps due to more availability (people on call, easier preparation, easiness to completion)

At the end:

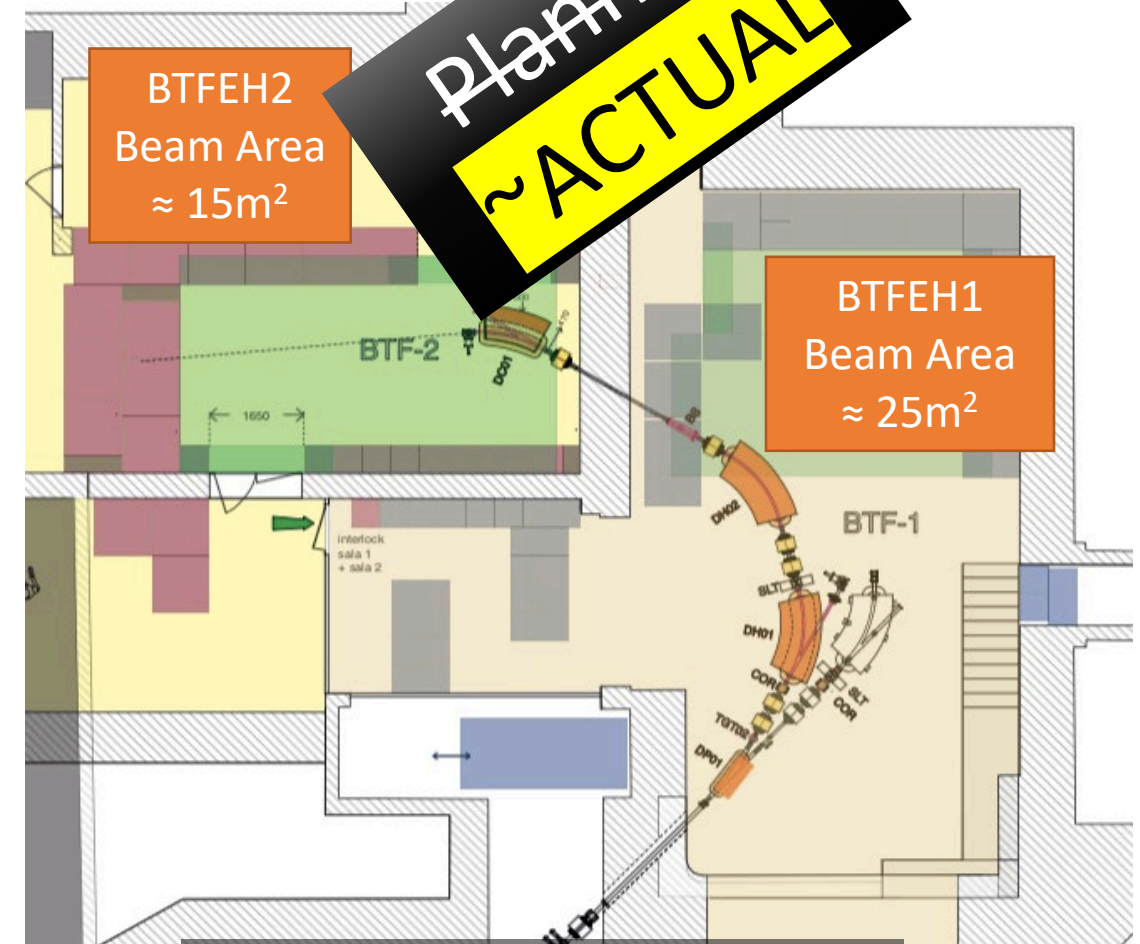
- Delayed start to wait KATHERINE parcel (at the end definitely lost)
- **Only three working day losing** due to unexpected events in three months
- **8 working days due to single COVID alert** (no further infections)
- Few days due to vacation (Easter)
- Gross total **50 w-day from scratch to final vacuum pumping** with all items in the correct place



LAYOUT



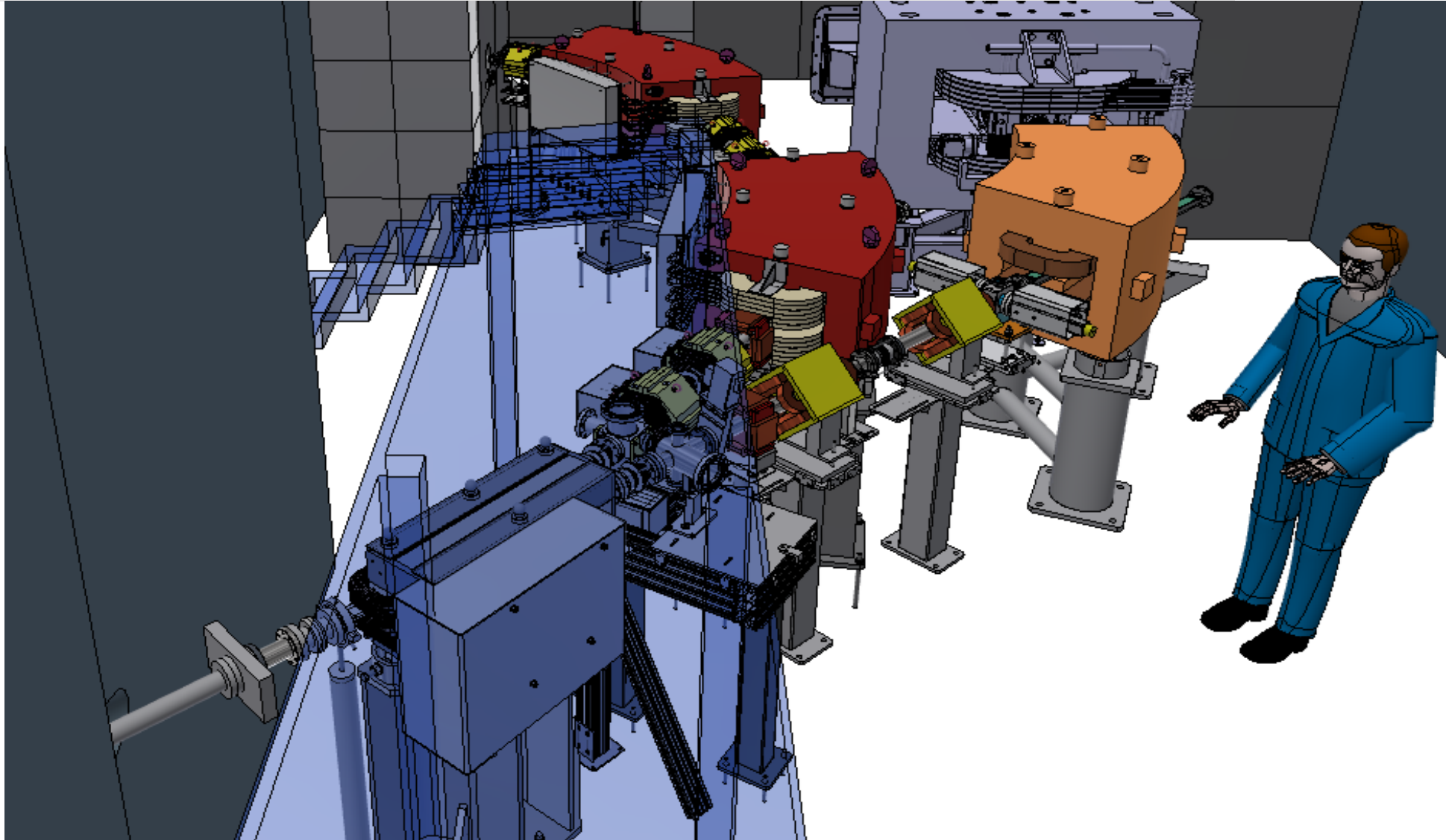
- Single Beam Line
- Near to BTF-CR



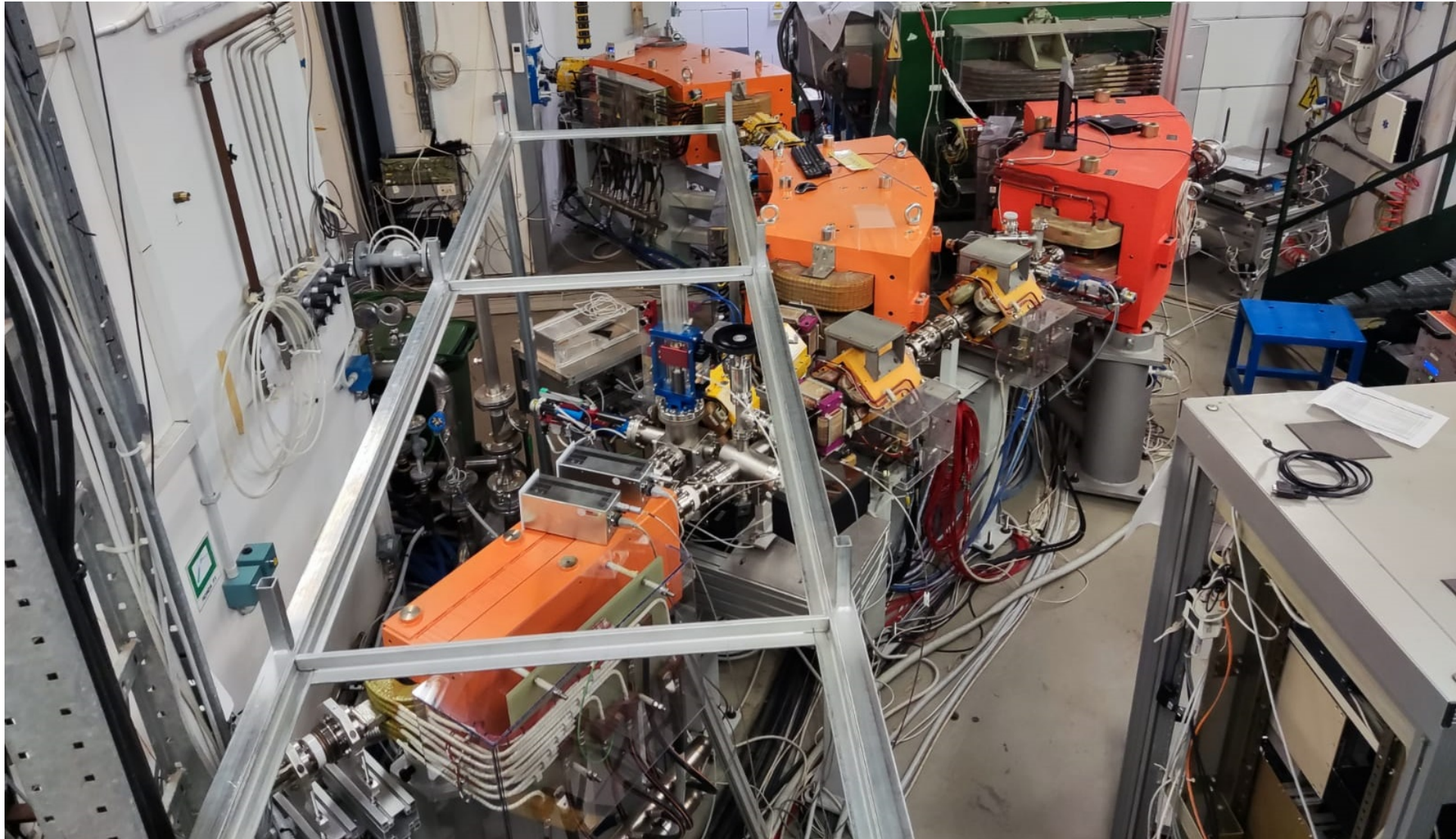
- Two Alternative Beam Line
- CR moved to different location
- Duty cycled operations

57th Scientific Committee Meeting May 9-10, 2019

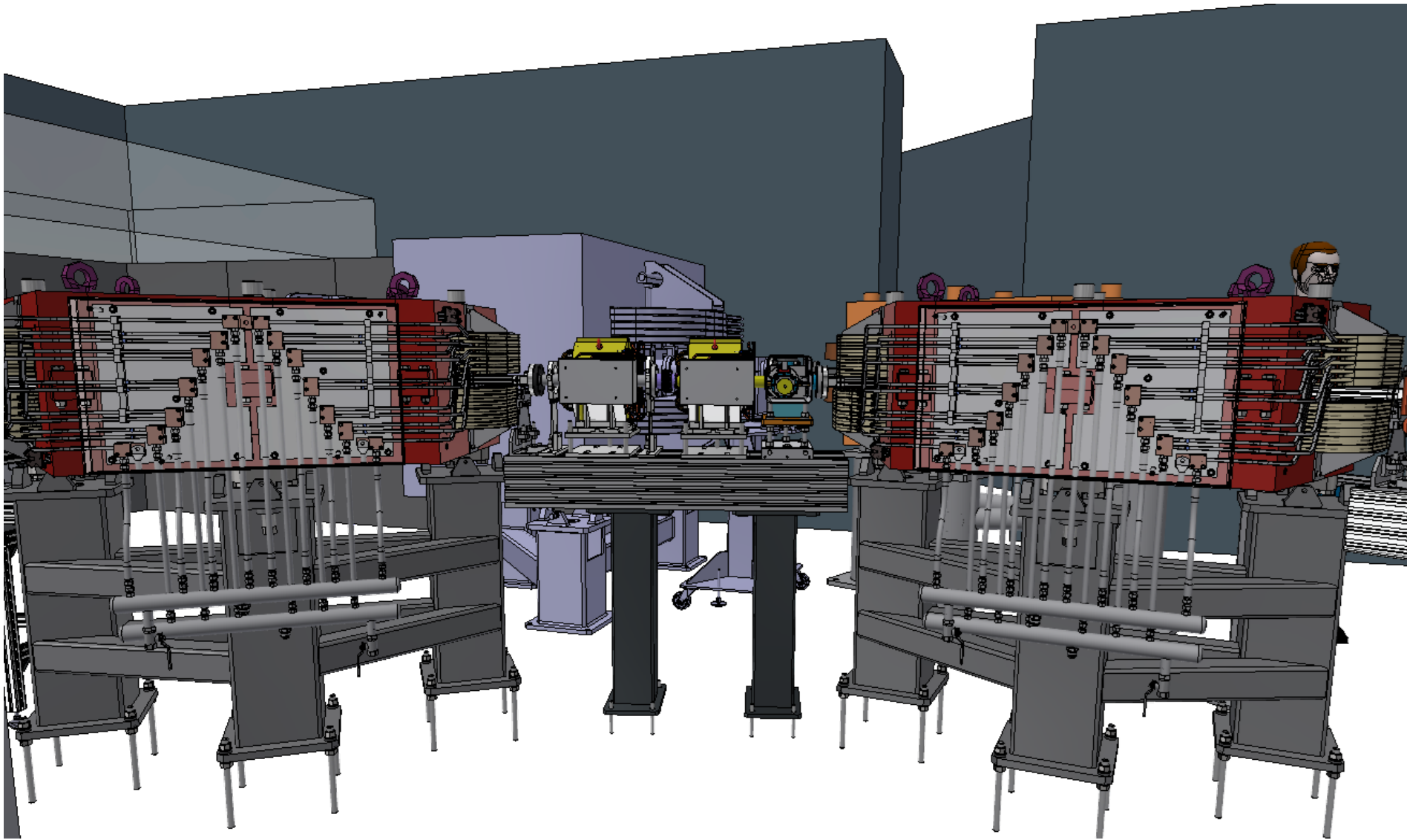
BTF2 COMMISSIONING - INSTALLATION



BTF2 COMMISSIONING - INSTALLATION



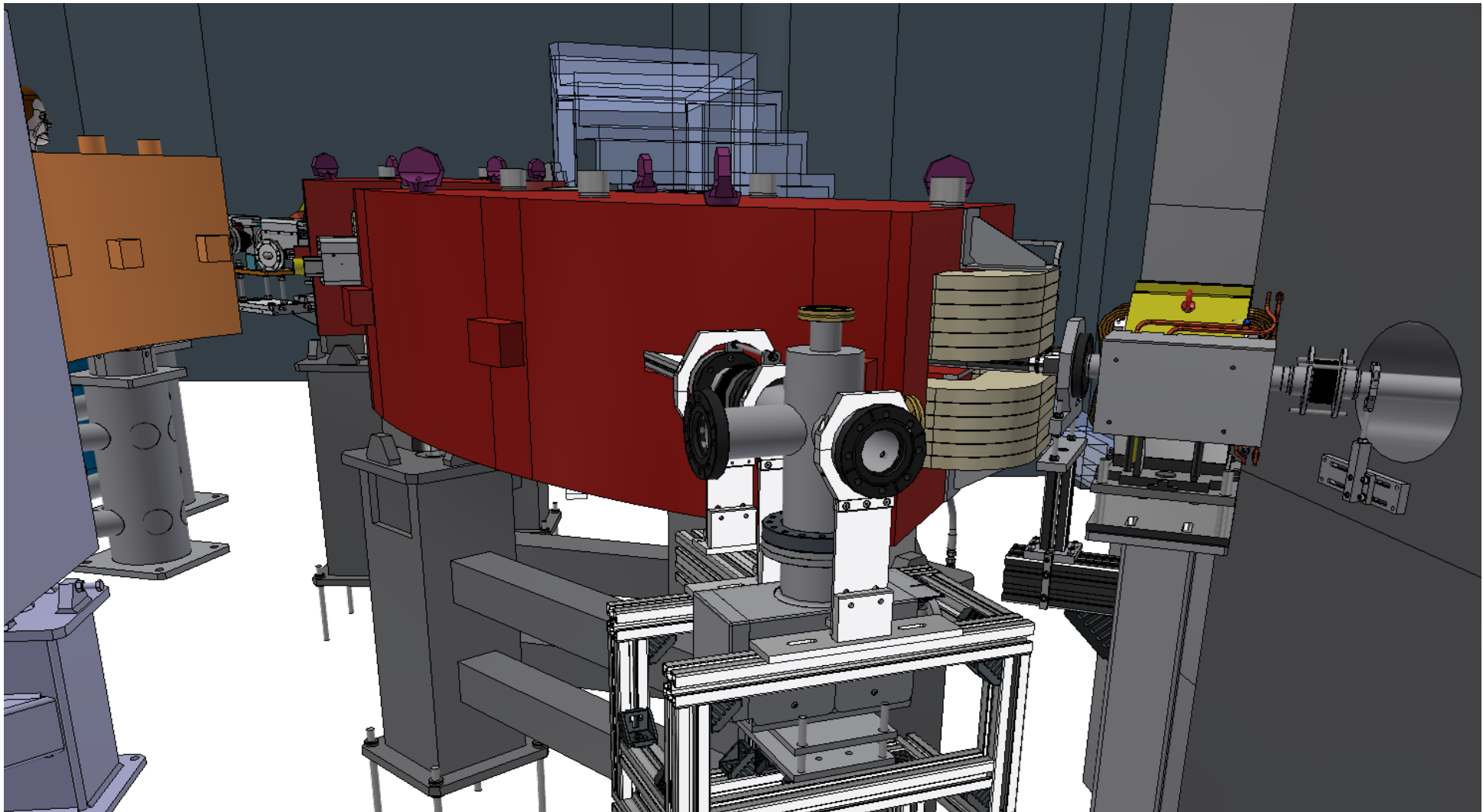
BTF2 COMMISSIONING - INSTALLATION



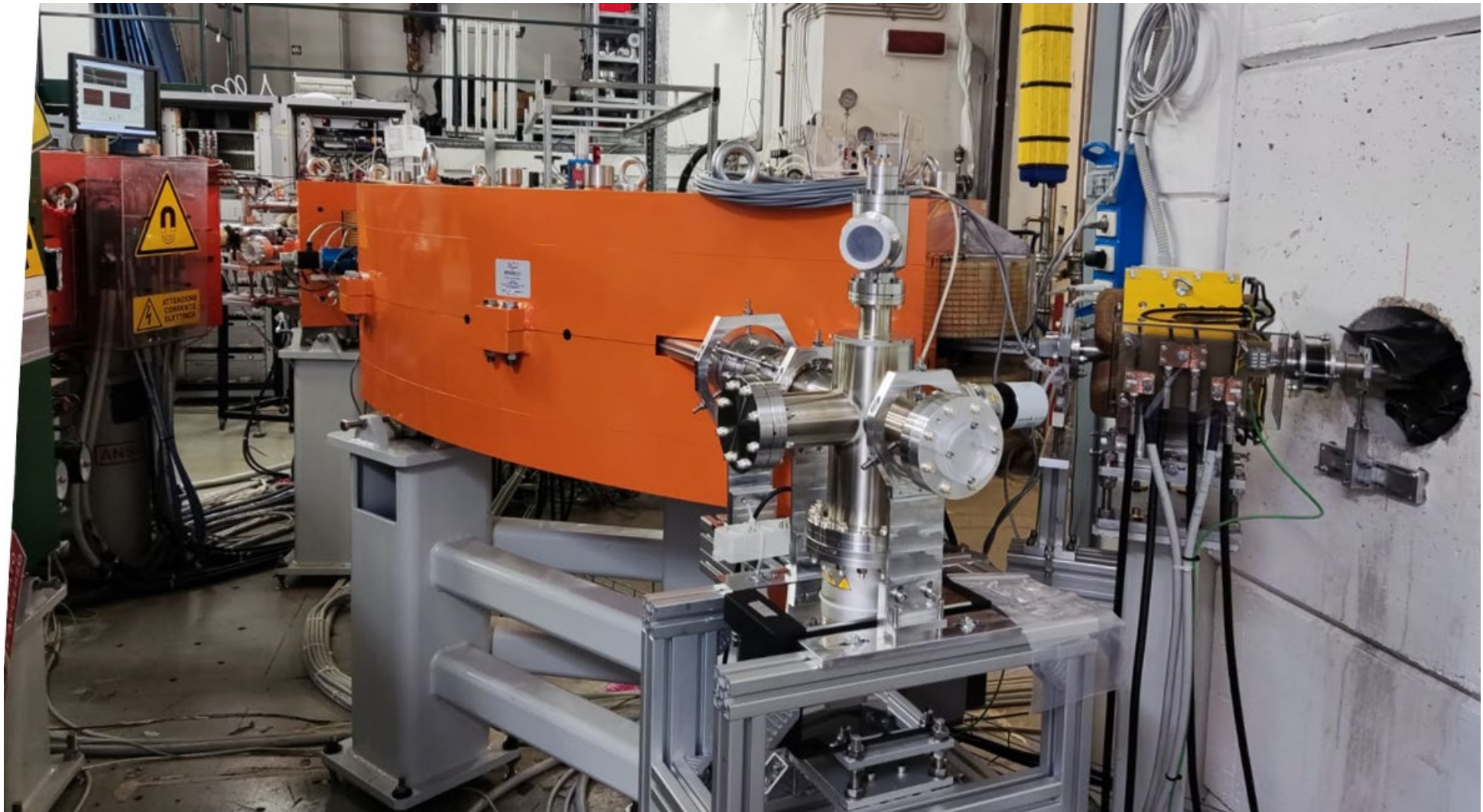
BTF2 COMMISSIONING - INSTALLATION



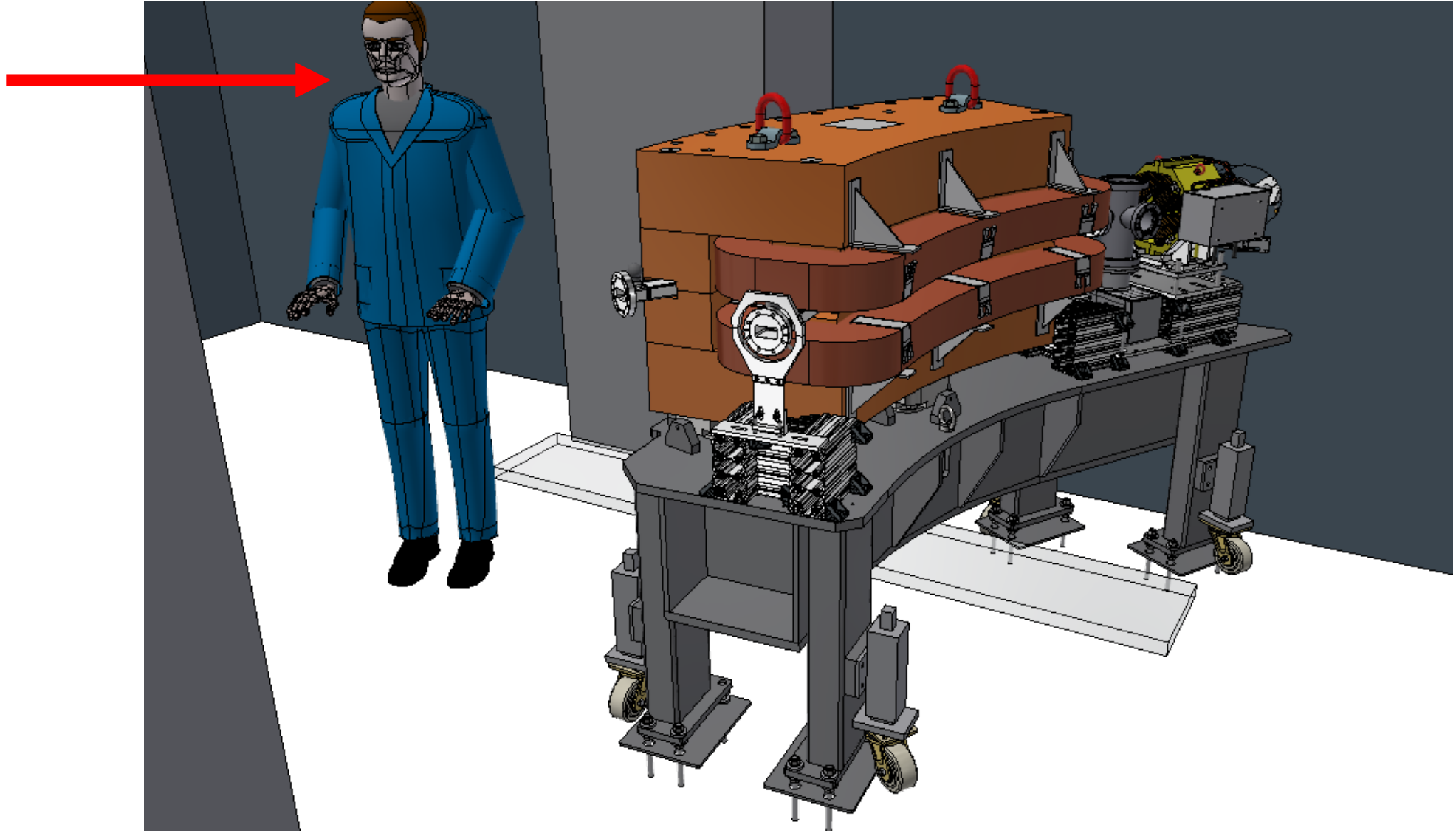
BTF2 COMMISSIONING - INSTALLATION



BTF2 COMMISSIONING - INSTALLATION



BTF2 COMMISSIONING - INSTALLATION



BTF2 COMMISSIONING - INSTALLATION



BTF2 COMMISSIONING – MECHANICS



- More step of measurements ✓
 - At magnet placement
 - After vacuum installation
 - At the end of vacuum pumping
- Implemented in Three different geographical network
 - LINAC (very hard to reach, needs stop of)
 - BTFEH1 renew'd and tested
 - BTFEH2 implemented and tested
- Magnets and pipes in position ✓
 - Vacuum pipes not well cleaned for UHV ✓
 - Mostly by crane and muscle
 - DHSTB203 and its support (5Ton) by only muscles, wheels and tough guys
- Few slightly out of 0.1mm placing error
- COMMISSIONING DONE

| | CENTER OFFSET | | | | | |
|-------------------------|----------------|------------|------------|--------------|--------------|--------------|
| | DELTA(NOM-MIS) | | | | | |
| | DeltaX(mm) | DeltaY(mm) | DeltaZ(mm) | DeltaRx(deg) | DeltaRy(deg) | DeltaRz(deg) |
| BTF2 | | | | | | |
| DHPTB102 mean arc point | -0.014 | -0.129 | -0.102 | -0.025 | -0.007 | 0.000 |
| DHPTB102 pole center | -0.014 | -0.129 | -0.107 | -0.025 | -0.007 | 0.000 |
| QUATB201 | -0.080 | 0.020 | 0.030 | 0.010 | -0.007 | -0.030 |
| QUATB202 | 0.020 | -0.080 | 0.000 | -0.018 | -0.022 | -0.013 |
| DHSTB201 | 0.000 | -0.080 | 0.020 | -0.002 | 0.006 | 0.003 |
| QUATB203 | 0.020 | -0.110 | 0.000 | -0.037 | 0.034 | 0.024 |
| QUATB204 | -0.050 | 0.070 | 0.010 | 0.028 | -0.011 | -0.046 |
| DHSTB202 | -0.080 | 0.030 | -0.030 | 0.013 | -0.001 | -0.002 |
| QUATB205 | -0.010 | 0.060 | -0.060 | 0.010 | -0.017 | -0.035 |
| QUATB206 | 0.030 | 0.010 | -0.020 | -0.030 | -0.016 | -0.041 |
| DHSTB203 | 0.010 | 0.010 | 0.050 | -0.007 | 0.001 | -0.001 |
| BTF1 | | | | | | |
| QUATB003 | -0.270 | -0.048 | -0.034 | -0.011 | 0.027 | 0.040 |
| QUATB004 | 0.051 | -0.050 | -0.085 | 0.006 | -0.005 | 0.023 |
| DHSTB002 | 0.121 | -0.010 | 0.053 | -0.007 | -0.007 | 0.001 |



DONE by Mech. Eng. Service (AD)

BTF2 COMMISSIONING – PS MAGNETS

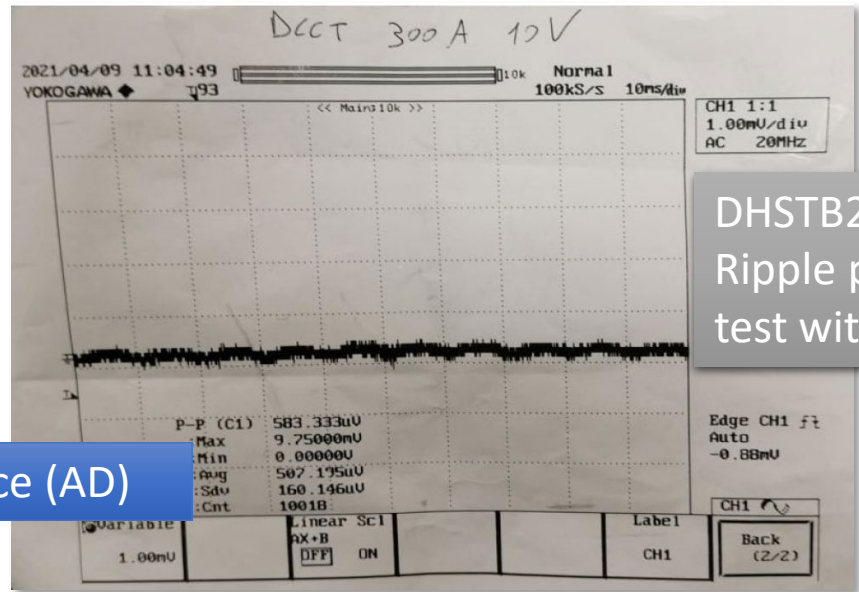
- PS Level
 - Interlock ✓
 - Ripple ✓
 - Full power test
 - BTF2 full on for 1 hour ✓
 - Confirmed SAT test offline parameters ✓
- MAGNETS have just been measured ✓
- All items within max admitted ripple
- COMMISSIONING DONE

«Worst» magnets within 200ppm p-p

| MAGNET ID | Test I [A] | Max I [A] | Scope V _{pp} [μv] | DCCT I _{pp} [mA] | Ripple p-p DCCT [ppm] |
|------------|------------|-----------|----------------------------|---------------------------|----------------------------|
| DHSTB202 ✓ | 269 | 290 | 583 | 17.5 | 65 |
| DHSTB203 ✓ | 255 | 290 | 500 | 15 | 52 |
| QUATB203 ✓ | 93 | 100 | 833 | 25 | 250 (100 noise subtracted) |
| QUATB204 ✓ | 93 | 100 | 917 | 27,5 | 275 (125 noise subtracted) |



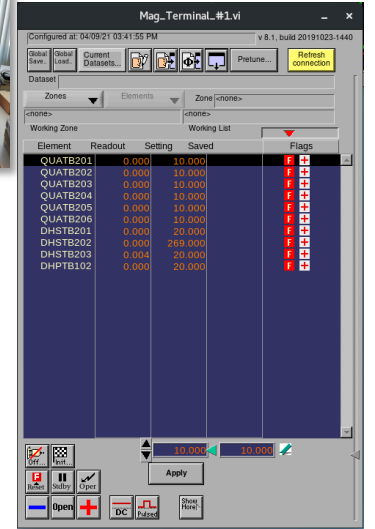
DONE by Magnet Service (AD)



DHSTB202@269A
Ripple plot in situ
test with final cabling



BTF2 COMMISSIONING – DCS

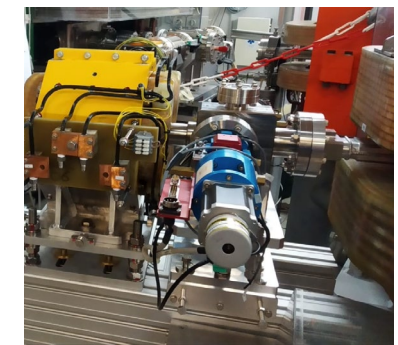


- Scrapers and target
 - Cable ✓
 - Controls ✓
 - Full excursion and reproducibility test ok ✓
 - GUI (just linking in the existing one) ✓
- COMMISSIONING DONE

- DCS Devil (last in test order)
 - Develop ✓
 - Implementation in DAFNE DCS ✓
 - Just stuff of GUI layout ✓
 - Full Commands set test ok ✓
 - Control command ✓
 - Interlock reception ✓
 - Interlock readout ✓
- COMMISSIONING PRACTICALLY DONE

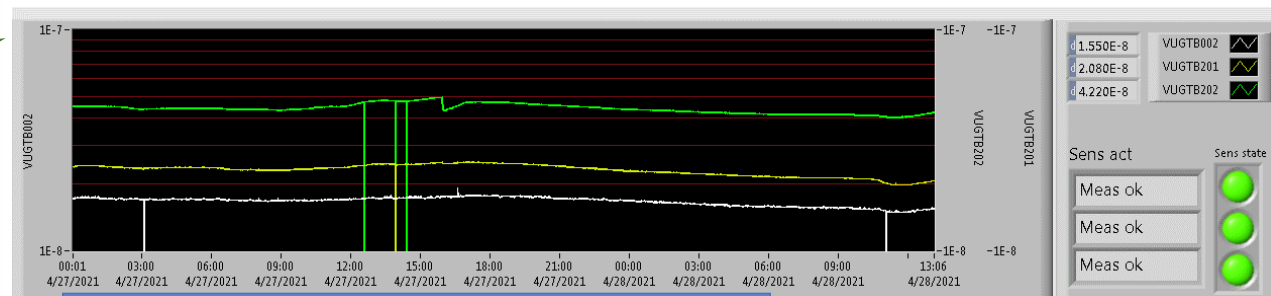
DONE by Control Service (AD)

| ELEMENTS | | Final Specs in situ | | PID Values | | Relative Encoder data (Design) |
|--------------|------|---------------------|-------|------------|------|--------------------------------|
| Nome SLT | Asse | R[ohm] | L[mH] | Kp | Ki | Final range [mm] |
| SLT TB 005 L | 20 | 0.91 | 3.35 | 4.36 | 0.47 | 39.04 (40) |
| SLT TB 005 R | 21 | 0.98 | 3.45 | 4.40 | 0.47 | 39.51 (40) |
| SLT TB 006 L | 25 | 1.02 | 4.41 | 4.31 | 0.47 | 40.00 (40) |
| SLT TB 006 R | 24 | 1.00 | 3.37 | 4.27 | 0.46 | 39.23 (40) |
| TGT TB 002 | 22 | 0.91 | 3.22 | 4.17 | 0.45 | 99.57 (100) |



BTF2 COMMISSIONING - VACUUM

- SCRAPERS Test - Operation ✓
- BEAM STOPPER Test (Operation waits Safety Sys.) ✓
- VACUUM WINDOWS Test - Operation ✓
- PUMPS and VACUUM SENSORS Test - Operation ✓
- **VACUUM OPERATION Reliable** ✓
- **Reaching final vacuum 10E-9mbar slowly but constant**
- COMMISSIONING DONE

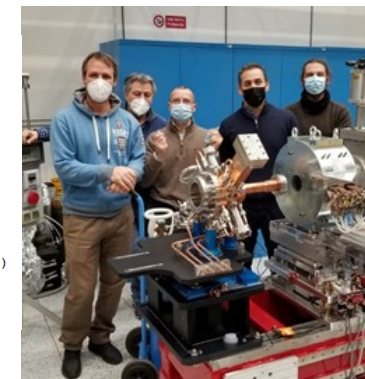
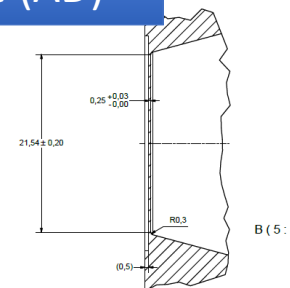


DONE by Vacuum Service (AD)

Vacuum Windows

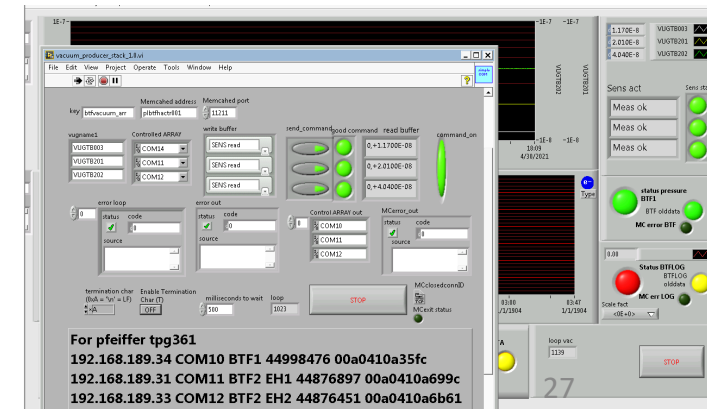
- SAFETY (internal) = My (press foil) – 125µm operative
- DHSTB002 Straight line = Ti (brazed foil) – 25µm
- DHSTB201 & 202 Straight line: Al (machined from solid) – 310µm
- DHSTB203 Bend & Straight line: Al (machined from solid) – 520µm

Leak tightness
(overall BTF2 line)
 $< 6.2E-10 \text{ mb} \cdot \text{l/s}$



Vacuum subsystems on the new layout work well

- Sensor Readout implemented in LV, on BTF Slow control
- Interlocks and valve readout to be implemented in DAFNE supervisor (within 1 month)



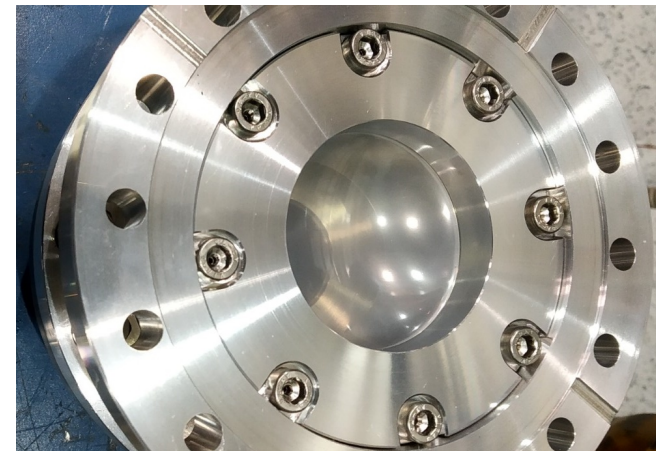
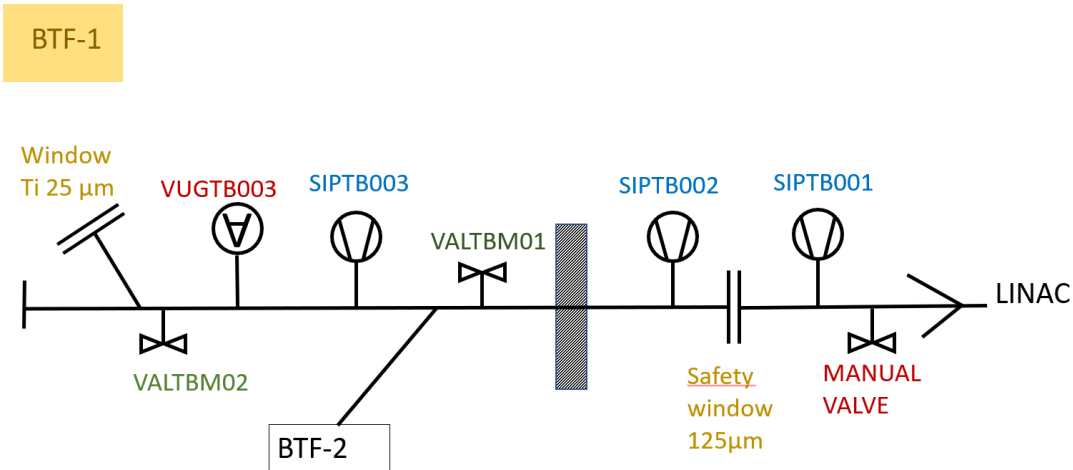
| key | hw address | hw address | hw address |
|----------|------------|------------|------------|
| VUGTB002 | COM10 | COM11 | COM12 |
| VUGTB201 | COM10 | COM11 | COM12 |
| VUGTB202 | COM10 | COM11 | COM12 |

For pfeiffer tpg361
 192.168.189.34 COM10 BTF1 44998476 00a0410a35fc
 192.168.189.31 COM11 BTF2 EH1 44876897 00a0410a699c
 192.168.189.33 COM12 BTF2 EH2 44876451 00a0410a6b61

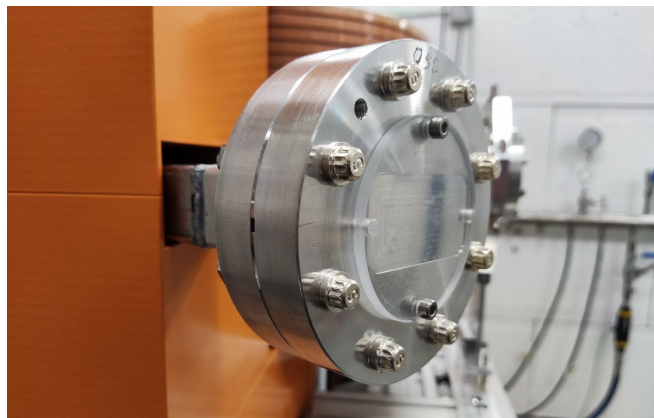
BTF2 COMMISSIONING - VACUUM LAYOUT



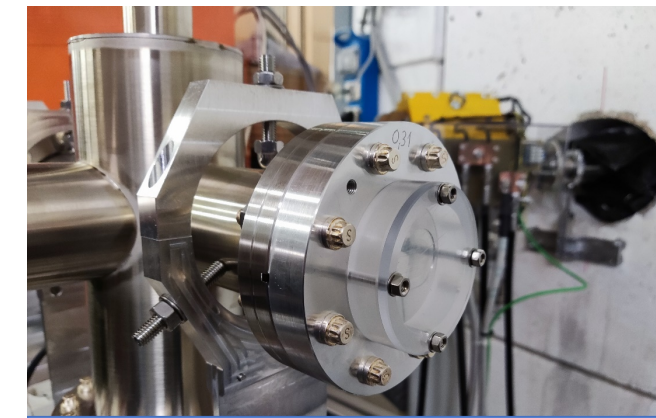
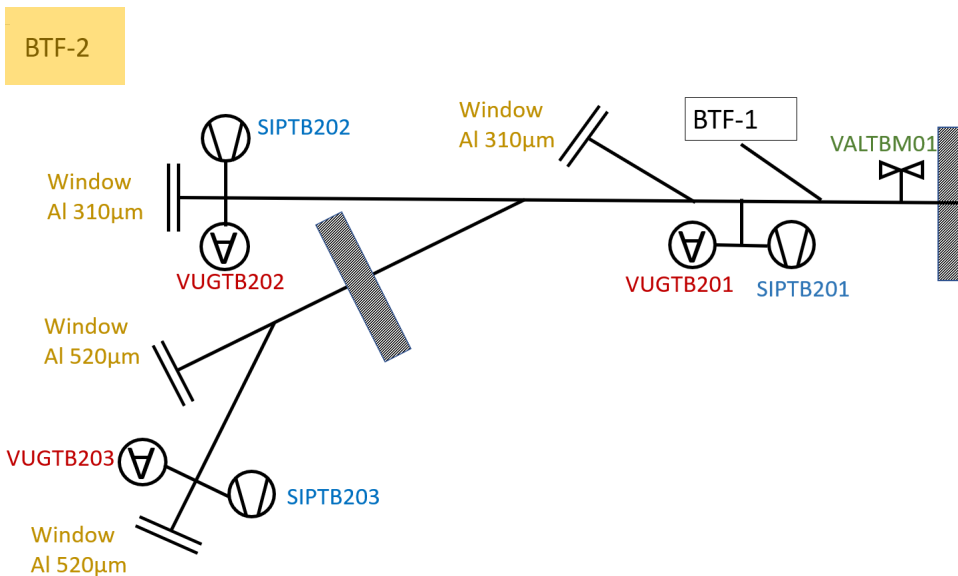
Ti window



Mylar safety window



Al window



Al window

BTF2 COMMISSIONING – INTERLOCKS

- Full test of interlocks done

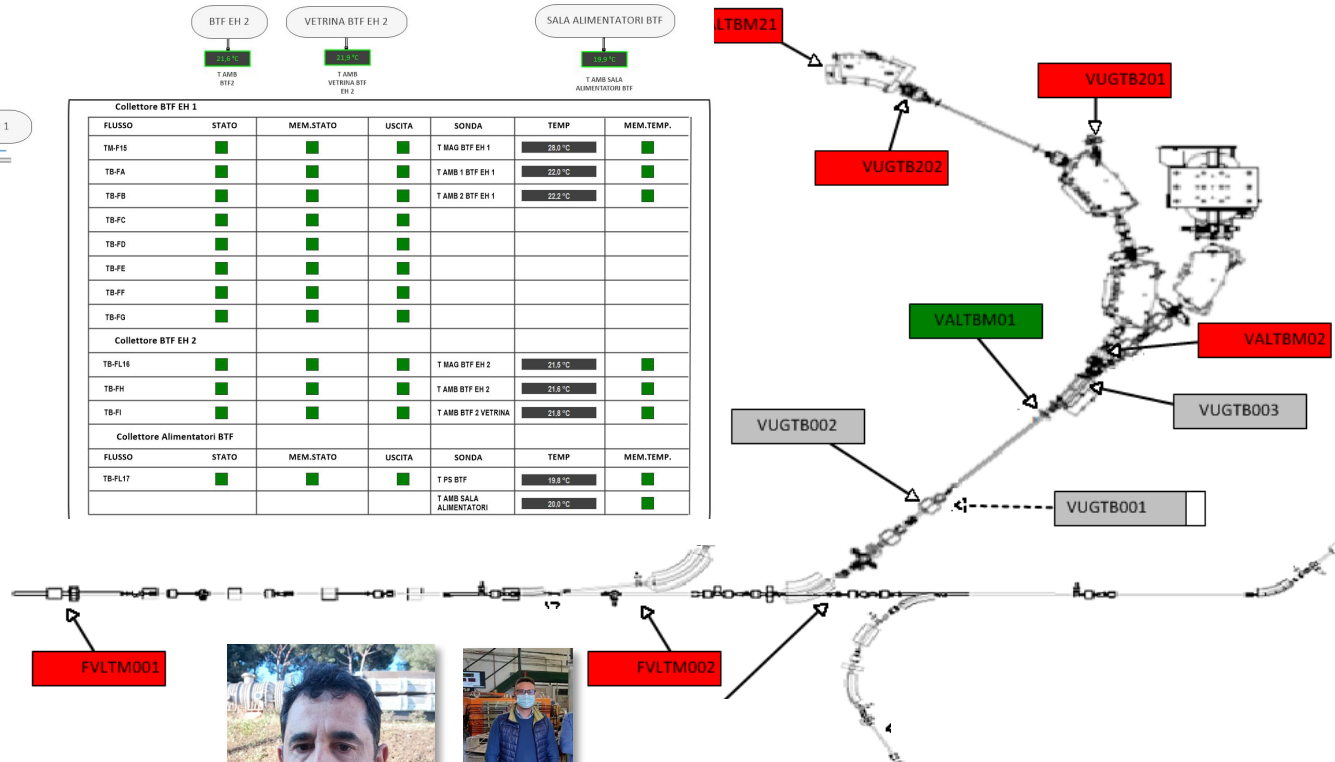
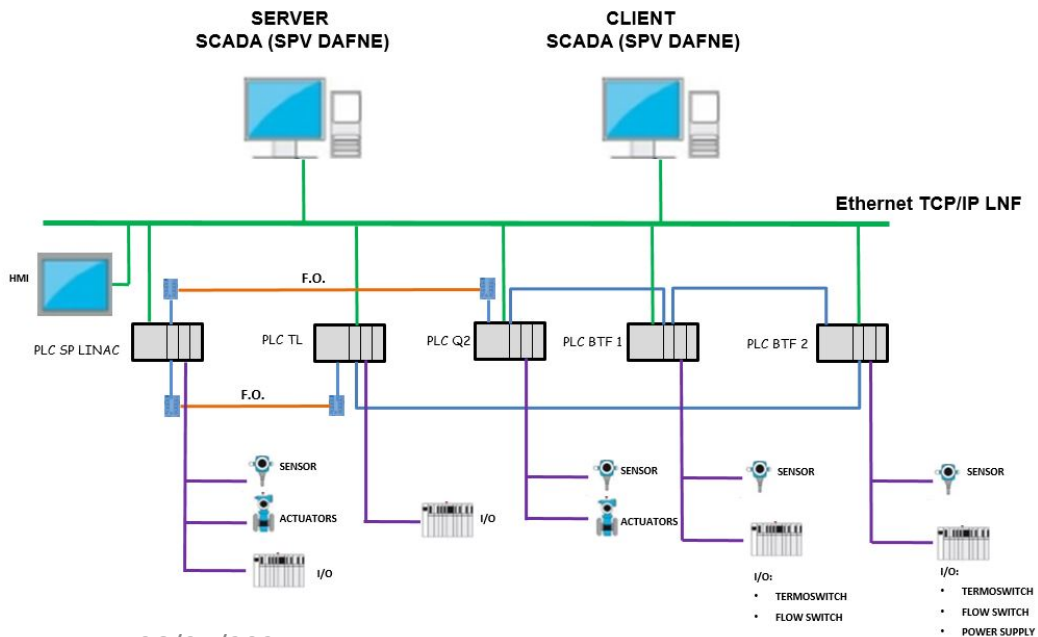
- PS level ✓
- PLC level ✓
- SCADA readout level ✓
- Fluid pressure and flux ✓

- COMMISSIONING DONE

DONE by Electrical Plant Serv. (DT)



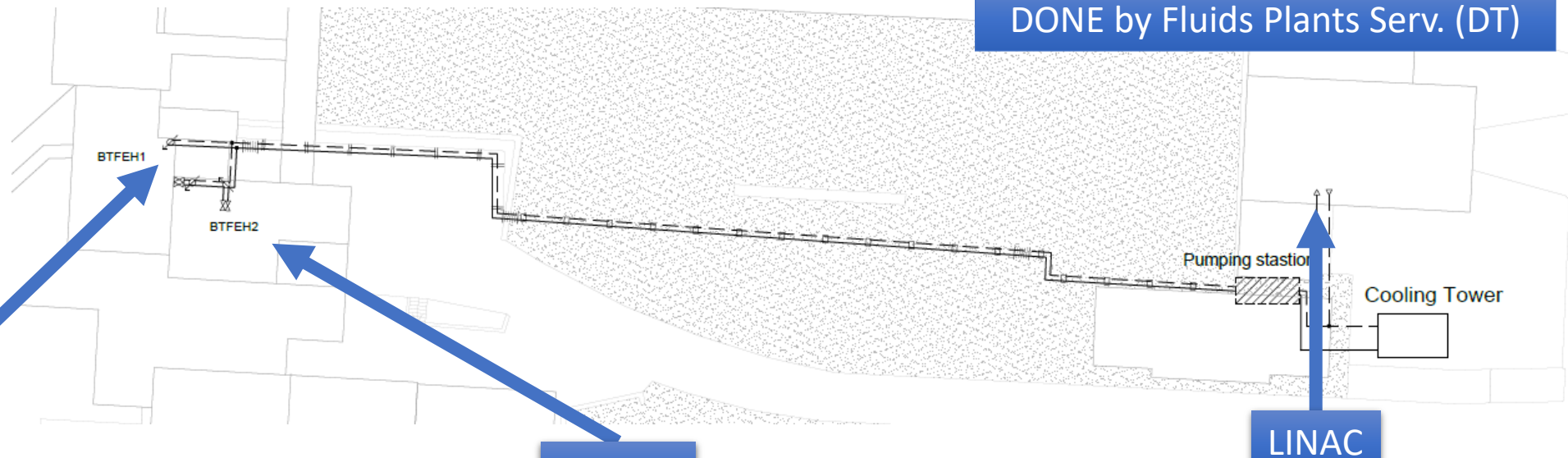
Rete del sistema di controllo e supervisione degli impianti ausiliari LINAC E BTF



LNF SC61



BTF2 COMMISSIONING - FLUIDS



BTFEH1

| MAGNET ID | TYPE | ΔT [°C] | ΔP [bar] | Water Flow [l/min] | Nominal Magnet DC Power [kW] |
|---------------------|------------|-----------------|------------------|--------------------|------------------------------|
| DHSTB 02 | Dipole | 26 | 2,6 | 12 | 19 |
| DHPTB102 | Dipole | 15 | 3 | 7 | 7,8 |
| DHSTB201 | Dipole | 15 | 3 | 18,5 | 18 |
| DHSTB202 | Dipole | 15 | 3 | 18,5 | 18 |
| QUATB03 | Quadrupole | | 2,3 | 0,7 | 1,1 |
| QUATB04 | Quadrupole | | 2,3 | 0,7 | 1,1 |
| QUATB201 | Quadrupole | 10 | 3 | 0,7 | 1 |
| QUATB202 | Quadrupole | 10 | 3 | 0,7 | 1 |
| QUATB203 | Quadrupole | 10 | 3 | 0,7 | 1 |
| QUATB204 | Quadrupole | 10 | 3 | 0,7 | 1 |
| QUATB205 | Quadrupole | 10 | 3 | 0,7 | 1 |
| Total BTFEH1 | | | | 60,9 | 70 |

BTFEH2

| MAGNET ID | TYPE | ΔT [°C] | ΔP [bar] | Water Flow [l/min] | Nominal Magnet DC Power [kW] |
|---------------------|------------|-----------------|------------------|--------------------|------------------------------|
| DHSTB203 | Dipole | 10 | 3 | 15,4 | 11 |
| QUATB206 | Quadrupole | 10 | 3 | 0,7 | 1 |
| Total BTFEH2 | | | | 16,1 | 12 |

DONE by Fluids Plants Serv. (DT)

LINAC

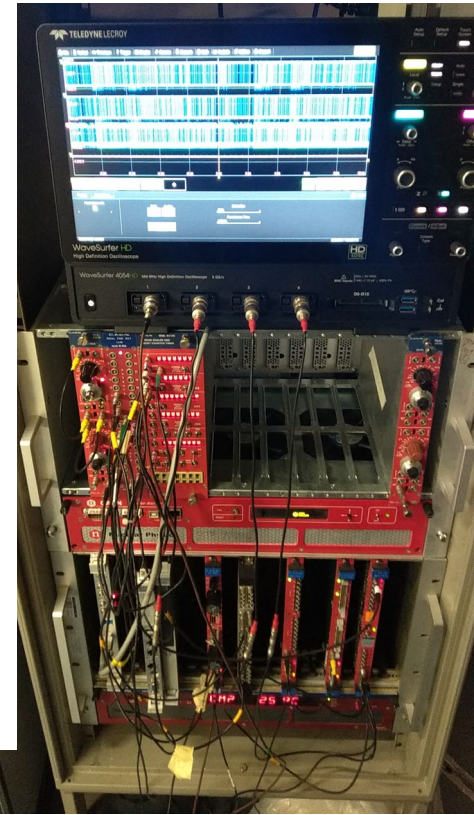
| MAGNET ID | TYPE | ΔT [°C] | ΔP [bar] | Water Flow [l/min] | Nominal Magnet DC Power [kW] |
|--------------------|------------|-----------------|------------------|--------------------|------------------------------|
| DHPTB101 | Dipole | | 0,3 | 3 | 3 |
| DHPTS01 | Dipole | 18 | 0,8 | 1,8 | 2,24 |
| DHSTS01 | Dipole | | 2,3 | 8 | 7,25 |
| DHSTB 01 | Dipole | 26 | 2,6 | 12 | 19 |
| QUATB101 | Quadrupole | 18 | 2,7 | 0,702 | 0,9 |
| QUATB102 | Quadrupole | 18 | 2,7 | 0,702 | 0,9 |
| QUATB01 | Quadrupole | | 2,3 | 0,702 | 1,1 |
| QUATB02 | Quadrupole | | 2,3 | 0,702 | 1,1 |
| QUATM01 | Quadrupole | 18 | 2,7 | 0,702 | 2,24 |
| QUATM02 | Quadrupole | | 0,3 | 3 | 3 |
| QUATM03 | Quadrupole | | 0,3 | 3 | 3 |
| QUATM04 | Quadrupole | 18 | 2,7 | 0,702 | 0,9 |
| QUATM05 | Quadrupole | 18 | 2,7 | 0,702 | 0,9 |
| QUATM06 | Quadrupole | 18 | 2,7 | 0,702 | 0,9 |
| QUATM07 | Quadrupole | 18 | 2,7 | 0,702 | 0,9 |
| QUATM08 | Quadrupole | 18 | 2,7 | 0,702 | 0,9 |
| Total LINAC | | | | 37,82 | 48,23 |

- Test full power LINAC+BTF2 done ✓
- $\Delta T=14,1K$ (stable value after 1 hour)
(Expected value = 15,3K) ✓
- COMMISSIONING DONE

BTF2 COMMISSIONING -DAQ

by BTF&Control Serv. (DA)

- Low latency ETH 1Gbit comms
- Programmable in FPGA automated W/R routines
- Fully wrapped API's in !CHAOS environment
- Actual data data push jitter 3ms VM based CU and non local subnet
- Up to 100Hz triggered data download in standard configuration (SCALER+QDCs+PIO+TDCs+TU)



| Name CU | Status | Timestamp | U |
|----------------|--------------------------------------|--------------------|----|
| BTF/DAQ/BTFDAQ | ▶ | 5/5/2021, 15:48:53 | 00 |

BTF/DAQ/BTFDAQ

Update Dataset Format save close

CU-MDS Latency(ms) NaN {

▼ "output" : {

```

"ndk_uid": "BTF/DAQ/BTFDAQ",
"dpck_ds_type": 0,
"dpck_seq_id": 31580,
"cuclk_run_id": 1620222063650,
"dpck_ats": 1620222524862,
"dpck_hr_ats": 1620222524862038,
"ACQUISITION": 31579,
"TRIGGERS": 36025,
"TRIGGERS_VALID": 37967,
"TRIGGER LOST": 4446,
"TRIGGER_FREQ": 71.42857142857143,
"TRIGGER_EFREQ": 71.42857142857143,

```

▼ "QDC965HI" : [

```

90,
70,
83,
85,
85,
73,
99,
70,
68,

```

Generic Control

| Scheduling(us) | Live | Log | History | Restore |
|----------------|---|---|---|---|
| 1 | enable <input checked="" type="radio"/> / disable <input type="radio"/> | enable <input type="radio"/> / disable <input checked="" type="radio"/> | enable <input type="radio"/> / disable <input checked="" type="radio"/> | on init <input type="checkbox"/> / disable <input type="checkbox"/> |

DASHBOARD LINKS

- [Documentation](#)
- [Ticketing](#)
- [Dashboard project](#)

ate:995 Latency:6 LatencyAvg:33.05 OpsOk:77 Errors:0Timeouts:0

The SIS3153 interfaces the popular Universal Serial Bus (USB) and Ethernet to the VMEbus. It uses the Cypress Semiconductor Corporation FX3 chip as USB3.0 host controller. The modules functionality comprises:

- Ethernet (UDP) connectivity (Described in 'SIS3153 - Ethernet Addendum')
- USB3.0 / Superspeed USB functionality
- USB2.0 and USB1.1 compliance
- VME master read cycles:
 - IACK, A16/A24/A32
 - D8/D16/D32/BLT32/MBLT64/2eVME/2eSST160/2eSST267/2eSST320
- VME master write cycles:
 - A16/A24/A32
 - D8/D16/D32/BLT32/MBLT64/2eVME
- VME slave; not implemented yet
- 2 digital front panel inputs (NIM or TTL level, select by jumper or register bits)
- 2 digital front panel outputs (NIM or TTL level, select by jumper or register bits)

BTF2 COMMISSIONING –USER CALL SOFTWARE



Welcome, Albert Einstein [logout](#)

Submission call

Period*
16/05/2022 - 22/05/2022

*NOTICE: Overbooking may not be accepted

Team Leader
Albert Einstein

Experiment Full Name
A Large Ion Collider Experiment

Experiment Short Name
ALICE

Description

Short description

upload type file 1 file1.pdf
upload type file 2 file2.pdf

submit

Required data

| | |
|-----------------------------------|------|
| Roll out Duration (hours) | 6 |
| Dose to be integrated | 1000 |
| Minimum particles Energy [25-750] | 45 |
| Maximum particles Energy [25-750] | 500 |

Editin Call/Run - General

Start Booking Period 01/04/2022 End Booking Period 31/12/2022

Open call days before 90 Submission days 60 Time technical/committee management 30

open call date: 01/01/2022 open call end date: 02/03/2022

Time create team (days) 20 Days to create team 15 Days to approve team 5

First date: 15/03/2022 end date: 30/03/2022 First date: 30/03/2022

Booking slot block (days) 7 Max contiguous slot (MCS) 2

Enable overbooking Free booking start day of week
 Enable auto-accept booking Specific start day of the week

monday

next

Editin Call/Run - General

Exclude booking period

01/04/2022 - 03/04/2022
01/05/2022 - 15/05/2022
30/05/2022 - 05/06/2022

previous next

Welcome, Luca Foggetta [logout](#)

Period 16/05/2022 - 22/05/2022 Team Leader Enrico Fermi

Experiment Bombardamento neutronico Experiment Short Name BN

Description

Short description

Uploaded file
[file1.pdf](#) [file2.pdf](#)

Required data

| | |
|-----------------------------------|------|
| Roll out Duration (hours) | 7 |
| Dose to be integrated | 1000 |
| Minimum particles Energy [25-750] | 45 |
| Maximum particles Energy [25-750] | 500 |

cancel reject accept

next

by BTF&Computing Serv.

Welcome, Enrico Fermi [logout](#)

Team management

| Experiment | Team Leader | Period | Status |
|------------|--------------|-------------------------|-----------|
| BN | Enrico Fermi | 16/05/2022 - 22/05/2022 | Confirmed |

All
 Confirmed
 Accepted
 Rejected
 Waiting

| Name | Email | Invited | Account | Submitted | Granted |
|-----------------|------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Enrico Fermi | Enrico.Fermi@pnisperna.it | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Ettore Majorana | Ettore.Majorana@pnisperna.it | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Franco Rosetti | Franco.Rosetti@pnisperna.it | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Emilio Segré | Emilio.Segre@pnisperna.it | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Welcome, Luca Foggetta [logout](#)

Technical/committee management

May 2022

previous confirm calendar

From scratch, the tools to manage:

- user call
- Facility booking and team access
- run time

Intended as generic tool for all LNF (and more) facilities

- Needs one to merge with access LNF-INFN software and rules
- Implementation with different level of abstraction
- Automated dispatching to lower secretary load

Will be implemented in the next months

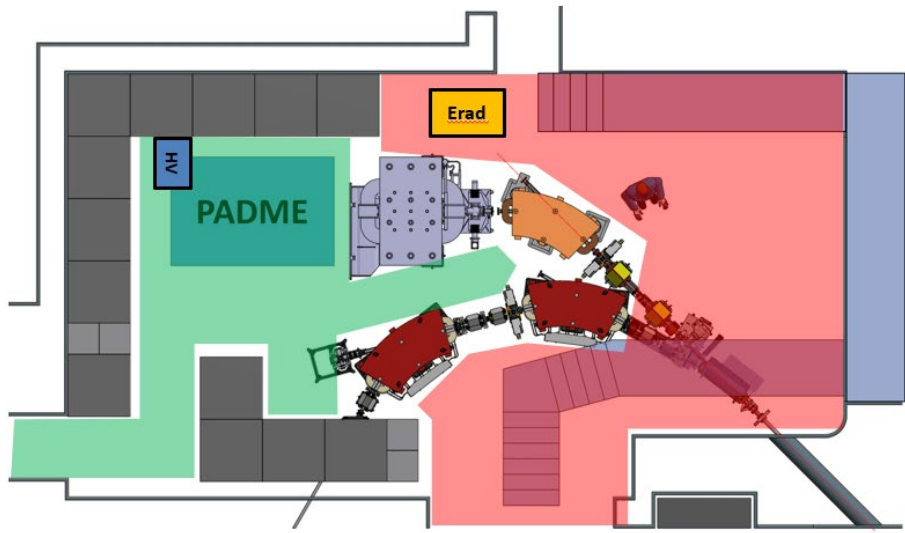
BTFE COMMISSIONING – SAFETY & SHIELDING

By LINAC (DA), FISMELE & Building (DT) Services

- New search/patrol (intermediate step with PADME magnet in situ) and related elements in place ✓
- **Not already commissioned** (to avoid services overlaps) needs shielding ends ✓
- Needs dedicated DAFNE stop to be test and linked to DAFNE safety system



BTFE Experimental HALL 1



LNF SC61



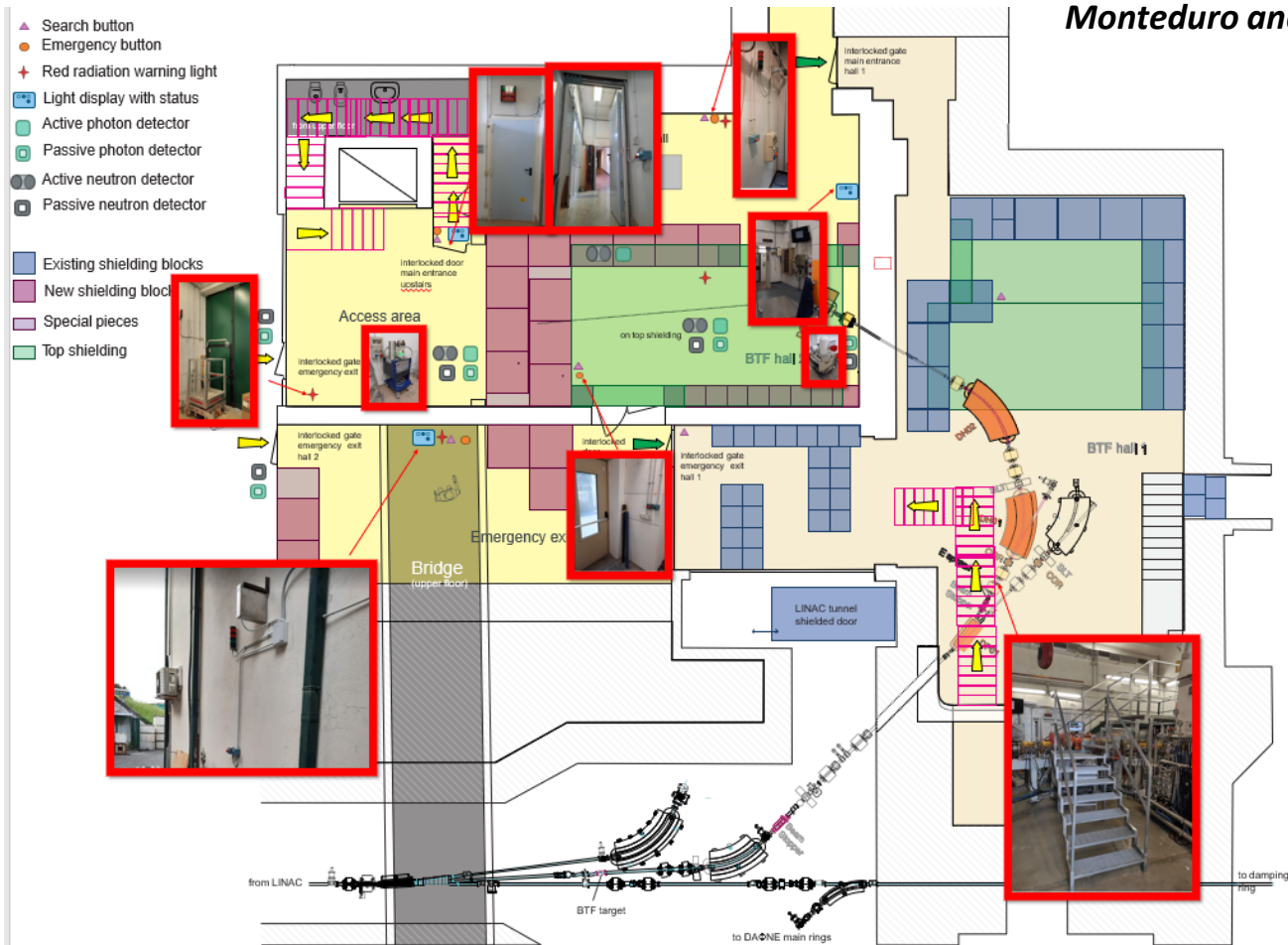
Today BTFEH1 shielding



33

BTF2 COMMISSIONING – SAFETY

LINAC Group (A. Cecchinelli, S. Strabioli, R. Zarlenga in collaboration with M. Monteduro and M. Belli) & S. Pioli



LINAC STATUS

- KlyC has a faulty vacuum window that led lower output power in PADME run, but we fix the problem and obtain operative output for DAFNE operations in January 21
- Fault less than 5% of availability time
- UPGRADE&CONSOLDATION ongoing
- Now pulsing at 25Hz, ready to SIDDHARTA data taking at 50Hz
- Personnel deeply involved in many different project



Last Damping Ring
injected Positron current
record (19 pulse/inj)

LINAC SCHEDULED ACTIVITIES

- **LINAC-DAFNE-BTF**

- **LINAC**

- RUN DAFNE (02-Feb-2021 up to ...)
 - DAFNE Run coordinators:
 - Buonomo, Foggetta, Di Giulio
 - Ordinary Maintenance:
 - Modulators
 - LINAC auxiliary
 - Extraordinary Maintenance and consolidation
 - Vacuum pump PS Substitution,
 - UFS Power supplies
 - Quadrupoles Power supplies
 - Correctors Power supplies
 - Modulator Consolidation:
 - Solid State Power supplies in Mod A and C
 - Upgrade
 - Building and install of new modulator
 - Test Solid CERN state Switch on new Modulator

- **BTF**

- BTF2 Safety
 - BTF2 Installation and commissioning
 - ERAD project

- **SPARC**

- Modulator Maintenance
 - Safety Check

- **SABINA**

- New C band Modulator at SPARC
 - New directional couplers
 - Study for new HVPS current for HV stability for K1 K2

- **TEX (LATINO)**

- Safety installation and Check
 - Klystron commissioning and TEST
 - Modulator SAT

- **SINGULARITY**

- LINAC CONTROL Memcached DATA and AI feedback test

- **EUPRAXIA**

- WA4 Integration
 - WP12 RF Power and distribution

SCICOM RECOMMENDATIONS

Recommendations DAFNE-LINAC-BTF:

- Continue to ensure a coherent, well targeted maintenance and consolidation programme for the Linac with due regard to the spares situation. This should be accompanied by full fault tracking and rigorous scrutiny and follow-up of all issues arising.

1) Maintenance: a well defined ordinary and extraordinary maintenance program was shown to the Division.

We have a well determined ordinary maintenance procedure, but we don't have the manpower to do it in the asked time. The procedure to obtain 1 FTE Tecnician was started 1 year ago and for COVID delay is in conclusions in those days.

2) The consolidation programme is ongoing.

We have a well determined consolidation program but **we do it in the opportunistic way during the period when the accelerator complex is turned off and the maintenance are ongoing.** The program consists in:

- New vacuum pumps for on the linac, we start in Dec. 2020 with the waveguide network pumps power by the klystron C. We need to identify the period for the remain parts (A, B, D) in respect with DAFNE act.s
- New UFS power supplies - Installed
- Install HVPS power supply in ModA and ModC, install last PT15:1 on ModA
- We have also an upgrade program to finish with (5th Mod).

Ordinary Maintenance: Modulator

| | Annual | 6 months | 3 month | month |
|------------------|--------|----------|---------|-------|
| Focus p.s. | M | | | C |
| Variac kly Fil. | M | | | C |
| Variac BIAS | M | | | C |
| Trasf. kly FIL. | M | | C | |
| Trasf. BIAS | M | | C | |
| Inductors PFN | | C | | |
| Capacitors PFN | | C | | |
| Cables PFN | | | C | |
| Interlock relais | M | | | |
| SCR fuse | | M | | |
| Controls relais | C | | | |
| Charging diodes | M | | C | |

| | Annual | 6 months | 3 month | month |
|-------------------|--------|----------|---------|-------|
| H.B. Diode | M | C | | |
| Charg. Inductor | M | | | |
| Charg. Capacitors | M | | C | |
| Thy FIL. Trasf. | M | | C | |
| Thy Res. Trasf | M | | C | |
| Thy. Trigger | M | C | | |
| Thy cooling FAN | | C | | |
| Thy Values | | | | M |
| Oil in the tanks | M | | C | |
| Vk Ik measure. | | M | | |
| EOL Clipper | | M | | C |
| Mod. FAN | | | C | |

C= Check M=Maintenance

Ordinary Maintenance: LINAC Auxiliary

| | Annual | 6 months | 3 month | month |
|-------------------|--------|----------|---------|-------|
| SLED water/ T | M | | C | |
| Kly cooling | M | | | C |
| Tank cooling | M | | | C |
| Fire safety syst. | M | C | | |
| Control PCB | | | C | |
| Linac Timing | | C | | |
| LLRF source | | C | | |
| LLRF booster | | C | | |
| Rf diode calib | M | | | |
| Safety | | M | | |
| Linac Termal isp. | M | | | |

| | Annual | 6 months | 3 month | month |
|-------------------|--------|----------|---------|-------|
| Pos Mod. Thy | M | | C | |
| Pos Mod. FAN | | | | |
| Magnets P.S. | M | | C | |
| GUN PS | M | | | |
| WCM | M | | C | |
| BPM | | C | | |
| Odoscope | | | | M |
| HVPS oil pressure | | | | |
| HVPS cables | | M | | C |

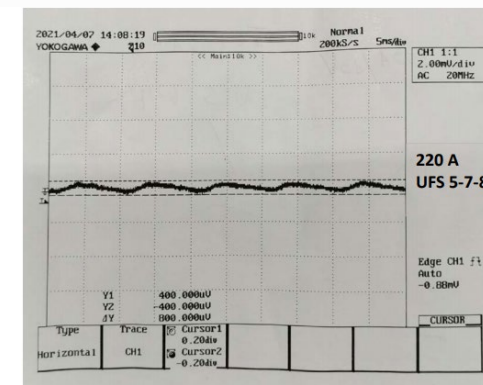
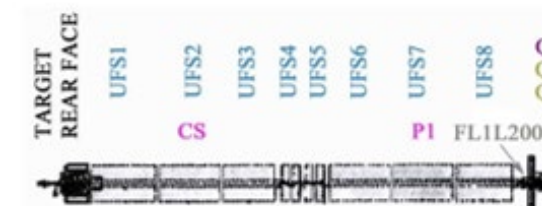


Figure 3 - Ripple a I=220A

SCICOM RECOMMENDATIONS

Recommendations DAFNE-LINAC-BTF:

- Continue to ensure a coherent, well targeted maintenance and consolidation programme for the Linac with due regard to the spares situation. This should be accompanied by full fault tracking and rigorous scrutiny and follow-up of all issues arising.

3) KlyC has a faulty vacuum window, but we fix the problem and we obtain operative output for DAFNE operations (35MW without induced faults, no arcs°as).

The klystron spare status was discussed with company and we agree on the new warranty terms.

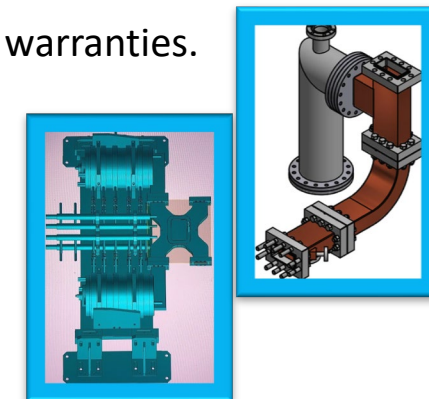
A dedicated periodically check procedure for the other spare klystrons was requested from company for maintain warranties.

Other spare compontes was studied:

➤ Study on new ELBOW Solution for LINAC_DAFNE (Design by **F. Cardelli** and Vacuum Service) **Order done.**

➤ To Buy new S band SLED for (LINAC_DAFNE, SPARC??): **obtained a budgetary quotation.**

Other spare components are, as usual, at our dispoasable.



4) The faults tracking is ongoing, a daily report for all the faults is available for the analysis.



| | | | |
|------------------------|---------------------|--------|--------|
| Modulator A | Klystron Current | 022121 | 0116AM |
| Modulator C | Enclosure Interlock | 022121 | 0129AM |
| Modulator D | Clipper Current | 022121 | 0141AM |
| Modulator C | Enclosure Interlock | 022121 | 0211AM |
| Frascati Safety System | Facility Interlock | 022121 | 0211AM |

06/05/2021

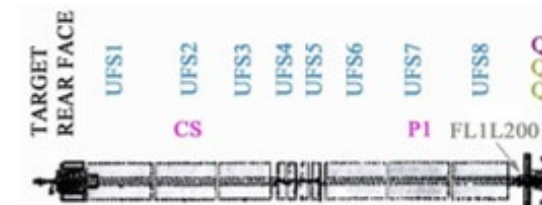


LNF SC61



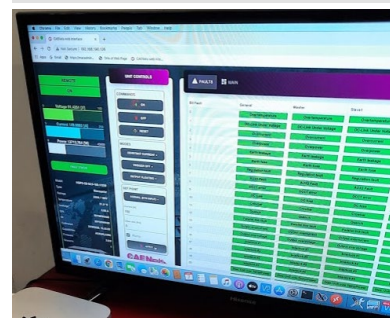
➤ UFS Power supplies

- Installed in APRIL 2021 for TEST on UFS 578 then in operation.
 - DA Support: Magnets Service, Control Service (+Network), LINAC Service
 - DT Support: Idraulic and electric services



INTERNAL STATUS REGISTER

- OVP - Over Power condition
- DCCT FAULT
- Ext. Interlock #4
- Ext. Interlock #3
- Ext. Interlock #2
- Ext. Interlock #1
- Regulation Fault
- Earth Fuse
- Earth Leakage
- Main Fault
- OVT - Over Temperature condition
- Input OVC - Input Over Current
- Waveform execution
- Ramping
- #7
- #6 Update Mode [#7 #6] -> [00]:Normal [11]:Analog input
- Reg. Mode [0]:C.C. [1]:C.V.
- #3
- #2 Control Mode [#3 #2] -> [00]:Remote [01]:Local
- Fault
- ON/OFF - [1]:Module is enabled



44 ppm

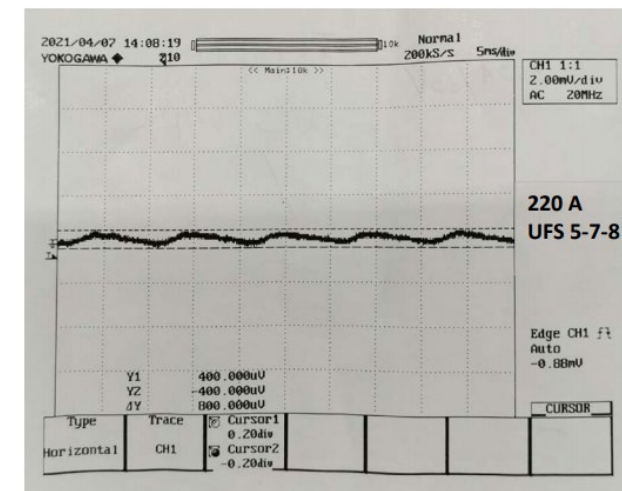
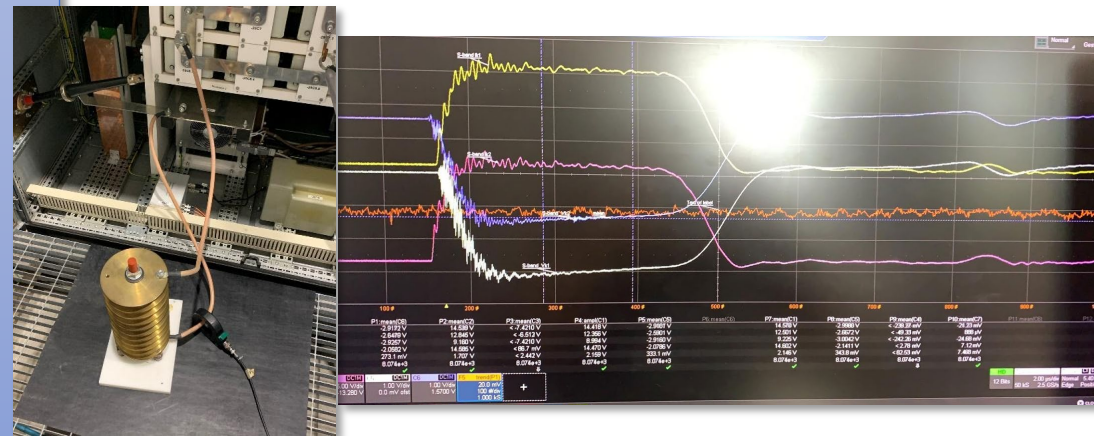


Figure 3 - Ripple a I=220A

SPARC MODULATOR MAINT.

SPARC

- Check Modulator Status and change consumables
 - Few problems with new vacuum ion pump power supply.
 - Problem with oil leak from oil pump in C-band modulator.
 - HV instability in K2 due to the cables condition.
 - K2 Modulator Cleaning



09/12/20



20/11/20



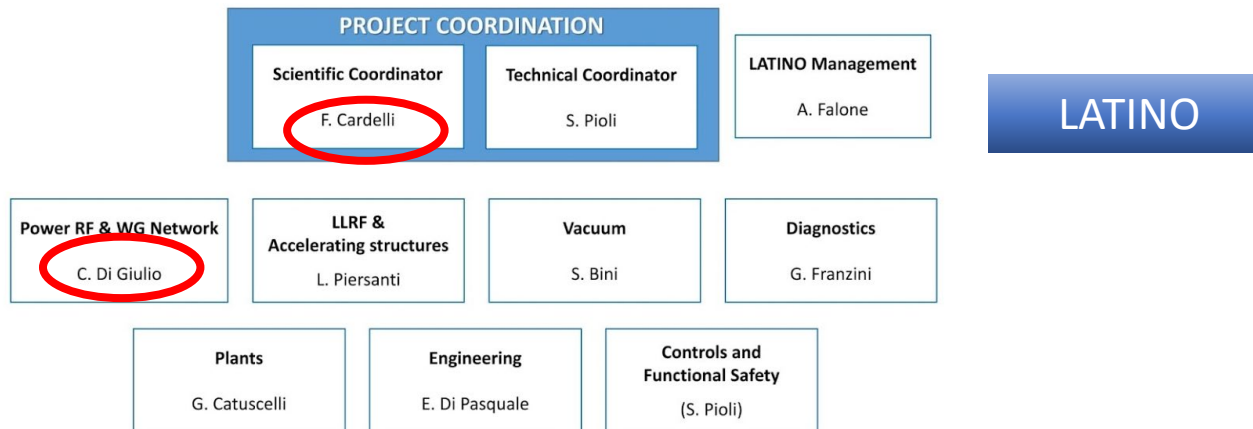
26/01/21



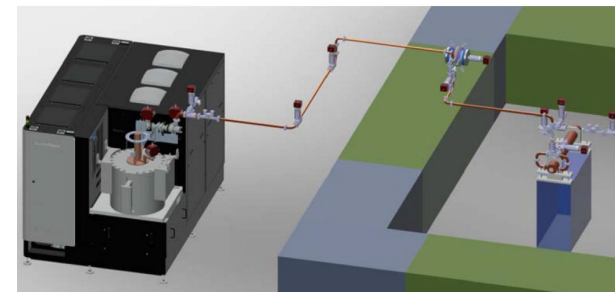
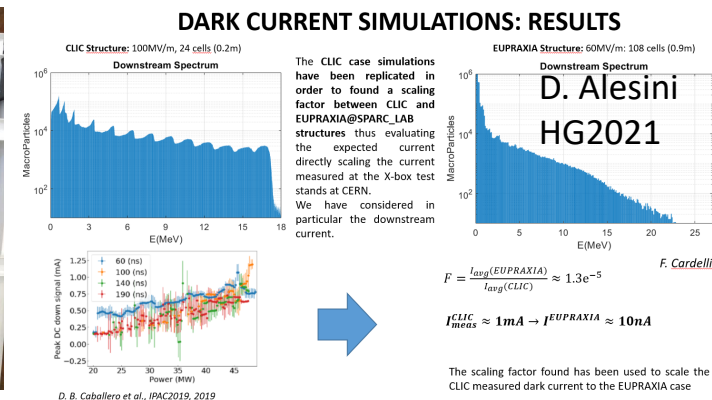
06/04/21



TEX Organization Chart



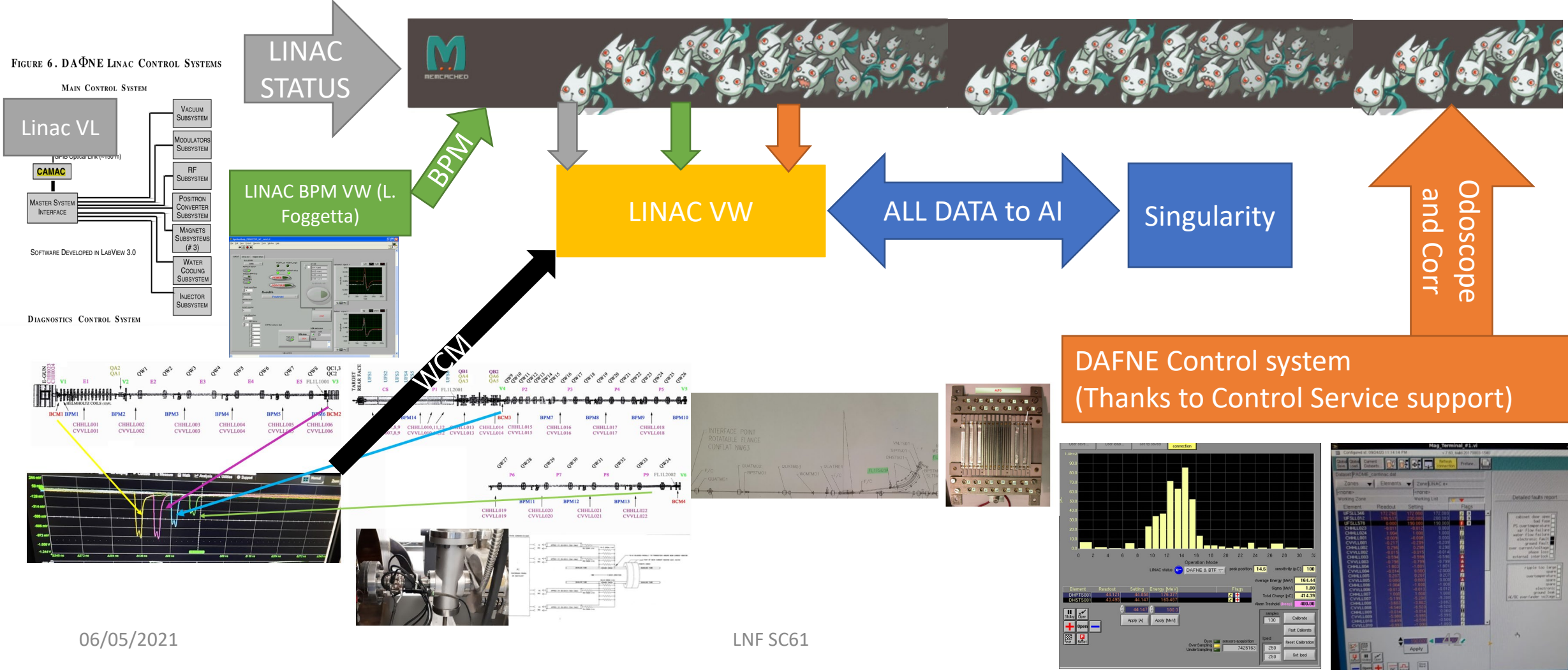
- Modulator Control System SAT with Scandinova (18/11/20)
- Safety installation and check on going (S. Pioli).
- Check of waveguide network (F. Cardelli).
- Study of klystrons installation procedure (F. Cardelli).



SINGULARITY PROJECT

- Send LINAC CONTROL DATA to **Artificial Intelligence** for learning&process (Leader S. Pioli)
- Definition of data LINAC data collector
 - (WCM, Energy Charge BPM → Linac Magnet elements Linac Correctors RF Vks)

INFN CNS5



➤ Integration WA4 (B. Buonomo)

➤ RF Power WP12 (F. Cardelli)

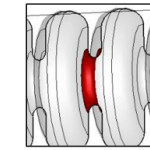
➤ Study of dark current for EUPRAXIA structure (more details in International Workshop on Breakdown Science and High Gradient Technology (HG2021) by D. Alesini)

➤ Design and check of X-band waveguide components

➤ Study of RF power distribution of EUPRAXIA@SPARC_LAB (more details in HG2021 Courtesy by D. Alesini)

DARK CURRENT SIMULATIONS: SETUP

- The work has been done by F. Cardelli and is based on the work done at CERN by T. Lucas, D. B. Caballero and colleagues ([1],[2]).
- Dark current:** field emitted electrons captured by the RF fields and transported up to the end of the structure. Its evaluation is necessary for radiation protection calculations for both EUPRAXIA@SPARC_LAB and TEX bunkers.
- General comment:** the dark current **strongly scales with accelerating field** because to two effects:
 - decrease of the emitted current due to the lower surface field (emission effect);
 - decrease of the capture efficiency (capture process)
- Simulations have been done with CST studio (Eigenmode solver, PIC solver)



constants function of the metal work function Φ

$$J = d\beta^2 E^2 e \frac{-b}{\beta E}$$

surface electric field

$\beta = 30$ (field enhancement factor)
 $\Phi = 4.5$ eV (work function)

CLIC style structure 24 cells

$E_{acc} = 100$ MV/m

EUPRAXIA@SPARC_LAB style structure 108 cells

$E_{acc} = 60$ MV/m



[1] T. G. Lucas, High Field Phenomenology in Linear Accelerators for the Compact Linear Collider, PhD Thesis, University of Melbourne, 2018

[2] D. B. Caballero et al., Dark current analysis at CERN, WEPRB059, Proceedings of IPAC2019, 2019

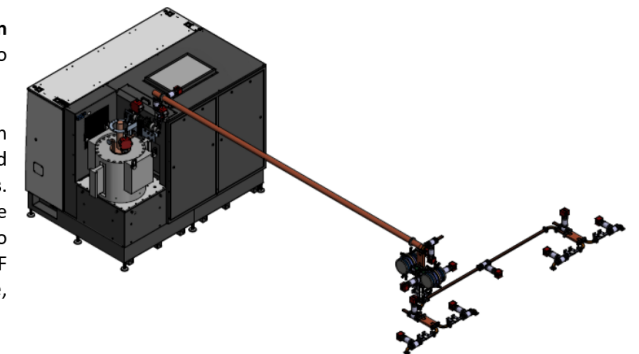
WAVEGUIDE SYSTEM: COMPONENTS AND ATTENUATION

⇒ We have considered both a **symmetric than an asymmetric waveguide distribution system** to optimize the rf pulse arrival wrt the beam

⇒ **X-band technology requires strong R&D activity** in order to evaluate and define the acceptance and quality procedures of the **different components**. Most of the components we have inserted in the layout have been developed by CERN but we have to perform their test at the EUPRAXIA nominal RF parameters (BOC, pumping units, circular waveguide, rf loads,...).

⇒ **There are some rf components that still need to be developed** or retuned (circular-rectangular mode converter, pumping system for circular waveguide)

⇒ Unfortunately the **attenuation of the X band WR90 waveguide is strong** (~0.1 dB per meter) and the careful calculation of the total rf losses is important (10-15% power attenuation!).



| Low Energy Asymmetric Module | | | |
|------------------------------|--------------|-------------------------|--------------|
| Structure A, B | | Structure C, D | |
| WR-90 total length [mm] | 3214,82 | WR-90 total length [mm] | 5449,83 |
| WC-50 total length [mm] | 4678,00 | WC-50 total length [mm] | 4678,00 |
| BOC loss [dB] | -0,097 | BOC loss [dB] | -0,097 |
| WR-90 loss [dB] | -0,315 | WR-90 loss [dB] | -0,534 |
| WC-50 loss [dB] | -0,058 | WC-50 loss [dB] | -0,058 |
| total loss [dB] | -0,470 | total loss [dB] | -0,689 |
| total loss [%] | 10,25 | total loss [%] | 14,66 |

| | Loss dB/m |
|------|-----------|
| WR90 | -0,098 |
| WC50 | -0,0124 |

CONCLUSIONS

- PADME RUNS accomplished
 - RUN2 physics graded delivered $6,28E+12$ PoT, overall delivered $> 7E+12$ PoTs, good beam quality from PADME analysis
- BTF UPGRADE close to the end
 - On time, now fixing safety system and mounting shielding
 - Next step beam commissioning foreseen in the second part of May
- In the second part of 2021 we want to be ready for users and the other external activities
 - After BTF2 beam commissioning will start the **users' campaign call** and the other activities as E-RAD (after DAFNE shutdown in July)
- BTF accomplished all its past duty during 2020, adding a delayed user run and new diagnostic development
 - still maintaining scientific and dissemination duty (CERN, IEAP and BL4S, BTTB9, IPAC21, IBIC2021, LNF internal) even in this “iron and concrete” period.
- LINAC continuously up for DAFNE and BTF
 - Initially pulsing at 25Hz to overcome KlyC vacuum windows induced faults,
 - Ready to SIDDHARTA data taking at 50Hz
 - We are up with a 0,93 uptime over 24/7 operations

BTF2 COMMISSIONING – PEOPLE

Many thank to all the LNF Divisions (Accelerator, Technical, Research) and Administration

To all the **technicians**, the spinal cord of these Labs: **Grazie a tutti ragazzi, siete grandi, la storia di questo grande laboratorio la scrivete voi ogni giorno!!!!**

Thanks to these young team leaders for BTF2 installation.
Although in Italy, they have less 40!!!



G. Catuscelli - Interlocks



S. Lauciani – Mech Eng



A. Liedl - Vacuum



A. Vannozzi - Magnets