LINAC & BTF

58th Scientific Committee Meeting
Nov. 11-12 , 2019

ACTIVITIES

A lot of ones (and problems) of course since last meeting

- Execution of **test beam campaign on BTF-2**
- **PADME test run**
- Build a **second beam-line (BTF-2)** and experimental hall
- **LINAC** activities

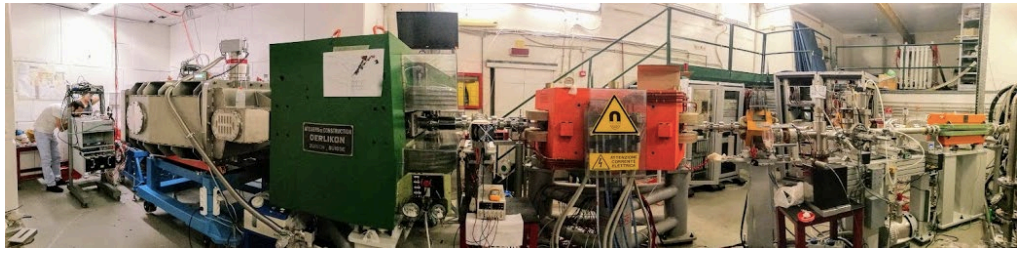
BTF ACTIVITIES

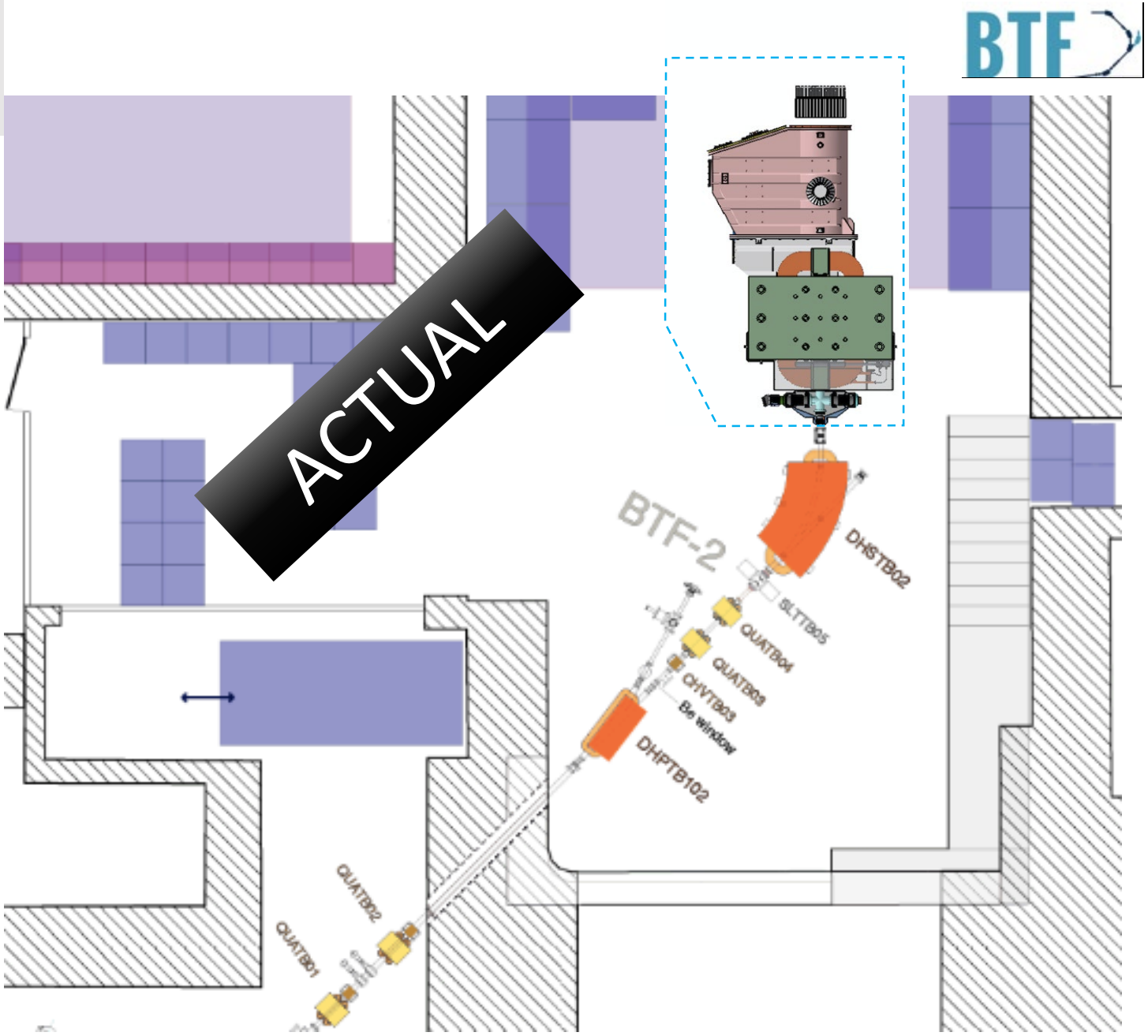
1. *Now in shutdown for Be window failure in BTF1-BTF2 lines*

2. Restart with long primary positron pulses for the **PADME run**
   - **Done but not complete due to 1.**

3. **Test-beams**
   - **Done (on scheduled stop till Jan20 then delayed)**

4. **Final BTF 2 installation and commissioning**
   - **Not yet started due to 1.**





LINAC ACTIVITIES

- **Consolidate the LINAC**: extend lifetime of 10 years
  - Implementing HVPS on 4 mod's
    - **50% full operative since months**
  - Substituting mod's and subsystem old electronics with a new embedded one
    - **Prototyping on Mod. B.**
  - Improved Maintenance and Diagnostics
    - **80%, full operative (scattered in time parasitize machine operations)**

- Critical implementation for just one reason

  LINAC has to be ready for all of the scheduled activities (and <u>we got it</u>):
  - BTF user run
  - DAFNE in SIDDARTHA run
  - PADME run

TIMELINE

Till Last Scientific commitee

01/04/2018: Start of beam line dismounting

04/07/2018: Third part of funding available (650 k€)

12/07/2018: First beam in BTF-1 line beam setup

20/07/2018: END of beam commissioning

Aug. 2018 : Summer shutdown

15/09/2018: Restart LINAC op. and PADME RUN1

23/10/2018: Status report to INFN MAC

21/12-07/01 2019 : Winter shutdown and maint.

26/02/2019: First beam in BTF-2 line beam setup

01/03/2019: END of PADME RUN1

04/03/2019: LINAC available for DAFNE

06-29/03/2019: LINAC HVPS Mod.B installation

30/03/2019: LINAC ready for DAFNE

08/04/2019: LINAC on for SIDDHARTA&BTFexp run

09/05/2019: Last Scientific Committee 57th

10/06/2019: First user in BTF-2 line beam setup

02/07/2019: Last user in BTF-2 line beam setup

07/07/2019: LINAC tuning for PADME run

08/07/2019: PADME test run start

25/07/2019: BTF change setup for PADME BKG study with BeW

-> Failure on BeWindow

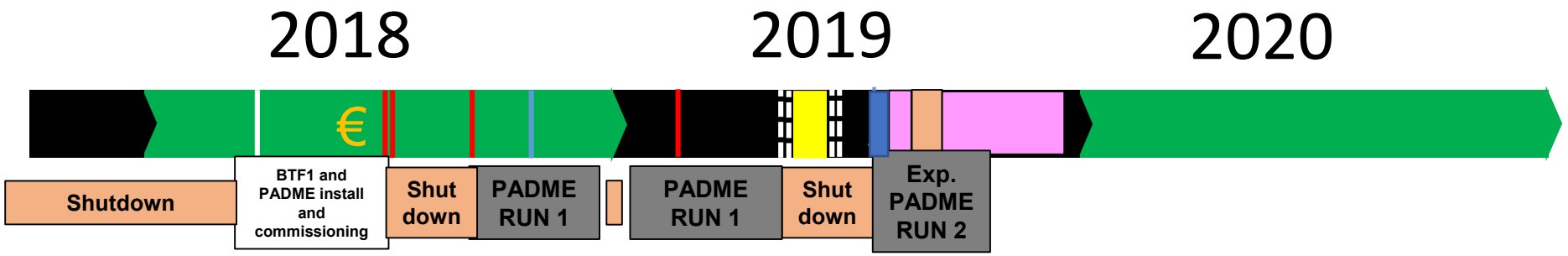
Aug. 2019 : Summer shutdown

~~**09->10/2019: Expected BTF2 installation**~~

~~**11->12/2019: Expected PADME RUN-phase 2 start**~~

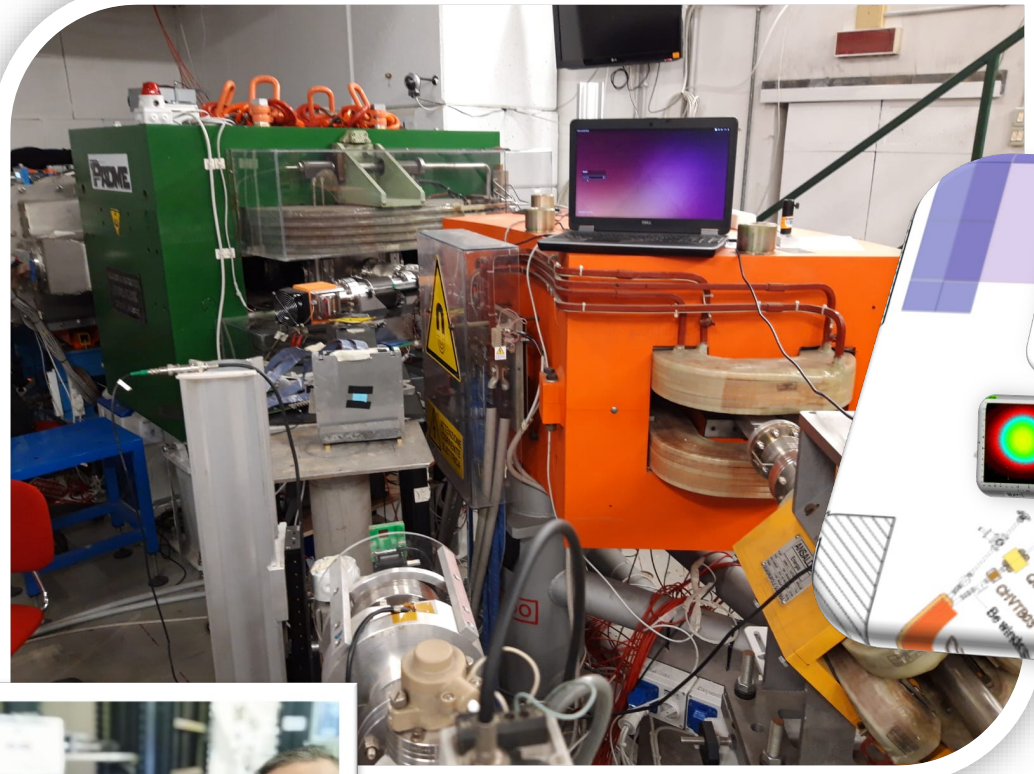
Sep. 2019: Definition and implementations of the relative safety procedures by RSPP and forming cleaning team

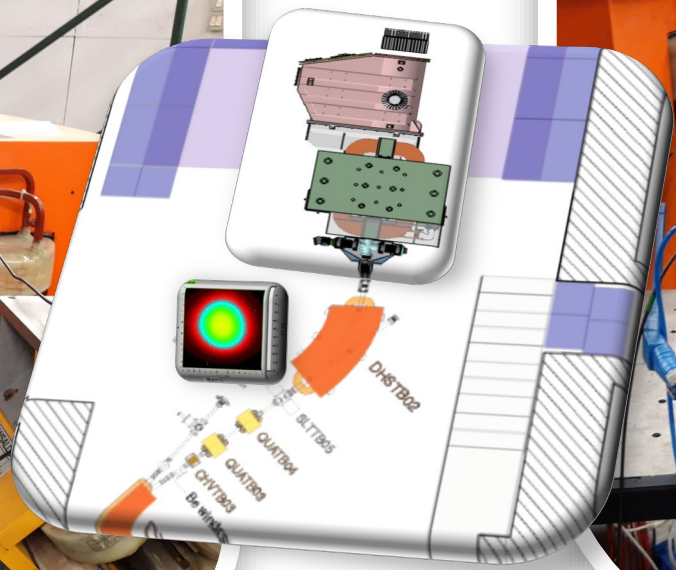
Oct. 2019: start of very complicate cleaning trials

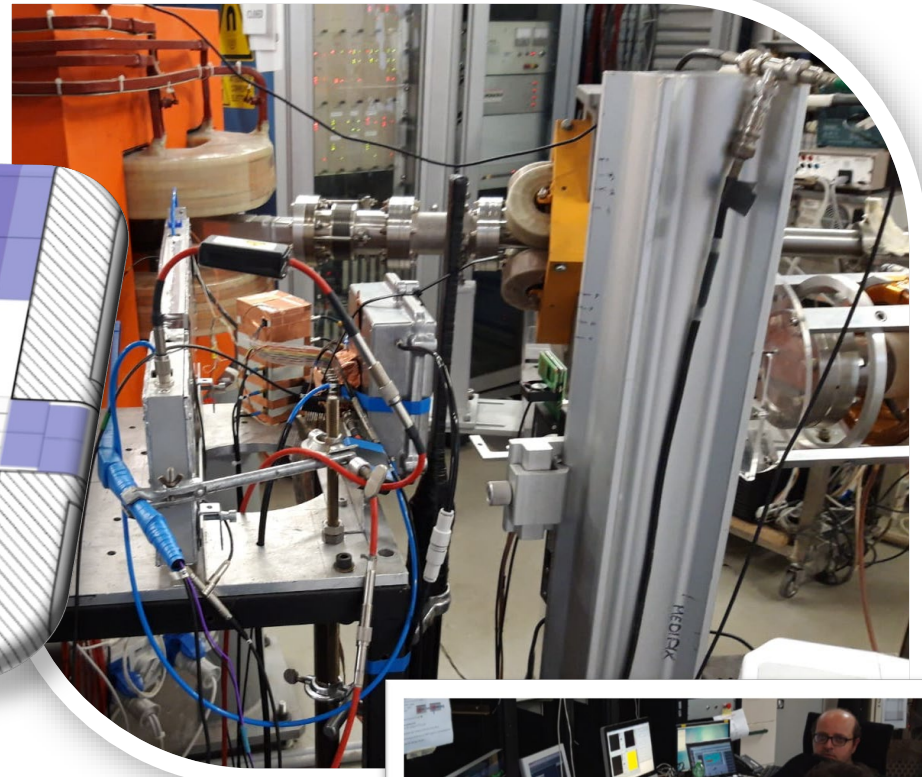


BTF SLIDES

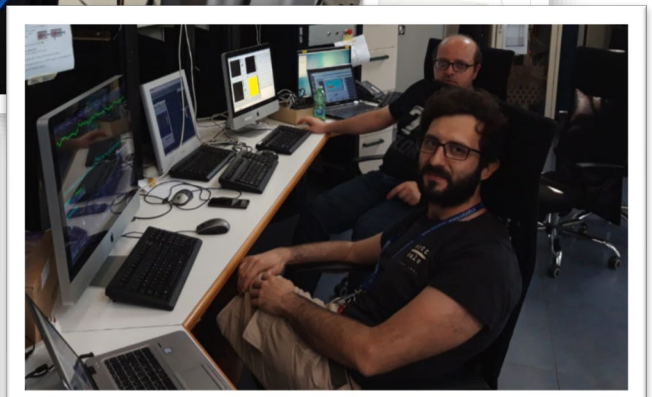
BTF-2 USERS







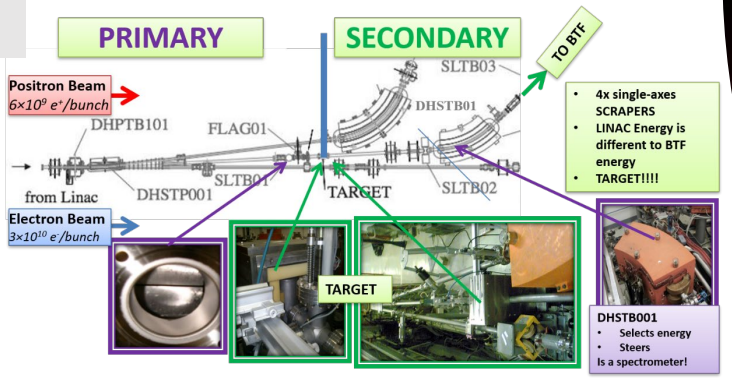
- Three weeks of reserved run (one also for BTF staff) -> H24 7/7
- Not easy location for installation and not so much space for users (i.e. no trolley table) but we got it
- Hard (hot) time for one user due to rooftop fail
- Beam time experiences as success for all the users (they said)

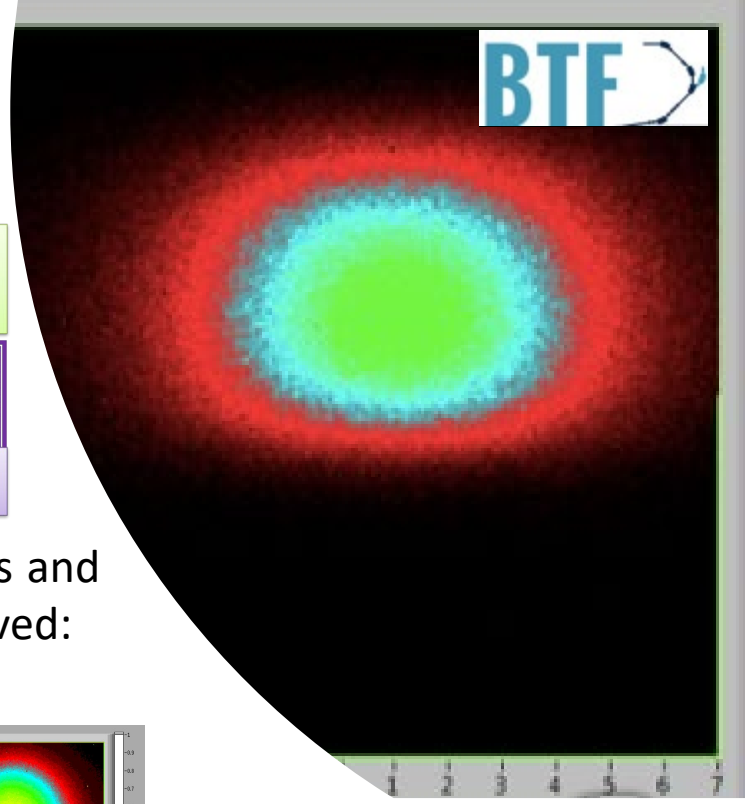


BTF SHORT RECAP

BTF beam transport

Primary or secondary beams

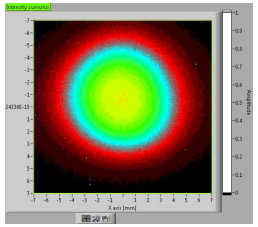


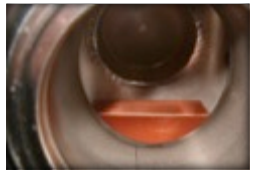


The beam can be delivered in different modes: **dedicated** or **opportunistic** operations and **with** or **without** attenuating target. Different ranges of beam parameters can be achieved:

LINAC Conditioned Primary Beam, E_0

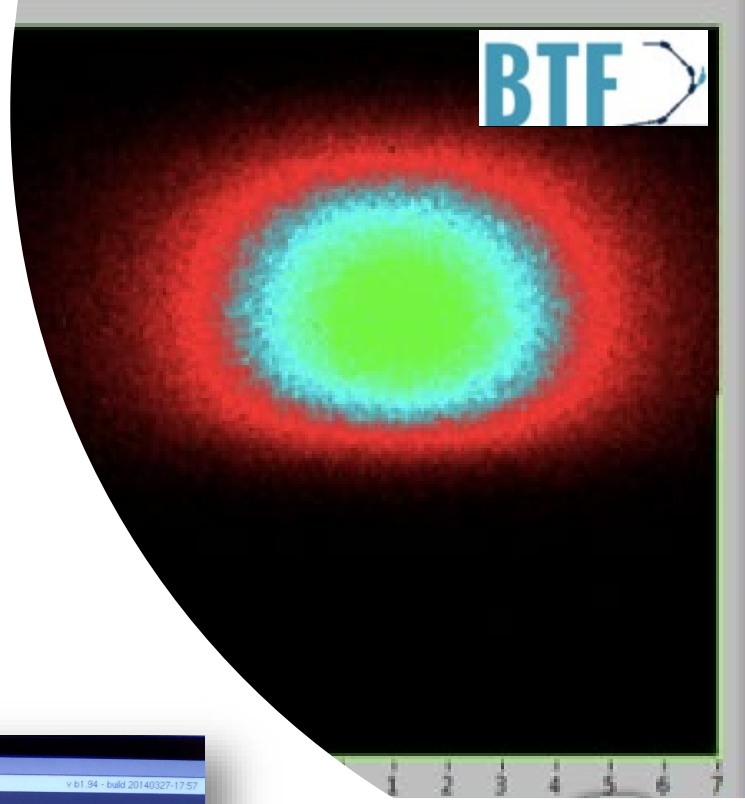
- Fixed energy, E_0
  - Steering and transverse tuning
- High current
  - from top current
  - tunable in 6 orders of magnitude from 10^{10} prim/bunch





Cu target, 1.7-2-2.3 x_0

- Tunable energy
  - All energies from E_0 to ≈30 MeV
- Tunable multiplicity
  - From max(E) to single particle per shot
- Particle type decoupled from LINAC



BTF **secondary** beam commissioning

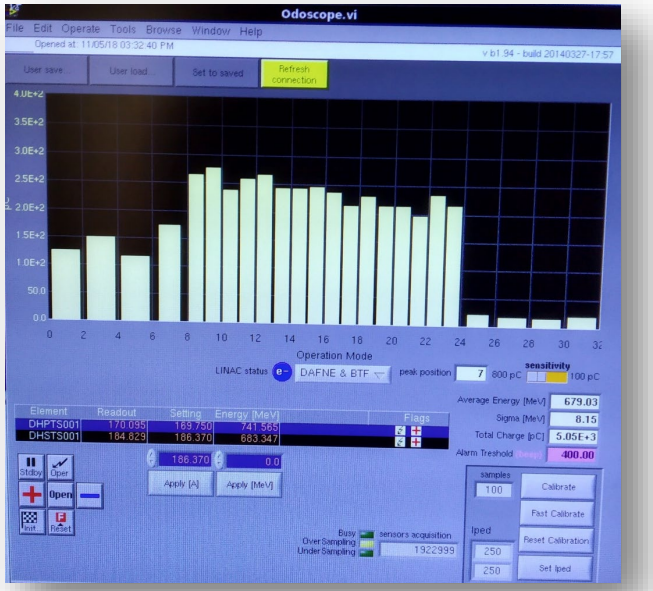
July 2018 – *Lessons learned*

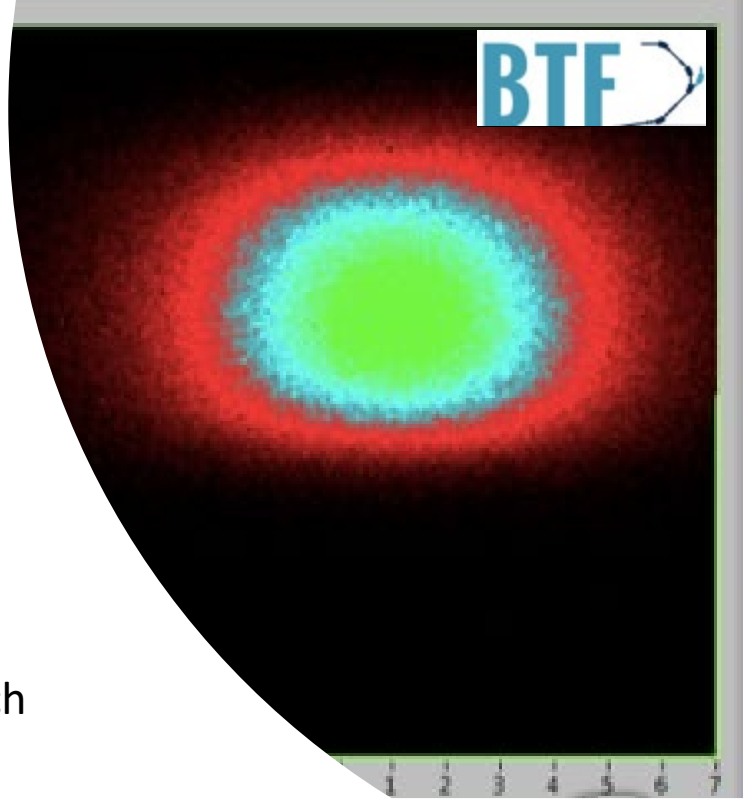
Last **Secondary Beam configuration** for PADME:

- Secondary Positron Beam Production at the **BTF target**
  - Electron Primary energy 670MeV
  - LINAC current higher than DAFNE ops
  - Multiplicity max(545MeV, scraper'd) above 25k
  - Very good beam control and run stability for PADME

Drawbacks

- **Primary beam energy spread more than 6%, beam losses**
- Diagnostics and services (vacuum expecially) ageing
- Implementation of safety rules (i.e. cool down of target)
- Background in PADME (see PADME presentation)
- LINAC cathode ageing (charge+timing)





BTF **primary** beam

March 2019 – *Lessons learned*

Actual **Positron Primary Beam configuration** for PADME:

- Beam Production at the LINAC converter **target**
  - Primary transported energy 490MeV, good spot
  - Very low LINAC current (10^7 pos/bunch) then scraping to reach 25k POT/bunch
    - lower background
  - Limited rad damage issues
  - Higher multiplicity than 25k is not a problem
  - Seems better beam energy spread (PADME estimate at TPX level less than 0.3%)
  - **Achieved a good stability in position and multiplicity** => still working on

Drawbacks

- Lower maximum beam energy due to beam loading and off-timing
- Achieved good beam control and runtime stability for PADME but needs higher correction rate
- **Difficult measurement LINAC current monitor (BCM, BPM), better after BCM upgrade**

PADME TEST RUN - SUMMARY

Scheduled short run, from BTF side

- Fixing parameters for best primary beam
  - PADME got a better transverse parameters beam with significant lower low energy background

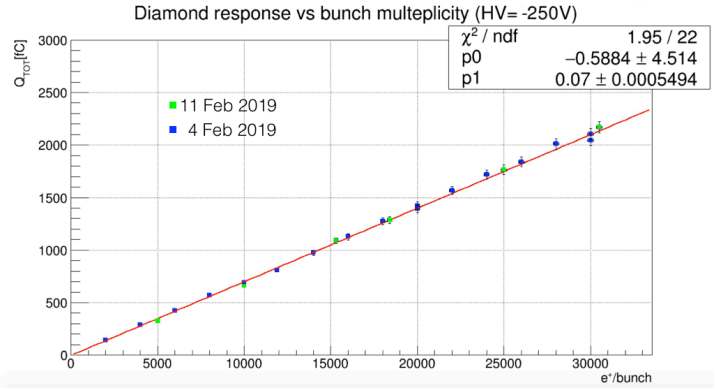
- Discover external/internal background origin on PADME

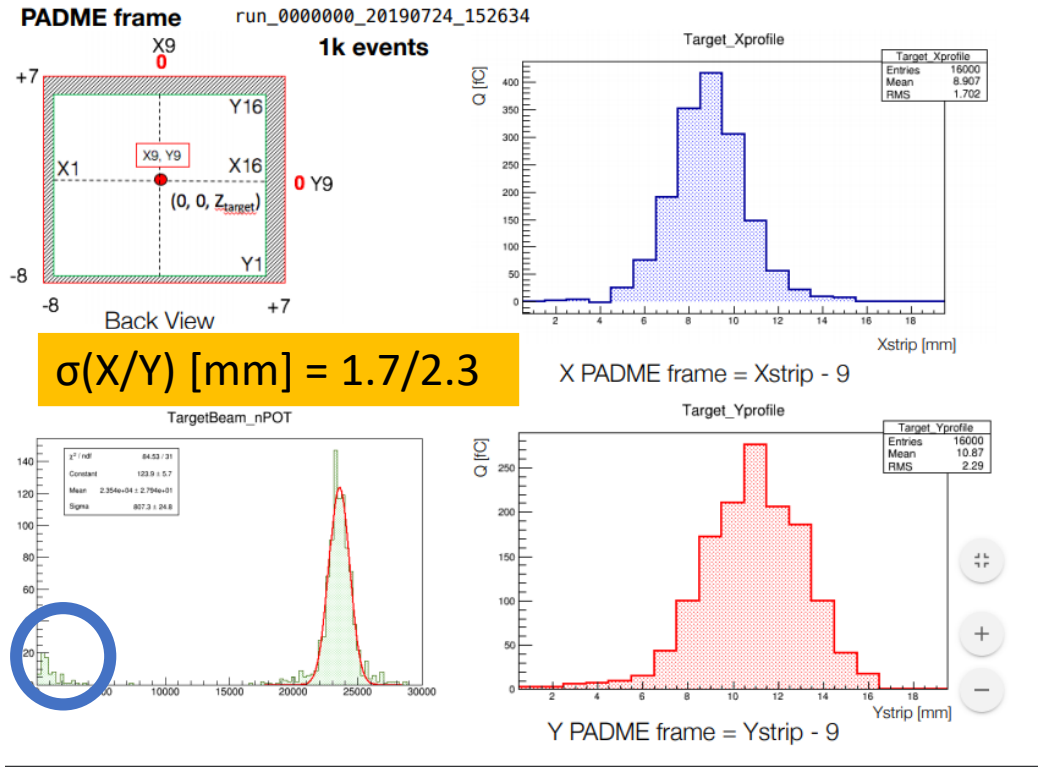
Setup variation from RUN1

- Handshaked changing of the Berillium window position
- Vacuum conditions (Dynamic pumping only in PADME vessel)

Run with some delays due to:

- Air conditioning failure (installation of splitters in a weekend to reduce temperature fluctuations)
- Little Vacuum service problems due to RUN1 irradiation damage (spread also in the SIDDHARTA run, mostly flags and slits)
- Berillium window breaking

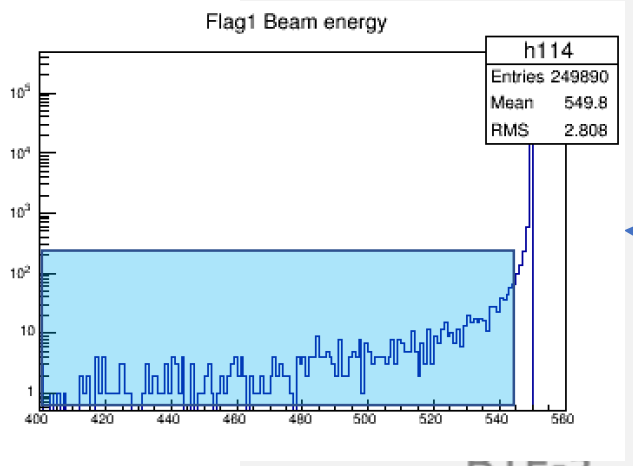




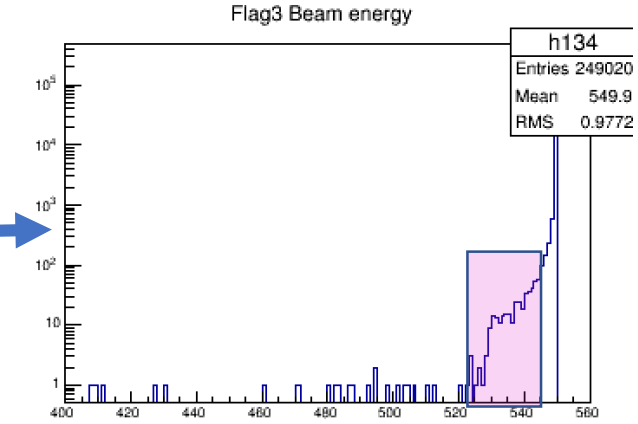
PADME BACKGROUNG CHANGE BEW POSITION

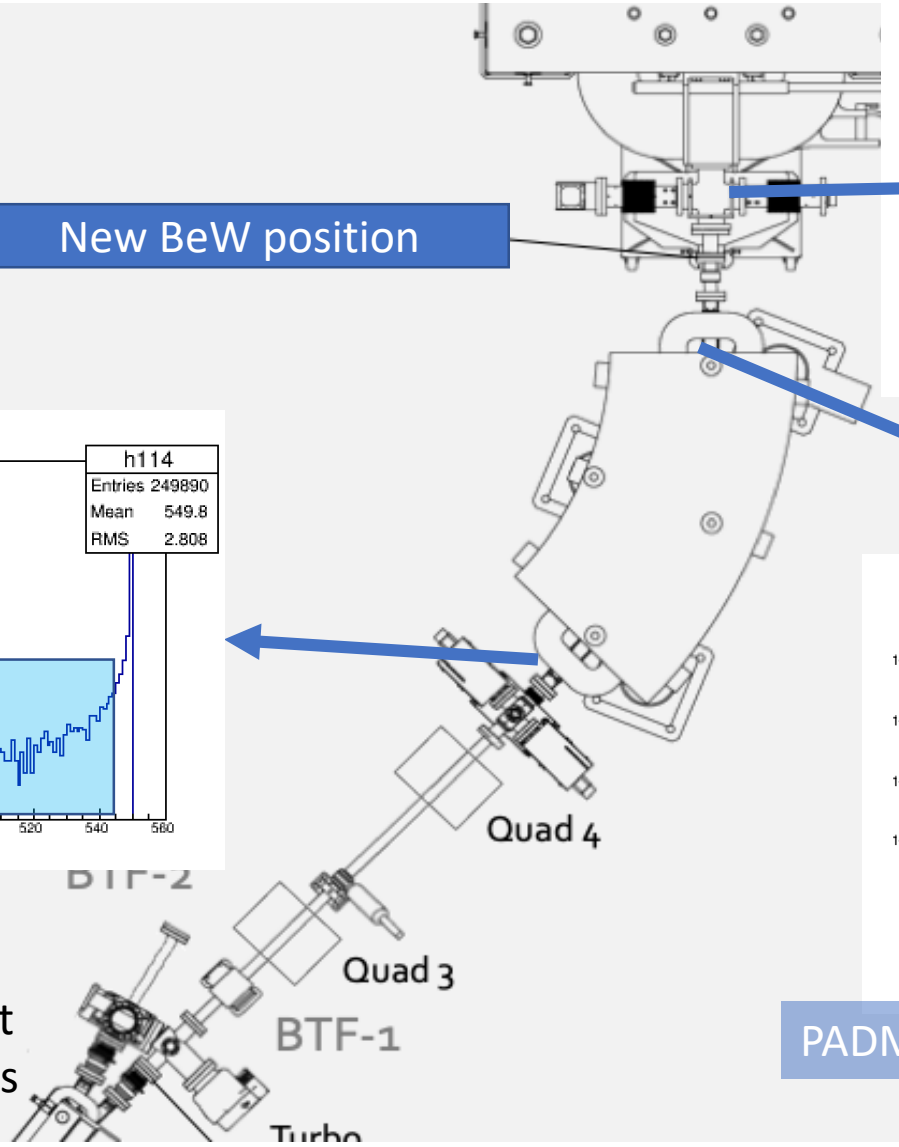
Motivation for moving Be Windows:
- PADME simulations
- deep discussions with BTF staff

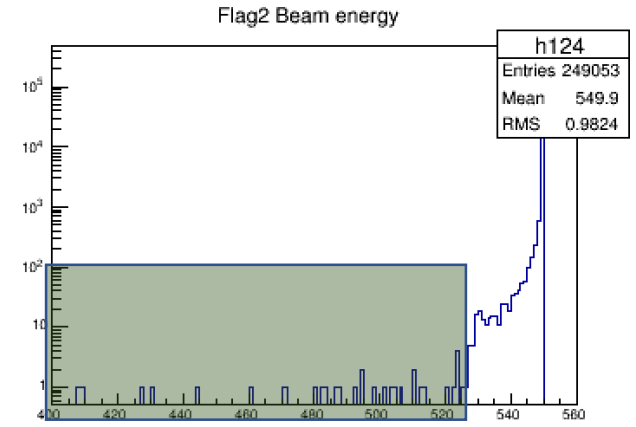
- **Brem'd positrons**
- **Missing ones maybe on pipes**
- **Survived positrons in the vacuum pipe then in PADME chamber**



New BeW position







PADME courtesy -> Gianotti pres.

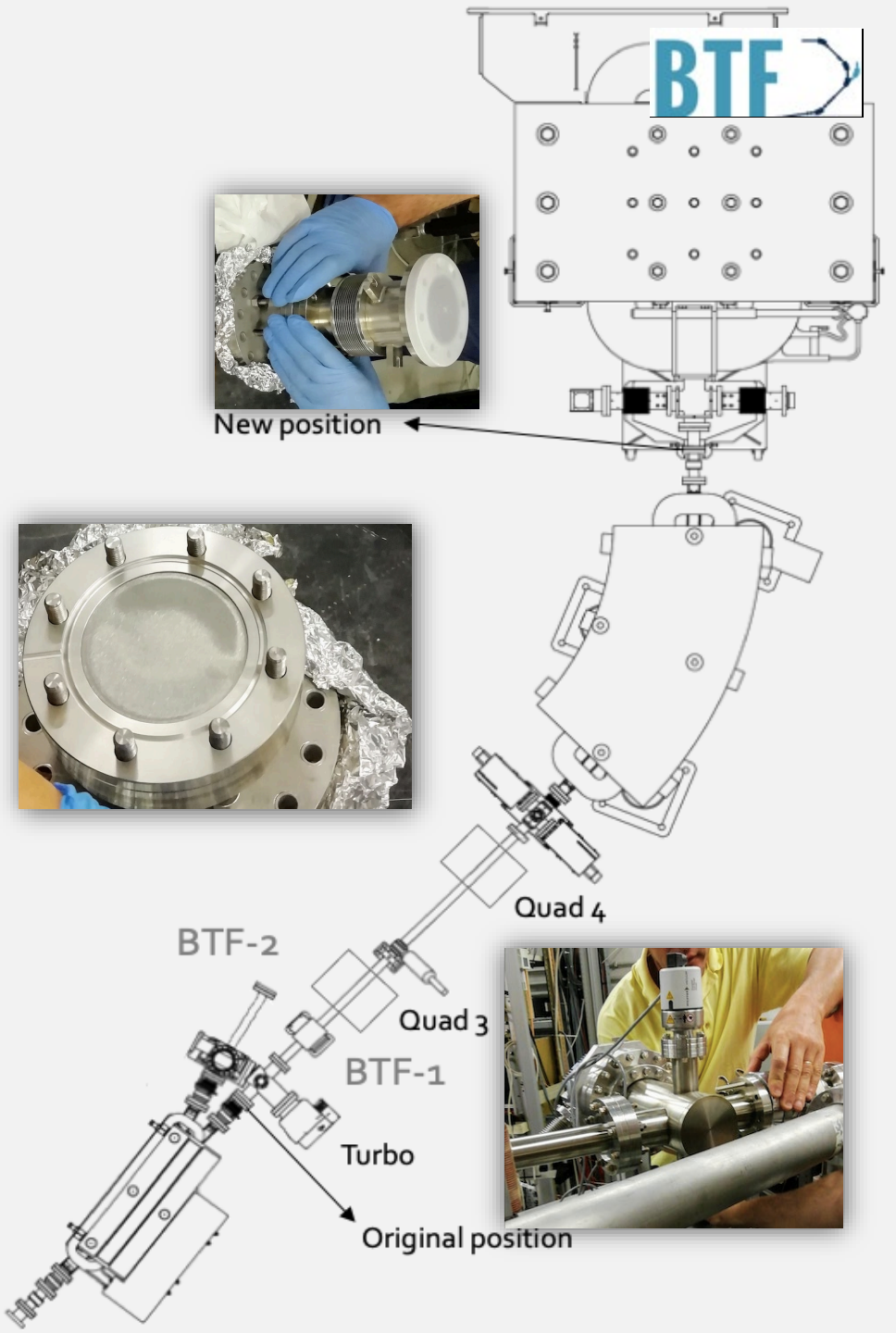
So we got a fix with old setup on primary beam in test run then:
- BeW replacing PADME target, 10 cm upstream it
- scheduled 3 days of run before summer holidays
- See side effect on Ecalo deposited energy

BERYLLIUM WINDOW FAILURE

Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati

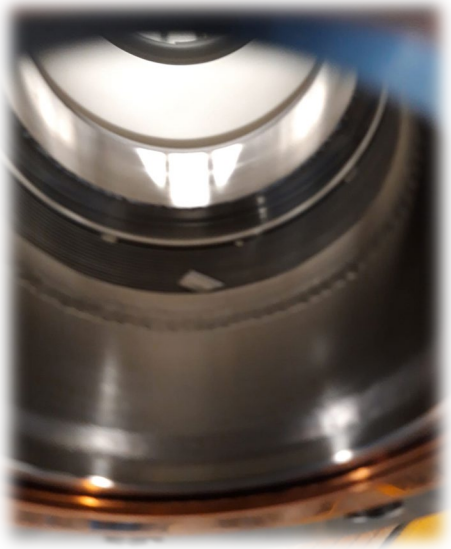
Aiming to lower background due to Brem'd off track/off energy positrons

- Assembly mounted in new position, between BTF dipole (orange) and experiment dipole (green)
- First trial leaks, new window directly mounted on the assembly
- During pre-vacuum operations, Be windows collapsed
- **Event on July 25th -> BTF area off-limits**
- **Access to BTF area (including BTF-2 new hall) closed with no exceptions (Environmental sampling in first days of August)**
  - **Environmental sampling excluded Be outgassing in air and fragments on the ground**
- **Discussions on procedures and planning until Sep. 19th**
- **Cleaning Team building, training and preparation in the meanwhile**
- **BTF1 Hall preparation and first trials on cleaning and pipes internal sampling on first week October**
- **Sampling result on 14th Oct.**



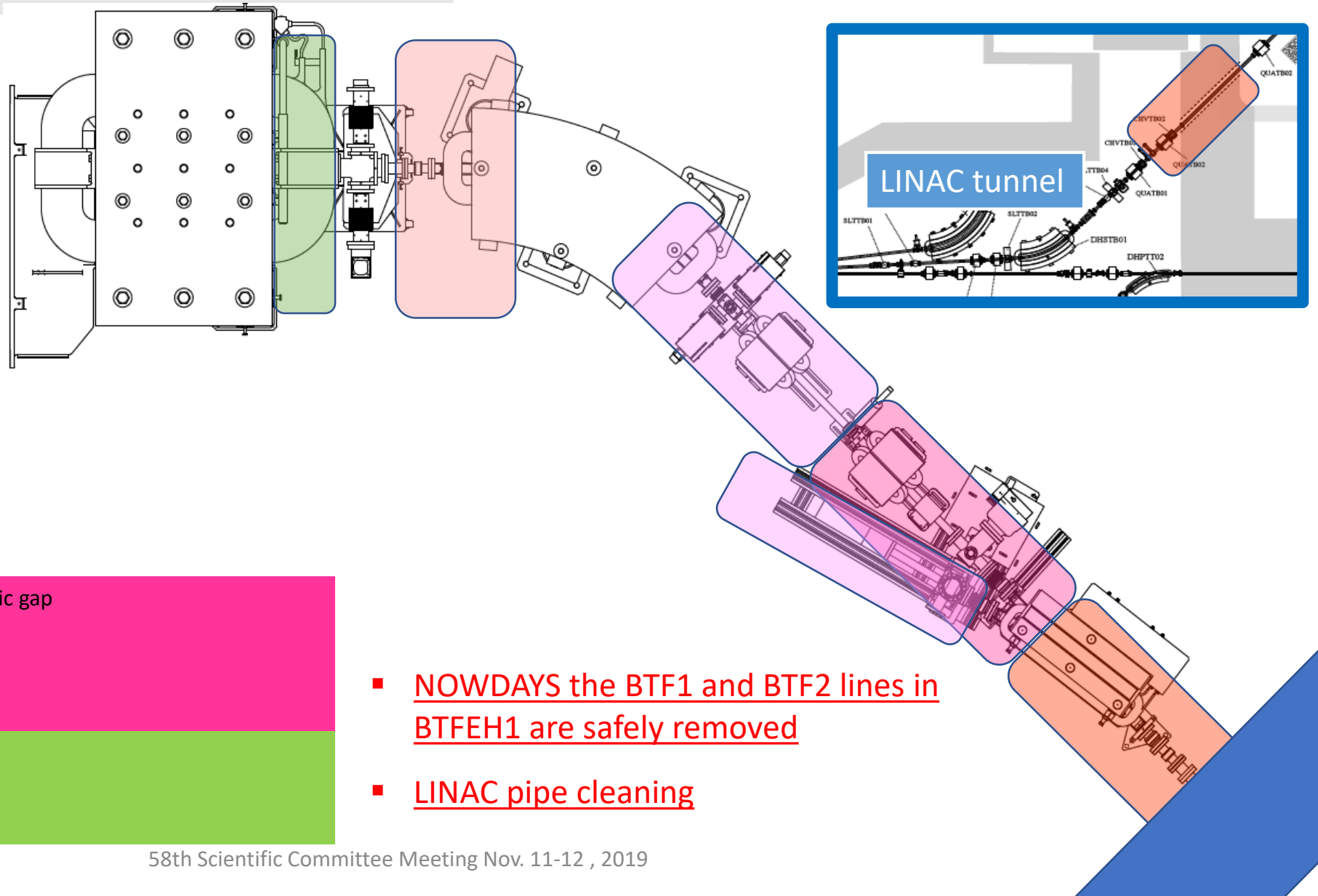
BERYLLIUM WINDOW FAILURE

OCTOBER - 19



BERYLLIUM WINDOW SAMPLING

- <u>All the line involved in the failure</u>
- BTF1 found deposits growing towards LINAC
- BTF2 seems less but not clean
- PADME seems not touched
- The gate valve half-way on the BTF channel has protected the LINAC transfer lines but the involved the pipe crosses LINAC tunnels thick wall



- Pipes, valves, pressure sensors, bellows, ceramic gap
- BTF-side pumps (TMP, Ionic and scroll)
- Flags, slits, vacuum cross and windows
- Two Be windows (final vacuum breaking)
- LINAC tunnel pipes up to gate valve

- PADME downstream cross
- PADME detectors
- PADME vacuum chambers

- <u>NOWDAYS the BTF1 and BTF2 lines in BTFEH1 are safely removed</u>
- <u>LINAC pipe cleaning</u>

PLANNING

Targets acquired since from failure

Understanding the affected area
Make, test and start cleaning procs on easy-to-clean items
Redesign and start refurbishing of the involved parts has just been started
Safe removal of involved parts (except LINAC pipe)

GONE

Targets to be acquired

LINAC pipe cleaning (difficult removal, old cabling and rad issues)

GO

- Rebuild temporary only BTF1 line (just one disassembly for BTF2 installation (DP01 removal))
- Put in run PADME experiment for two months
- At the PADME stop, start BTF2 line installation and commissioning in the following two months

NO GO

- Remove shields, supports and pipe from wall (interlocking DAFNE activities)
- Adding 2m to replace LINAC pipe
- As in the GO case

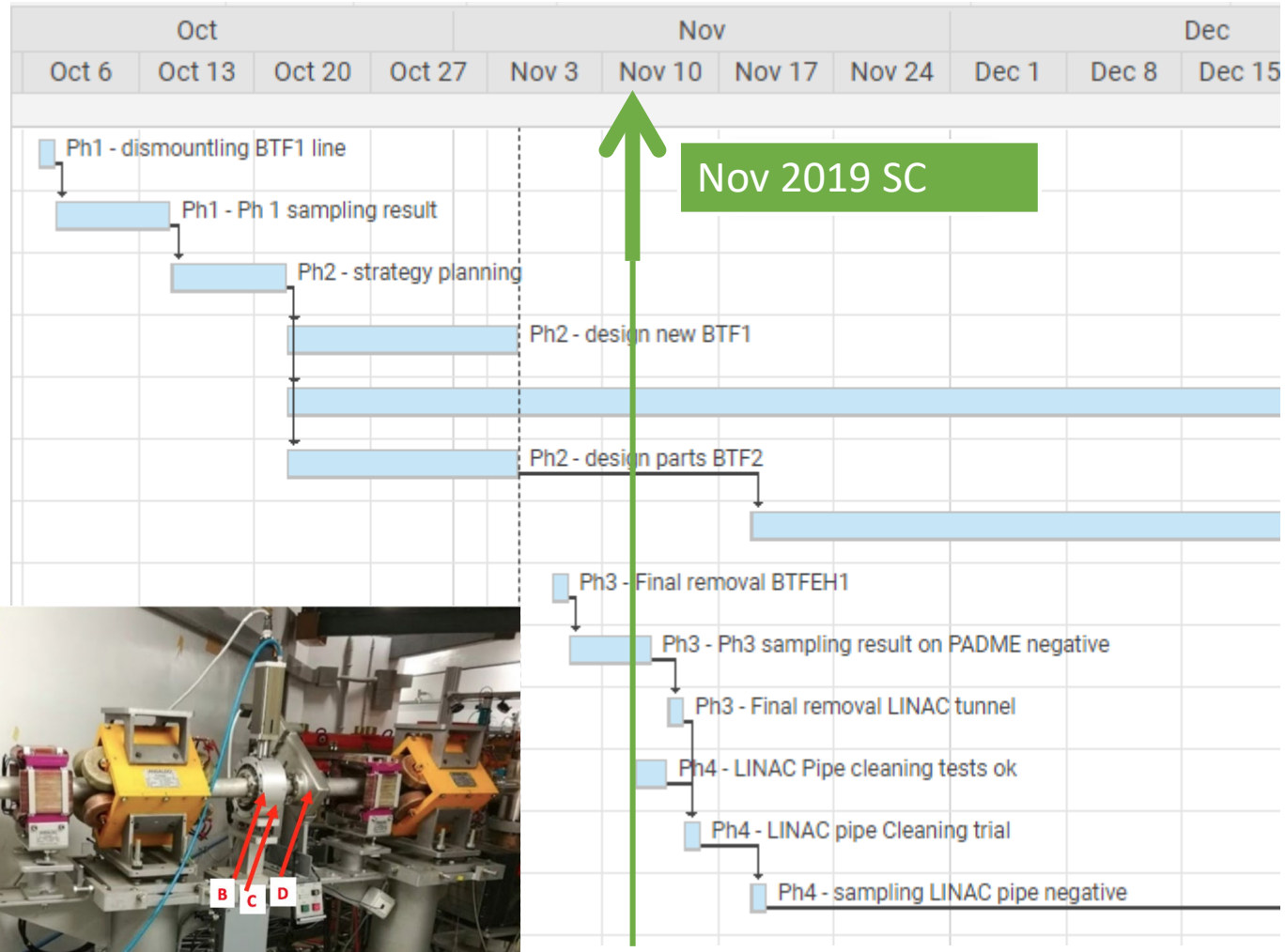
BTF1 ACTUAL PLANNING

-> Sampling results of LINAC pipe cleaning process is fundamental

-> Also waiting sampling results on PADME cross

-> The new (already) ordered parts also has tight timing

Up to now, we are on schedule for this new time planning

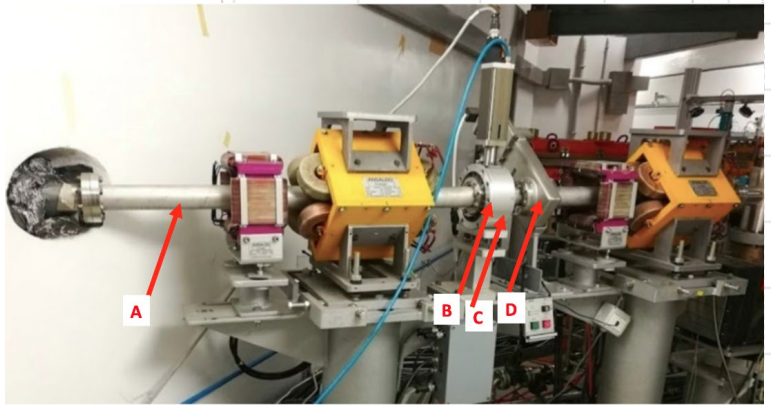


7 Nov. BTF1 dismounting, preparation of LINAC tunnel's part-> DONE

12 – 13 Nov. Test of cleaning procs for LINAC tunnel's part

14 Nov. dismounting of the LINAC tunnel's part;

18 Nov. Cleaning trial of the LINAC beam line, follows surface samplings



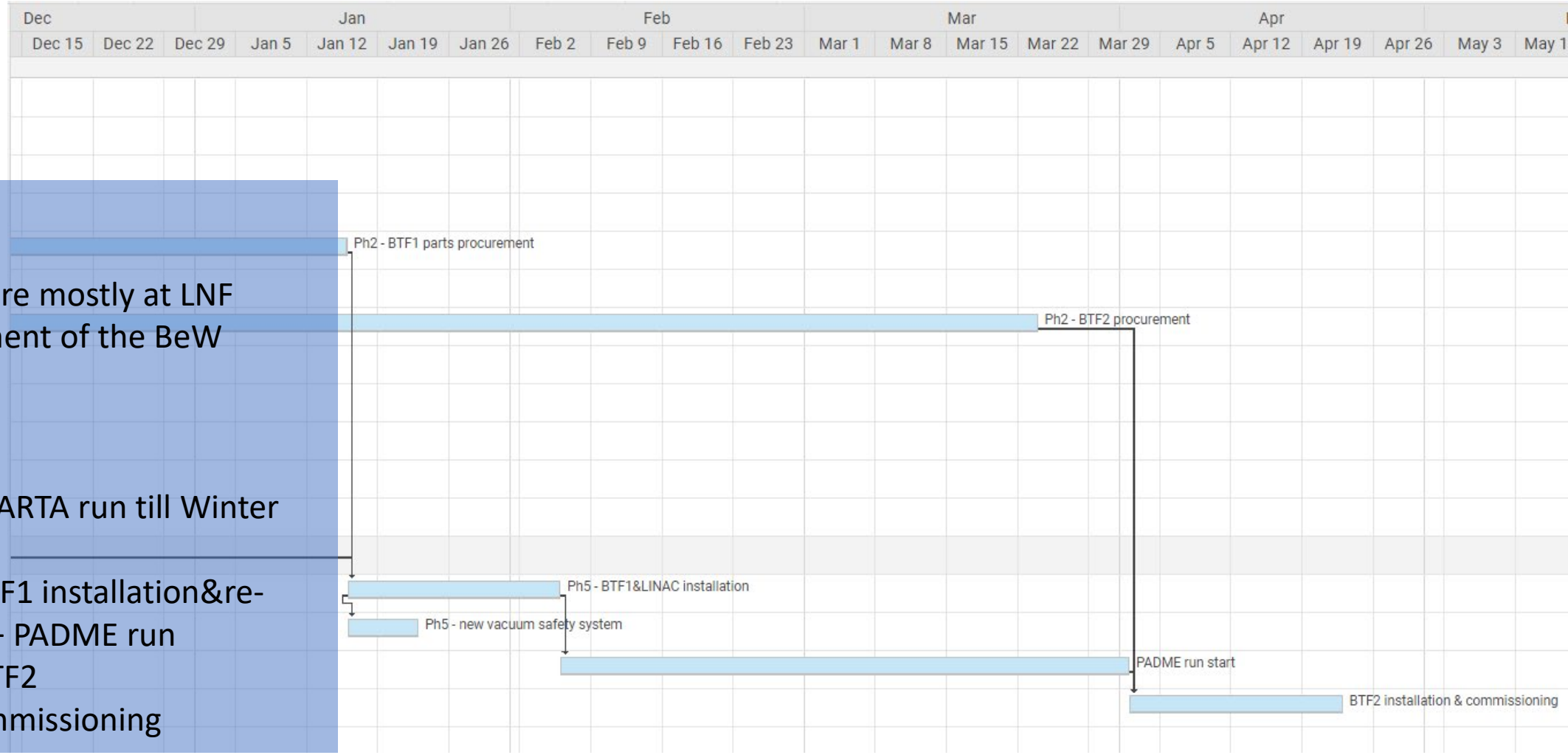
BTF2 ACTUAL PLANNING

Actual Status:

- BTF2 elements are mostly at LNF
- Needs procurement of the BeW involved parts

Actual planning

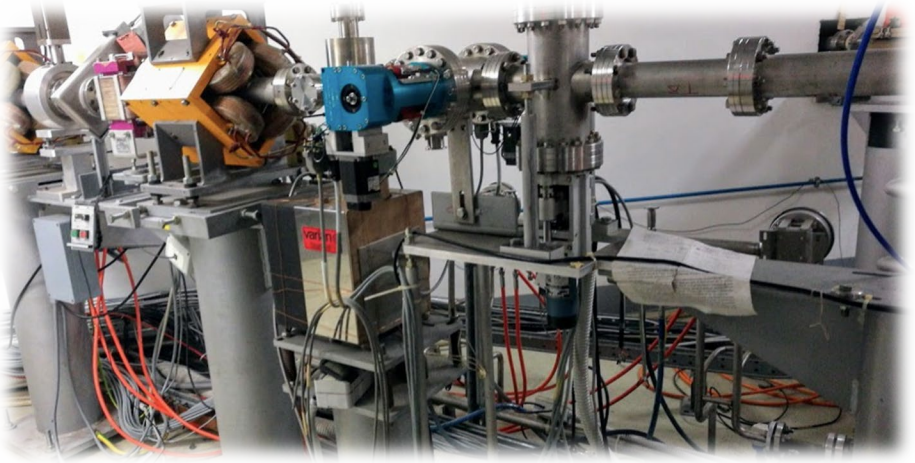
- Foreseen SIDDHARTA run till Winter stop
- On Feb. 2020 BTF1 installation&re-commissioning + PADME run
- On Apr/ 2020 BTF2 installation&commissioning



NEW VACUUM LAYOUT

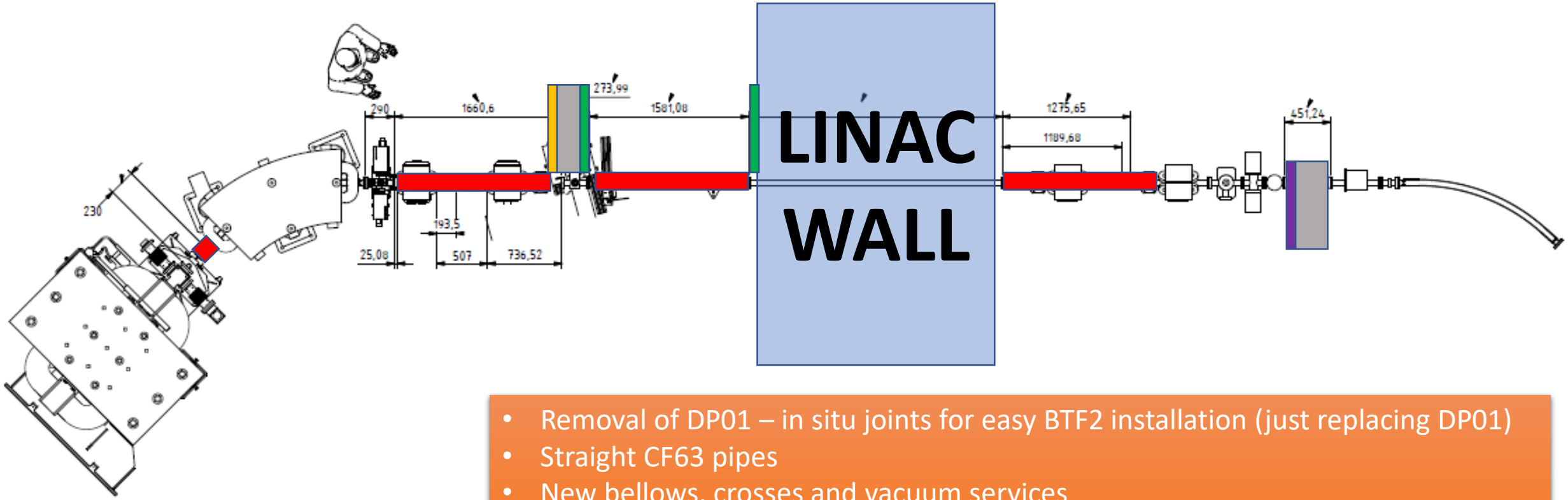
New (and old) Constraints

- Using a different material (e.g. Mylar) is a valid candidate $X_0(Be)=0.8X_0(Mylar)$
- Using more than one, but thinner window, would give additional safety margin with the some total thickness crossed by the beam
- Vacuum separation between PADME (10^{-5} mbar) and the LINAC (10^{-9} mbar) has to be leak tight
- PADME needs again less multiple scattering and Bremsstrahlung
  - scrapering far away will not avoid asymmetric energy spread but is a cure for the off-track
- Ideal solution is a low thickness, metallic gating valve (permitting high and low intensity) before DHSTB001 (moment selector magnet) but not mech and vacuum feasible



MYLAR DRAWBACKS → Is a polymer -> no rad tolerant -> frequent maintenance

NEW BTF TRANSIENT LAYOUT



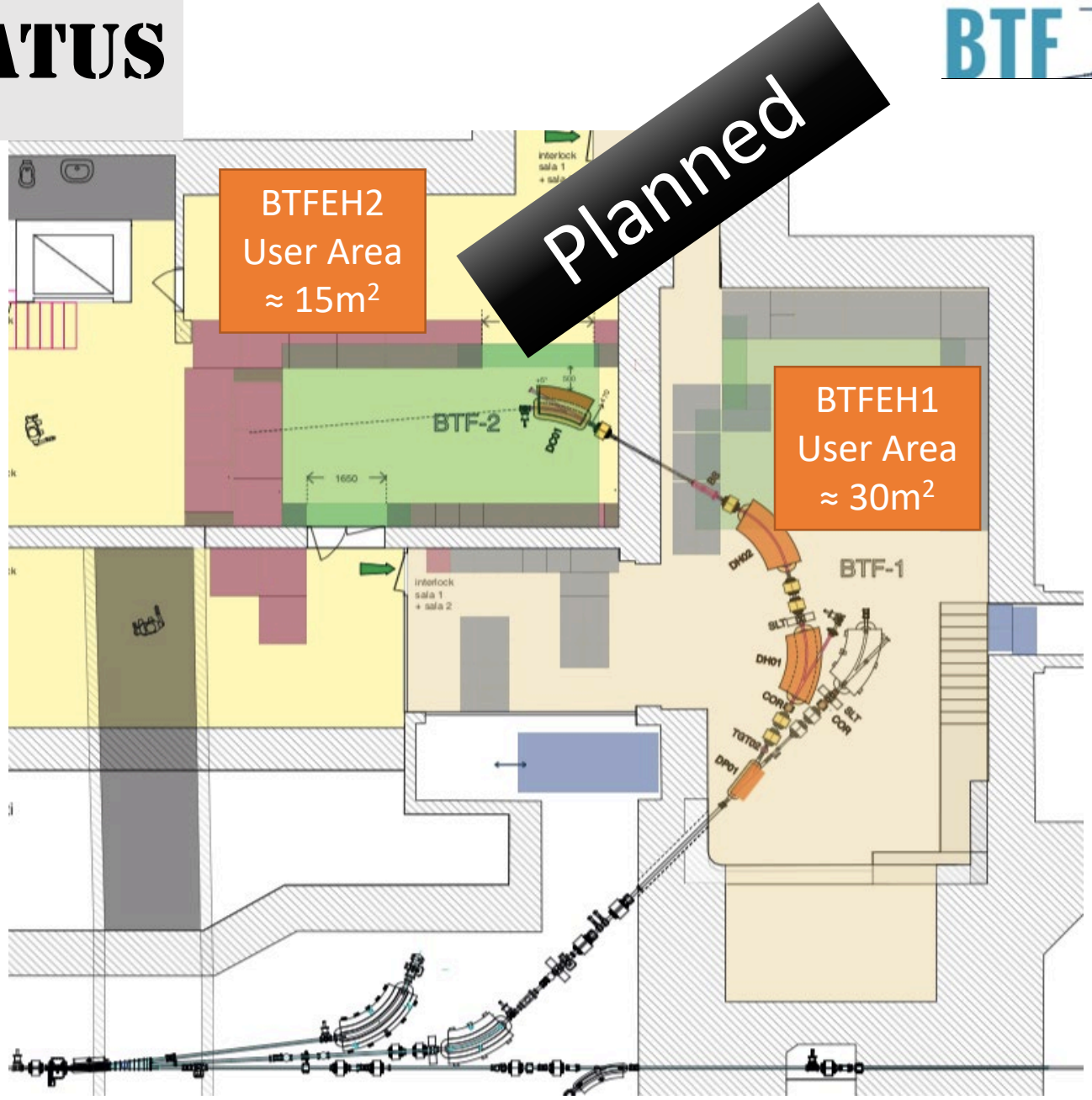
- Vacuum Service
- Pipes
- Vacuum Break (150um-mylar)
- Secondary Vacuum Break (40um-mylar)?
- Valves

- Removal of DP01 – in situ joints for easy BTF2 installation (just replacing DP01)
- Straight CF63 pipes
- New bellows, crosses and vacuum services
- New ceramic gap for BTF2 installation
- Low leak fast valve upstream in LINAC – ACC area
- Different vacuum separation from PADME to BTF/LINAC volumes
- BTF2 pratically untouched

BTF UPGRADE SLIDES

BTF DOUBLING STATUS

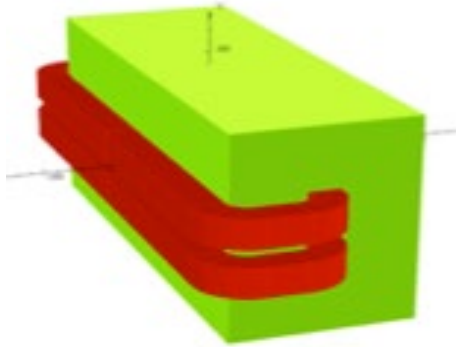
	Old BTF	Planned BTFs
Magnets number	11 (3Dip,6Qua,2Cor)	+ 12 (+4Dip,6Qua,2Cor)
Scrapers (axes)	8	+4
Beam stoppers	1	+1
Targets	1	+1
ICTs	3	+2
DAQ	1	+1
Ion Pumps	4 (2 for user vac)	+3



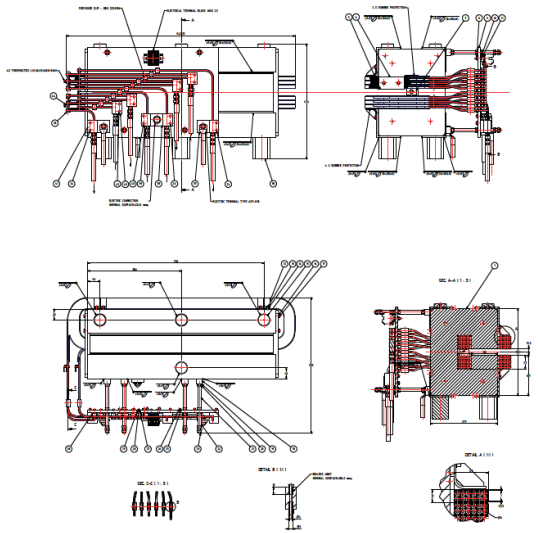
- ***Increased water cooling capability***
  - **70% - planned in 2020 before BTF2 installation**
- ***Increased stability air conditioned system***
  - **100% - now in shutdown due to BeW**
- ***Big control room***
  - **100%**
- ***New Power Supply hall***
  - **100%**

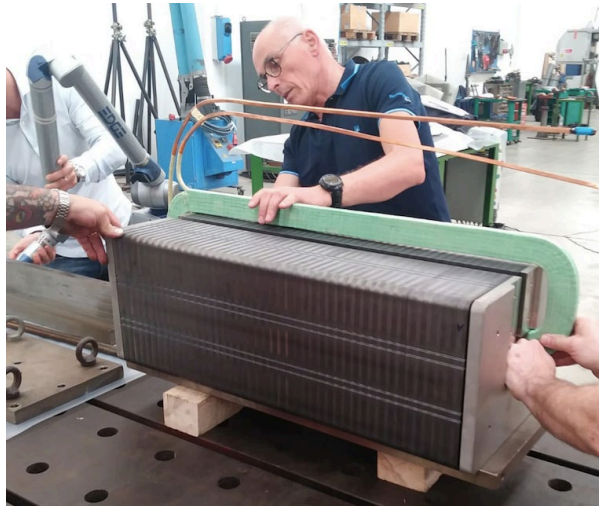
BTF DOUBLING LINE / MAGNETS

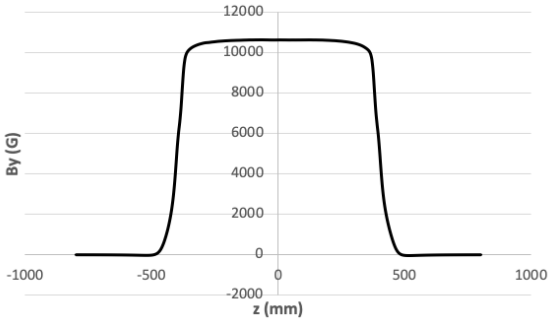
Fast C-dipole

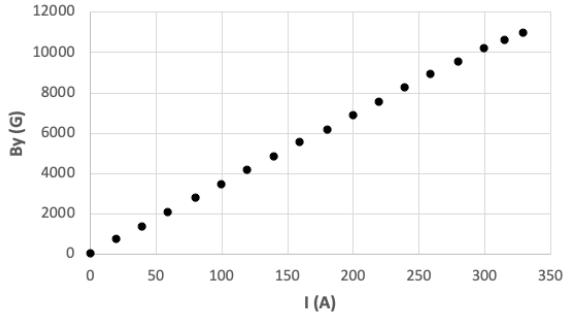


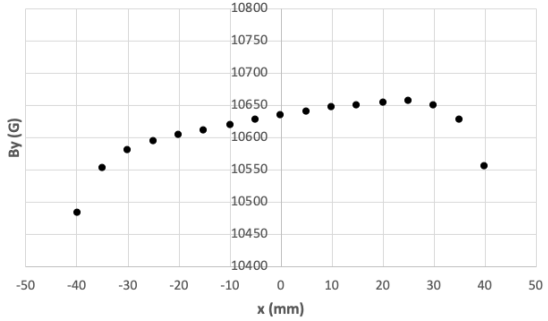
- Fast dipole - In house design (Late 2017)
- Construction at ORMET (Genova)
- Some issues on pole but seems ok
- Assembly in strong collaboration with LNF technicians
- Delivering, characterization and installation in June 2018
- Just used for BTF-2 beam commissioning and users





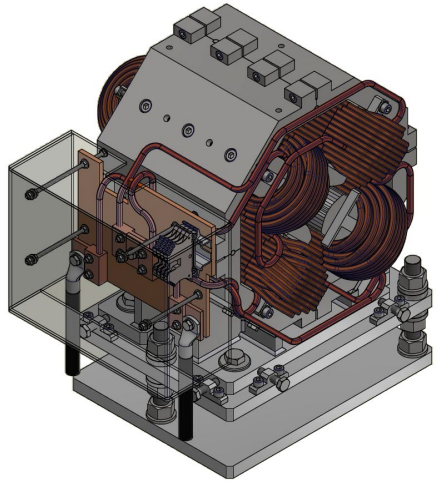


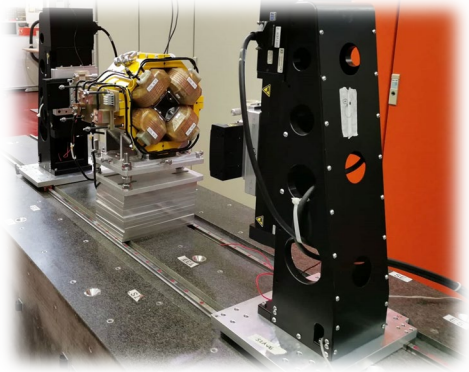


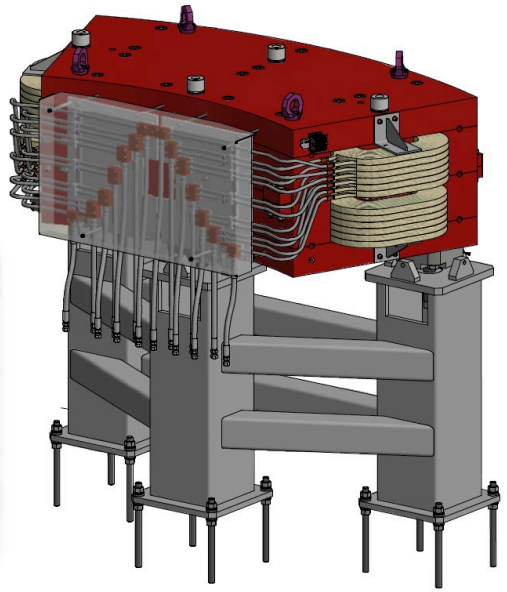


BTF DOUBLING LINE / MAGNETS

QUADS - H-dipoles







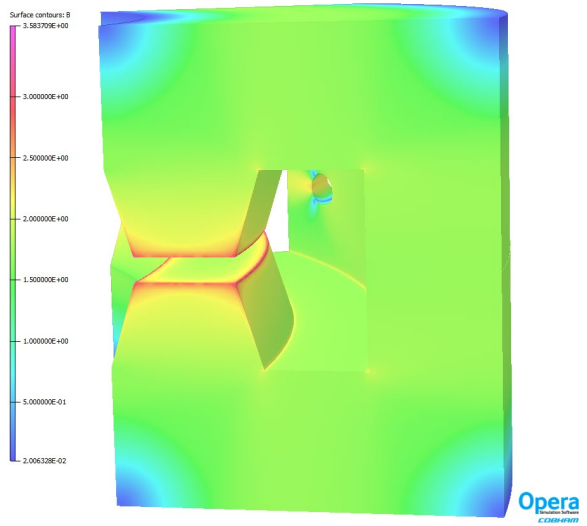
- In house design and assembly (Late 2017)
- Construction at SIGMAPHI
- Arrived @LNF in August
- Just measured with new measurement desk
- Magnets have good performances (little residual skew and octupolar components but in the required limits)
- Slightly better gradient then requested
- ~~Installation prob Autumn 2019~~ **Due to BeW breaking**

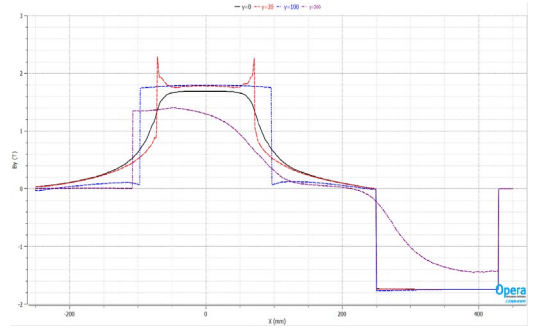
- H dipole - In house design and assembly (Late 2017)
- Construction at SIGMAPHI
- Delivering & characterization complete: March 2019
- Very good results in field measurements
- ~~Installation prob Autumn 2019~~ **Due to BeW breaking**

BTF DOUBLING LINE / MAGNETS

C-Dipole

- Design and Construction at DANFYSIK
- ABOUT to start the design
  Uncertainity on the real date due to internal scheduling problem on this magnet
- DANFYSIK sets the commissioning in April 2020





MAIN SPECIFICATIONS		
	Unit	**Value**
Beam Energy	MeV	920
Maximum Field	T	1,6878
Bending Radius	m	1,8
Magnet Lenght	mm	1108
Bending Angle	deg	35
Pole Iron Gap	mm	35
Integrated Field Quality		$1.3*10^{-3}$ over ±15mm
Number of turns per coil		104
Conductor dimensions	mm	9,5x9x5/ bore 5,5

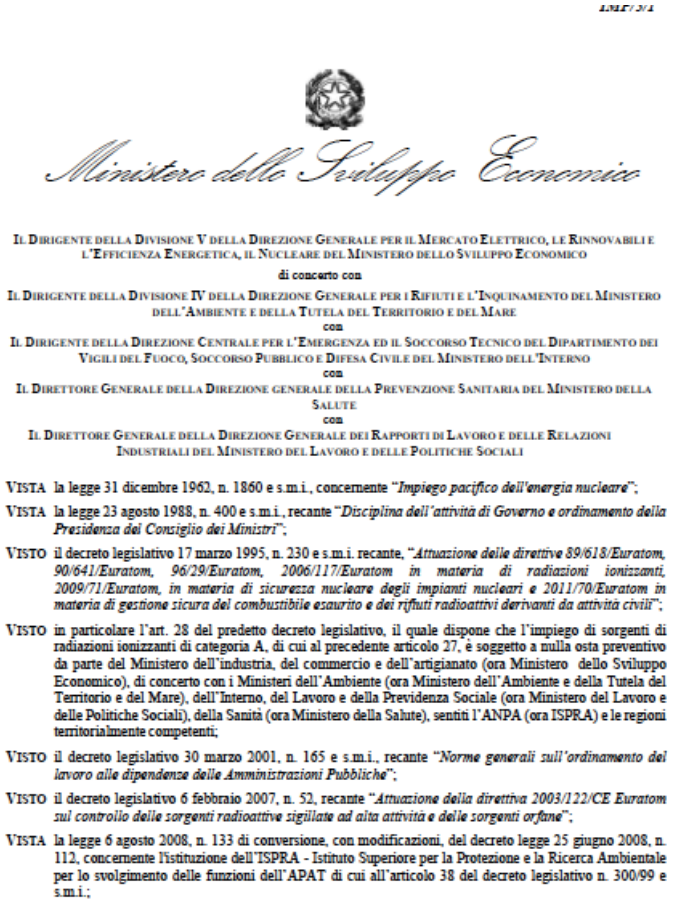
Assigned on	**05-2019**
Conceptual design for LNF review:	15-11-2019
Final Design for LNF review:	19-11-2019 (just one week!)
Assembly of magnet complete at Danfysik:	13-03-2020
Tested magnet ready for shipment:	27-03-2020

NEW POWER SUPPLY HALL

- New room for hosting the power supplies for the 10 new magnets
- Needs reinforcement of the floor due to full racks weight
- All cables (interlocks-mains-power) routed

- Networking settled up
- QUAD-DP-DH PS are tested with magnets
- DC01 Ready to be tested with magnets
- Commissioning date for the QUADS-DH and DC will be set during the BTF2 installation

NEW AUTHORIZATION BTF ENV.



Ministero dello Sviluppo Economico

IL DIRIGENTE DELLA DIVISIONE V DELLA DIREZIONE GENERALE PER IL MERCATO ELETTRICO, LE RINNOVABILI E L'EFFICIENZA ENERGETICA, IL NUCLEARE DEL MINISTERO DELLO SVILUPPO ECONOMICO

di concerto con

IL DIRIGENTE DELLA DIVISIONE IV DELLA DIREZIONE GENERALE PER I RIFIUTI E L'INQUINAMENTO DEL MINISTERO DELL'AMBIENTE E DELLA TUTELA DEL TERRITORIO E DEL MARE

con

IL DIRIGENTE DELLA DIREZIONE CENTRALE PER L'EMERGENZA ED IL SOCCORSO TECNICO DEL DIPARTIMENTO DEI VIGILI DEL FUOCO, SOCCORSO PUBBLICO E DIFESA CIVILE DEL MINISTERO DELL'INTERNO

con

IL DIRETTORE GENERALE DELLA DIREZIONE GENERALE DELLA PREVENZIONE SANITARIA DEL MINISTERO DELLA SALUTE

con

IL DIRETTORE GENERALE DELLA DIREZIONE GENERALE DEI RAPPORTI DI LAVORO E DELLE RELAZIONI INDUSTRIALI DEL MINISTERO DEL LAVORO E DELLE POLITICHE SOCIALI

VISTA la legge 31 dicembre 1962, n. 1860 e s.m.i., concernente "*Impiego pacifico dell'energia nucleare*";

VISTA la legge 23 agosto 1988, n. 400 e s.m.i., recante "*Disciplina dell'attività di Governo e ordinamento della Presidenza del Consiglio dei Ministri*";

VISTO il decreto legislativo 17 marzo 1995, n. 230 e s.m.i. recante, "*Attuazione delle direttive 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 2006/117/Euratom in materia di radiazioni ionizzanti, 2009/71/Euratom, in materia di sicurezza nucleare degli impianti nucleari e 2011/70/Euratom in materia di gestione sicura del combustibile esaurito e dei rifiuti radioattivi derivanti da attività civili*";

VISTO in particolare l'art. 28 del predetto decreto legislativo, il quale dispone che l'impiego di sorgenti di radiazioni ionizzanti di categoria A, di cui al precedente articolo 27, è soggetto a nulla osta preventivo da parte del Ministero dell'industria, del commercio e dell'artigianato (ora Ministero dello Sviluppo Economico), di concerto con i Ministeri dell'Ambiente (ora Ministero dell'Ambiente e della Tutela del Territorio e del Mare), dell'Interno, del Lavoro e della Previdenza Sociale (ora Ministero del Lavoro e delle Politiche Sociali), della Sanità (ora Ministero della Salute), sentiti l'ANPA (ora ISPRA) e le regioni territorialmente competenti;

VISTO il decreto legislativo 30 marzo 2001, n. 165 e s.m.i., recante "*Norme generali sull'ordinamento del lavoro alle dipendenze delle Amministrazioni Pubbliche*";

VISTO il decreto legislativo 6 febbraio 2007, n. 52, recante "*Attuazione della direttiva 2003/122/CE Euratom sul controllo delle sorgenti radioattive sigillate ad alta attività e delle sorgenti orfane*";

VISTA la legge 6 agosto 2008, n. 133 di conversione, con modificazioni, del decreto legge 25 giugno 2008, n. 112, concernente l'istituzione dell'ISPRA - Istituto Superiore per la Protezione e la Ricerca Ambientale per lo svolgimento delle funzioni dell'APAT di cui all'articolo 38 del decreto legislativo n. 300/99 e s.m.i.;

1/4

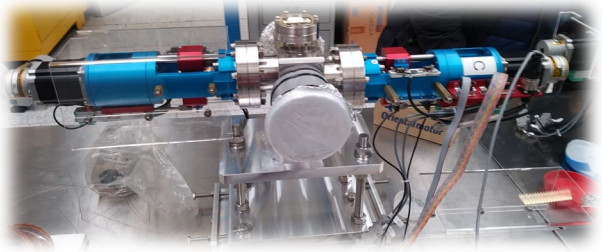
- Mandatory for driving the beam in the new bunker
- Signed by 5 different Government Departments
- Registered Sep. 20th, 2019 (Submitted Mar. 15th, 2018)
- Received Oct. 1st, 2019

Actions required (on Oct. 7th by the RPO):

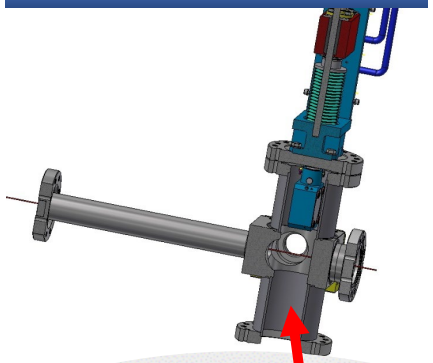
- Both formal (documentation to be produced)
- And actual work: e.g. modifications for complying with fire prevention plan
- Schedule and issues to be discussed

BTF DOUBLING LINE / ELEMENTS

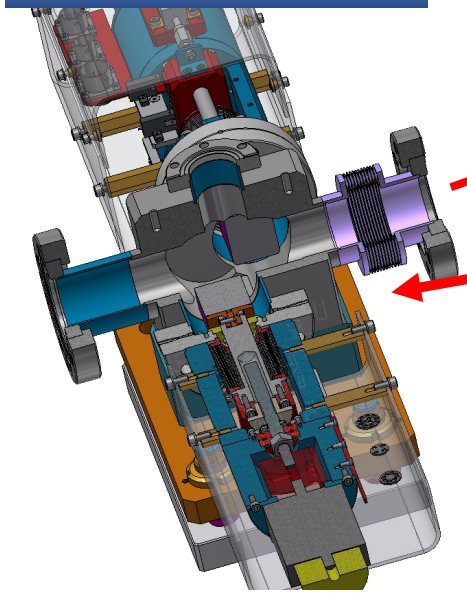
Scrapers, target, beam stopper and pipes

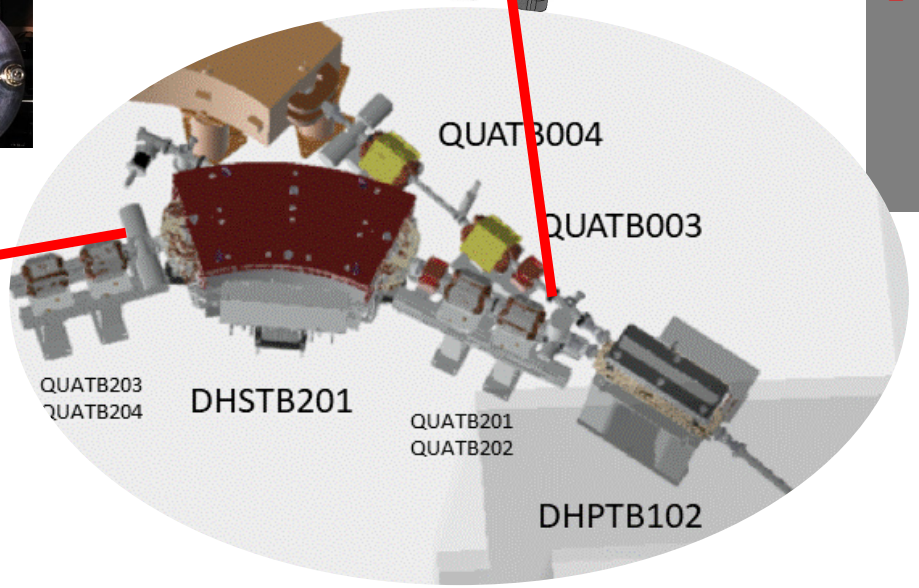


Beam stopper and target



Overlapped blade scrapers





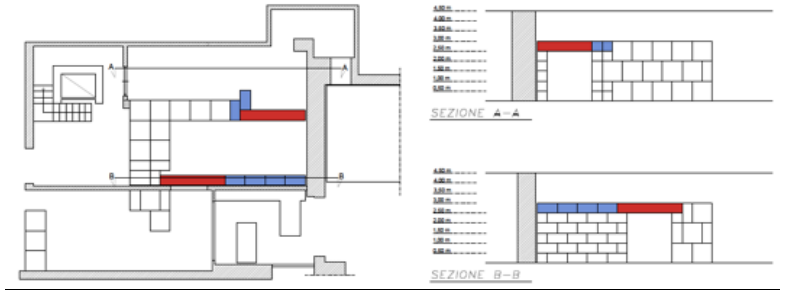
- In house new design of:
  - overlapped blade scraper (10um step)
  - two position, thin Cu target
  - thin walled pipes for DP(installed) and DC(working) magnets
- For the scrapers and target:
  - Electronics, controls, vacuum OK!
  - Ready to be installed – cabling to be completed shortly

BTF DOUBLING LINE / BTF-2 BUNKER

Mar. 2019

- Completely mapped with overall BTF+LINAC placing network
- Not totally complete, waiting the BTF2 magnets installation and cooling pipeline joints
- All of the remaining concrete blocks are ready
- Some bunker fire protection parts have to be completed

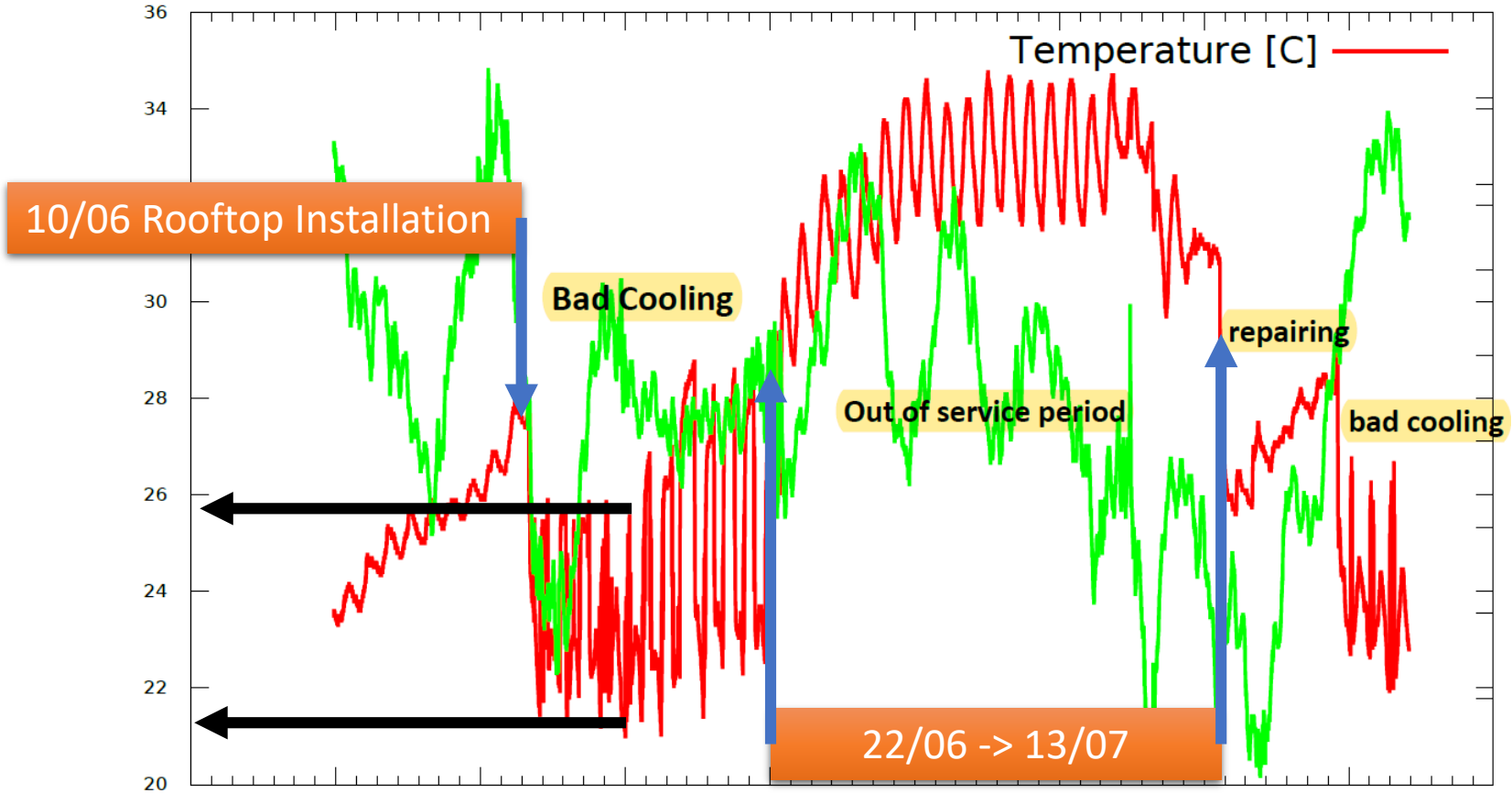
Last civil engineering for preparing external bunker structure (covers gap with LINAC tunnel external wall)



BTF DOUBLING LINE / SERVICES AIR

Apr. 2019

June 2019



Used for PADME RUN1 and BTF2 commissioning
BTF1 rooftop had big problems and failure due to bad assembly or transportation
Assistance with huge delivery time -> DAFNE operations overlapping
BTF2 rooftop seems working better

Used for PADME RUN1 and BTF2 commissioning -> Very hot summer

- Users with a local air conditioner to improve temperature stability
- Rush for PADME test run with additional splitter in BTF1 to overcome temperature fluctuations
- **Now the problem seems fixed**

BTF DOUBLING LINE / SERVICES COOLING

Sep. 2018

Up to now

- Long pipes from cooling tower (far right) to the BTF building (far left)
- New heat-exchanger and pump, bringing chilled water for supplying additional 100 kW in the BTF areas
- Final step (1 week): disconnection of existing (smaller) pipes inside modulators hall and reconnection: needs to stop LINAC

Final connection to the cooling tower (on one side) and to the BTF new collector (on the other) scheduled (as soon as possible) in accordance with DAFNE/PADME programs

LINAC SLIDES

shortly

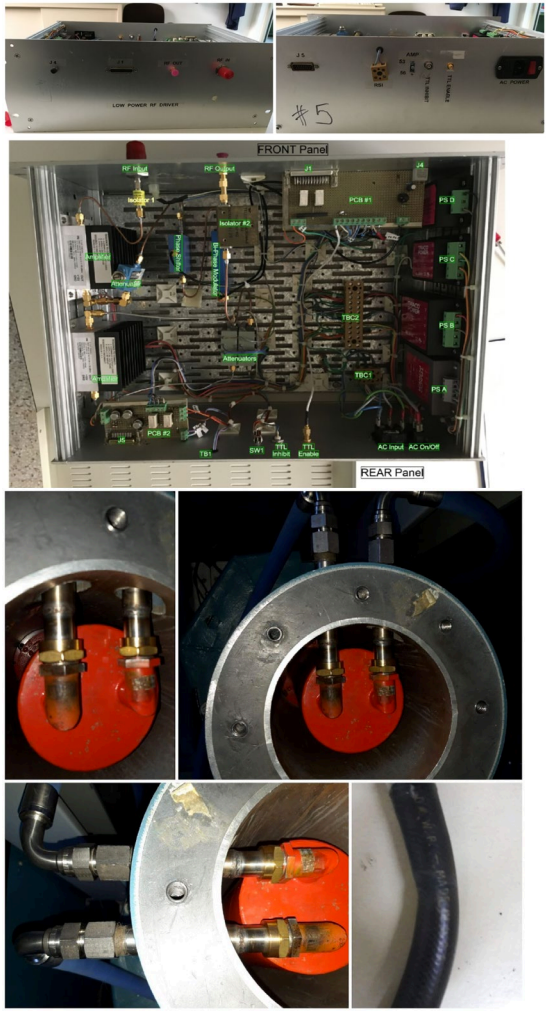
LINAC ACTIVITIES

Linac last uptime

- for DAFNE and BTF2 users from March to June 2019
- for PADME in July 2019.
- for DAFNE from September 2019, scheduled stop this week

Linac Maintenance:

- Thyratron substitution on Mod. D with new cooling new PS from 4000 to 6300h (20 September 2019).
- CCPS fault on Mod B(JULY 2019). Substitution with spare part.
- Corrector power supply faults in July 2019 for overtemperature in modulator hall.
- Mod B 1 focus power supply fault. (September 2019) **Under investigation**.
- Water in tank of mod D(July 2019)due to collector O-ring damaged by radiation fixed. All klystron collectors pipe joints and o-rings overhauled.
- Pre-buncher stepper motor attenuator and phase-shifter fault. (JULY 2019). FIXED with new model requesting calibration of the control system. New connectors setup.



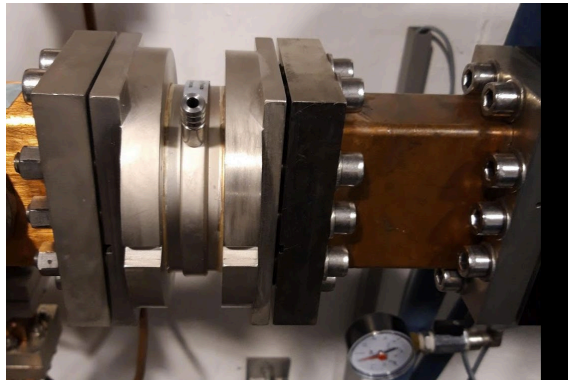
Linac Consolidation

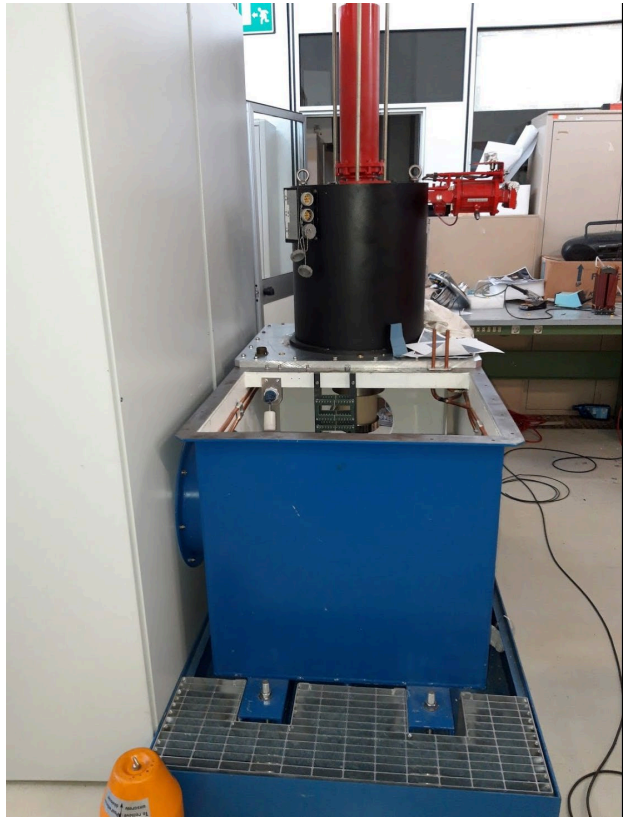
- New LLRF System (June 2019). New LLRF control system in September 2019.
- New cooling pipe for Klystrons (August 2019)
- New Kly collector O-Ring for Mod. A,B and C (August 2019)

LINAC ACTIVITIES

Linac Upgrade

New Modulator developed status on
Tank and focus magnet installation
Internal tank services installations





SPARC-Lab:

More support on modulator and klystron&safety system.

- Checks on problems in kly cooling system
- RF Waveguide window substituition & conditioning
- Check and fix vacuum pumps interlocks model.

Safety system:

DAFNE SS - fixed programmable plc fault in head modulator hall.

LINAC MAIN FAULTS

Capacitor charging power supply fault in mod B:

- Fault TDK HVPS due to a 50 cents. operational amplifier that develops fake error status.
- 6 July 2019 fault, used spare power supplies
- 26 July 2019 send to TDK and come back to the LNF at 26 September 2019.

Pulser & Cathode

- Scheduled Gun Cathode substituitions due to exaust grid (for PADME run 4months -> 8 years at 10 ns)
- Gun pulser fault on cathode grid – nightly substituitions but the long pulse spare had a bad impedance problem
- New Cathode activation accomplished in 2 days but no emissions (0.63 Ohm resistance when in run and then grid shorts), prob. due to cathode filament defect
- The second trials ok (in two days) with spare gun pulser (short pulse generation)
- We are out of long pulse generator (shipped - producter already alerted)

PEOPLE

BTF group

Bruno Buonomo+, Claudio Di Giulio, Luca Foggetta,

Gianfranco Morello, Paolo Valente

+BTF technical manager and LINAC head

LINAC staff

Maurizio Belli*, Riccardo Ceccarelli, Alberto Cecchinelli , Renato Clementi*,

Graziano Piermarini, Luis Antonio Rossi, Serena Strabioli, Raffaele Zarlenga

* Retired

Technical and Accelerator Divisions services

Sergio Cantarella, Oreste Cerafogli*, Enrico Di Pasquale, Alessandro Drago, Adolfo Esposito, Oscar Frasciello, Andrea Ghigo, Simona Incremona, Franco Iungo, Stefano Lauciani, Roberto Mascio, Stefano Martelli, Marco Paris, Stefano Pioli, Luigi Pellegrino, Francesco Putino, Ruggero Ricci, Ugo Rotundo, Lucia Sabbatini, Claudio Sanelli, Franco Sardone, Giancarlo Sensolini, Alessandro Stecchi, Angelo Stella, Alessandro Vannozzi & DAFNE operators for runs

* Retired

CONCLUSIONS

- BTF-1 routinely operational since September 2018 – now in shutdown due to BeW failure
- Test run partially accomplished
- Beam delivered also on the temp BTF-2 line with users, operating the beam switching dipole
- Huge delay due to BeW failure
  - Cleaning in progress
  - BTF1 redesigned in simpler way to easy PADME restart and to match BTF2 installation
  - Refurbishing already started
- IF cleaning BTF-LINAC pipes will be ok:
  - In this case, PADME restart foreseen in February 2020
- Installation of last part of BTF-2 branch possible in April 2020
  - Magnets, supports, etc. for transporting the beam in the second bunker are available but some parts have to be refurnished due to BeW failure – just started
  - Authorization of bunker BTFEH-2 arrived – civil setup and authorizations has to be completed

CONCLUSIONS

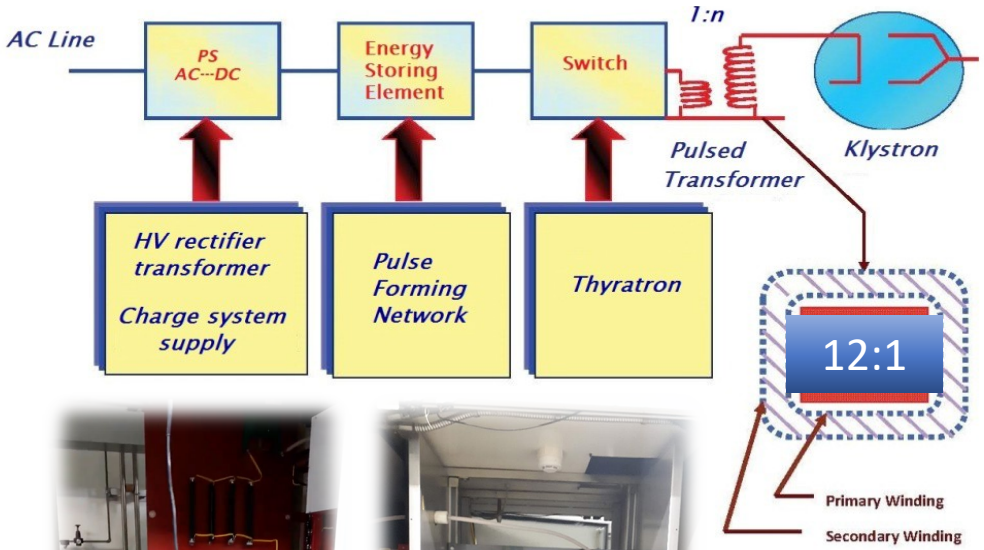
THANKS for the patience

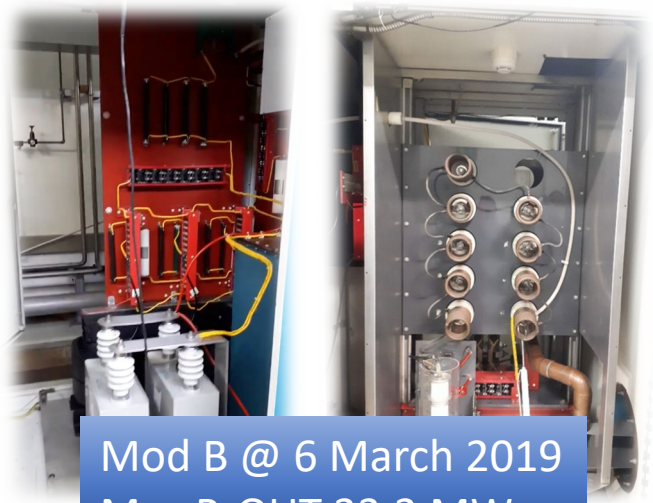
SPARE SLIDES

LINAC UPGRADE – MOD.B FINAL SETUP

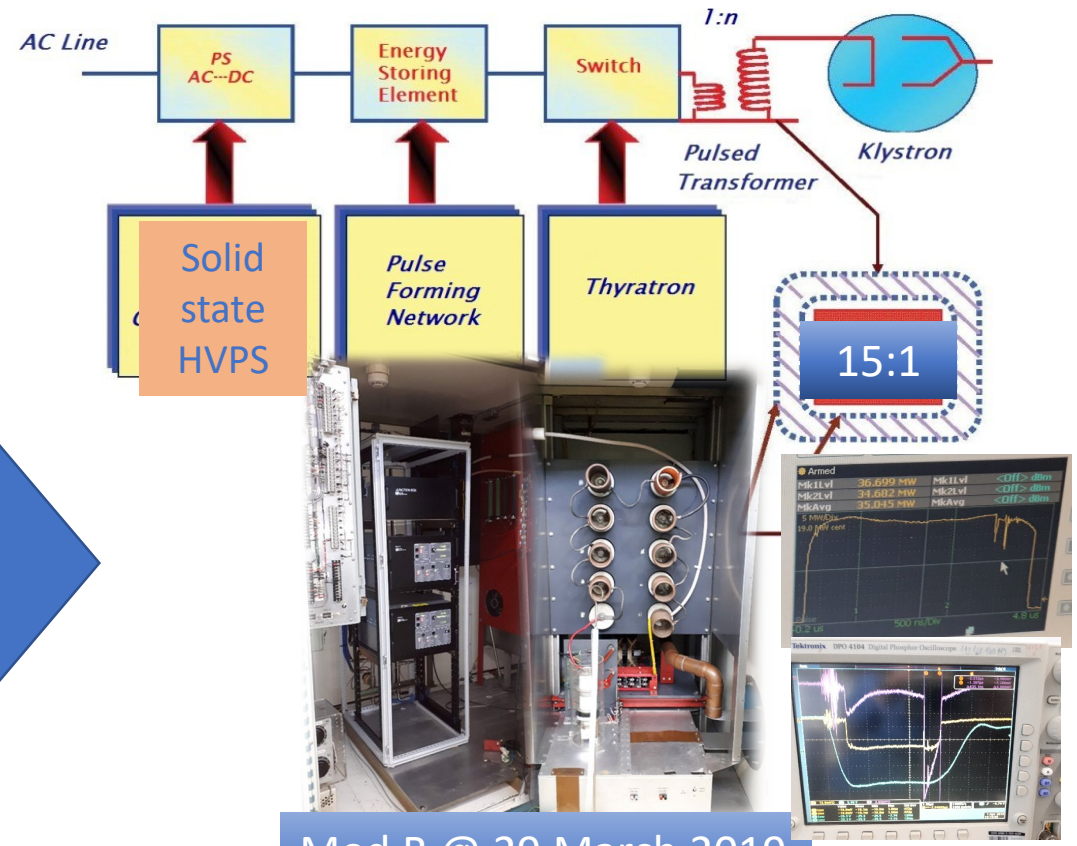
Old fashioned HV 3-p rectifier to solid state cap charging HVPS

- Bid assigned to TDK -> bunch of couple Mod.303, at each arrival prompt installation to mods
- Fully operational on mod D in test setup from March 2018.
- Fully operational from 29th March of 2019 in final setup in modulator B.





Mod B @ 6 March 2019
Max P. OUT 33.2 MW



Mod B @ 29 March 2019
Max P. OUT 36.1 MW

LINAC UPGRADE – MOD.B FINAL SETUP

Huge retrofit effort to match the previous TITAN BETA HVPS installation, both for aged electronics and safety implementation philosophy

Mod. **D** test setup

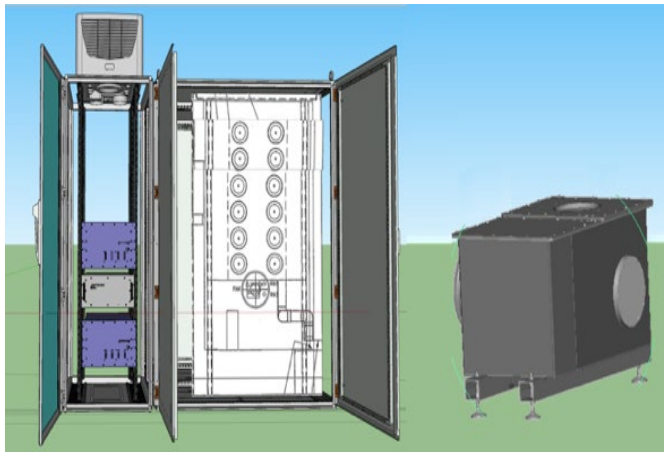
Mod. **B** HVPS final setup

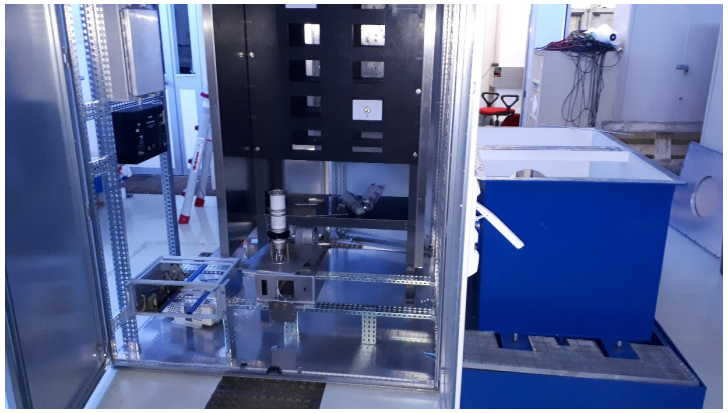
Mod. **B** LCS test setup

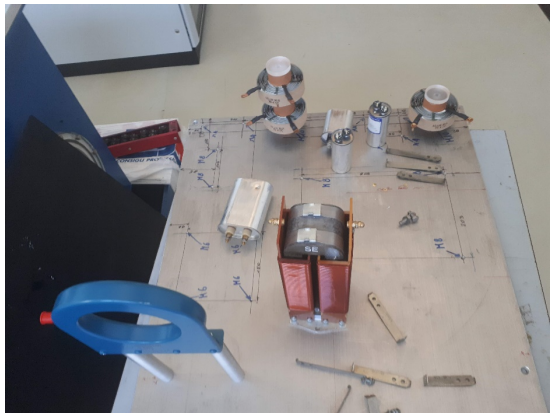
New Local Control System installed on mod B in «spy» mode:

- Based on NI C/RIO+PXI
- Software development in progress
- The FPGA DAQ runs monitoring the modulator, without controlling it.
- Working since beginning of Oct: ’18
- The fault statistics detected between old control system and new ones are consistent at 98%. In investigation the differences.
- Test on the Analog and Digital Signal on-going and **first try to control** the modulator with new system tested for 1h in April 2019.
- Still to be tested in dedicated mode for safety issue on Mod B

LINAC UPGRADE - NEW E MODULATOR

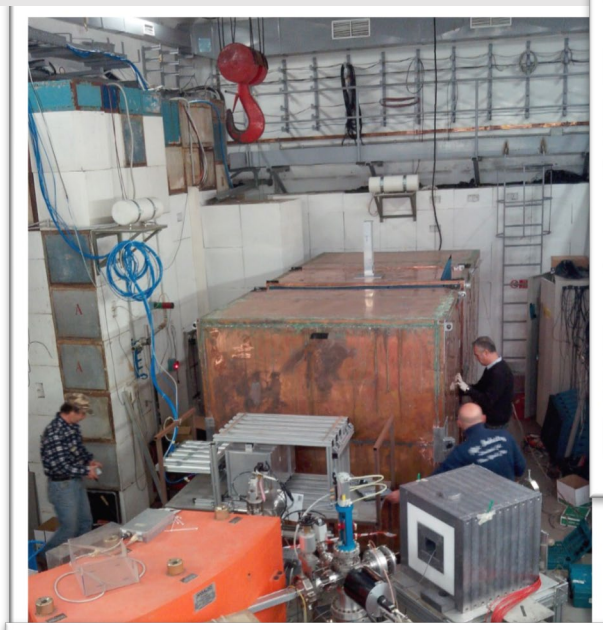


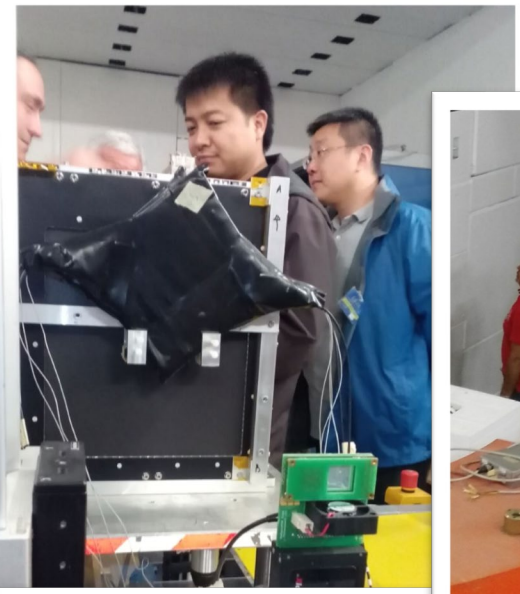


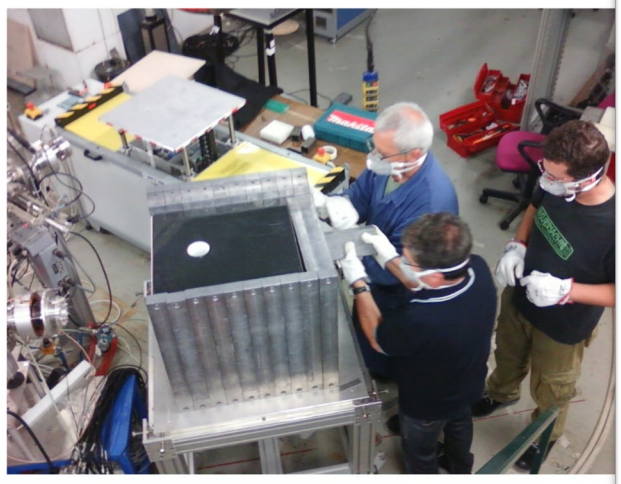


- Using test experience will optimize the design for the new modulator in house installation
- All of the Tank elements are in preparation for installation
- Some re-machining in the tank due to construction errors
- These items are in slow but constant implementation

BTF AMARCORD



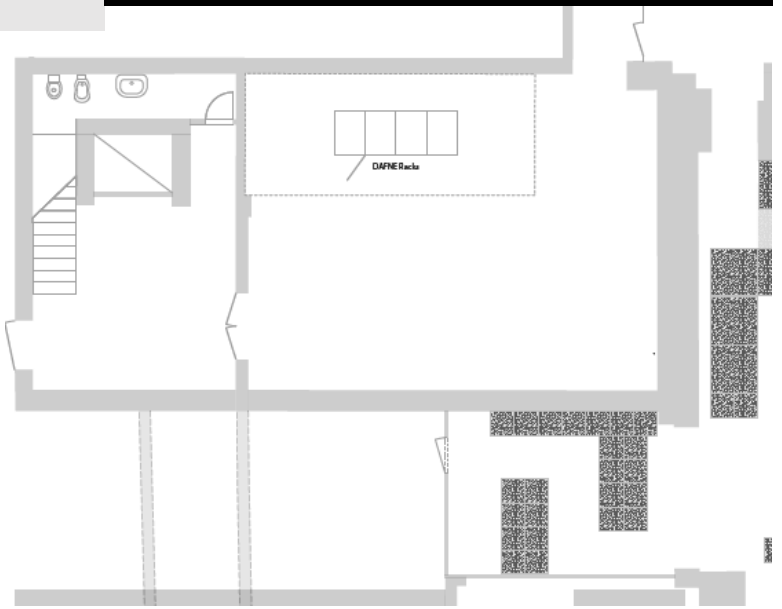




Thank you for the attention

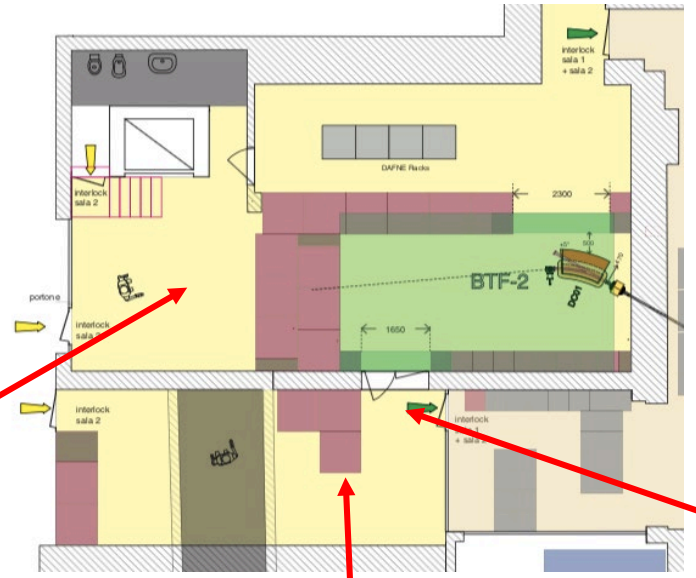
EXTERNAL BTF EXP. HALL 2

Starting point civil w.
(Winter 2018)



EXTERNAL BTF EXP. HALL 2

Start Civil w. Phase 1
(Winter 2018)

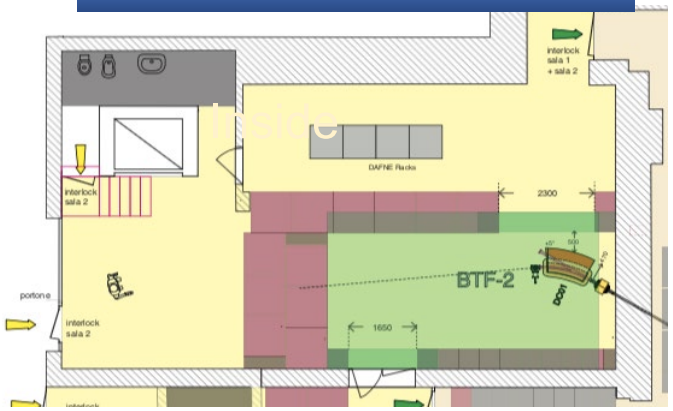


- New main entrance
- BTF 2 Secondary entrance
- Improving floor strength for BTF2 shielding chicane

INTERNAL BTF EXP. HALL 2

Start & Preparation (Winter 2018)

formerly BTF control room

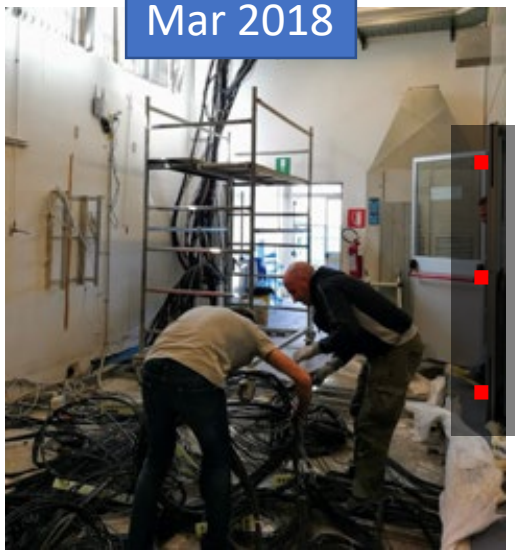


Dec 2017

Jan 2018

Feb 2018

Mar 2018



- Dismantling control room equipment
- Fixing interference with DAFNE subsystems
- Remove false floor

- Deeply joined with very fragile DAFNE subsystem
- Re-organize **all cables routing**
- Prepare demolitions

INTERNAL BTF EXP. HALL 2

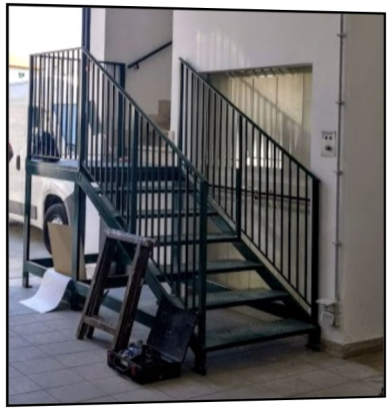
Civil w. Phase 2 (Spring 2018)

- Make room for the bunker in the second experimental hall
- Remove internal wall

INTERNAL BTF EXP. HALL 2

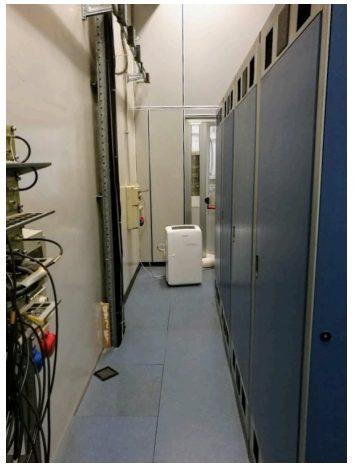
Civil w. Phase 2
(Spring 2018)

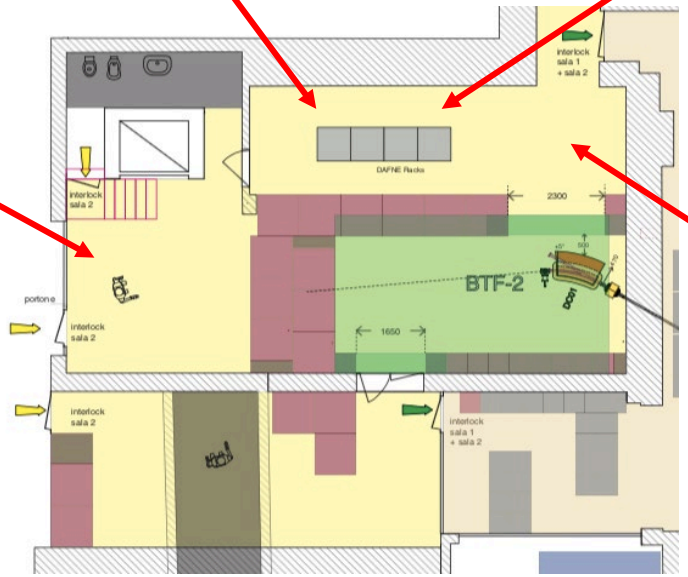
- Reinforcing pavement for magnet installation
- Working over on cable pit for 9 years…



INTERNAL BTF EXP. HALL 2

Civil w. Phase 2 (Summer 2018)

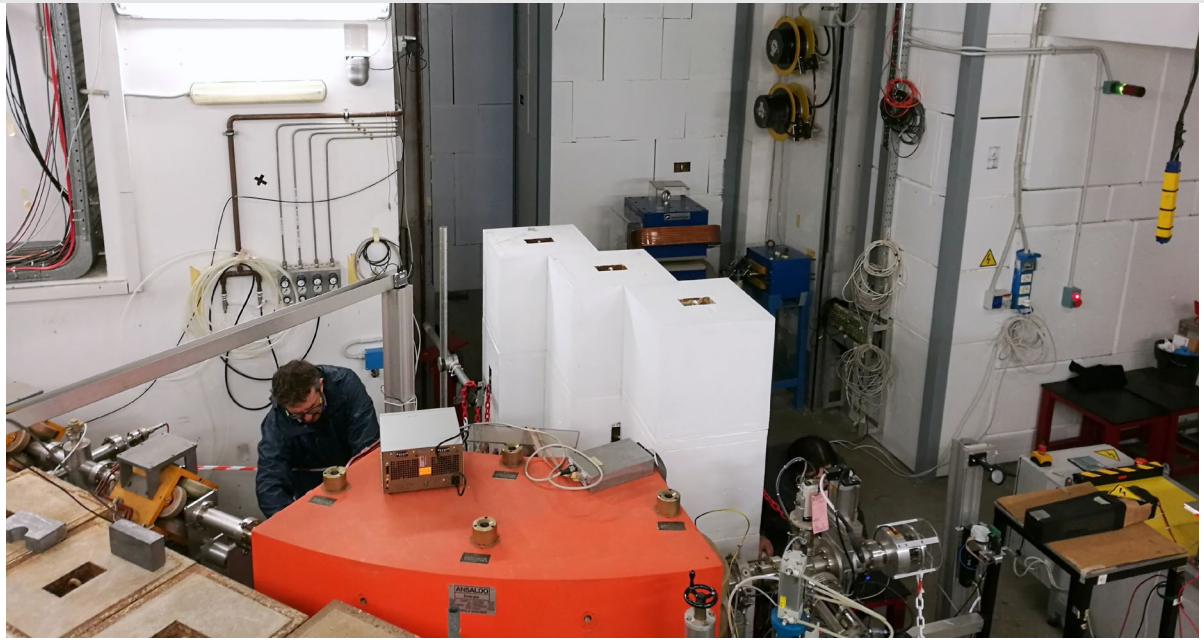


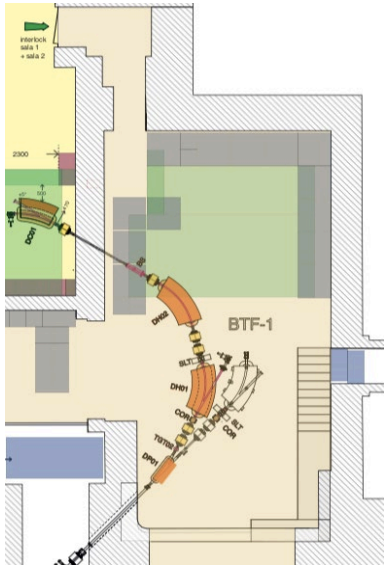


- Maintaining a conditioned space for DAFNE racks
- Make a comfortable passage for BTF1 and racks op.s
- Deeply accordance with RSPP and Rad Safety group

INTERNAL BTF EXP. HALL 1

Preparation & start
(Winter/Spring 2018)



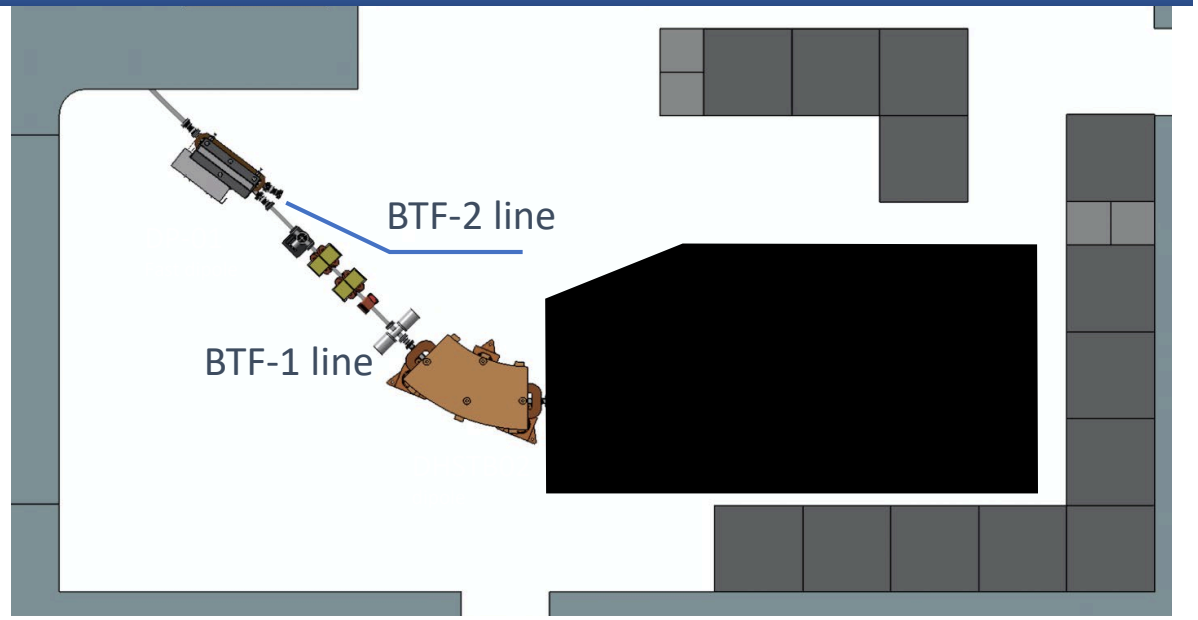


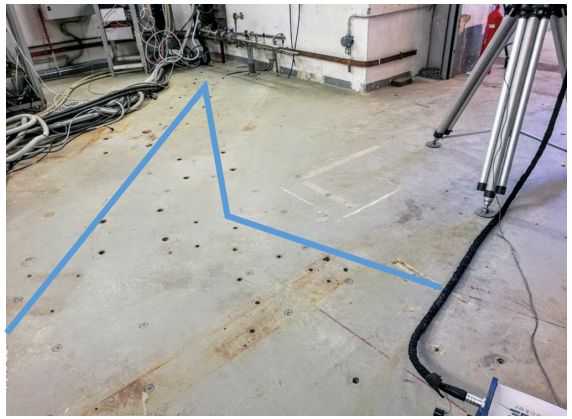
- Dismantling (almost all) cables, shielding, services
- Removing vacuum pipe and pumps, magnets and girder
- Has been found the perfect match with the assembly operation in BTFEH 2

INTERNAL BTF EXP. HALL 1

Civil w. Phase 2
(End Spring 2018)

Ready for hosting PADME (Init Summer 2018)

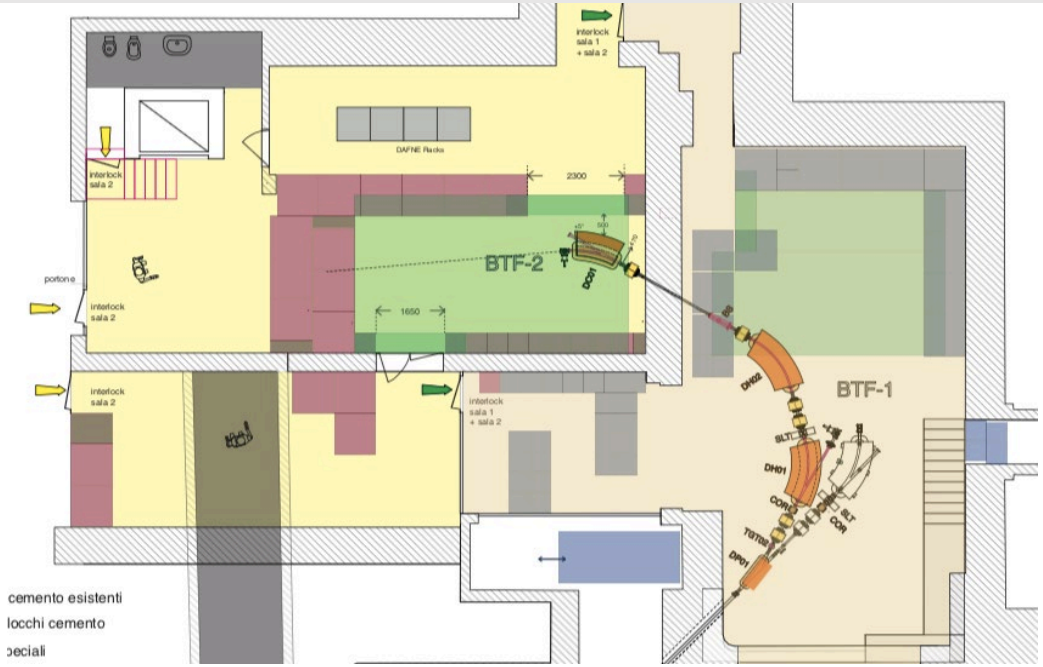


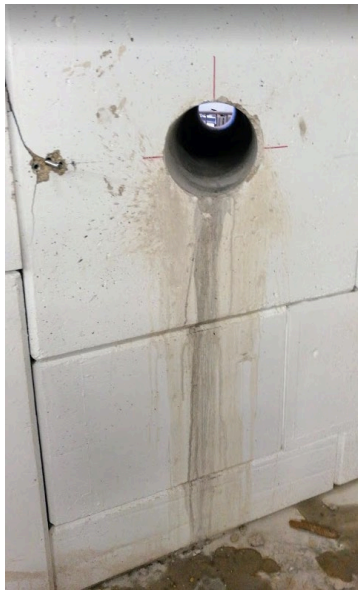


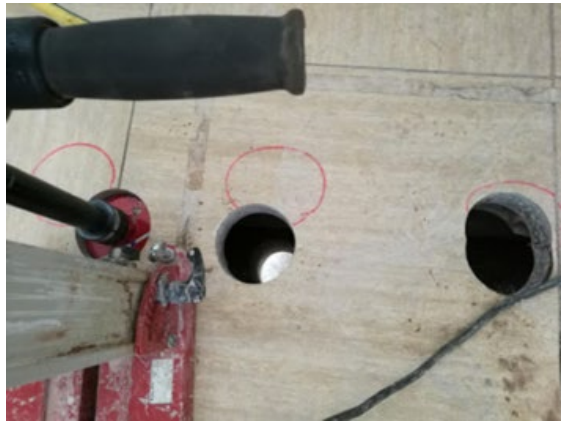
- Both of the halls prepared for a fresh installation
- Blue lining and hole drilling
- New services started to be implemented in (supervisor endpoint, new compressed air and water cooling pipeline)
- Restoring the fixed alignment sight point for the entire BTF1 and BTF2 alignment network

INTERNAL BTF EXP. HALL 1&2

Civil w. Phase 2
(End Spring 2018)



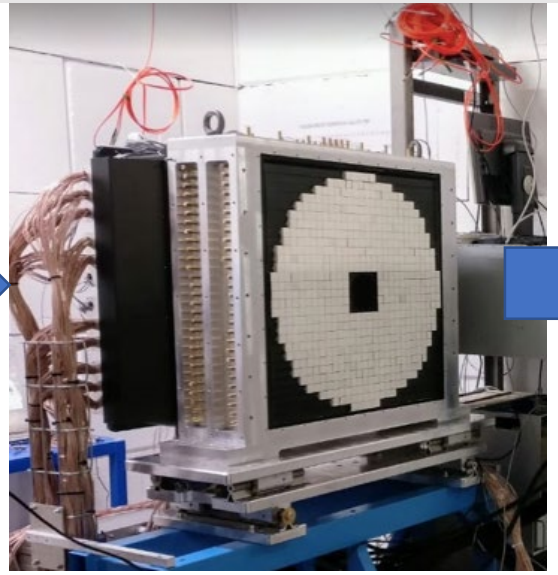


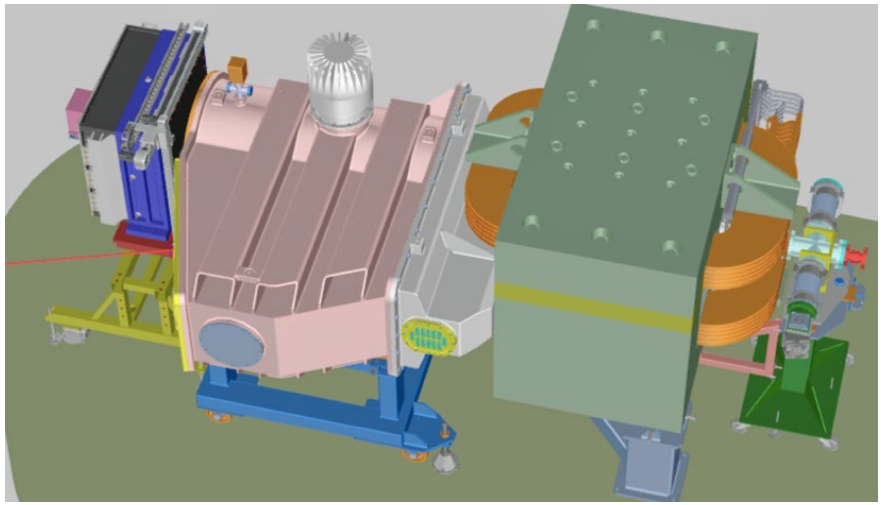


- Drilling hole for pipe in BTFEH2
- Holes also for a new Power Supply hall, second floor
- Implementation of a new routing for cables (safety, interlocks, power supply)
- Implementation of the upgraded safety system

BTF1&PADME INSTALLATIONS

BTF 1 Commissioning (June2018)





- Very strong collaboration between PADME team and LNF-AD-BTF staff to match PADME detectors in BTF environment (network, air, cooling, power, safety, controls and rad interlocs…)
- Implemented safety rules for BTF access by PADME user

Quads

QUADS

- QUANTITA’ 7
- Gradiente nominale 20 T/m
- Diametro Apertura 45 mm
- Lunghezza del nucleo magnetico 180 mm
- Larghezza del nucleo magnetico 270 mm
- Altezza del nucleo magnetico 270 mm
- Corrente Nominale 93 A
- Numero di spire per polo 45
- Sezione del conduttore 5mmx5mm (foro diametro 3 mm)
- Resistenza del magnete 116 mΩ
- Induttanza del magnete 22 mH
- Tensione nominale 11 V
- Potenza nominale 1020 W
- Peso del ferro 48 kg
- Peso del rame 16 kg
- Peso totale 64 kg
- Numero di circuiti dell’acqua per magnete 2
- Aumento di temperatura dell’acqua 18 °C
- Portata totale nominale 0.015 l/s
- Velocità nominale dell’acqua 1 m/s
- Perdita di pressione nominale 3.7 bar

DC01

Magnet type	DC01
Quantity	1
Beam Energy (MeV)	920
Deflection Angle (°)	35
Gap Aperture (mm)	35
Curvature radius (mm)	1800
Nominal flux density (T)	1.71
Maximum Integrated Field Quality	1E-3 over ±15 mm
Maximum $\Delta B/B_0$	1E-3 over ±15 mm
Hollow Copper Conductor Dimension provided by INFN (mm)	9.5x9.5 hole diameter 5.5
Beam trajectory height from the floor (mm)	1240
Maximum coils overhang from the iron yoke end faces (mm)	250
Minimum Clearance Between the two Coils (mm)	60

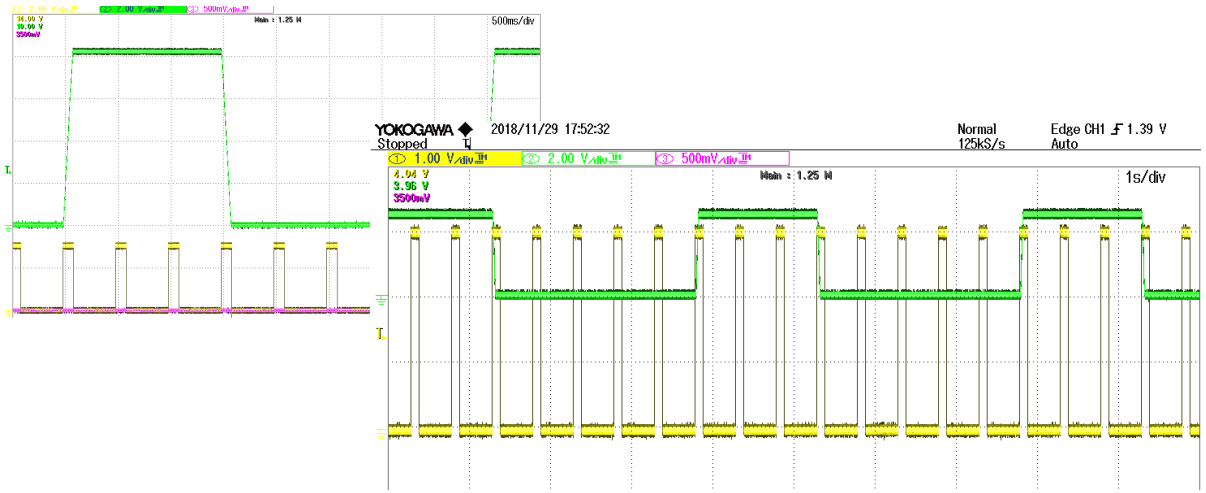
PARAMETER	VALUE
Beam Energy (MeV)	926
Deflection Angle (°)	35
Nominal flux density (T)	1.7099
Maximum Integrated Field Quality	7.7E-4 over ±15 mm
Maximum $\Delta B/B_0$	2.4E-4 over ±15 mm
Overall Width (mm)	855
Overall Height (mm)	686
Overall Length (mm)	1440
Mechanical iron yoke aperture angle (°)	33.77
Turns per pole	130
Pancake per pole	5
Pancake turns configuration	13horizontal 2vertical
Hollow conductor cross section (mm)	9.5x9.5mm hole diameter 5.5mm
Magnet resistance (mΩ)@25°C	209
Magnet inductance (mH)	436
Nominal current (A)	235
Nominal voltage (V)	60
Nominal power (kW)	12
Iron weight (kg)	1800
Copper weight (kg)	480
Total weight (except the magnet support) (kg)	2280
Nominal water temperature drop ΔT (°C)	15
Nominal total water flow (l/min)	14.5
Nominal water velocity (m/s)	1.02
Nominal pressure drop ΔP (bar)	3

BTF DOUBLING LINE / POWER SUPPLY

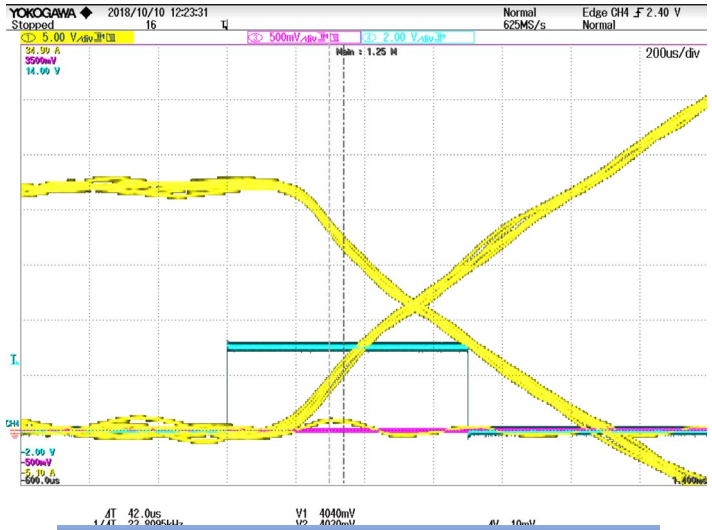
Fast C-dipole

- Used for BTF-2 beam commissioning with DAFNE timing sequence signal
- EEI manufactured in strong collaboration with LNF
  - Implementation of an automated beam delivery machine in the PS firmware, initially for debugging purposes
- Cable routing complete for all of the magnets in the new BTF PS hall
- Delivered in December 2018
- Installation in June 2019 after fixing the new BTF PS hall, not ready due to needed floor enhancement

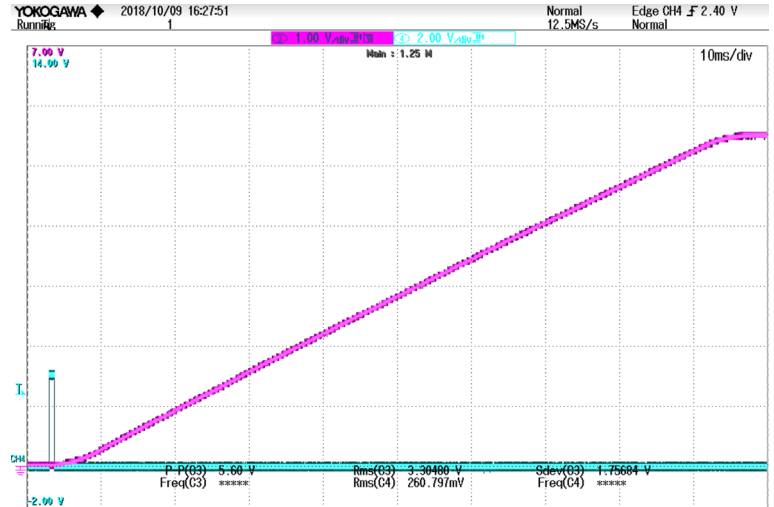
Temporary location of pulsed dipole power supply (waiting for final cooling system)



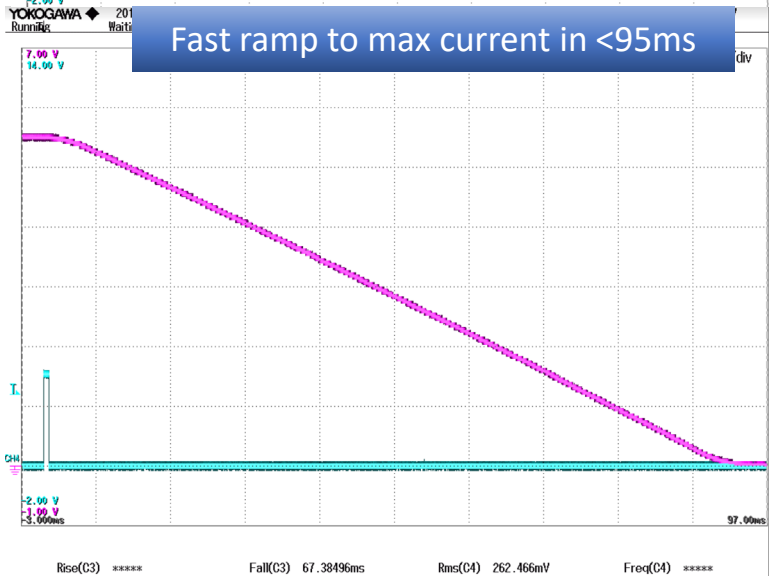
BTF D. L. – FAST DIPOLE POWER SUPPLY

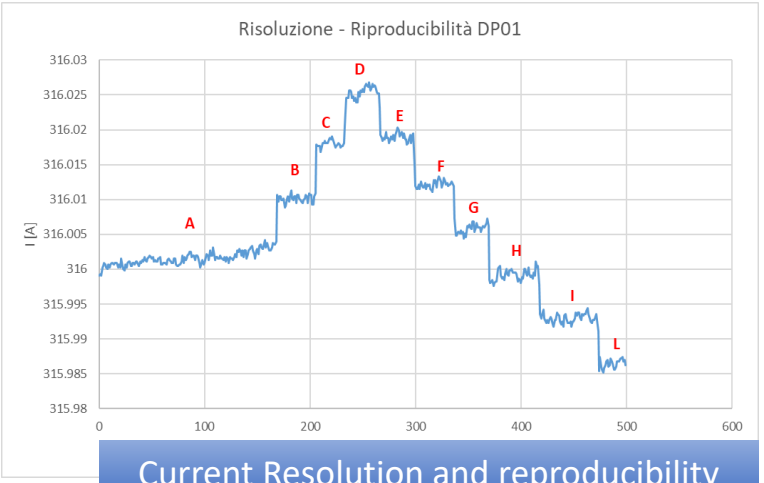


Ramp start time jitter < 50µs

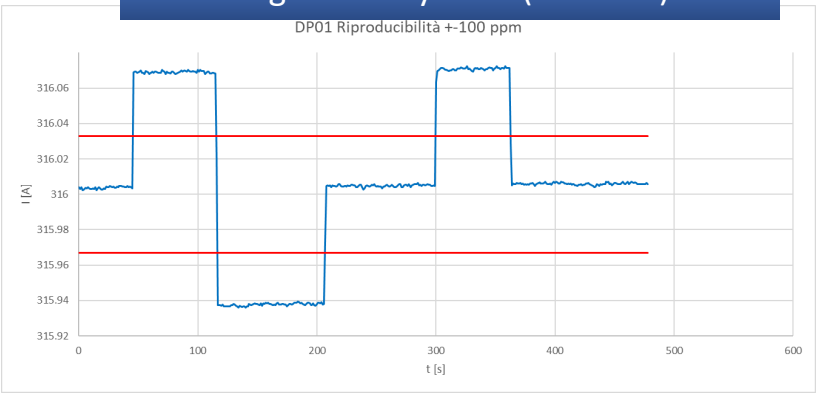


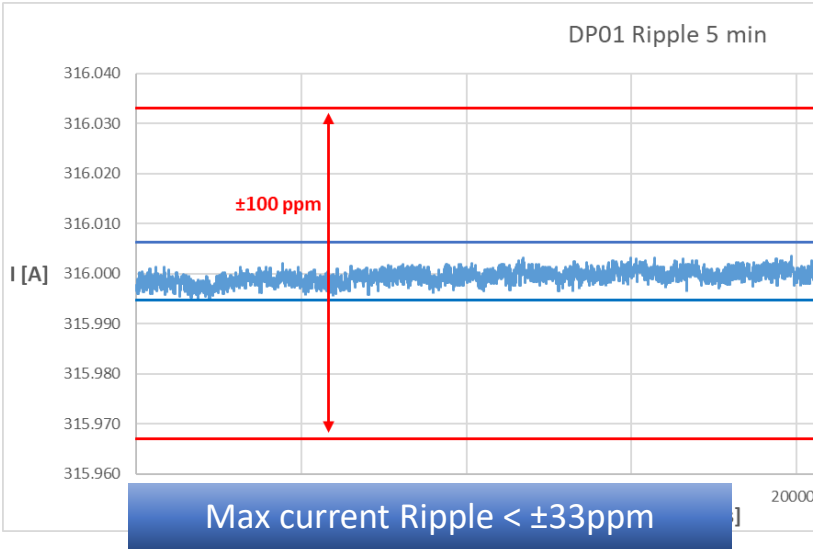
Fast ramp to max current in <95ms





Current Resolution and reproducibility at granularity level (±6.6 mA)

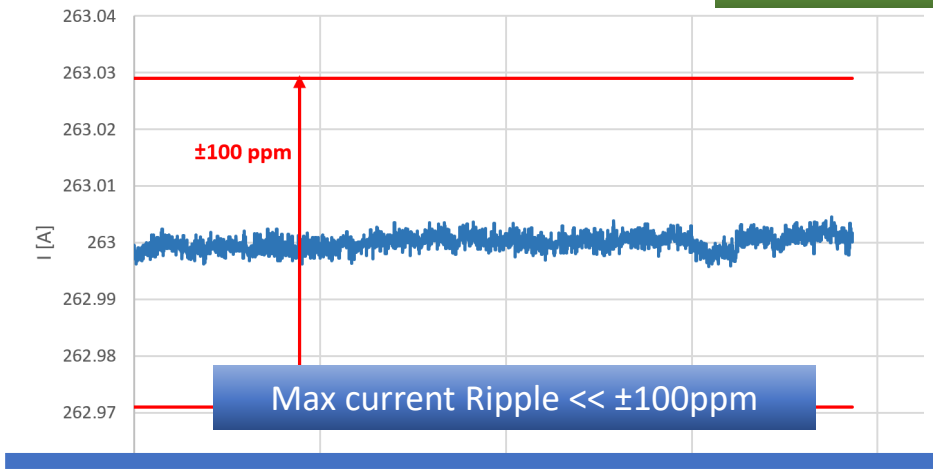




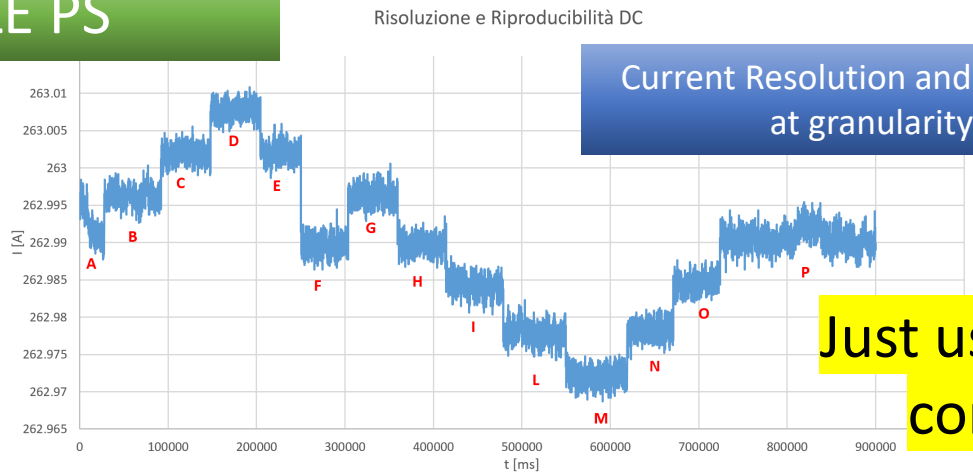
Max current Ripple < ±33ppm

BTF D. L. – DIPS&QUADS POWER SUPPLY

DIPOLE PS



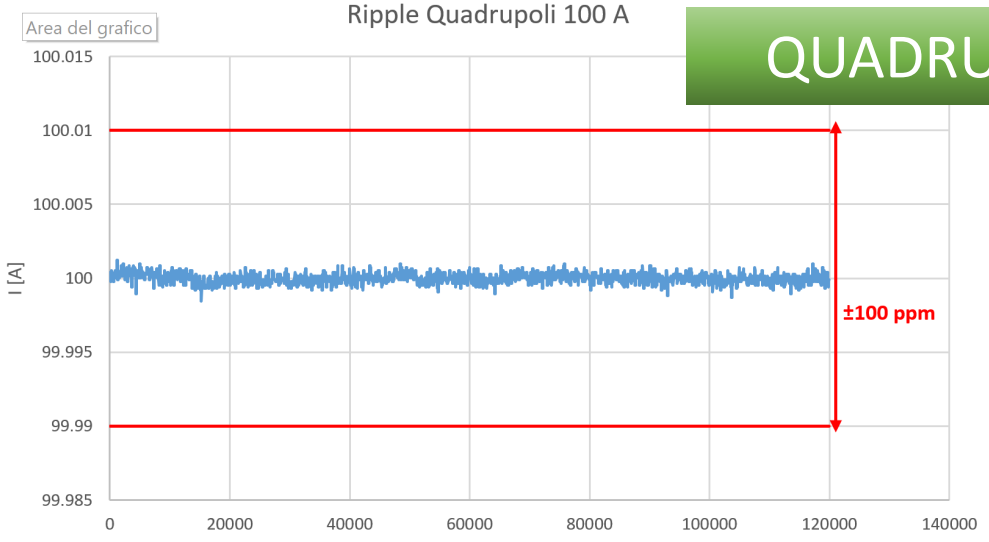
Max current Ripple << ±100ppm



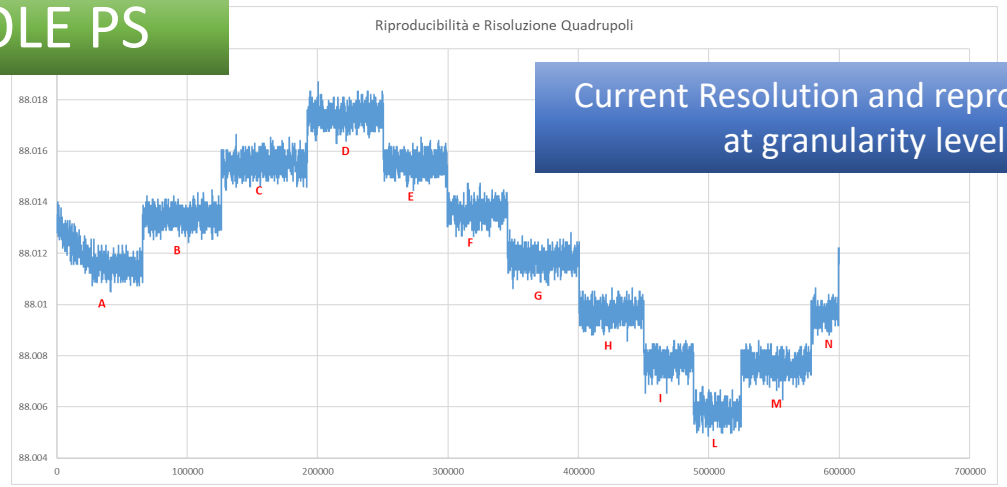
Current Resolution and reproducibility at granularity level

Just used for H-dipole commissioning

QUADRUPOLE PS



Max current Ripple << ±100ppm



Current Resolution and reproducibility at granularity level