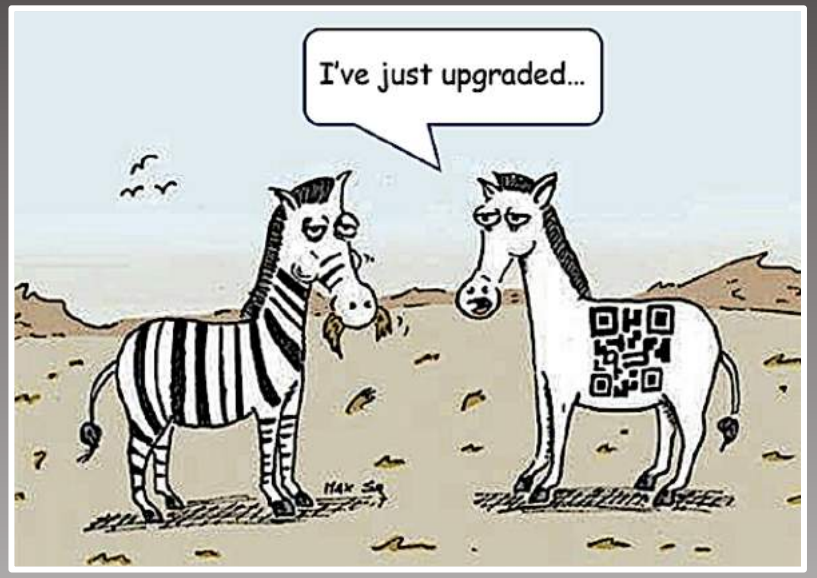
Status of the Beam-Test Facility

Paolo Valente on behalf of the **BTF staff** and the **BTF upgrade team**



May 14th, 2018

55th LNF Scientific Committee

Paolo Valente*, Bruno Buonomo, Claudio Di Giulio, Luca Gennaro Foggetta

*INFN Roma & Sapienza University

With support of Technical and Accelerator Departments:

Maurizio Belli, Bruno Bolli, Sergio Cantarella, Riccardo Ceccarelli, Alberto Cecchinelli, Oreste Cerafogli, Renato Clementi, Enrico Di Pasquale, Alessandro Drago, Adolfo Esposito, Oscar Frasciello, Andrea Ghigo, Simona Incremona, Franco Iungo, Stefano Lauciani, Roberto Mascio, Stefano Martelli, Graziano Piermarini, Luigi Pellegrino, Ruggero Ricci, Luis Antonio Rossi, Lucia Sabbatini, Claudio Sanelli, Franco Sardone, Giancarlo Sensolini, Serena Strabioli, Ugo Rotundo, Alessandro Stecchi, Angelo Stella, Alessandro Vannozzi, Raffaele Zarlenga

Users 2017

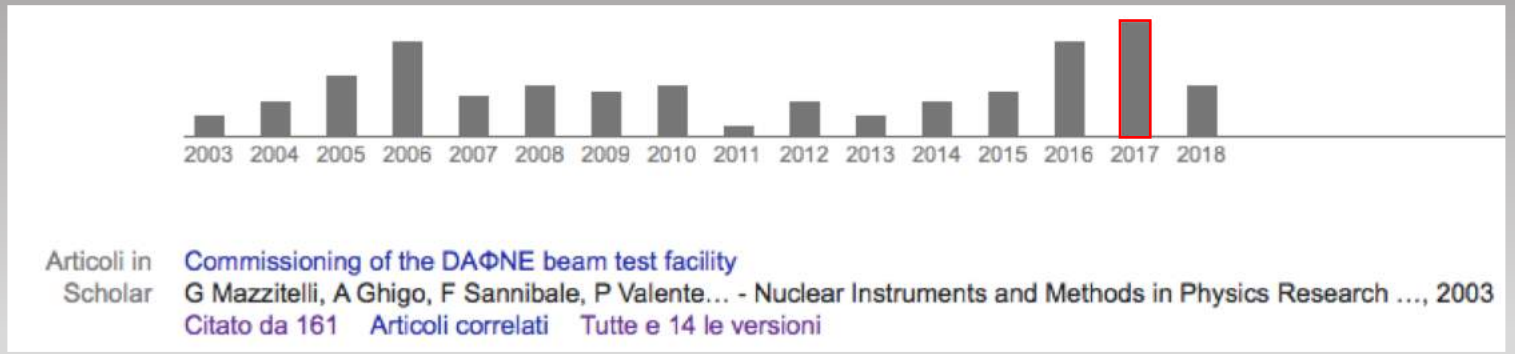
Start	End	User	Group Leader	Rollin/out (h)	beam (days)	dose	Min. Energy	Max. Energy	Particle	Min. Mult.	Max. Mult.	Info
2017-01-09	2017-01-23	**CHAOS**	foggetta luca	6	**14**	0.0	500.0	500.0	Electron	1.0	1000.0	DCS installation and test with slow control and feedbacks
2017-01-23	2017-01-30	**BTFstaff**	Paolo Valente	6	**7**	0.0	50.0	750.0	Electron	1.0	1000.0	shutdown
2017-01-30	2017-02-06	**BTFstaff**	Paolo Valente	6	**7**	0.0	50.0	750.0	Electron	1.0	1000.0	refurbishing of Si detector/tagging
2017-02-06	2017-02-13	**INSUB**	Michela Prest	6	**7**	0.0	50.0	750.0	Electron	1.0	1000.0	We will test a shashlik calorimeter readout by SiPMs and digitizers and both silicon and scintillating tracking detectors
2017-02-13	2017-02-20	**CYGNUS_RD**	Davide Pinci	6	**7**	0.0	25.0	500.0	Electron	1.0	1000.0	
2017-02-20	2017-02-27	**MIMOSA**	Spiriti Eleuterio	6	**7**	0.0	500.0	500.0	Electron	1.0	1000.0	Test del monitor delle caratteristiche del fascio della BTF per PADME con rivelatore a pixel tipo M28.
2017-02-27	2017-03-06	**BTFstaff**	Paolo Valente	6	**7**	0.0	50.0	750.0	Electron	1.0	1000.0	BTF for irradiation *CANCELLED*
2017-03-06	2017-03-13	**MEGII**	Paolo Walter Cattaneo	6	**7**	0.0	50.0	100.0	Electron	999.9	1.e+7	Irradiation of SiPMs for testing the behaviour of SiPM under 50-100 MeV electrons irradiation.
2017-03-13	2017-03-20	**BTFstaff**	Paolo Valente	6	**7**	0.0	50.0	750.0	Electron	1.0	1000.0	shutdown
2017-03-20	2017-03-27	**BTFstaff**	Paolo Valente	6	**7**	0.0	50.0	750.0	Electron	1.0	1000.0	BTF for irradiation
2017-03-27	2017-04-03	**DDG_LNF**	G.Bencivenni	13	**7**	0.0	500.0	500.0	Electron	1.0	1000.0	RWELL test
2017-04-03	2017-04-10	**3D-SOD**	Leonello Servoli	6	**7**	0.0	500.0	500.0	Electron	1.0	1000.0	Test of Silicon-On-Diamond and 3D-Diamond prototypes.
2017-04-10	2017-04-17	**PADME**	Paola Gianotti	6	**7**	0.0	100.0	500.0	Electron	1.0	10.0	Test of the PADME ECal e Veto prototypes. Single particle beam required
2017-04-17	2017-04-24	**ITS**	Eleuterio Spiriti	6	**7**	0.0	500.0	500.0	Electron	1.0	1.e+4	The goal of the test is to validate prototype(s) of the ITS modules before mass production.
2017-04-24	2017-05-01	**FIRB_CluCount**	Francesco Renga	6	**7**	0.0	500.0	500.0	Electron	1.0	100.0	Not possible on the week March 27- April 3, 2017
2017-05-01	2017-05-08	**MoRAD**	foggetta luca	6	**7**	0.0	50.0	750.0	Electron	1.0	1000.0	BTF for irradiation
2017-05-08	2017-05-15	**MU2E**	Ivano Sarra	6	**7**	0.0	60.0	140.0	Electron	1.0	2.0	We need good beam energy spread at 100 MeV
2017-05-15	2017-05-29	**BTFstaff**	Paolo Valente	6	**14**	0.0	50.0	750.0	Electron	1.0	1000.0	shutdown (maintenance and safety check)
2017-05-29	2017-06-05	**IMCP**	Paolo Meridiani	6	**7**	50.0	500.0	500.0	Electron	1.0	20.0	
2017-06-05	2017-06-12	**PADME**	Paola Gianotti	6	**7**	0.0	500.0	500.0	Electron	1.0	10.0	Final Calorimeter test
2017-06-12	2017-06-19	**BTFstaff**	Paolo Valente	6	**7**	0.0	50.0	750.0	Electron	1.0	1000.0	BTF for irradiation
2017-06-19	2017-06-26	**BTFstaff**	Paolo Valente	6	**7**	0.0	50.0	750.0	Electron	1.0	1000.0	BTF for irradiation
2017-06-26	2017-07-03	**E-RAD**	paolo valente	6	**7**	0.0	500.0	500.0	Electron	1.0	1.e+4	
2017-07-03	2017-07-10	**SIDDHARTA/AMADEU**	Catalina Petrascu	6	**7**	0.0	300.0	500.0	Electron	1.0	1000.0	
2017-07-10	2017-07-17	**PADME**	Paola Gianotti	6	**7**	0.0	100.0	500.0	Positron	1.0	1.e+5	Test of the PADME beam parameters with positrons of maximum possible energy, small divergence and spot, thin window (Mylar) or vacuum installation
2017-07-17	2017-07-24	**CRYSBEAM**	Gianluca Cavoto	40	**7**	0.0	50.0	500.0	Electron	1.0	200.0	See note sent to btf@lnf.infn.it
2017-07-24	2017-07-31	**MONDO**	Michela Marafini	6	**7**	0.0	50.0	750.0	Electron	1.0	1000.0	BTF for irradiation

ASIF and irradiation tests

1. The HEPD apparatus for the CSES mission , B. Panico et al., PoS EPS-HEP2017 (2017) 509.
2. Cygnus: development of a high resolution TPC for rare events, D. Pinci et al., PoS EPS-HEP2017 (2017) 077.
3. Fast timing hodoscope for CLAS12 and the first measurement of the γp → ωππp decay channel, S. M. Hughes, Ph.D. Thesis U. Edinburgh (2017).
4. The Calibration System of the E989 Experiment at Fermilab, A. Anastasi, Ph. D. Thesis Univ. Messina (2017).
5. PADME: Searching for dark mediator at the Frascati BTF, V. Kozhuharov et al., Il Nuovo Cimento 40 C (2017) 192
6. Status of positron beams for dark photon experiments, P. Valente, EPJ Web of Conferences 142, 01028 (2017).
7. POSEYDON - Converting the DAFNE Collider into a double Positron Facility, P. Valente, arXiv:1711.06877 [physics.acc-ph].
8. Search for the Dark Photon with the PADME Experiment at LNF, V. Scherini et al., arXiv:1712.01936 [hep-ex].
9. Experimental result on the propagation of Coulomb fields, R. de Sangro et al., J.Phys.Conf.Ser. 845 (2017) 012015.
10. Carbon nanotubes as target for directional detection of light WIMP, V. C. Antoci et al., arXiv:1707.02549 [physics.ins-det].
11. Performance of the PADME Calorimeter prototype at the DAΦNE BTF, M. Raggi et al., Nucl. Instrum. Meth. A 862 (2017) 31.
12. ORANGE: A high sensitivity particle tracker based on optically read out GEM, M. Marafini et al., Nucl. Instrum. Meth. A 845 (2017) 285.
13. From vertex detectors to inner trackers with CMOS pixel sensors, A. Besson et al., Nucl. Instrum. Meth. A 845 (2017) 33.
14. Electron beam test of key elements of the laser-based calibration system for the muon *g*-2 experiment, A. Anastasi et al., Nucl. Instrum. Meth. A 842 (2017) 86.
15. Negative ion Time Projection Chamber operation with SF6 at nearly atmospheric pressure, E. Baracchini et al., arXiv:1710.01994 [physics.ins-det]
16. Performance of the diamond active target prototype for the PADME experiment at the DAΦNE BTF, R. Assiro et al., arXiv:1709.07081 [physics.ins-det].
17. The construction of the Fiber-SiPM beam monitor system of the R484 and R582 experiments at the RIKEN-RAL, M. Bonesini et al., JINST 12 (2017) C03035.
18. Measurement of the energy and time resolution of a undoped CsI + MPPC array for the Mu2e experiment, O. Atanova et al., JINST 12 (2017) P05007.
19. Micro-channel plates in ionization mode as a fast timing device for future hadron colliders, A. Yu. Barnyakov et al., JINST 12 (2017) C08014.

Users publications 2017

Usual metrics: citations of NIM A515 (2003) 524



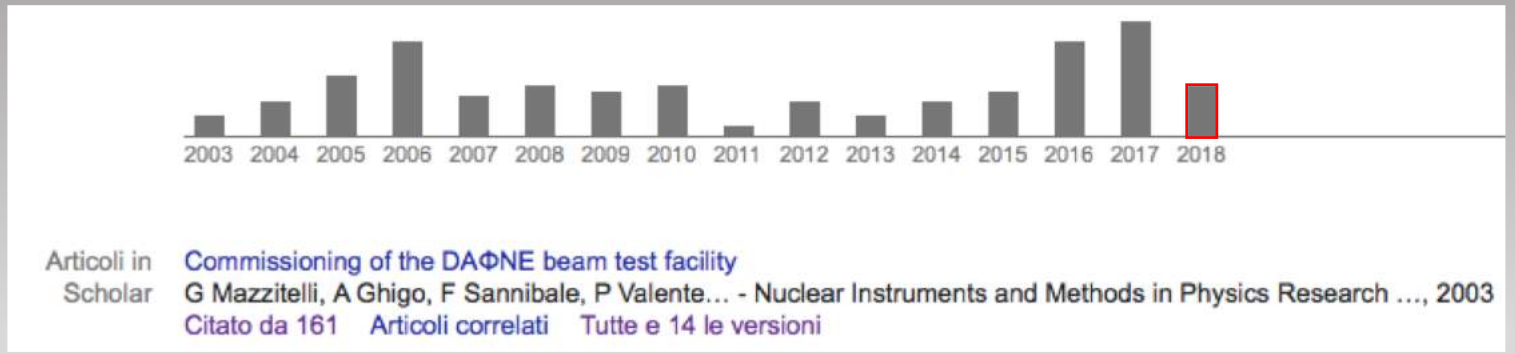
1. Performance of the prototype of the charged particle veto system of the PADME experiment, F. Ferrarotto et al., IEEE TNS 99 (2018).
2. Study of the Performance of an Optically Readout Triple-GEM, M. Marafini et al., IEEE TNS 65 (2018) 604.
3. Response of microchannel plates in ionization mode to single particles and electromagnetic showers, A. Yu. Barnyakov et al., Nucl. Instrum. Meth. A 879 (2018) 6.
4. Study of the performance of the NA62 small-angle calorimeter at the DAΦNE Linac, A. Antonelli et al., Nucl. Instrum. Meth. A 877 (2018) 178.
5. Study on the high energy particle detector calorimeter, B. Panico et al., PoS ICRC2017 (2018) 172.
6. The PADME Tracking System, G. Georgiev et al., arXiv:1804.00618 [physics.ins-det].
7. Dark Photon Search with PADME at LNF, G. Piperno, Int. J. Mod. Phys. Conf. Ser., 46, 1860047 (2018).
8. Status and prospects for the PADME experiment at LNF, P. Gianotti et al., EPJ Web of Conferences 166, 00009 (2018).
9. Design, status and perspective of the Mu2e crystal calorimeter, N. Atanov et al., arXiv:1801.03159 [physics.ins-det].
10. Combined readout of a triple-GEM detector, V. C. Antoci et al., arXiv:1803.06860 [physics.ins-det].

Users publications 2018

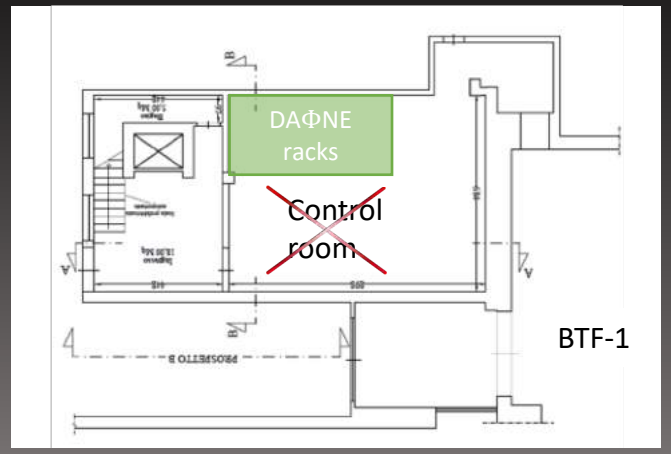
1. DAΦNE BTF Improvements of the Transverse Beam Diagnostics, P. Valente et al., JACoW-IPAC2017-MOPAB061.
2. Long beam pulses with SLED compression in DAΦNE LINAC, P. Valente et al., J. Phys. Conf. Ser. 874 (2017) no.1, 012017.
3. Status of positron beams for dark photons experiments, P. Valente, EPJ Web Conf. 142 (2017) 01028.

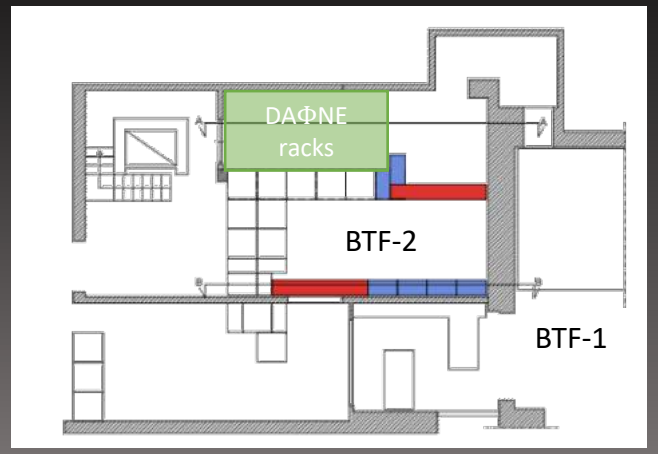
BTF staff

Usual metrics: citations of NIM A515 (2003) 524



New control room

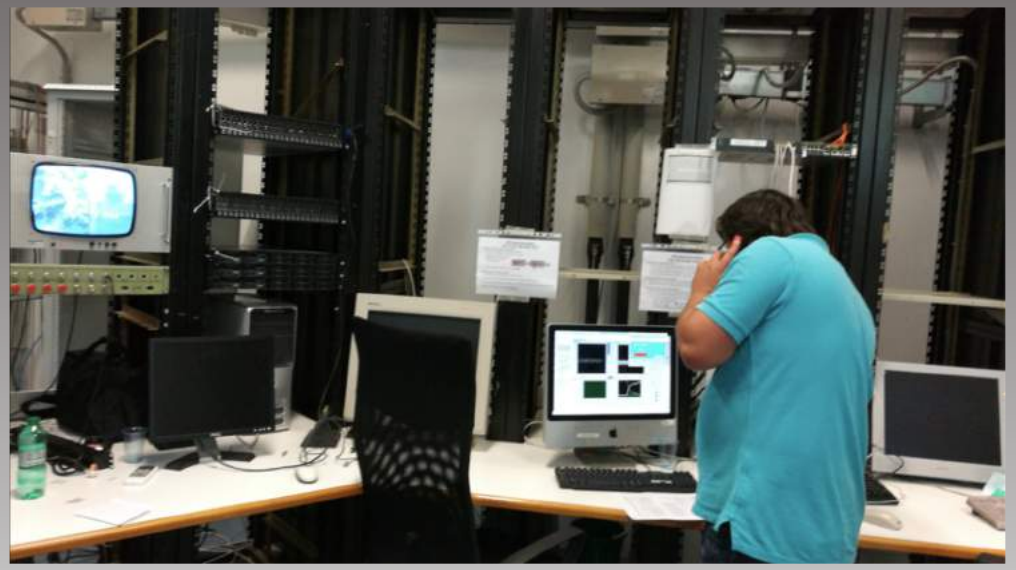




A new control room needed in order to enlarge the experimental area

- Satellite next to the DAΦNE main one
- Need to move or modify controls, monitoring and diagnostics cabling, networking, user services, etc.
- In particular: full **virtualization** of all services and diagnostics

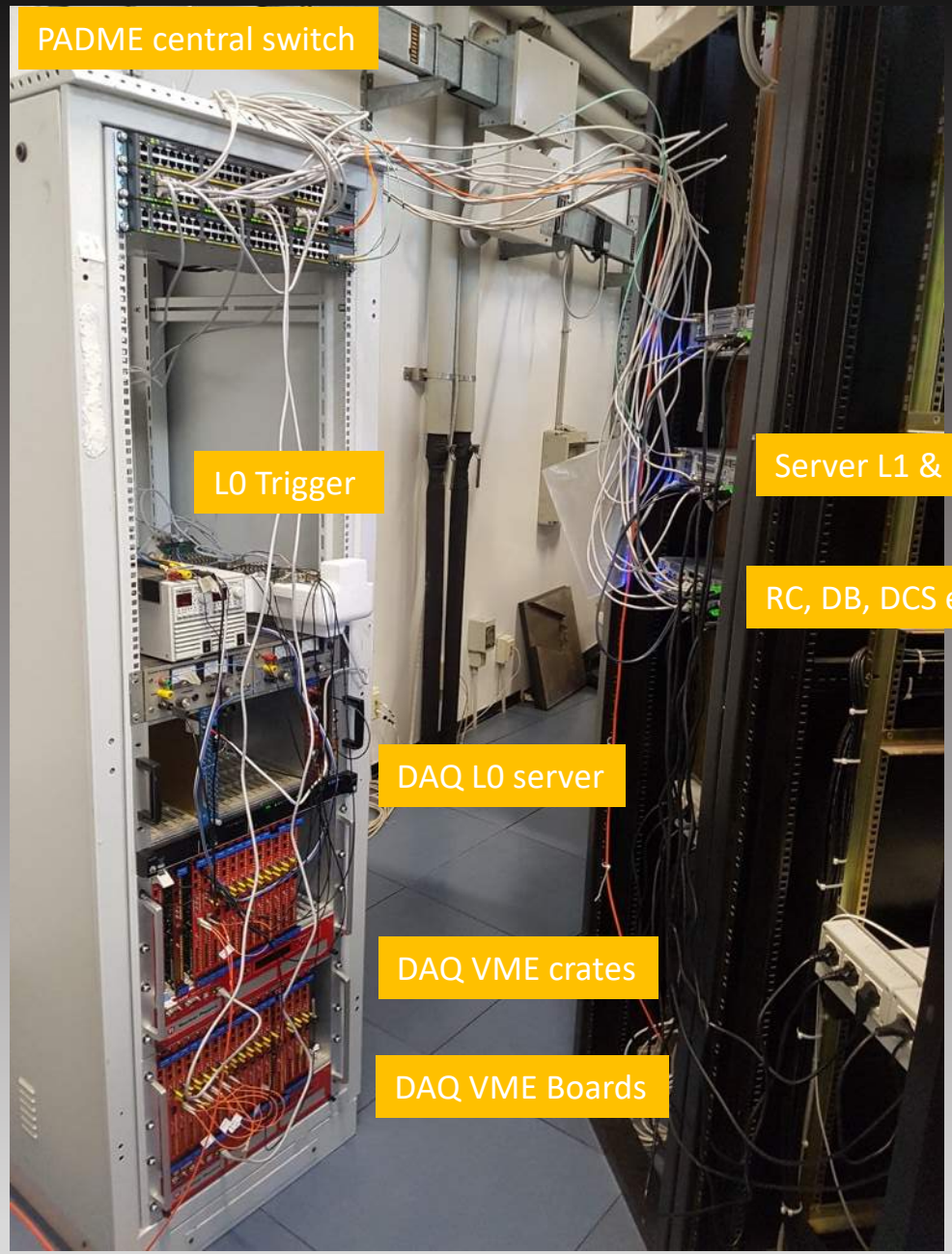
2016



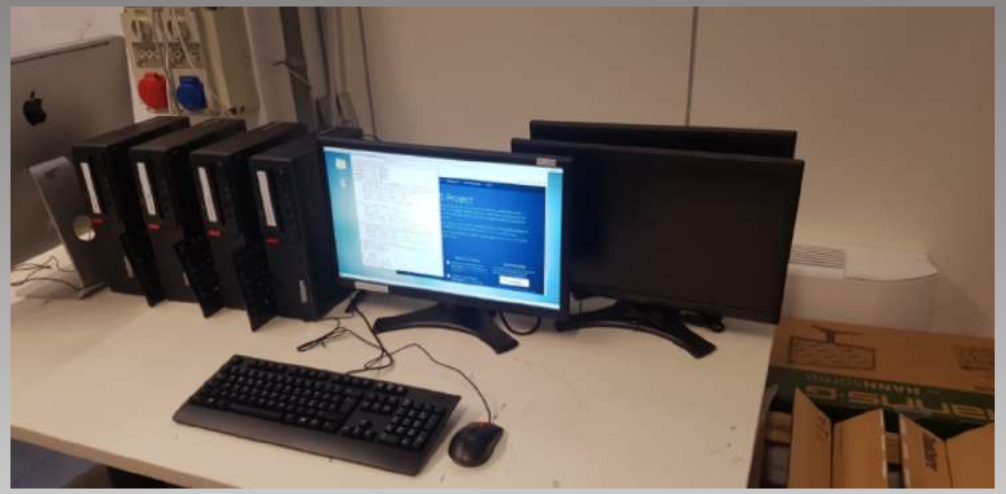
- New network infrastructure
- Move BTF control cabling
- Move BTF consoles

- Operational since **2017**
- Already hosting **PADME TDAQ infrastructure**

BTF control room ready for PADME

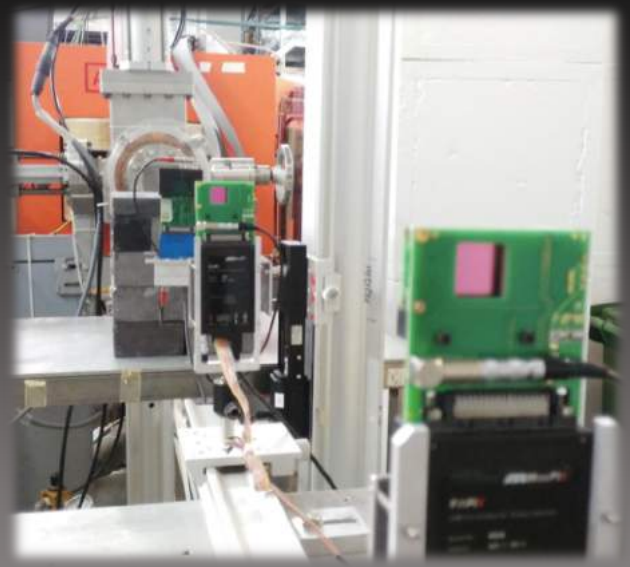


- BTF control room presently is hosting the PADME TDAQ and online test-stand
- The front-end part of the infrastructure (left rack) has to be moved in the BTF experimental area
- High-speed connection prepared (10 Gb fiber)
- PADME preparing shifters and experts work-stations

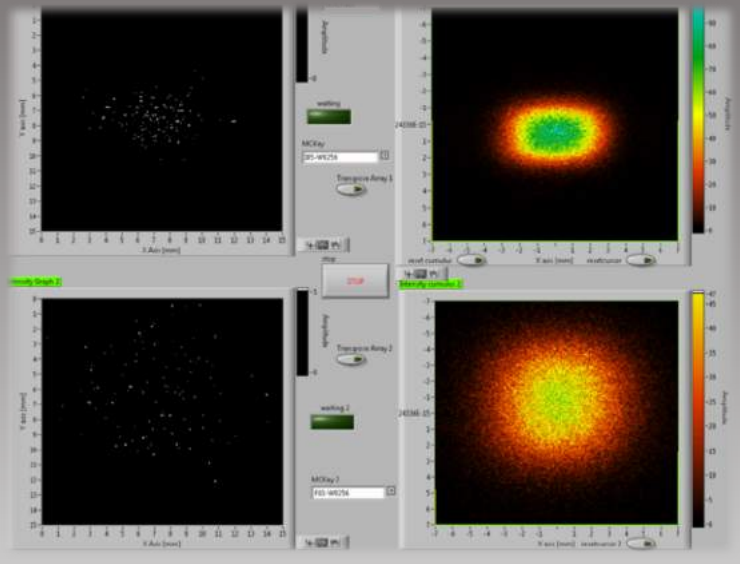


Improved diagnostics

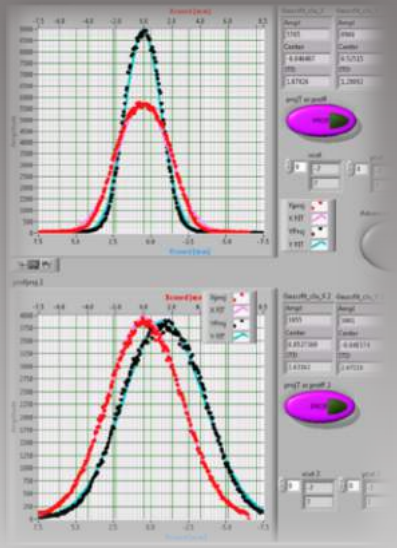
- Also thanks to the **control infrastructure revision**:
  - Improvement of **data-sharing** of beam diagnostics and controls with users: **Memcached** database
  - FitPIX detectors used both as **spot and intensity real-time diagnostics** tool at full BTF repetition rate (50 Hz)



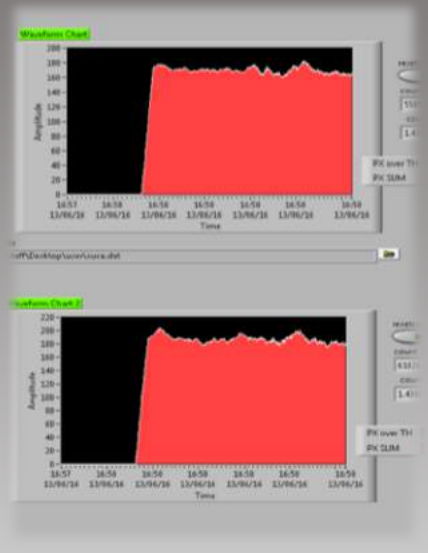
Shot-by-shot and integral spot monitoring



Spot size and position



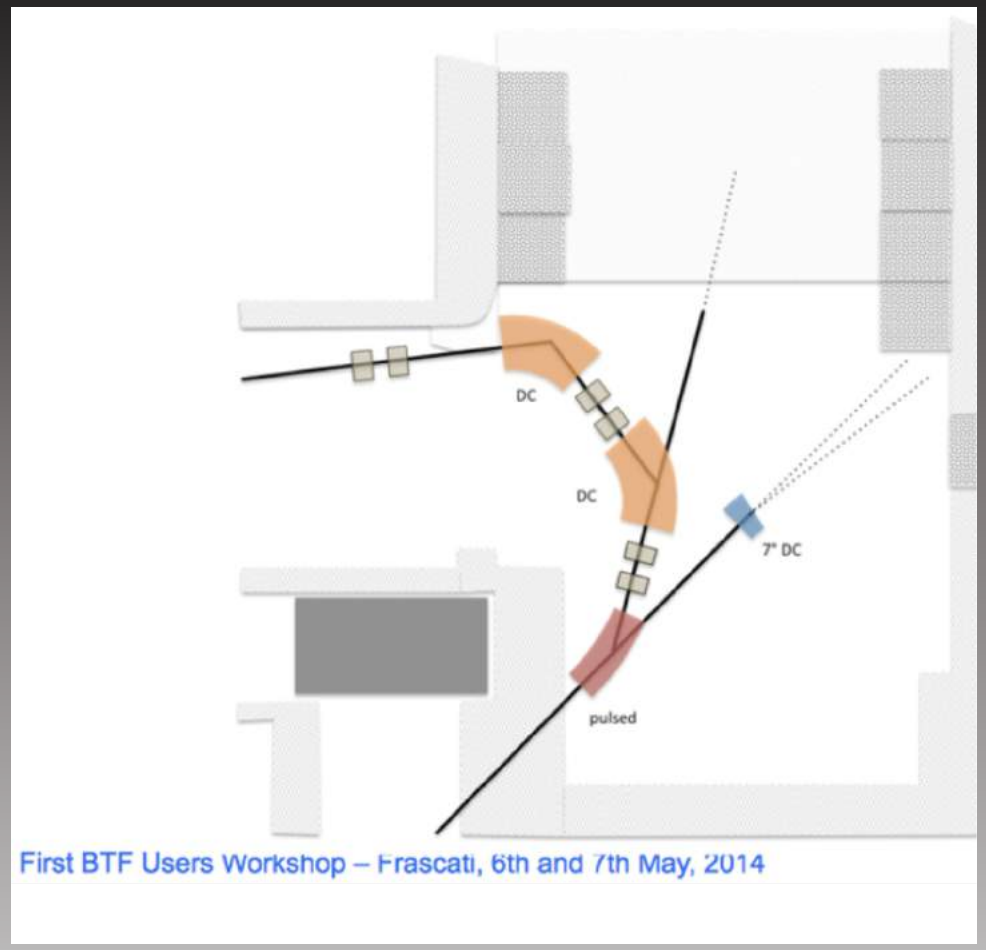
Intensity



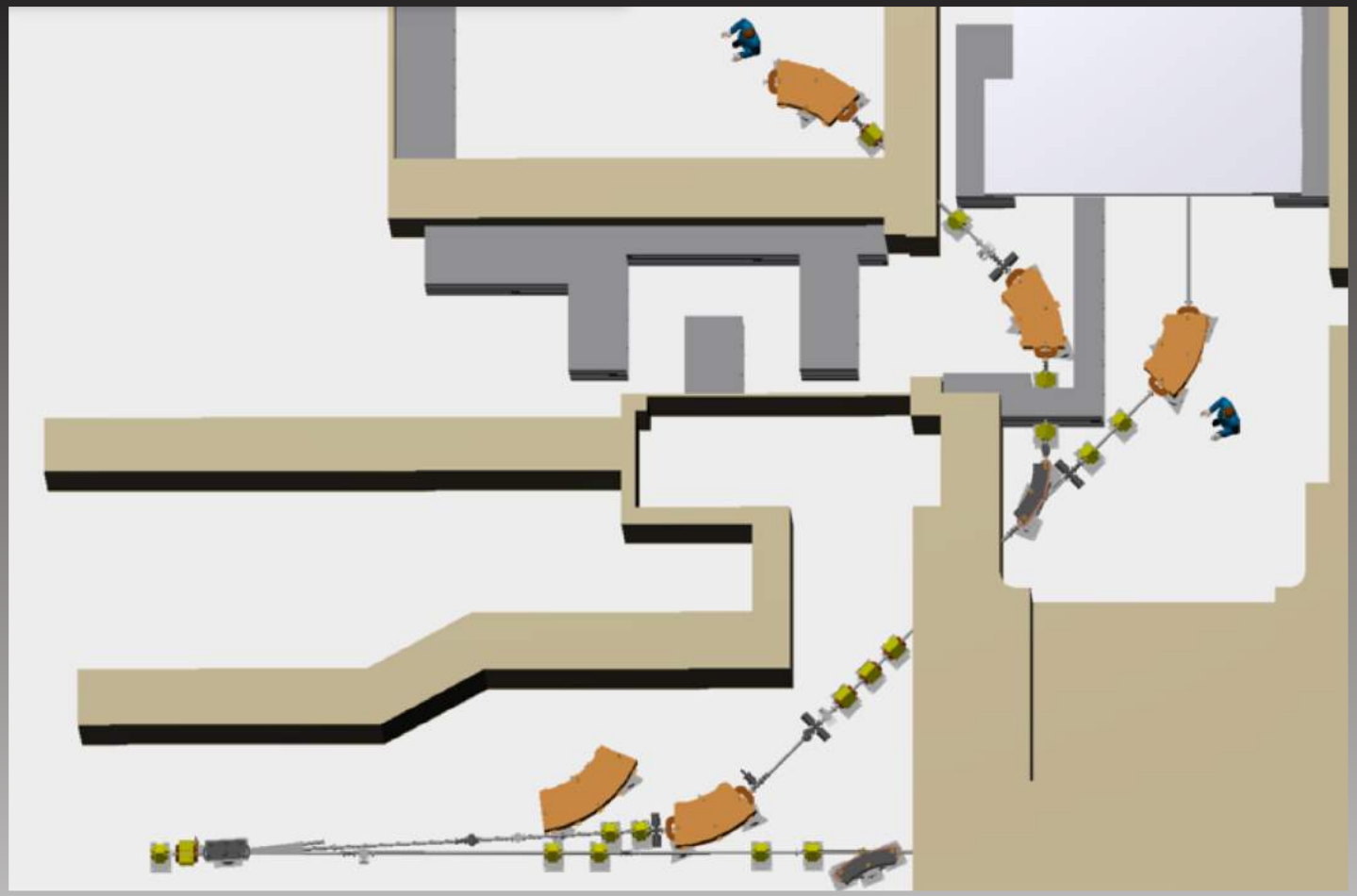
BTF upgrade objectives

- Second beam line (AIDA-2020 deliverable D15.4)
- Photon tagging system (AIDA-2020 deliverable D15.5)
- Linac consolidation
- Preparation for PADME dark photon experiment
- 2.6 M€ overall investment from INFN (GE through Machine Advisory Committee), available since ~1 year: 1.6 M€ (Apr. 2017) + 0.35 M€ (Oct. 2017) + 0.65 M€ (Feb. 2018)

BTF upgrade layout/1

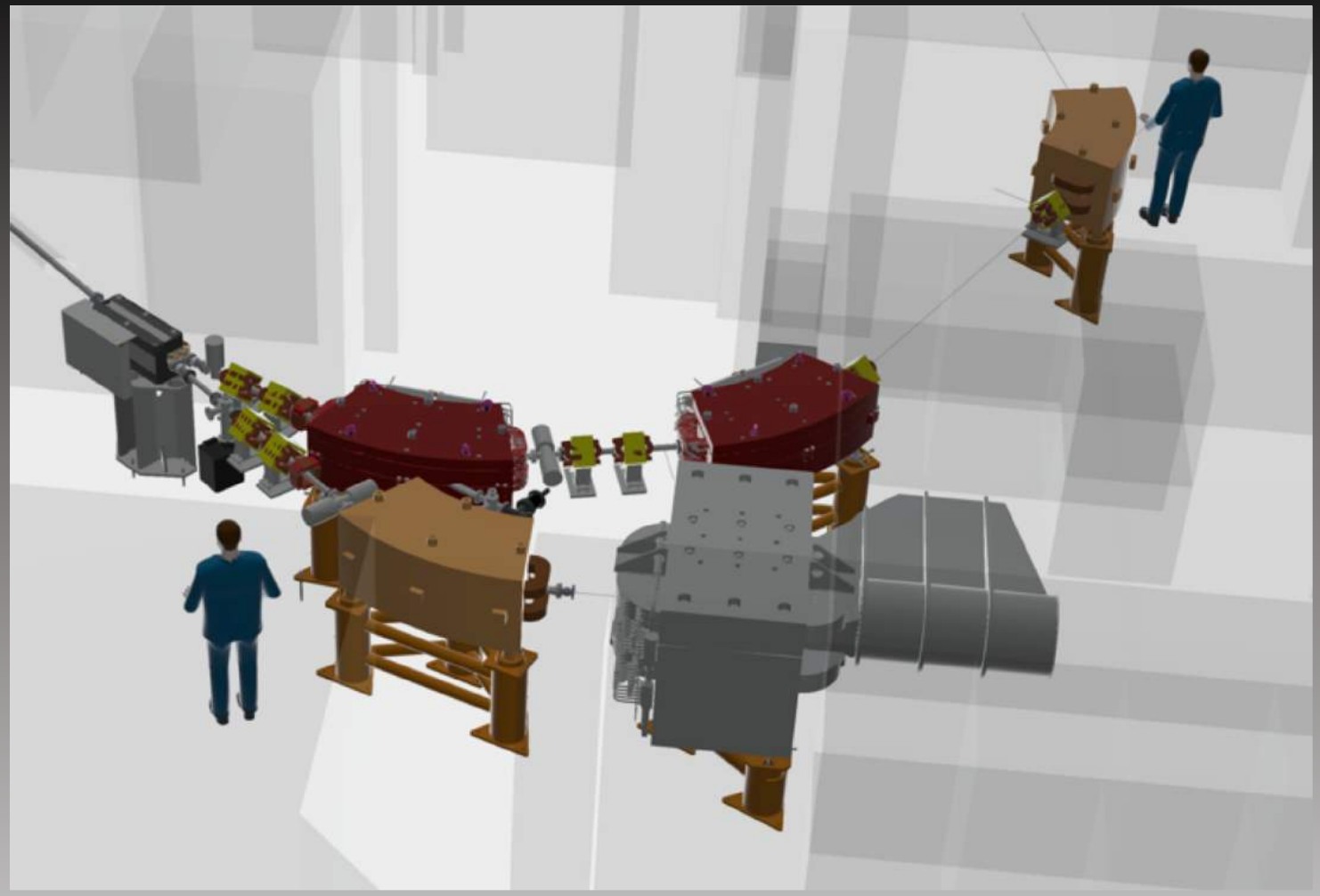


First sketch, May 2014



Conceptual Design Report, March 2016

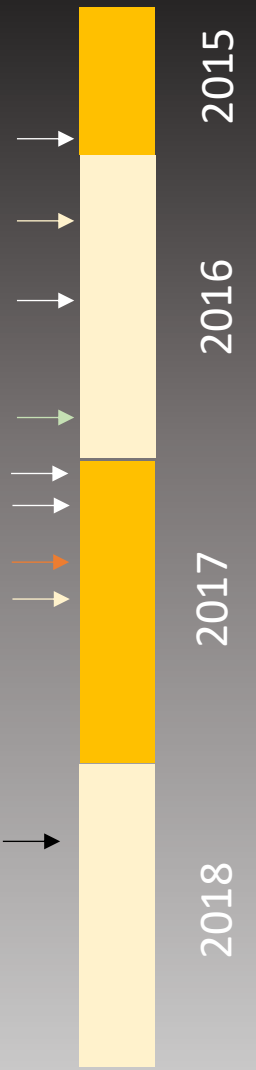
BTF upgrade layout/2



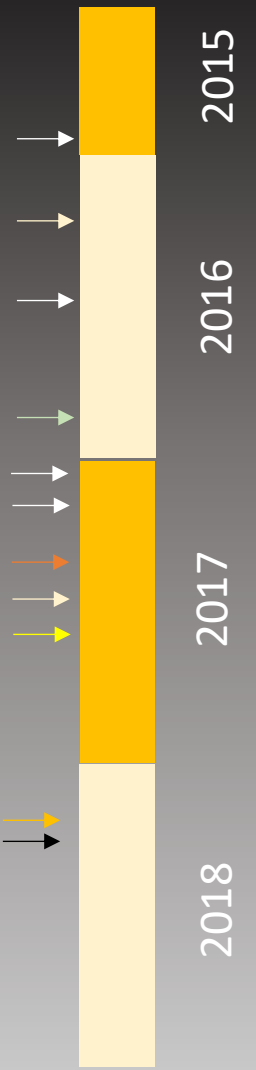
Final layout, 2016

Project timeline/1

- 1st Review MAC: **12/11/2015**
- 2nd Review MAC: **16/03/2016,** Proposal INFN-16-04/LNF
- Project reviewed with CERN (warm) magnet group: **22/06/2016**
- Final layout, integration of first long-term user (PADME experiment): **10/10/2016**
- INFN LASA meeting for new magnets: **17/01/2017**
- Bologna Workshop with Industry, jointly with INFN ILO: **01/03/2017**
- **LNF Open Day** with Industries: **15/06/2017**
- First funding: **06/04/2017**
- 3rd Review MAC: **22/06/2017**



Project timeline/2



- Normal BTF operations until **31/7/2017**
- DAΦNE operations for KLOE-2 experiment until **30/3/2018**

  Until this date, **no** major intervention on **accelerator complex** (linac, timing, transfer lines) nor **infrastructure** (cooling, conditioning, power, networking, services, buildings)

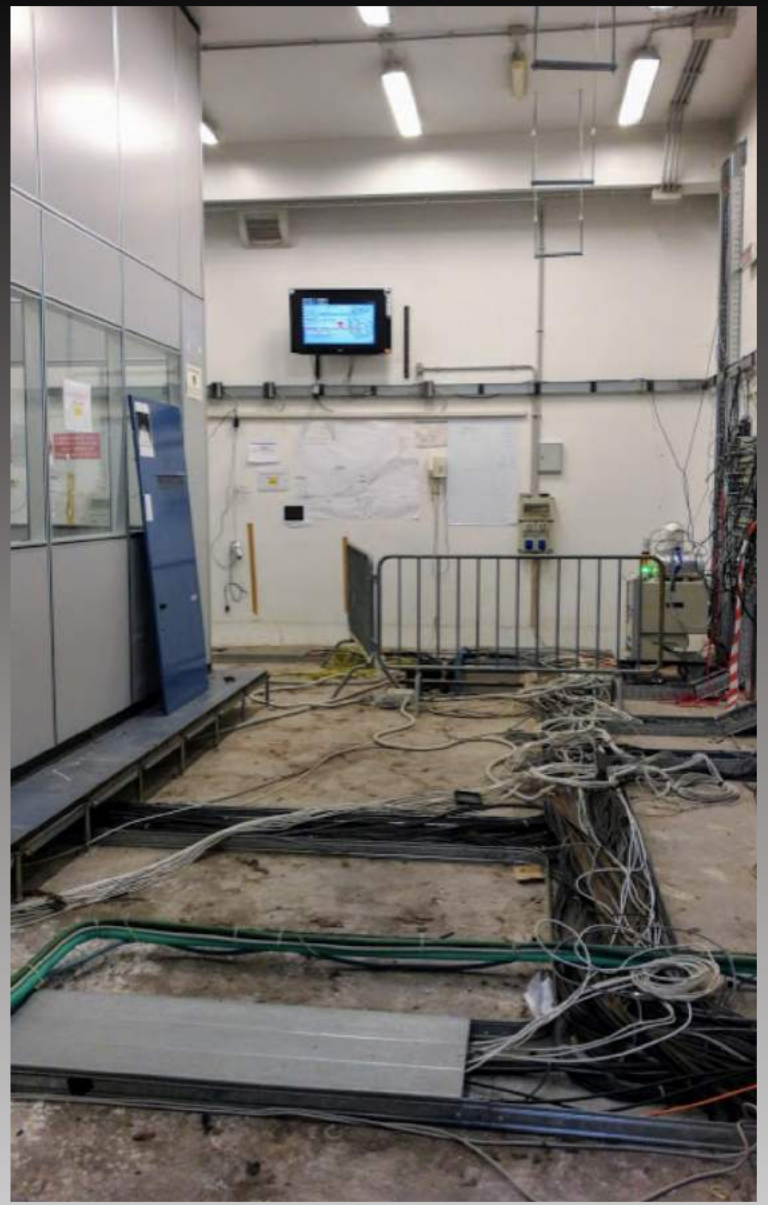
Final layout

Preparing second experimental hall

Inside

(former BTF control room)

Outside



- Remove control room equipment
- Remove false floor

April 2018

- Re-organize **all cables**
- Prepare for demolitions

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

1) **Enlarge main entrance**, allowing new bunker blocks and bins to be mounted
2) **Removable stairs** for allowing fork-lift and truck access through main doors
3) **New door** for accessing DAΦNE racks small room from outside the bunker
4) Second access door to the bunker (recycling existing fire-door)

1)


2)


3)


4)

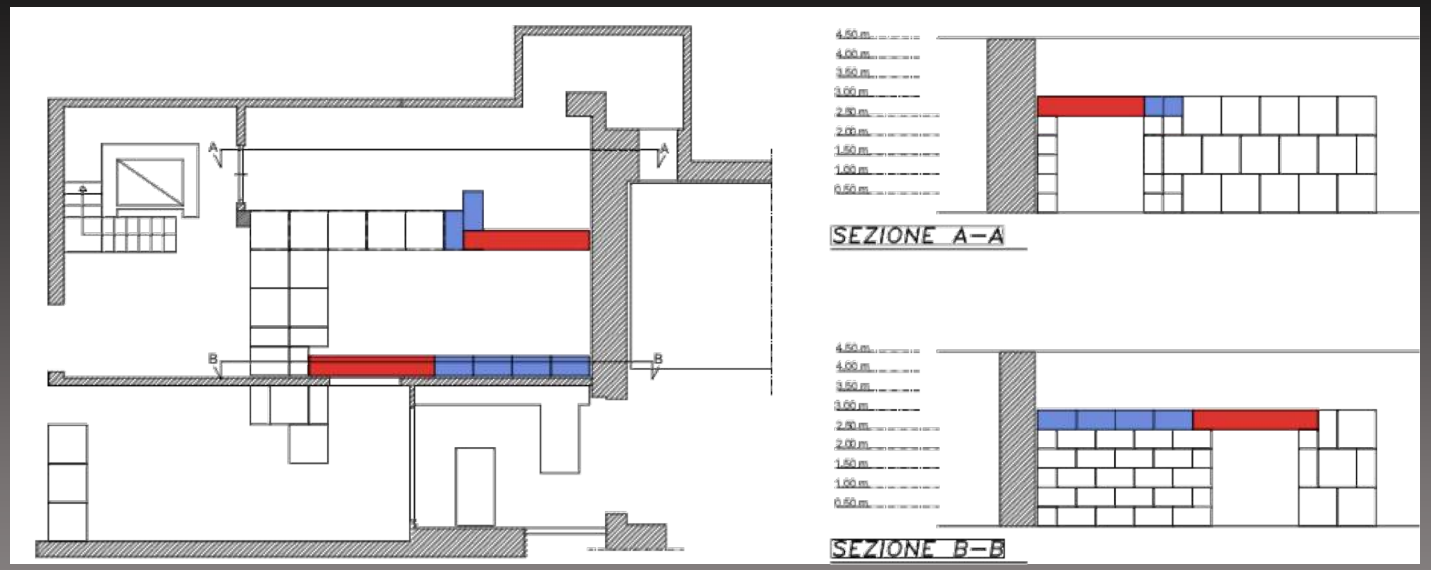
- Strengthen pavement for the new shielding chicane

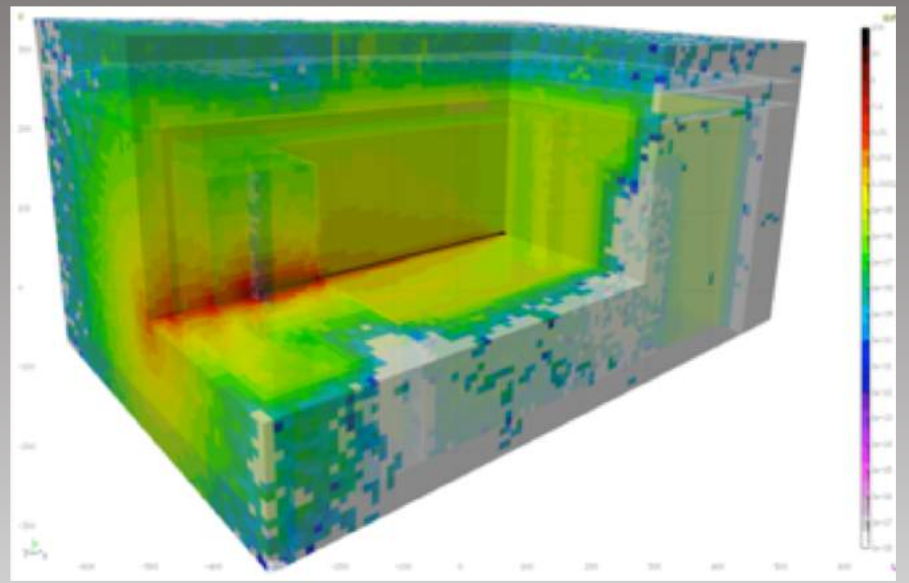
2017

April 2018

- New main entrance

New shieldings





BTF-1

- Already authorized for $3.12 \cdot 10^{10}\ e^-/s$ average flux

BTF-2

- Detailed FLUKA simulations for fixing the maximum allowed flux
- **No high-*Z* dump** to minimize neutron photo-production
- 2 m of concrete (at zero degrees)
- Keep <1 mSv/year for 6000 h operations
- Maximum average flux: $10^6\ e^-/s$

- Required **documentation** submitted to Authorities
- Reply with request of (small) clarifications
- Inspections carried on
- Expect approval, **if** no further investigation, **by summer**

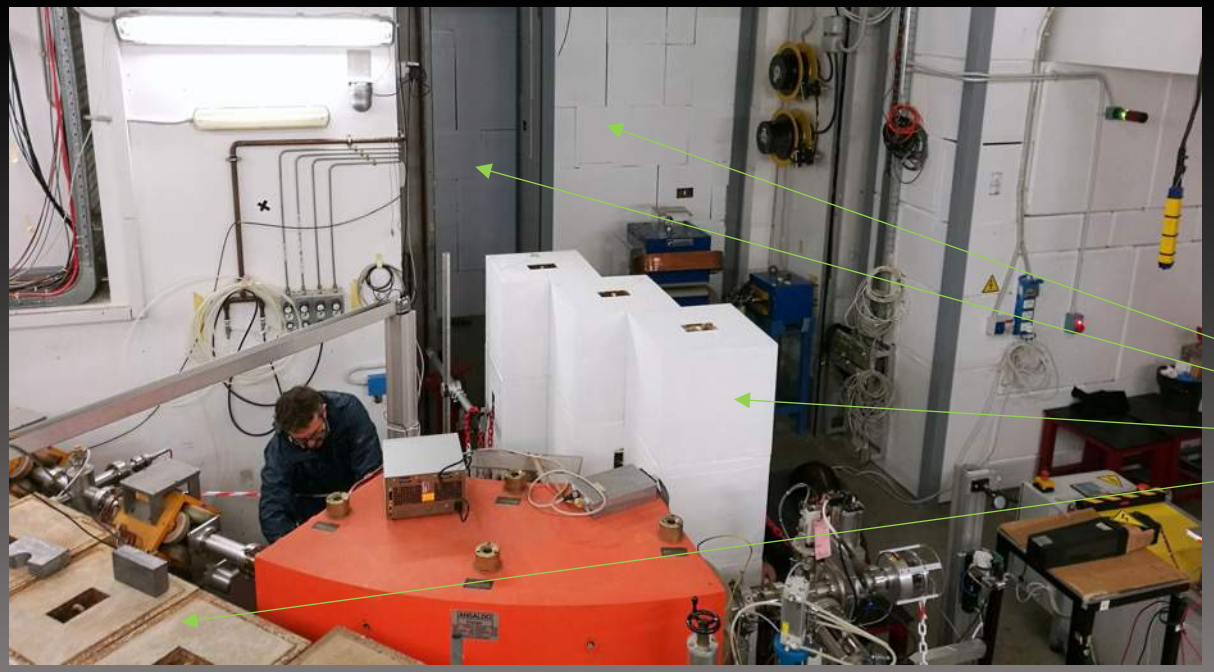
Dismounting the BTF line

2017

Remove diagnostics, services & cables

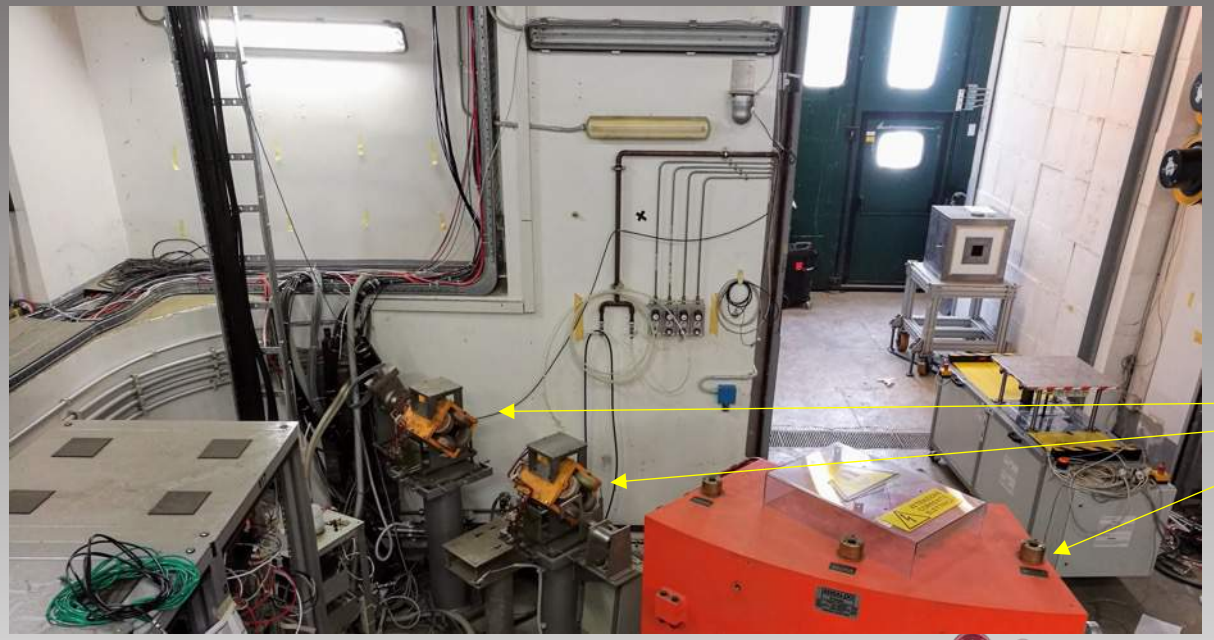
Remove vacuum pipe

2017



Remove shieldings

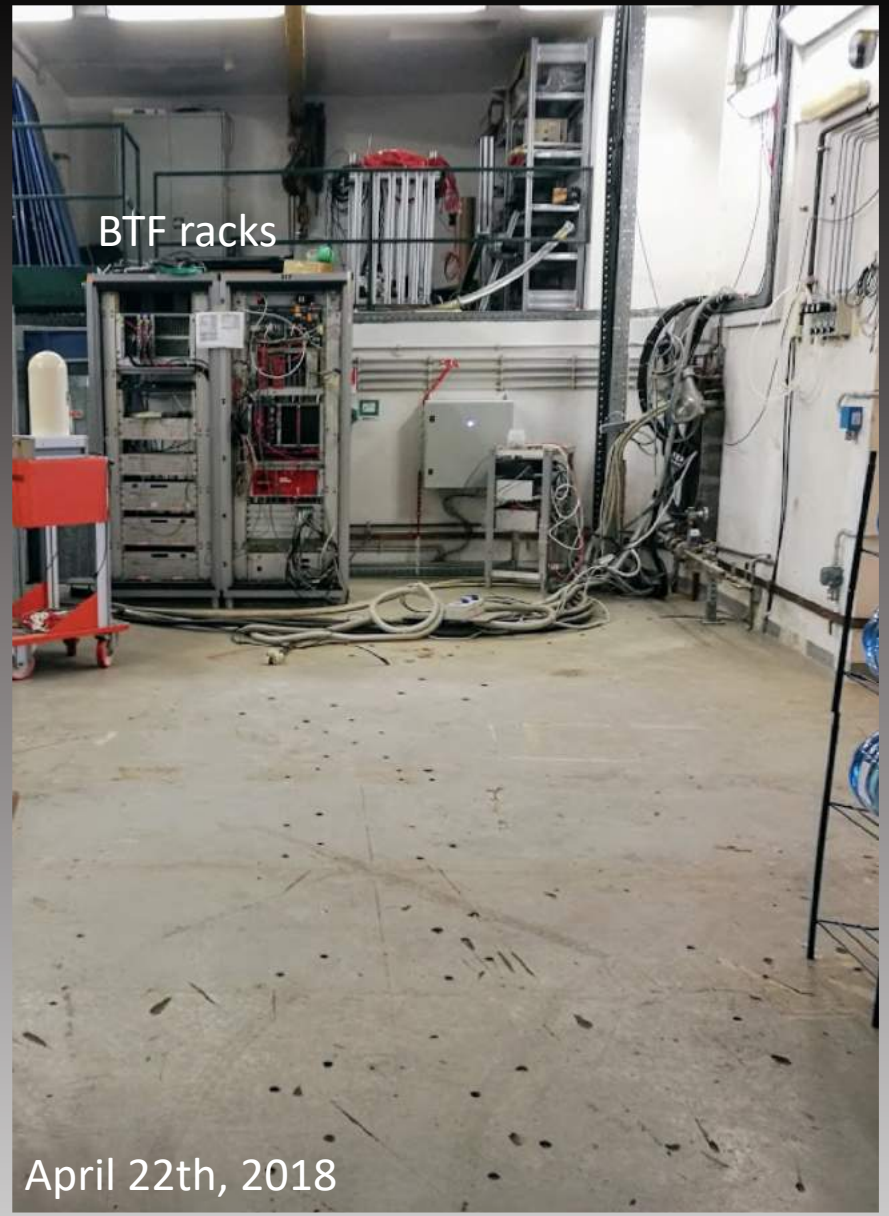
April 5th, 2018



Remove magnets

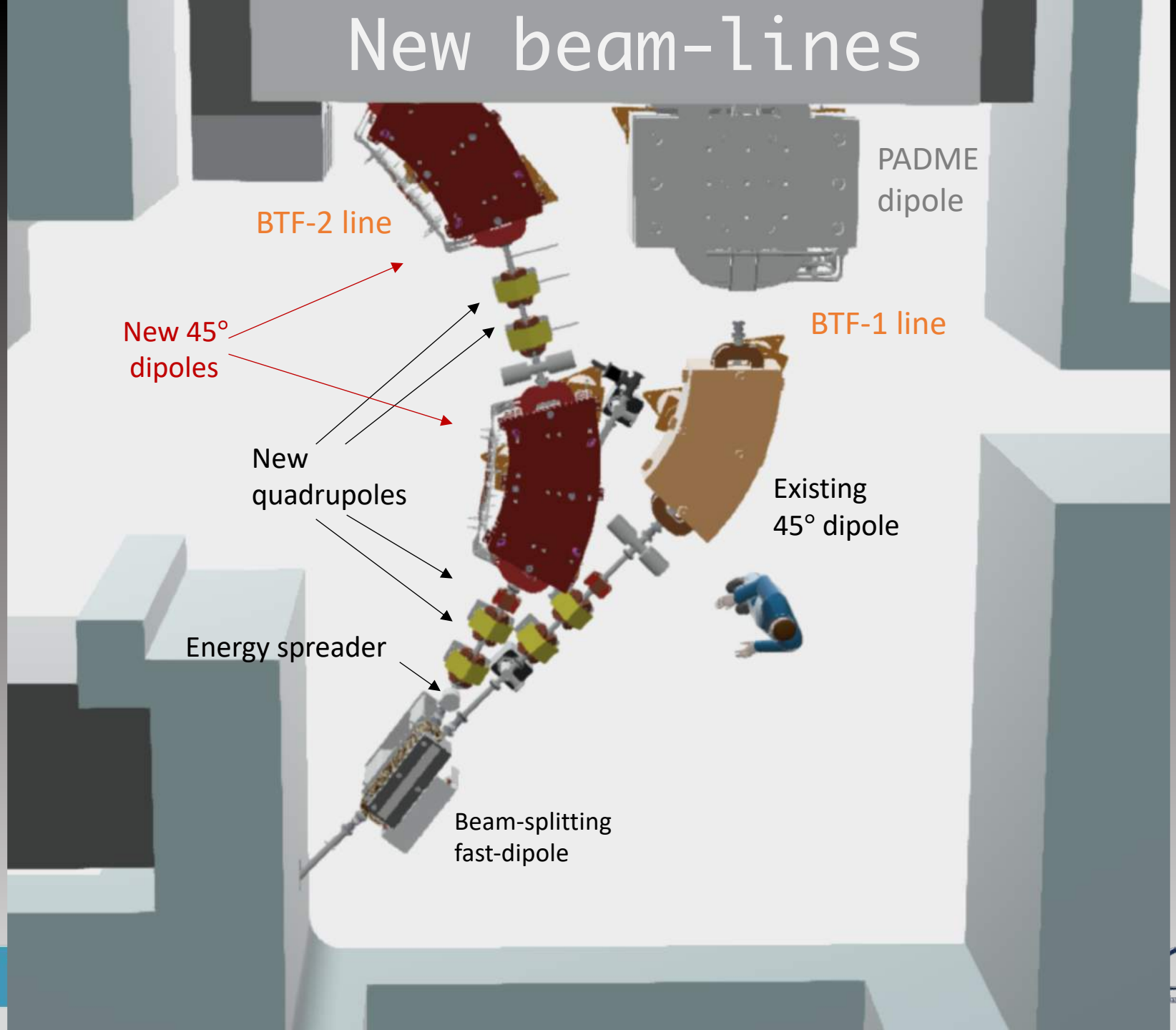
April 11th, 2018


BTF racks
2017

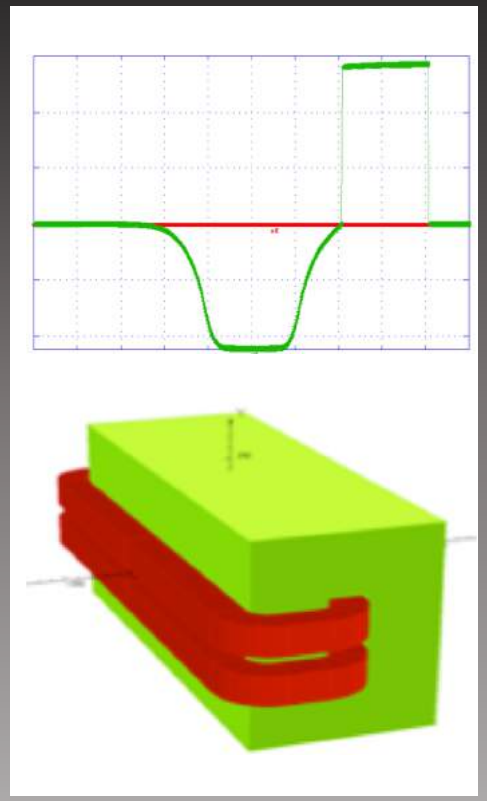

BTF racks
April 22th, 2018

- Services disconnected
- Revision of cooling distribution

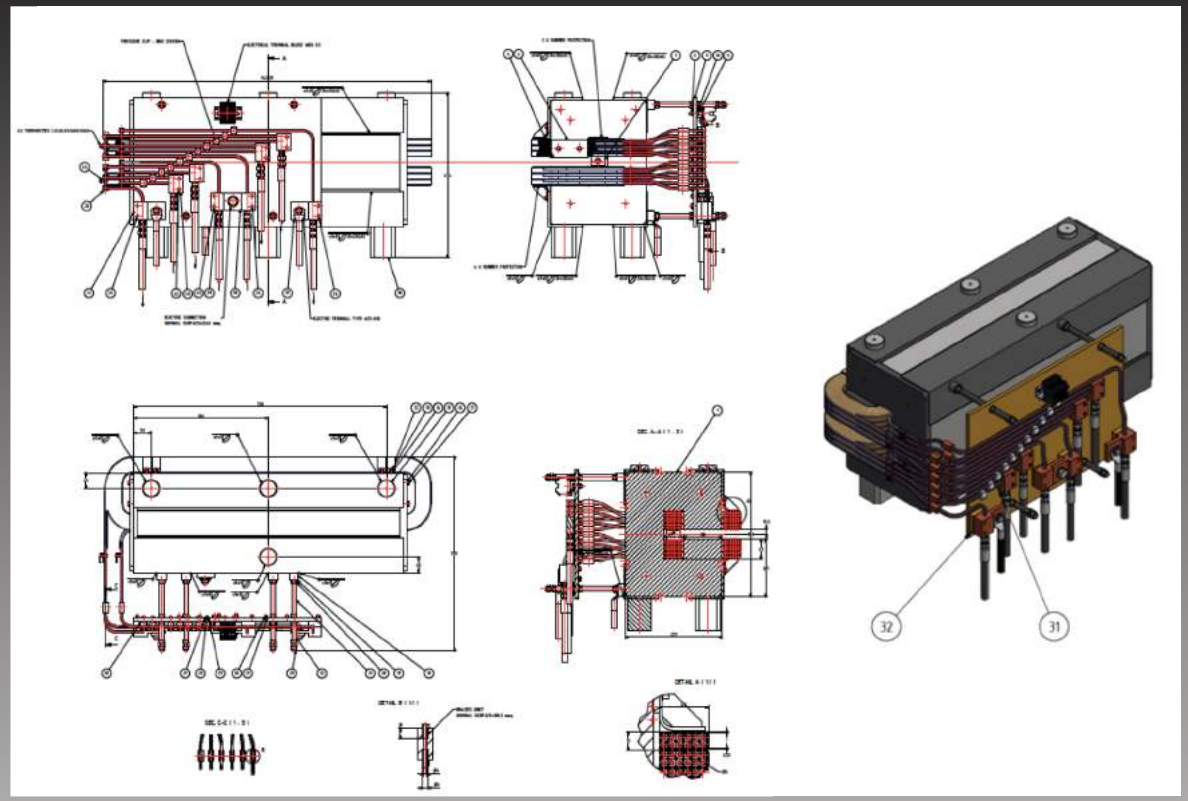
New beam-lines



Beam-splitting fast dipole

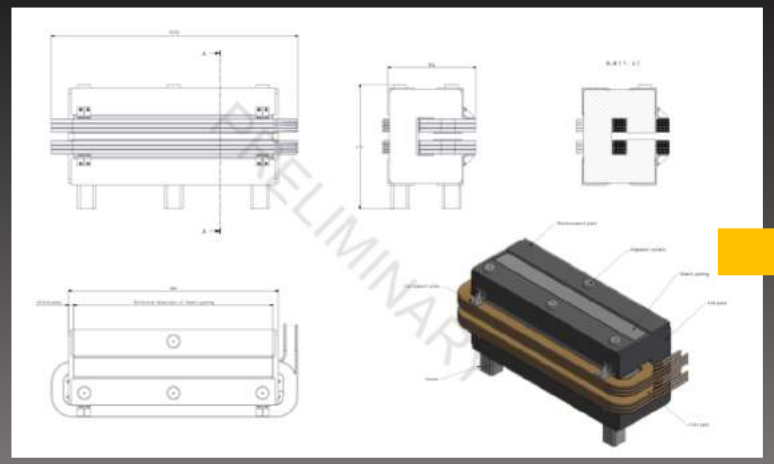


Magnetic design



Thermo-mechanical design and detailed constructive design

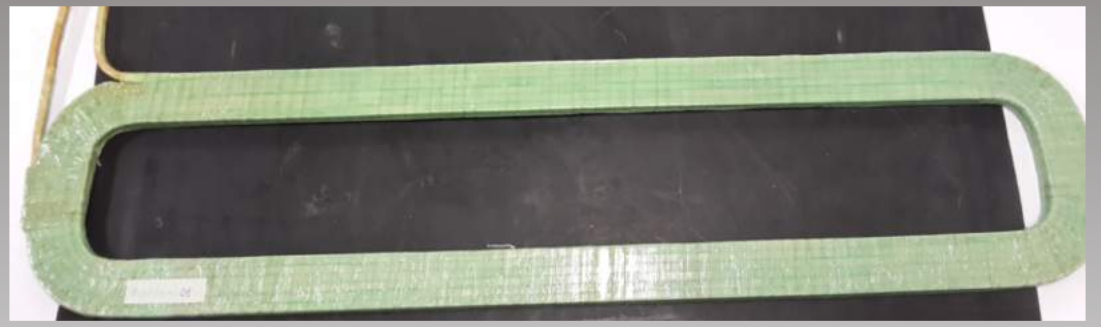
Beam-splitting fast dipole/1



- Construction at ORMET

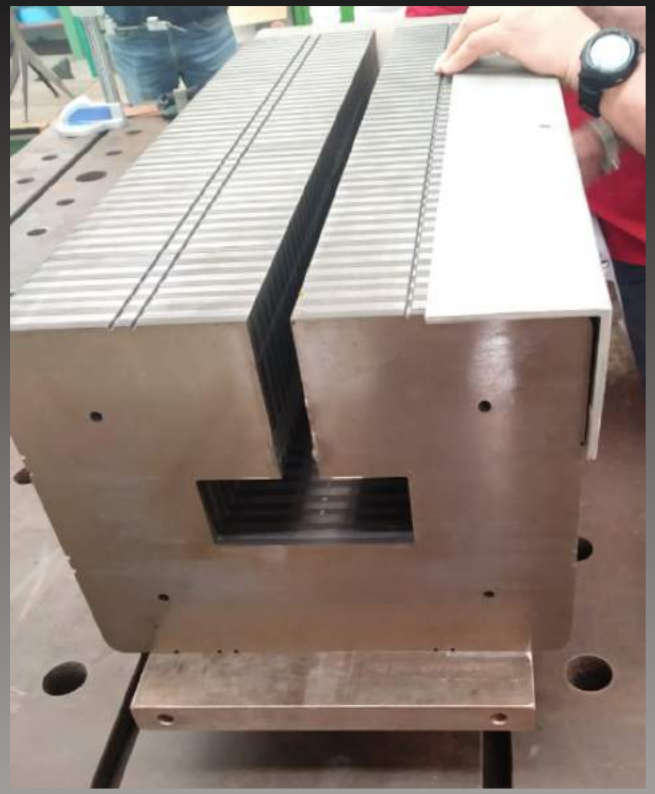
Laminated core assembly

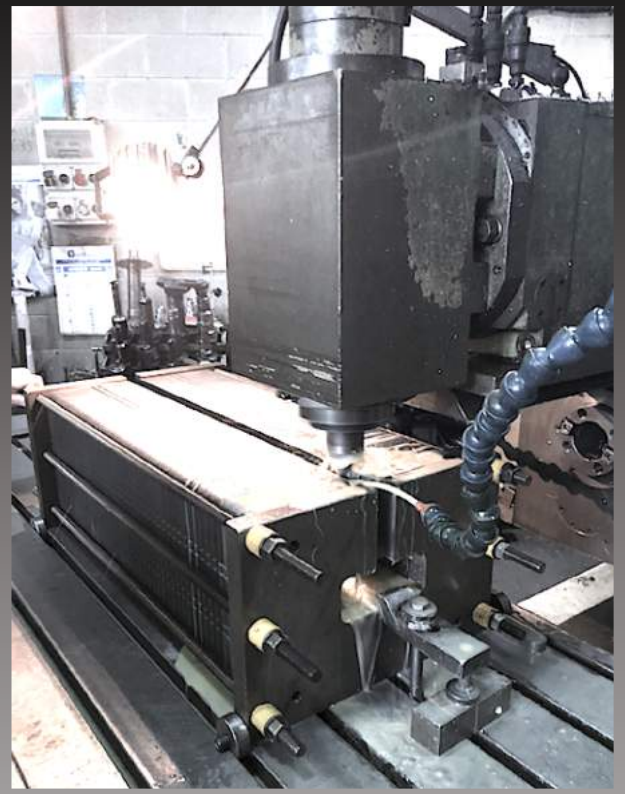
Iron laminations



Finished coil

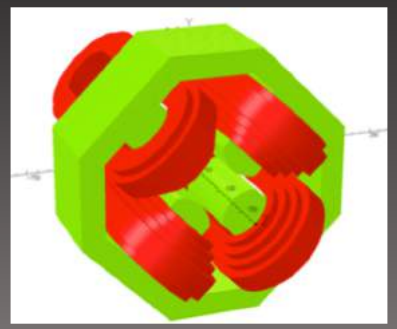
Beam-splitting fast dipole/2

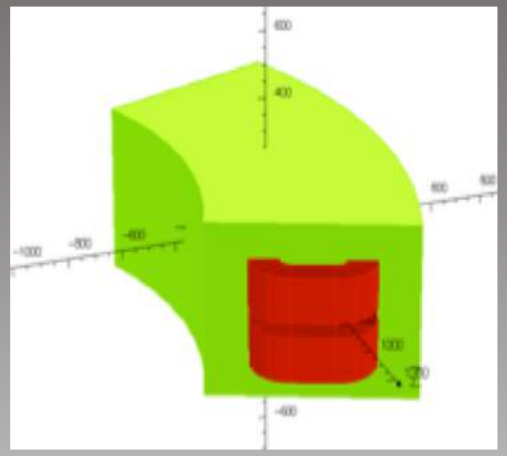




- All dimensions within specs, **except** poles surface
- OK after machining
- Final gap: 26.3 mm

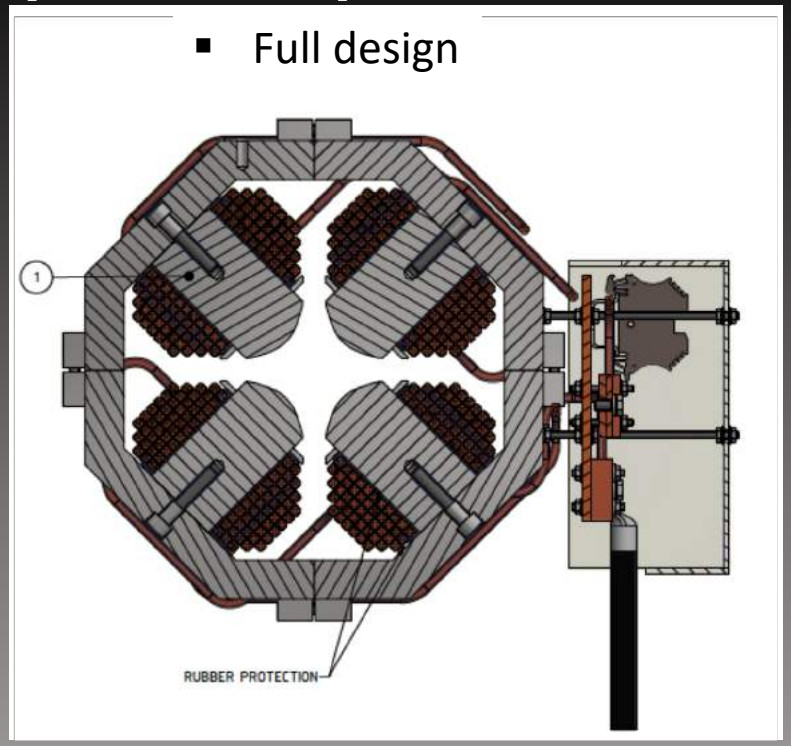
New quadrupoles and dipoles

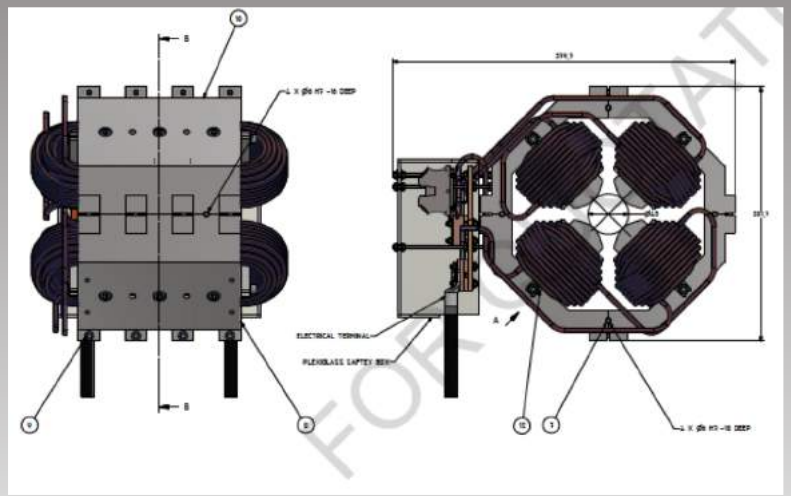


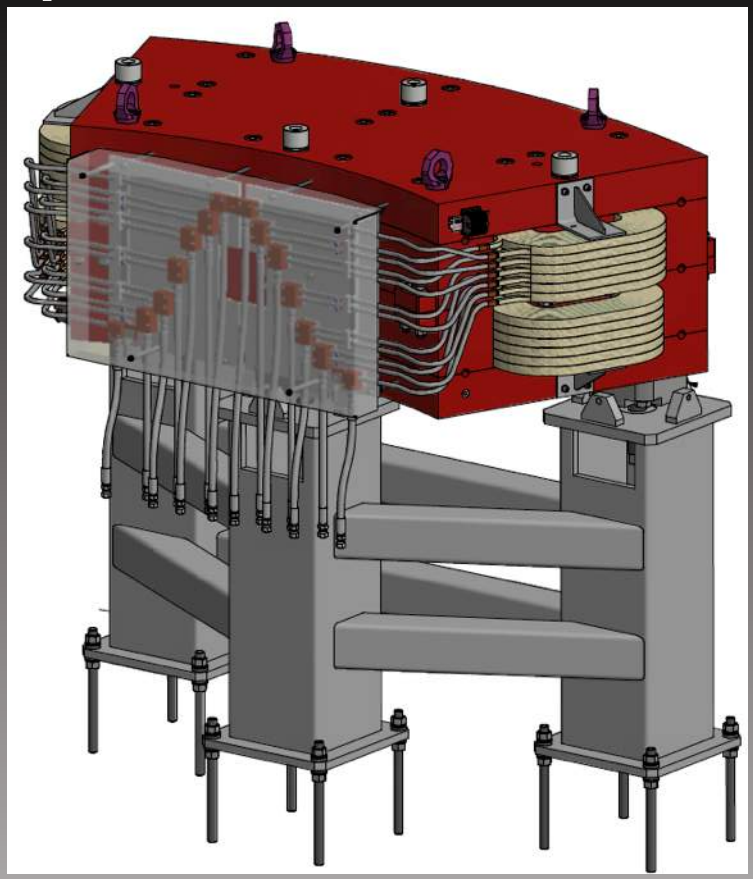


- Magnetic design

- Full design



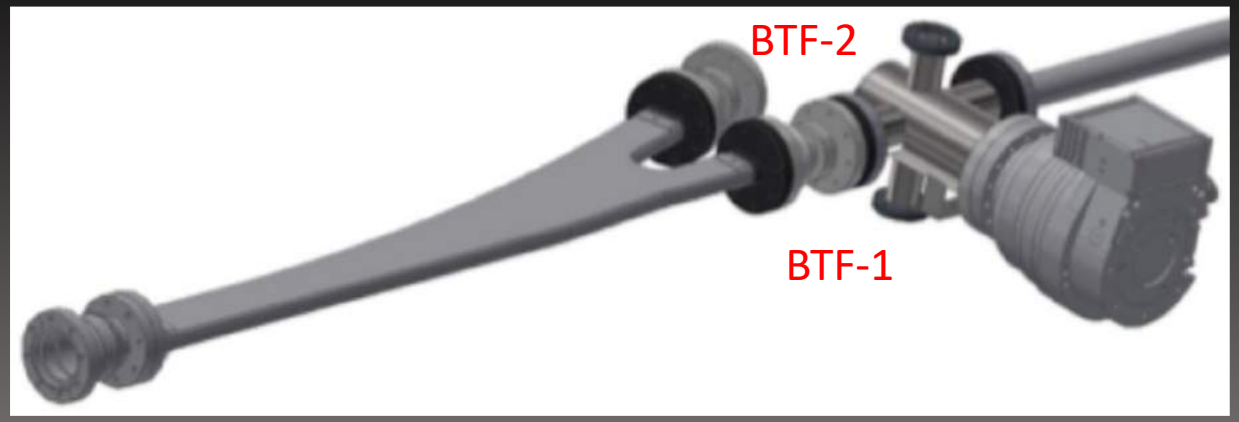




- Construction started at:

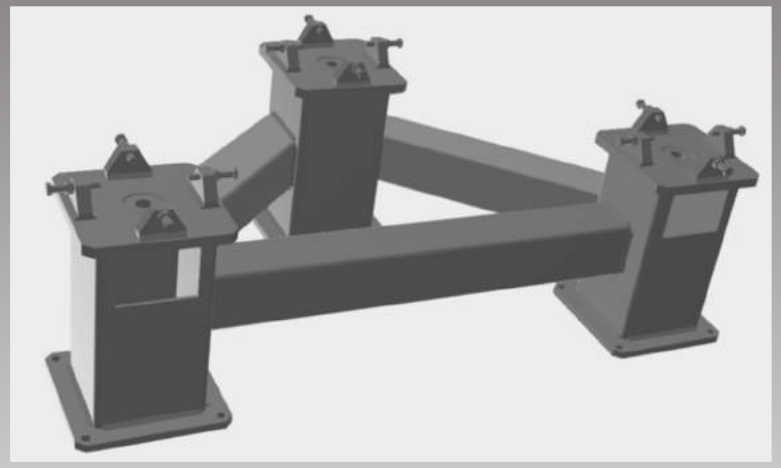
SIGMAPHI ACCELERATOR TECHNOLOGIES

Supports, pipes, etc.



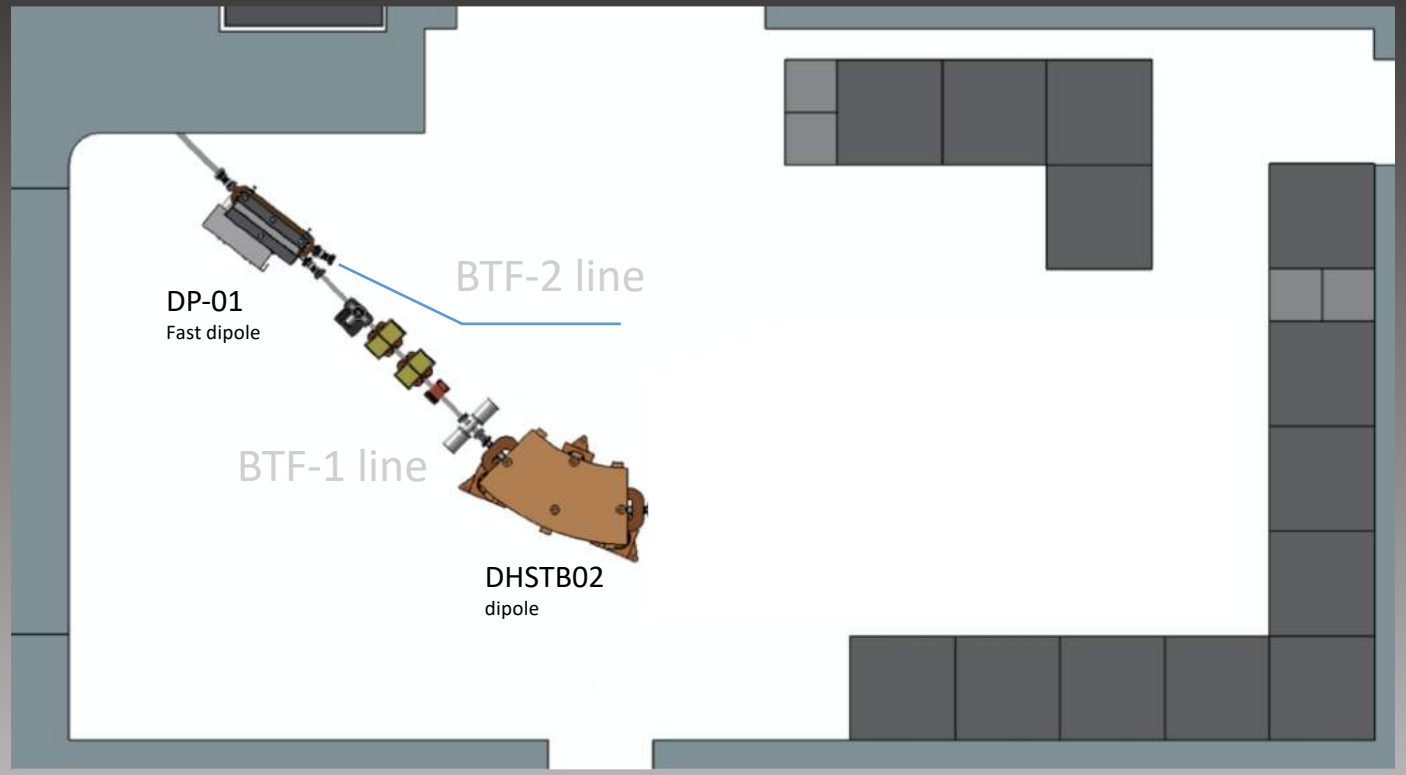
DP-01 dual-port vacuum chamber:

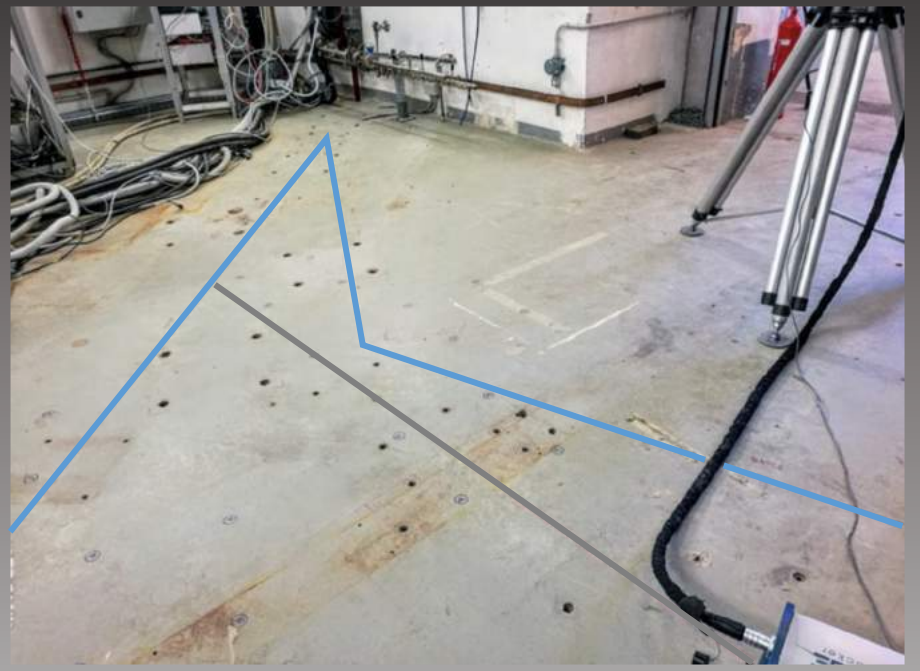
- Steel → Aluminium
- Simplified design



- Production on-going, several components already delivered or due in the next weeks

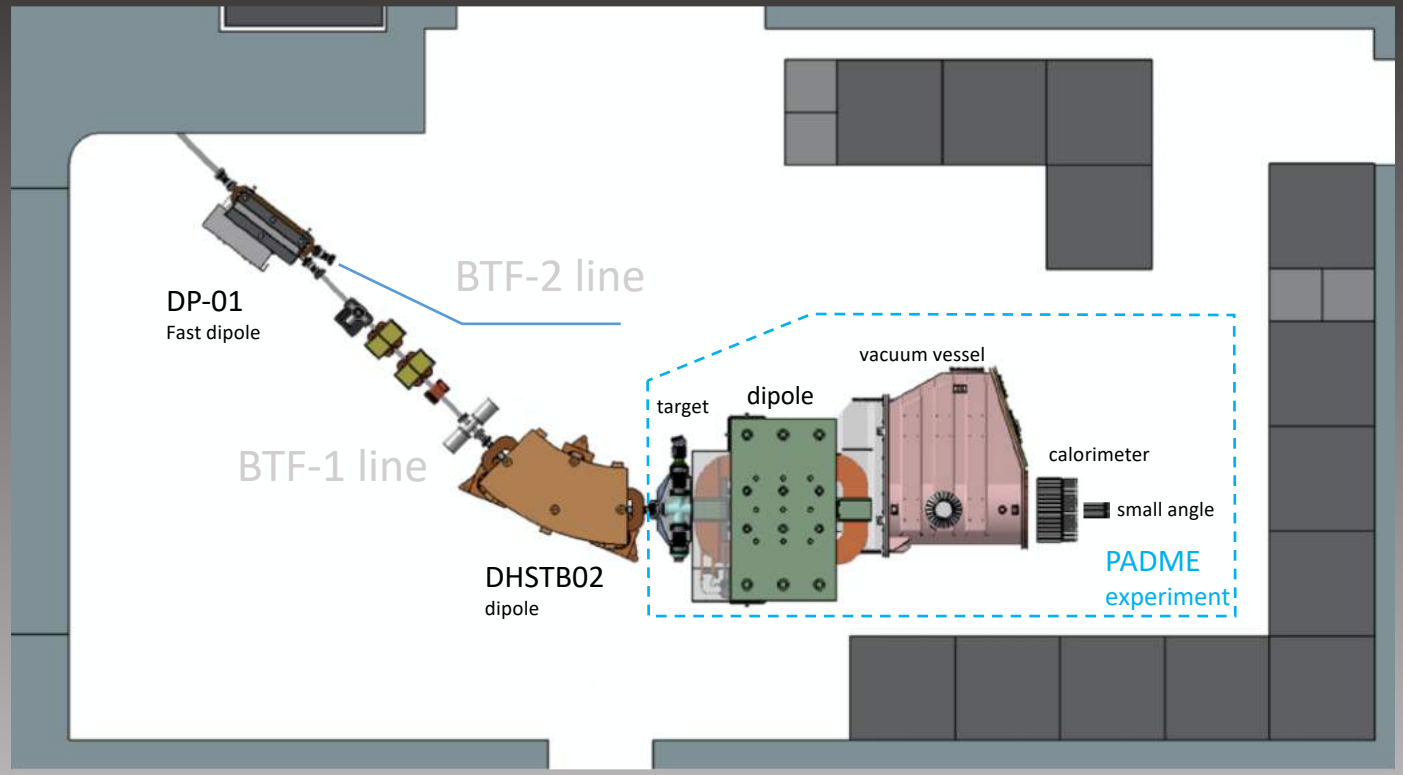
Alignment, blue-lining, drilling





- Coring out of the hole in the wall planned 15-16th May

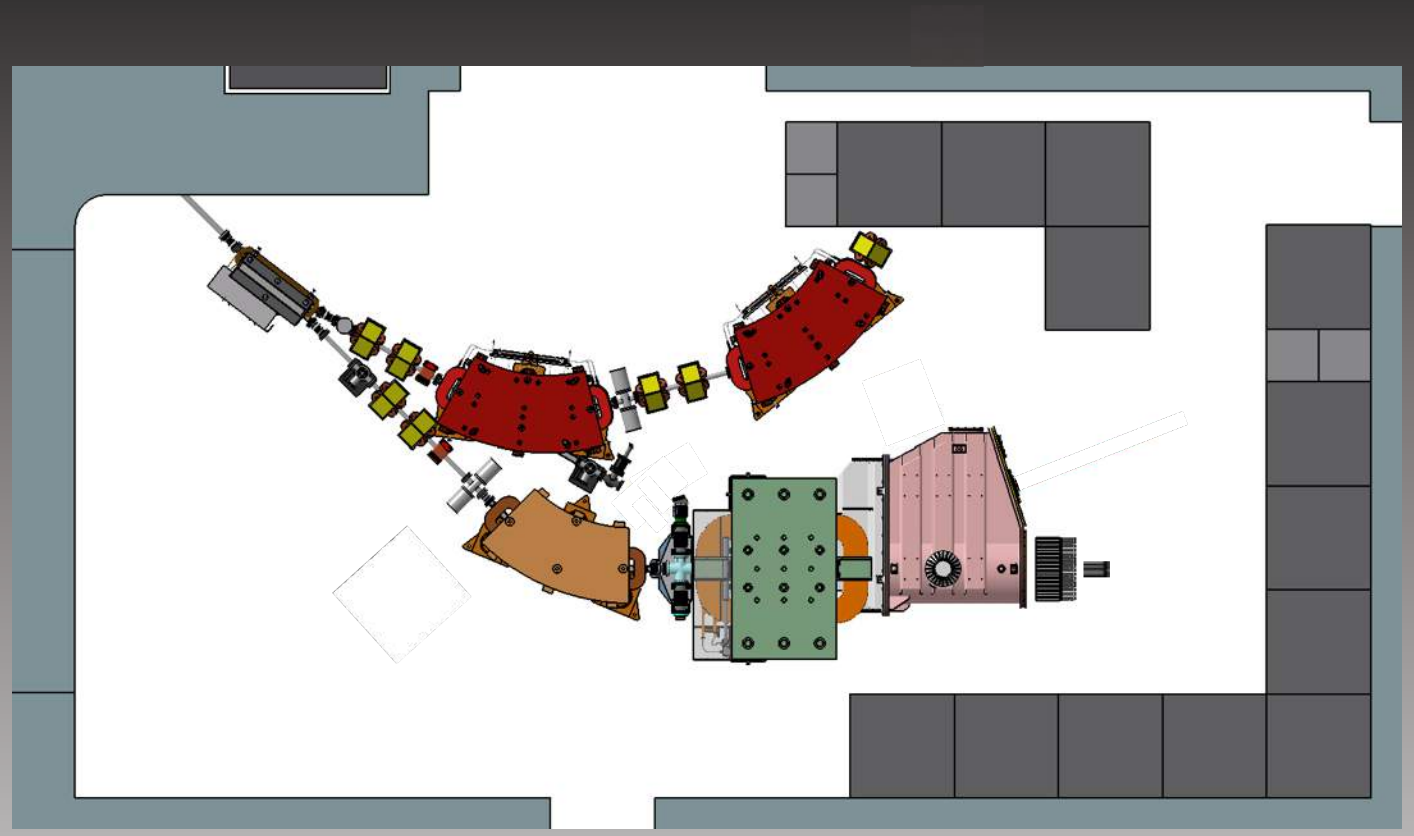
Next steps



By June 2018

- Install beam-splitting fast dipole DP-01
- Install Al, dual-port thin vacuum chamber
- Install BTF-1 line in **final position**
- Install PADME experiment
- Beam commissioning
- Start **PADME experiment run-1**

Next steps



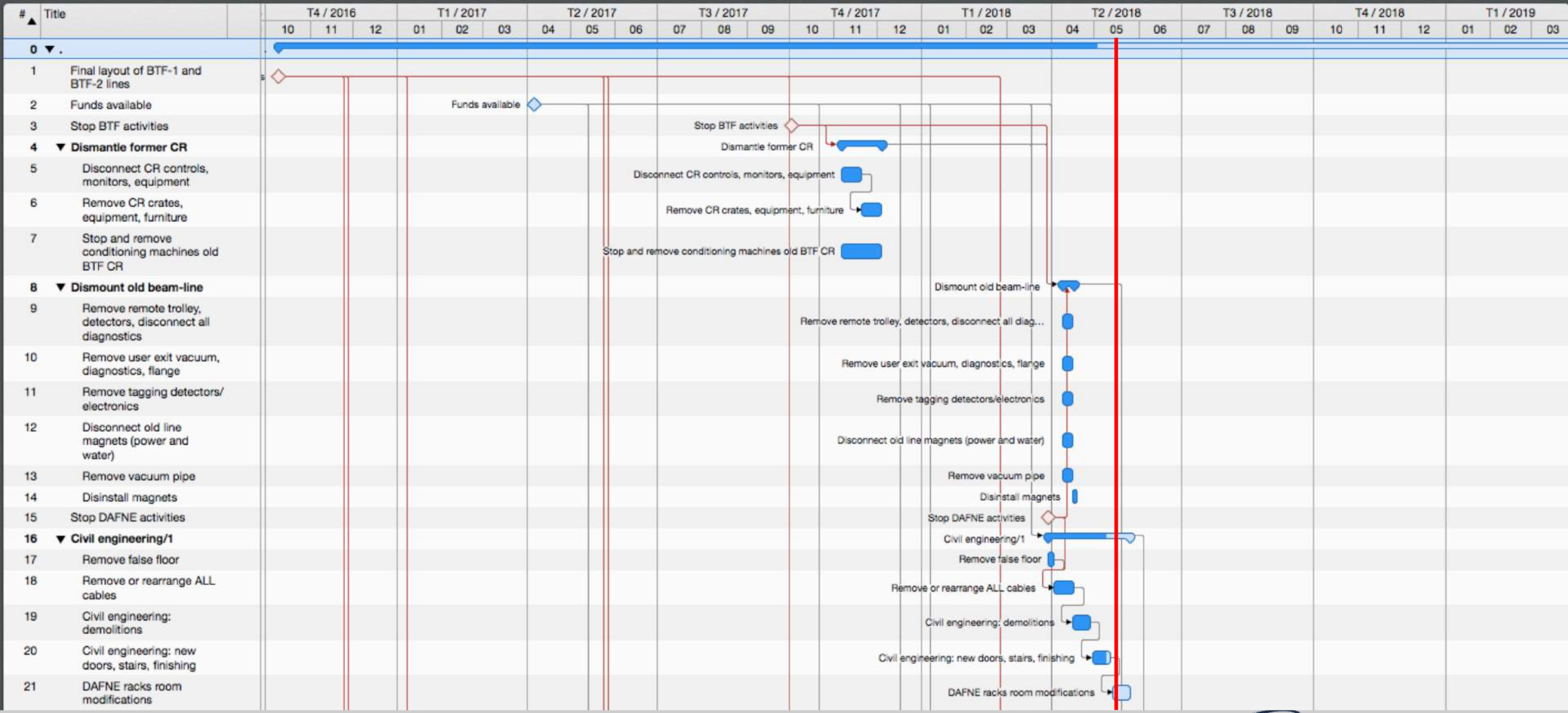
By June 2018

- Install beam-splitting fast dipole DP-01
- Install Al, dual-port thin vacuum chamber
- Install BTF-1 line in **final position**
- Install PADME experiment
- Beam commissioning
- Start **PADME experiment run-1**

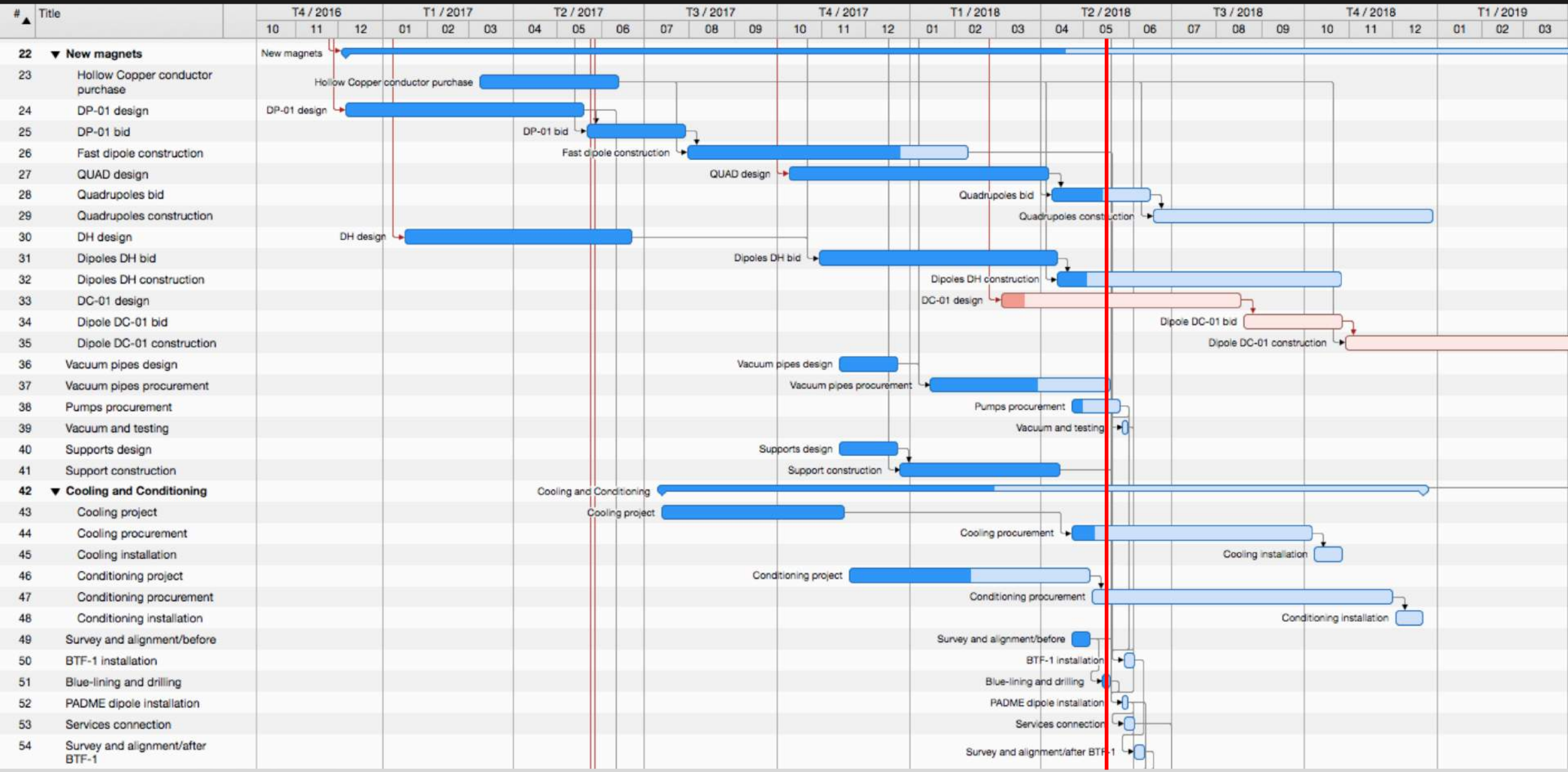
2019

- Install BTF-2 line
- Install photon tagging
- BTF-2 beam commissioning

Time plan/1


T4 / 2016
T1 / 2017
T2 / 2017
T3 / 2017
T4 / 2017
T1 / 2018
T2 / 2018
T3 / 2018
T4 / 2018
T1 / 2019
10 11 12 01 02 03 04 05 06 07 08 09 10 11 12 01 02 03 04 05 06 07 08 09 10 11 12 01 02 03
0 .
1 Final layout of BTF-1 and BTF-2 lines
2 Funds available
3 Stop BTF activities
4 Dismantle former CR
5 Disconnect CR controls, monitors, equipment
6 Remove CR crates, equipment, furniture
7 Stop and remove conditioning machines old BTF CR
8 Dismount old beam-line
9 Remove remote trolley, detectors, disconnect all diagnostics
10 Remove user exit vacuum, diagnostics, flange
11 Remove tagging detectors/ electronics
12 Disconnect old line magnets (power and water)
13 Remove vacuum pipe
14 Disinstall magnets
15 Stop DAFNE activities
16 Civil engineering/1
17 Remove false floor
18 Remove or rearrange ALL cables
19 Civil engineering: demolitions
20 Civil engineering: new doors, stairs, finishing
21 DAFNE racks room modifications
Funds available
Stop BTF activities
Dismantle former CR
Disconnect CR controls, monitors, equipment
Remove CR crates, equipment, furniture
Stop and remove conditioning machines old BTF CR
Dismount old beam-line
Remove remote trolley, detectors, disconnect all diag...
Remove user exit vacuum, diagnostics, flange
Remove tagging detectors/electronics
Disconnect old line magnets (power and water)
Remove vacuum pipe
Disinstall magnets
Stop DAFNE activities
Civil engineering/1
Remove false floor
Remove or rearrange ALL cables
Civil engineering: demolitions
Civil engineering: new doors, stairs, finishing
DAFNE racks room modifications

Time plan/2


T4 / 2016
T1 / 2017
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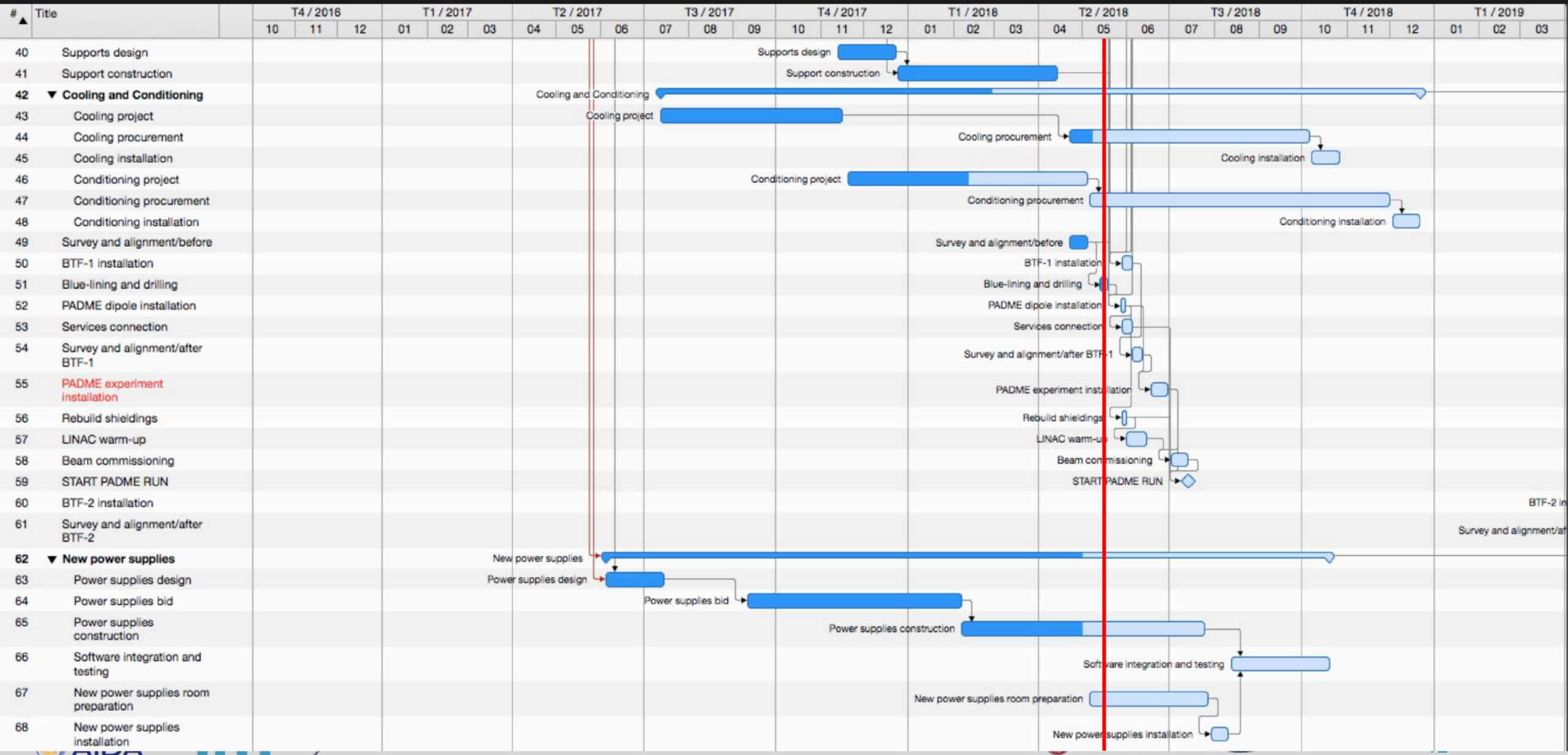
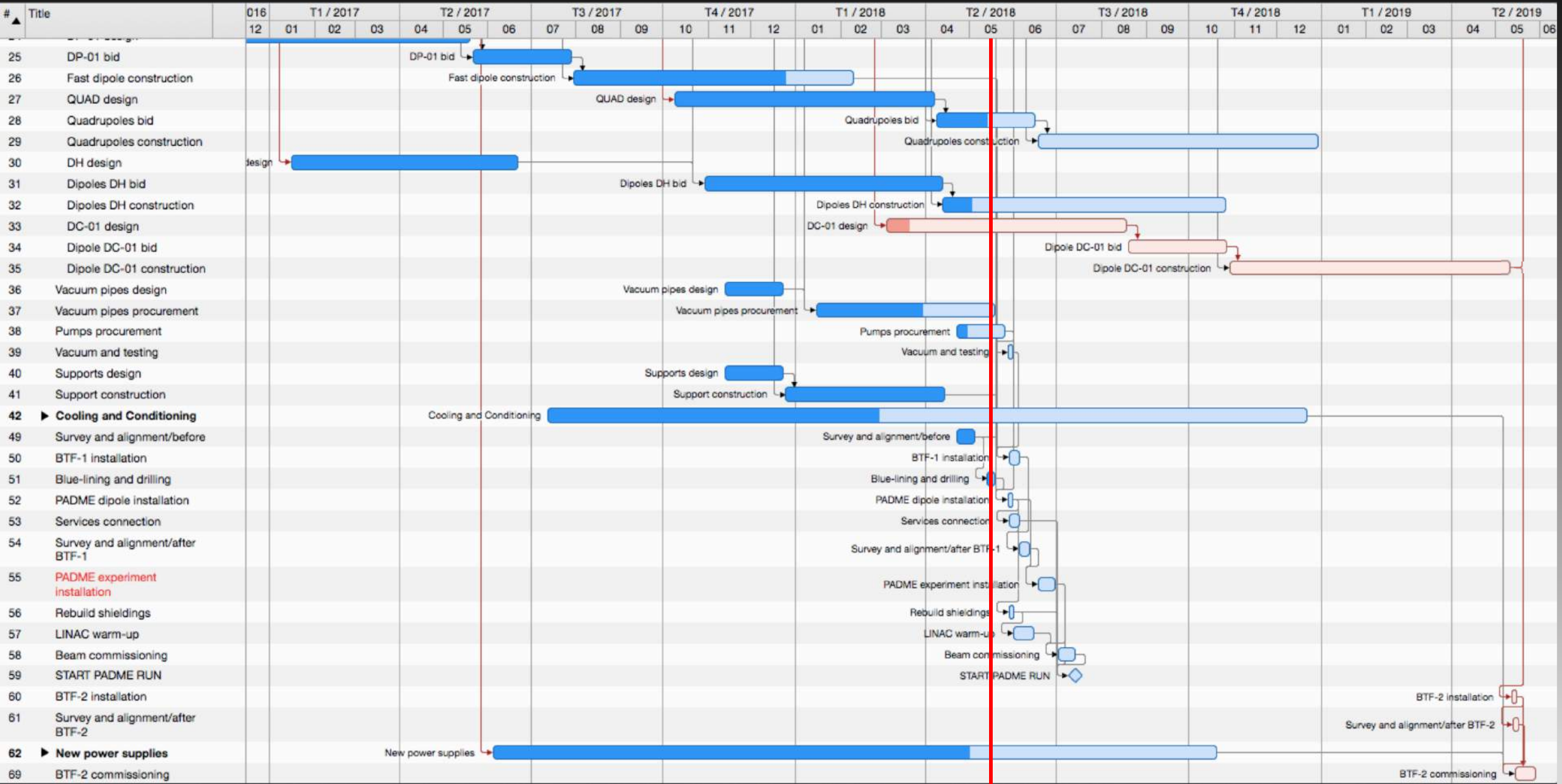
T3 / 2017
T4 / 2017
T1 / 2018
T2 / 2018
T3 / 2018
T4 / 2018
T1 / 2019
10 11 12 01 02 03 04 05 06 07 08 09 10 11 12 01 02 03 04 05 06 07 08 09 10 11 12 01 02 03
22 New magnets
23 Hollow Copper conductor purchase
24 DP-01 design
25 DP-01 bid
26 Fast dipole construction
27 QUAD design
28 Quadrupoles bid
29 Quadrupoles construction
30 DH design
31 Dipoles DH bid
32 Dipoles DH construction
33 DC-01 design
34 Dipole DC-01 bid
35 Dipole DC-01 construction
36 Vacuum pipes design
37 Vacuum pipes procurement
38 Pumps procurement
39 Vacuum and testing
40 Supports design
41 Support construction
42 Cooling and Conditioning
43 Cooling project
44 Cooling procurement
45 Cooling installation
46 Conditioning project
47 Conditioning procurement
48 Conditioning installation
49 Survey and alignment/before
50 BTF-1 installation
51 Blue-lining and drilling
52 PADME dipole installation
53 Services connection
54 Survey and alignment/after BTF-1

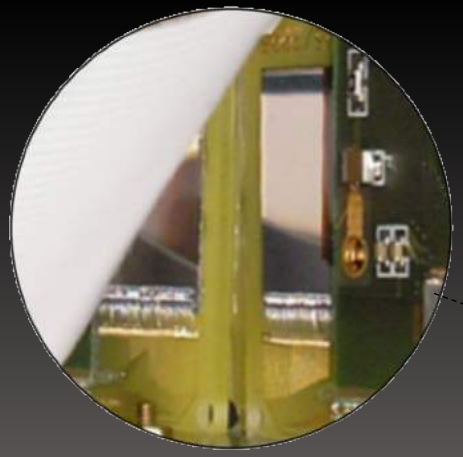
Time plan/3

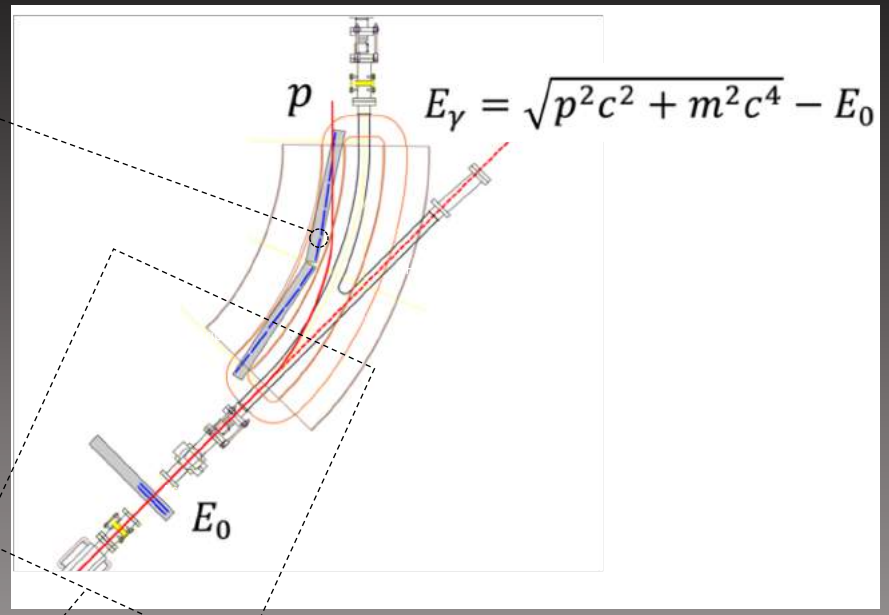

T4 / 2016
T1 / 2017
T2 / 2017
T3 / 2017
T4 / 2017
T1 / 2018
T2 / 2018
T3 / 2018
T4 / 2018
T1 / 2019
10 11 12 01 02 03 04 05 06 07 08 09 10 11 12 01 02 03 04 05 06 07 08 09 10 11 12 01 02 03
40 Supports design
41 Support construction
42 Cooling and Conditioning
43 Cooling project
44 Cooling procurement
45 Cooling installation
46 Conditioning project
47 Conditioning procurement
48 Conditioning installation
49 Survey and alignment/before
50 BTF-1 installation
51 Blue-lining and drilling
52 PADME dipole installation
53 Services connection
54 Survey and alignment/after BTF-1
55 PADME experiment installation
56 Rebuild shieldings
57 LINAC warm-up
58 Beam commissioning
59 START PADME RUN
60 BTF-2 installation
61 Survey and alignment/after BTF-2
62 New power supplies
63 Power supplies design
64 Power supplies bid
65 Power supplies construction
66 Software integration and testing
67 New power supplies room preparation
68 New power supplies installation
Supports design
Support construction
Cooling and Conditioning
Cooling project
Cooling procurement
Cooling installation
Conditioning project
Conditioning procurement
Conditioning installation
Survey and alignment/before
BTF-1 installation
Blue-lining and drilling
PADME dipole installation
Services connection
Survey and alignment/after BTF-1
PADME experiment installation
Rebuild shieldings
LINAC warm-up
Beam commissioning
START PADME RUN
New power supplies
Power supplies design
Power supplies bid
Power supplies construction
Software integration and testing
New power supplies room preparation
New power supplies installation

Time plan/4


#
Title
016
T1 / 2017
T2 / 2017
T3 / 2017
T4 / 2017
T1 / 2018
T2 / 2018
T3 / 2018
T4 / 2018
T1 / 2019
T2 / 2019
25 DP-01 bid
26 Fast dipole construction
27 QUAD design
28 Quadrupoles bid
29 Quadrupoles construction
30 DH design
31 Dipoles DH bid
32 Dipoles DH construction
33 DC-01 design
34 Dipole DC-01 bid
35 Dipole DC-01 construction
36 Vacuum pipes design
37 Vacuum pipes procurement
38 Pumps procurement
39 Vacuum and testing
40 Supports design
41 Support construction
42 Cooling and Conditioning
49 Survey and alignment/before
50 BTF-1 installation
51 Blue-lining and drilling
52 PADME dipole installation
53 Services connection
54 Survey and alignment/after BTF-1
55 PADME experiment installation
56 Rebuild shieldings
57 LINAC warm-up
58 Beam commissioning
59 START PADME RUN
60 BTF-2 installation
61 Survey and alignment/after BTF-2
62 New power supplies
69 BTF-2 commissioning

Photon tagging



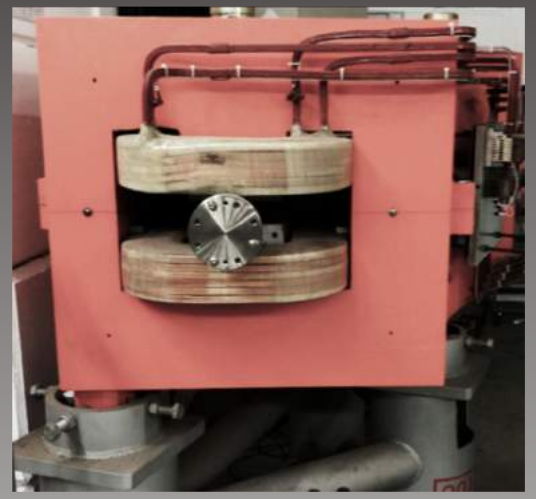


2005: designed and built in collaboration with the AGILE team, with the main purpose of the scientific payload calibration: Silicon trackers + calorimeter

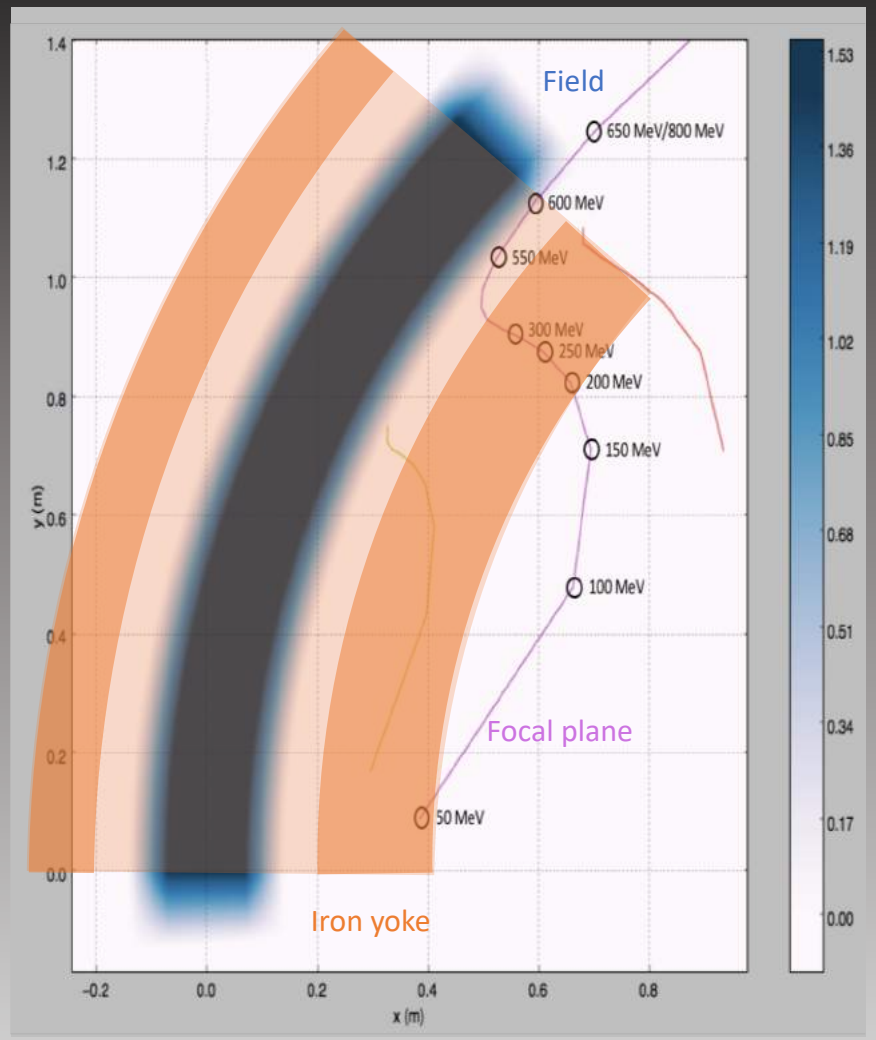
Issues with this configuration:

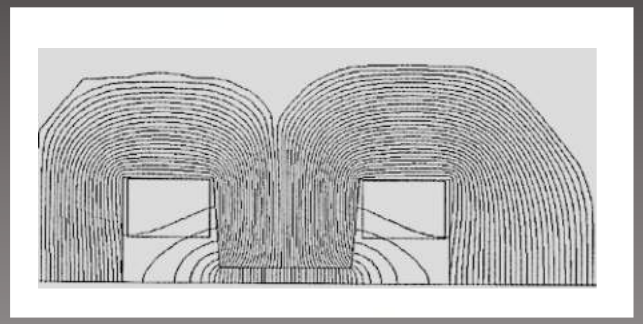
- **Low rate**
  - Due to limitations of **multiplexer** and custom-made DAQ boards
  - Need to select single tracks
- **Spurious events**
  - Scattered electrons hitting tagging modules from behind
  - Showering electrons due to grazing angles
- **Dead channels**
  - Many custom modules with **obsolescent** components
  - Some broken microstrip modules

Photon tagging

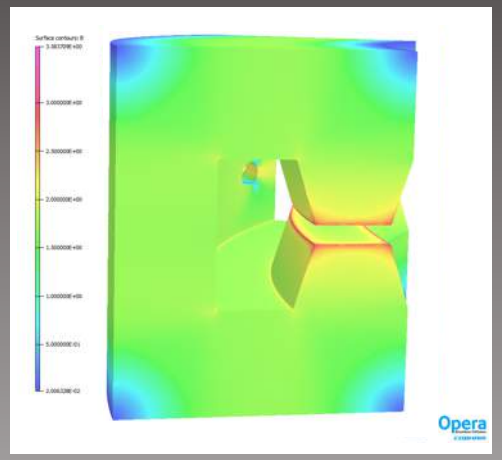


45 degrees, H-shape

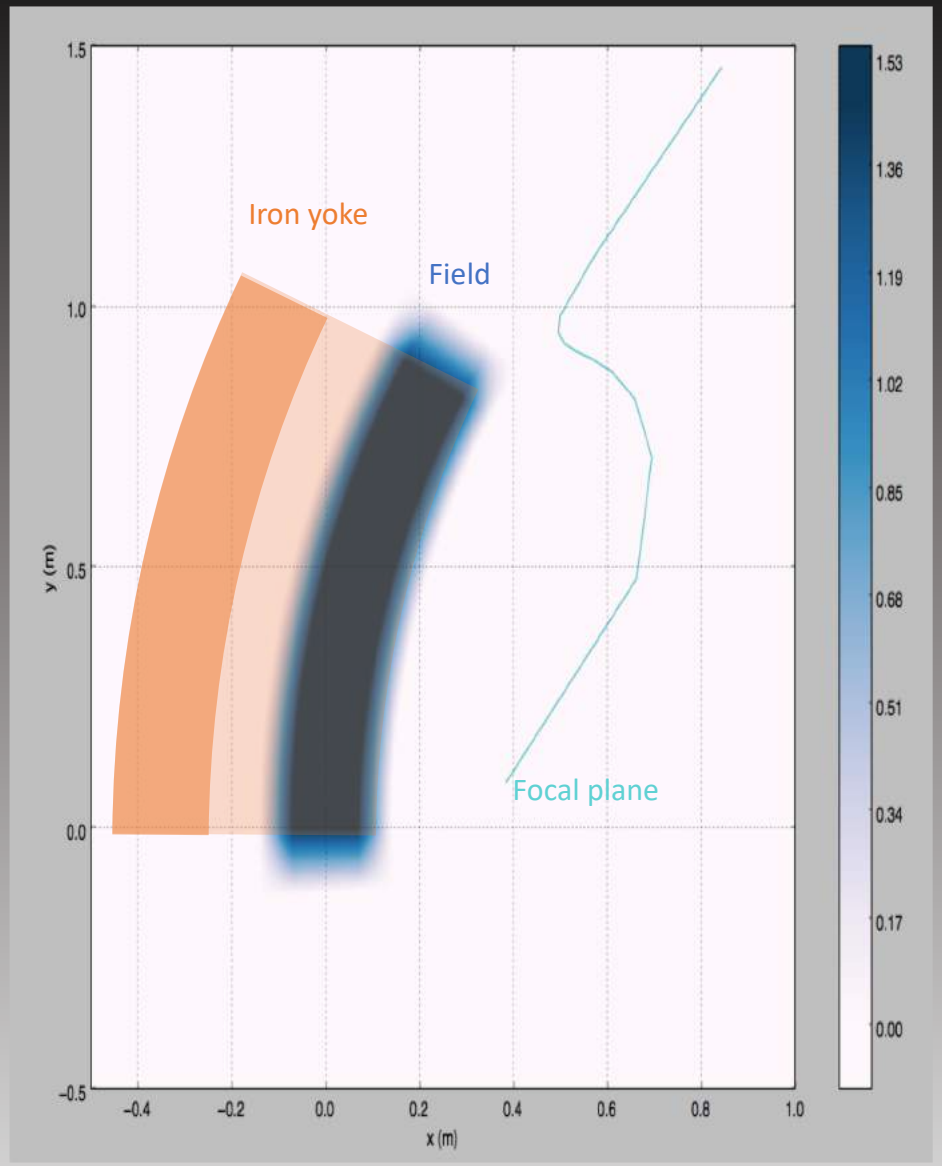


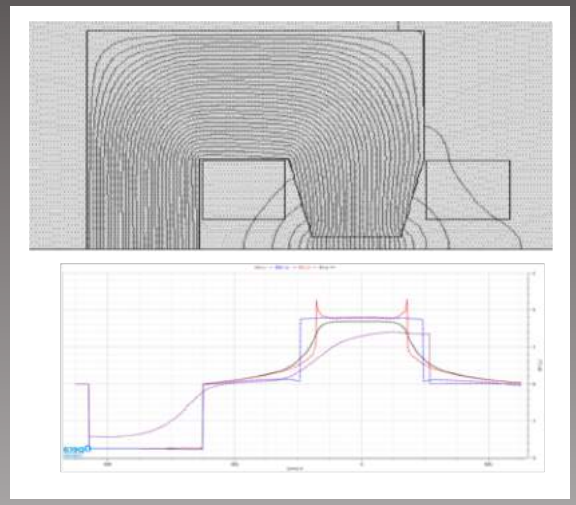


Photon tagging



30 degrees, C-shape

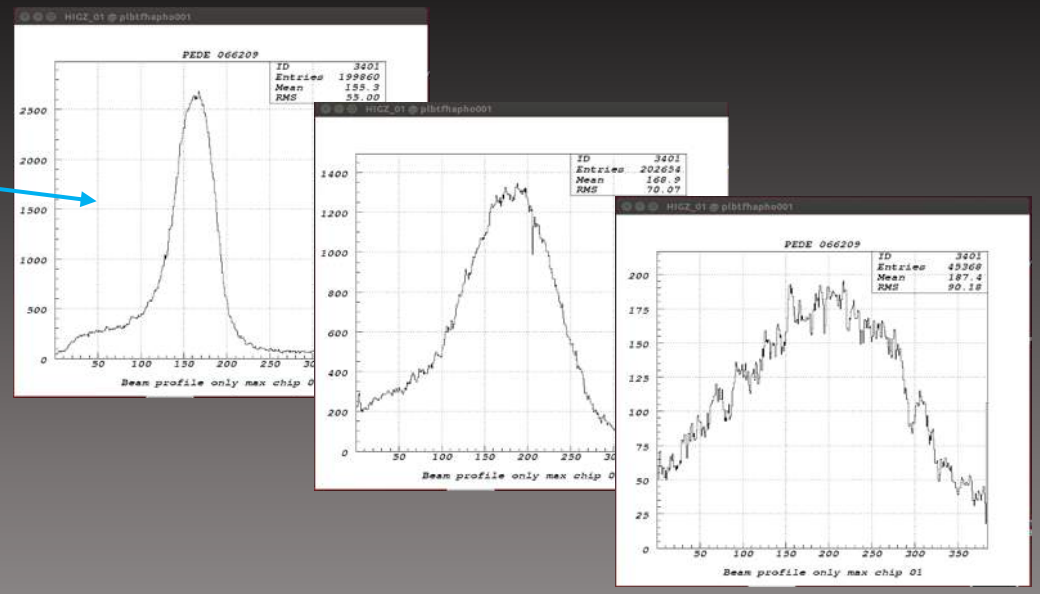




Hardware improvements

Intermediate step:

- Single SSD hybrid test stand
- SSD tested directly with beam in the DHSTB-02 inner arc
- Good status of most TAA1 chips
- 50 Hz trigger rate



Essentially fully functional but:

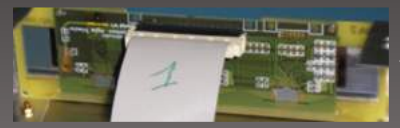
- No auto-triggering feature
- No hardware zero suppression
- No SSD hybrid multiplexing

Strong collaboration with Michela Prest and Erik Vallazza, Università Insubria, Como and INFN Trieste

Hardware improvements

- New FPGA logic board with an upgraded DC-DC converter (± 7,5V) to drive longer hybrid strip bus cables
- New FPGA board hosts logics for multiplexing 6× (3× each TAA1 ASIC), for an overall 2304 channels (serial)
- New analog and digital data bus layout
- Zero suppression can be implemented
- Self-triggering implemented

6×



Firmware and software improvements

- New firmware in the ADC board (VME Cyclone Board) implemented for reading 2034 strips digitized data in DMA VME cycle.
- A daughter board in VME Cyclone has been implemented to read and implement TAA1 self-triggering
- New firmware release in the 12 bit ADC board for digitizing up to 2304 TAA1 channels
- New DAQ and data analysis software has been implemented and successfully tested

System is ready for installation

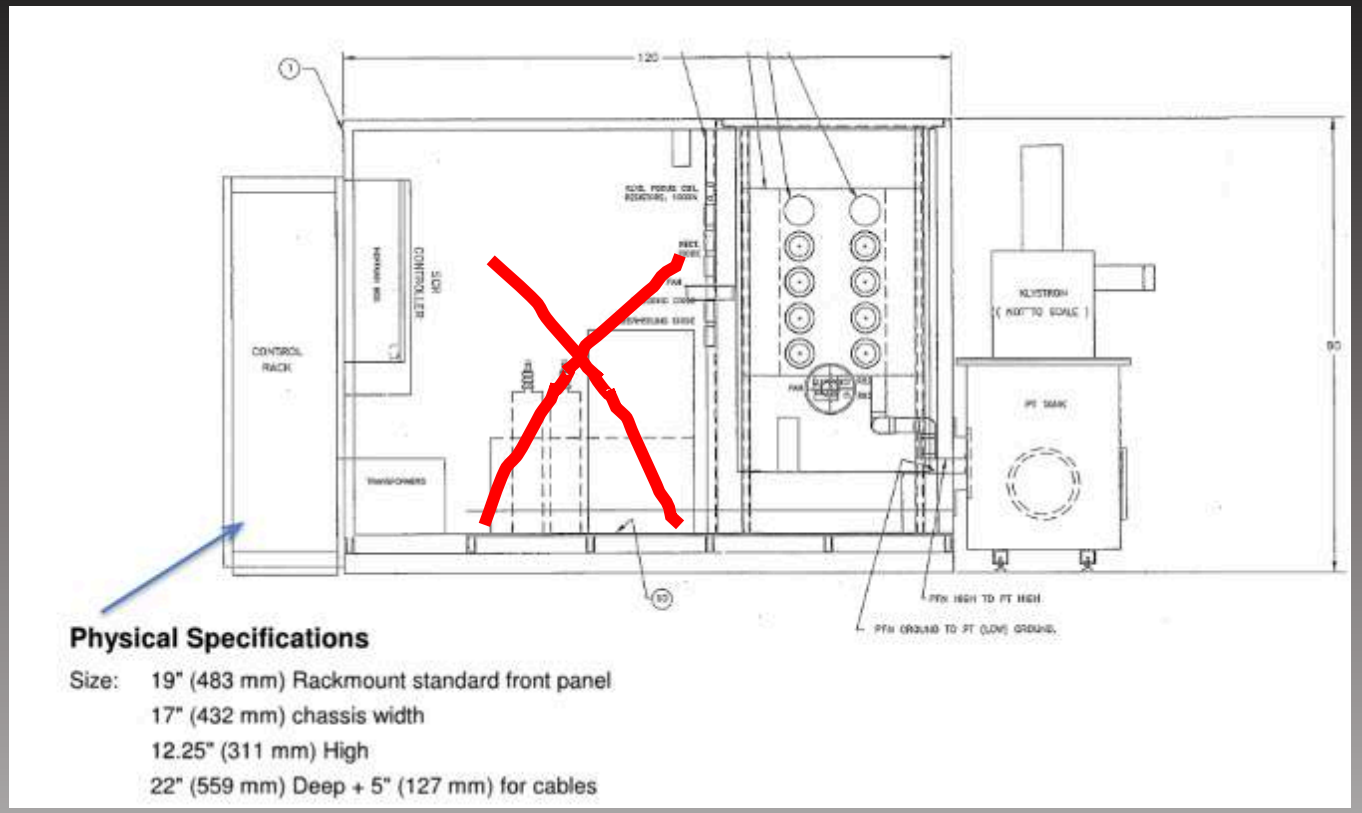
Linac consolidation

2 m of concrete

Modulator gallery

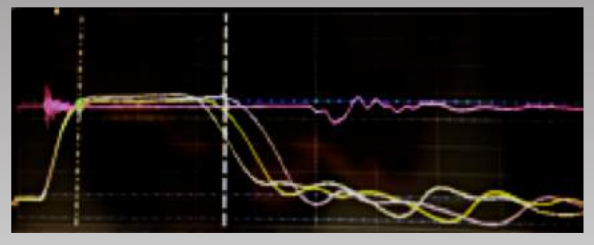
Linac tunnel

- PFN charging circuit: replace SCR system with solid state power supplies

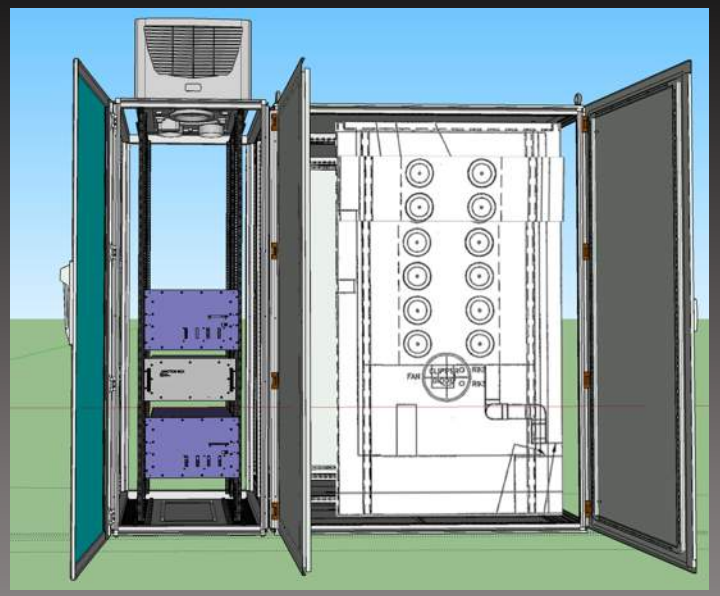


Physical Specifications

Size: 19" (483 mm) Rackmount standard front panel
17" (432 mm) chassis width
12.25" (311 mm) High
22" (559 mm) Deep + 5" (127 mm) for cables



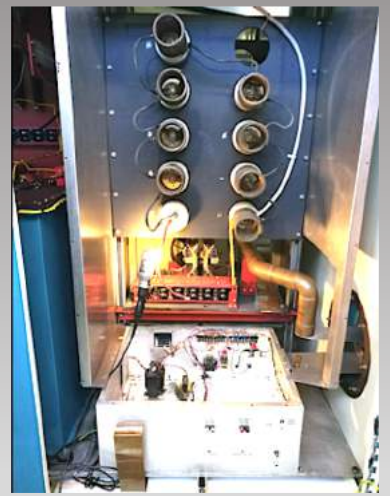
Linac consolidation: modulator renewal



New power suppies rack

Pulse Forming Network (PFN)

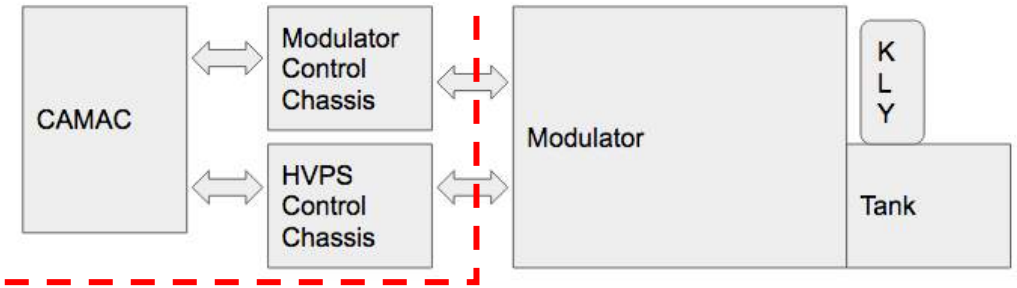
- Bid assigned (TDK), two pieces already delivered
- New PS in the new cooled rack now under test



- New tanks, new rack and many other components for RF test station delivered

Linac consolidation: modulator renewal

- **New control** and **interlock** system
  - Profit of new HV power supplies
  - Increase reliability and performance
  - Design **done**, using modern **modular electronics**
  - First unit **purchased**, currently under test
  - Software development **in progress**



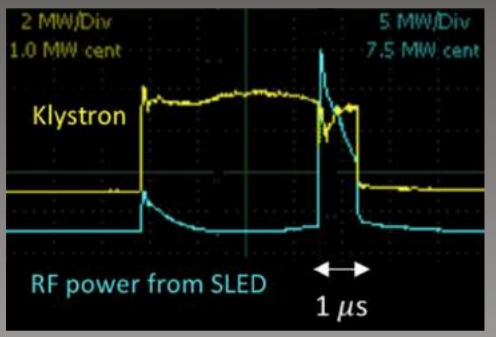
Replace with
Compact-RIO + PXI

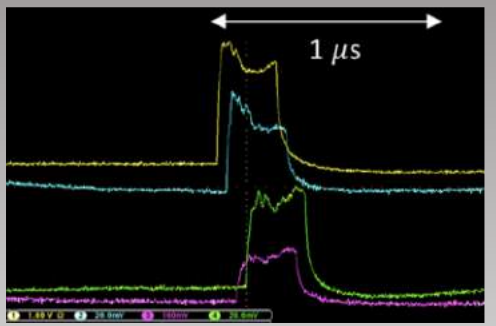
Linac getting ready for PADME

- **Maintenance** after KLOE-2 run: **done**
- New HV power supplies being tested on **modulator D** (already equipped with new, 15:1 pulse transformer)
  - All other development activities on the test modulator being installed as 5th RF station in the hall
  - Transparent to Linac operations
- Linac getting ready to restart in **mid June** for **warm-up** and **beam commissioning** for the PADME run

Beam configuration for **PADME**:

- Positron beam: explore the <u>two possibilities</u>:
  - Production at the linac **converter** and then accelerate with high-energy sections: higher intensity, lower maximum energy, **lower background** in BTF
  - Produce at the **BTF target**, from highest possible energy electron beam : higher maximum energy, lower maximum intensity and probably **higher background** in BTF hall
- Longest possible pulse: at least **100 ns**
  - Pulse length for DAΦNE injections: <13 ns (damping ring RF: 74 MHz)
- Tunable intensity: **10^4-10^5 positrons/pulse**
- **Energy:** at least **550 MeV**
  - Also 250 and 300 MeV needed: above and below m_X~17 MeV, the ^{8}Be boson





Conclusions/1

Minimize impact

General principles of the BTF upgrade:

- Stop LINAC and BTF activities for the **shortest possible time**
  - As much as possible testing offline
- **No impact** on physics experiments: KLOE-2, PADME and Siddhartha-2
  - Preserve the DAΦNE racks room
  - Delayed infrastructural work until the KLOE-2 experiment end, on **Mar. 30th, 2018**, and enable PADME restart for **beginning of July**.

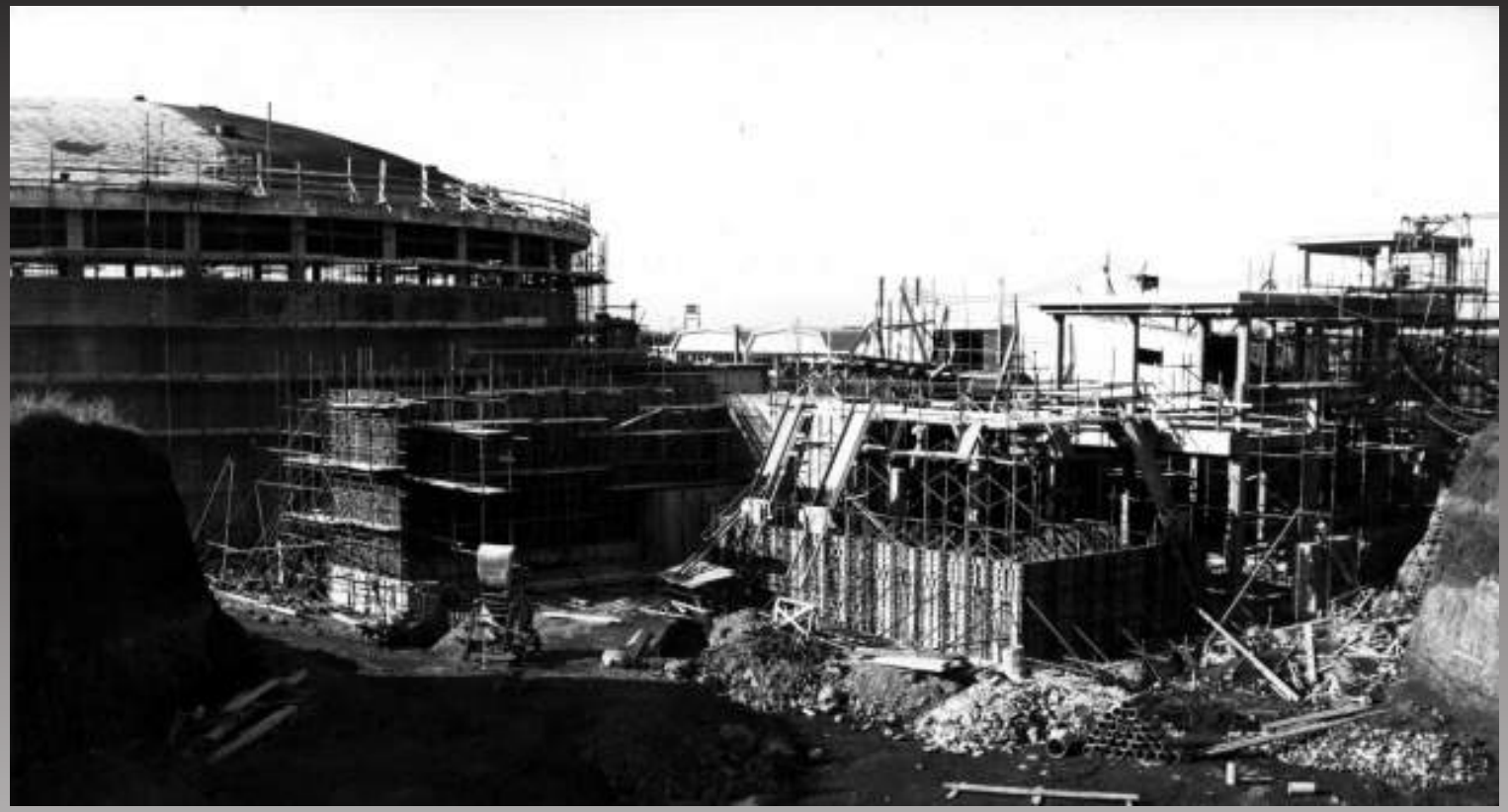
In addition we tried to:

- **Enable Italian SMEs** to bid for new components (magnets, vacuum, mechanics…)
  - Implied that full magnetic calculation, thermo-hydraulic and detailed mechanical design (for construction) performed by LNF, as well as quality tests and final magnetic measurements
  - The same applied to vacuum components, supports, diagnostics, accessories…

Conclusions/2

- **Linac consolidation** activities on-schedule
  - Hardware procurement essentially completed
  - Issue: the same team (basically) working on the operations and on the upgrade
- **Beam-line doubling** suffered significant delays but
  - Bidding practically complete
  - Infrastructural work resumed after some difficulties:
    - Civil engineering essentially completed (apart from bunker construction)
    - Projects for second line plants (cooling, conditioning …) under way
  - BTF-1 line rebuilding ongoing, resuming for the PADME run
  - Install BTF-2 line in the next winter shutdown

Do not stop in midstream



Construction of the pion hall (later BTF), 1966