BTF status and upgrade

BTF staff & upgrade team

BTF scientific staff

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

§post-doc AIDA-2020

LINAC technical staff

Maurizio Belli, Riccardo Ceccarelli, Alberto Cecchinelli, Renato Clementi, Graziano Piermarini, Serena Strabioli, Luis Antonio Rossi, Raffaele Zarlenga

BTF administration staff

Francesca Casarin, Maria Rita Ferrazza, Manuela Giabbai

Upgrade extended team

Bruno Bolli, Sergio Cantarella, Oreste Cerafogli, Adolfo Esposito, Oscar Frasciello, Andrea Ghigo, Simona Incremona, Franco Iungo, Roberto Mascio, Stefano Martelli, Lucia Sabbatini, Franco Sardone, Giancarlo Sensolini, Ruggero Ricci, Ugo Rotundo, Eleuterio Spiriti, Angelo Stella

*INFN Laboratori Nazionali di Frascati and *INFN Roma*

BTF 2015

- Start of activities delayed: from Jan. to **Mar.** and from Sep. to **Oct.** for BTF improvements (shielding, upgrade of control system, new control room)
- **175 beam-days overall**

Completely dismantled experimental hall (Summer 2015)

Legenda
Requested
Approved - **Main User**
Approved - *Co-user*
CANCELLED

Start	End	User	Group Leader	Rollin/out (h)	beam (days)	dose	Min. Energy	Max. Energy	Particle	Min. Mult.	Max. Mult.	Info	Priority
2015-03-09	2015-03-23	BTF-CHAOS	Luca Foggetta	6	14	0.0	500.0	500.0	Electron	1.0	1000.0	?CHAOS test with BEAM	Main user
2015-03-23	2015-03-30	MIMOSA	Spiriti Eleuterio	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	Dovendo ALICE valutare i risultati dei test in primavera si richiede il periodo possibilmente nella seconda meta di marzo.	Main user
2015-03-30	2015-04-06	BTFstaff	Paolo Valente	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	BTF test and maintenance	Main user
2015-04-06	2015-04-13	MU2E	Ivano Sarra	6	7	0.0	100.0	500.0	Electron	1.0	3.0	Test to be carried out before the Technology Review of the experiment that will be done at beginning of May 2015.	Main user
2015-04-13	2015-04-20	CRYSBEAM	G.Cavoto	6	7	0.0	500.0	500.0	Electron	1.0	1.e+4		Main user
2015-04-20	2015-04-27	3D-SOD	Leonello Servoli	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	The request is to test Silicon on Diamond detectors for MIP detection and grazing angle measurements.	Main user
2015-04-27	2015-05-04	BTFstaff	Paolo Valente	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	BTF test and maintenance	Main user
2015-05-04	2015-05-11	PADME	Mauro Raggi	6	7	0.0	500.0	500.0	Electron	1.0	1.e+5	Test of PADME calorimeter prototypes, LYSO and/or BGO Background measurements with thin scattering targets (e.g. 1 mm tungsten) in the range 10^3-10^5 particles/pulse	Main user
2015-05-11	2015-05-18	IMCP	Paolo Meridiani	6	7	0.0	500.0	500.0	Electron	1.0	100.0	.	Main user
2015-05-18	2015-05-25	PADME	Mauro Raggi	6	7	0.0	500.0	500.0	Electron	1.0	1.e+5	Test of PADME calorimeter prototypes, LYSO and/or BGO Background measurements with thin scattering targets (e.g. 1 mm tungsten) in the range 10^3-10^5 particles/pulse	Main user
2015-05-25	2015-06-01	MIMOSA	Spiriti Eleuterio	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	Final test before submission	Main user
2015-06-01	2015-06-08	PADME	Mauro Raggi	6	7	0.0	500.0	500.0	Electron	1.0	1.e+5	Test of PADME calorimeter prototypes, LYSO and/or BGO Background measurements with thin scattering targets (e.g. 1 mm tungsten) in the range 10^3-10^5 particles/pulse	Main user
2015-06-08	2015-06-15	BTFstaff	Paolo Valente	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	Plant maintenance	Main user
2015-06-15	2015-06-22	SIDDHARTA/AMADEU	Catalina Petrascu	6	7	0.0	500.0	500.0	Electron	1.0	1000.0		Main user
2015-06-22	2015-06-29	BTFstaff	Paolo Valente	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	Test dei rivelatori a Pixel da installare come tracciatore alla BTF. (Pixel Tracker)	Main user
2015-06-29	2015-07-06	TARI-54	S. Petrovic	6	7	0.0	50.0	500.0	Electron	1.0	1000.0	BTF GEM TPC and vacuum support required	Cancelled
2015-07-06	2015-07-13	JLAB12-Rome	Guido Maria Urciuoli	6	7	0.0	50.0	500.0	Electron	1.0	1000.0	The beam is requested to test silcon microstrip detectors to be installed as front part of the tracker of the SBS spectrometer to be installed in the experimental Hall A of JLab in Newport News, Virginia USA. The silicon microstrip detector construction i	Main user
2015-10-05	2015-10-12	CRYSBEAM	G.Cavoto	6	7	0.0	500.0	500.0	Electron	1.0	1.e+4		Main user
2015-10-12	2015-10-19	FIRB_CluCount	Francesco Renga	6	7	0.0	500.0	500.0	Electron	1.0	100.0	Calorimeter - High Voltage system - 2 gas lines (Helium - Isobutane)	Main user
2015-10-19	2015-11-02	EDIT2015	Ivano Sarra	6	14	0.0	500.0	500.0	Electron	1.0	1000.0	Per ora vorremmo solo riservare lo slot. Per le caratteristiche del fascio ed eventuali necessità integreremo la richiesta nel seguito	Main user
2015-11-02	2015-11-09	3D-SOD	Leonello Servoli	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	The request is to test Silicon on Diamond detectors for MIP detection and grazing angle measurements.	Cancelled
2015-11-09	2015-11-16	MONDO	Michela Marafini	40	7	2.0	500.0	500.0	Electron	1.0	10.0	HV, Gas System..	Main user
2015-11-16	2015-11-30	PADME	Mauro Raggi	6	14	0.0	500.0	500.0	Electron	1.0	1000.0	Test of PADME calorimeter prototypes together with a first spectrometer prototype 10^3-10^5 particles/pulse positron required (reduced to 2 weeks)	Main user
2015-11-30	2015-12-07	NEURAPID	Bedogni	3	7	0.0	500.0	500.0	Electron	1.0	1000.0	TESTING SP2 spectrometer with n@BTF target at 90° in high-intensity	Main user
2015-12-07	2015-12-14	ITS	Paolo Martinengo	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	In the framework of the upgrade of the ALICE experiment at LHC, the upgrade of the Inner Tracking System (ITS) plays a key role. The new ITS will consist of 7 layers of Monolithic Active Pixel Sensors. A second full scale (30mmx15mm) prototype has been	Main user
2015-12-14	2015-12-21	3D-SOD	Leonello Servoli	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	The request is to test Silicon on Diamond detectors for MIP detection and grazing angle measurements.	Main user

BTF 2016

- Not approved
- Cancelled/Maintenance

January-July:

- 2 development shifts
- 1 safety qualification stop
- 1 maintenance week
- 1 CHAOS-BTF joint shift
- **18 users slots**

Up to mid June:

- **≈160 users** (with double counting)

Jan / Feb / Mar / Apr / May / Jun / Jul

Start	End	User	Group Leader	Rollin/out (h)	beam (days)	dose	Min. Energy	Max. Energy	Particle	Min. Mult.	Max. Mult.	Info	Priority
2016-01-11	2016-01-25	BTF-CHAOS	Luca Foggetta	6	14	0.0	250.0	500.0	Electron	1.0	1000.0	Upgrade to CHAOS of BTF control system	Main user
2016-01-25	2016-02-01	BTFstaff	Paolo Valente	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	Plant maintenance	Main user
2016-02-01	2016-02-08	INSUB	Michela Prest	6	7	0.0	100.0	500.0	Electron	1.0	100.0	In collaborazione con l'Università dell'Insubria *RECUPERO*	Main user
2016-02-08	2016-02-15	ITS	Paolo Martinengo	6	7	0.0	500.0	500.0	Electron	1.0	1000.0		Main user
2016-02-15	2016-02-22	tof_diamonds	Roberto Cardarelli	6	7	0.0	500.0	750.0	Electron	1.0	1000.0		Main user
2016-02-22	2016-02-29	BTFstaff	Paolo Valente	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	BTF staff measurements	Main user
2016-02-29	2016-03-07	GMINUS2	Antonio Anastasi	6	7	0.0	300.0	500.0	Electron	1.0	1000.0		Main user
2016-03-01	2016-03-08	PADME	Mauro Raggi	6	7	0.0	100.0	600.0	Positron	1.0	1.e+4	Test of the PADME Ecal and target	Main user
2016-03-07	2016-03-14	MIMOSA	Spiriti Eleuterio	6	7	0.0	500.0	500.0	Electron	1.0	1.e+4	Si propone una misura di caratterizzazione del Timepix3 per applicazione in PADME cercando di risolvere la struttura temporale del bunch della BTF fino a 10e4 elettroni per bunch.	Main user
2016-03-07	2016-03-14	VIRHIS	Massimo Zambelli	6	7	0.0	27.0	27.0	Electron	1.0	1000.0		Main user
2016-03-14	2016-03-21	NRTUNRCA	Antonino Pietropaolo	8	7	0.0	500.0	500.0	Electron	1.0	1000.0		Main user
2016-03-21	2016-03-28	BTFstaff	Paolo Valente	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	BTF staff measurements at high intensity	Main user
2016-03-28	2016-04-04	CRYSBEAM	G.Cavoto	6	7	0.0	500.0	500.0	Electron	1.0	1.e+4	Diamond with Medipix readout	Main user
2016-04-04	2016-04-11	PADME	Mauro Raggi	6	7	0.0	100.0	600.0	Positron	1.0	1.e+4	Test of the PADME Ecal and target	Main user
2016-04-11	2016-04-18	MIMOSA	Spiriti Eleuterio	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	Test rivelatori a pixel monolitici per ALICE	Main user
2016-04-11	2016-04-18	NITEC	Elisabetta Baracchini	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	We are going to test the response, calibrate and characterize a small prototype TPC with 5 cm drift distance equipped with GEMPix readout with different gas mixtures at various pressure below 1 atm, both in conventional electron-carrier configuration and	Main user
2016-04-18	2016-04-25	BTFstaff	Paolo Valente	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	Safety qualification	Main user
2016-04-25	2016-05-02	LIMADOU	BRUNO SPATARO	8	7	10.0	25.0	120.0	Electron	1.0	1000.0	Dimensions of the HEPD calorimeter: 55 cm x 40 cm x 40 cm	Main user
2016-05-02	2016-05-09	mambo	Roberto Messi	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	test per il rivelatore MPRC	Main user
2016-05-09	2016-05-16	MONDO	Michela Marafini	25	7	0.0	50.0	500.0	Electron	1.0	100.0		Main user
2016-05-09	2016-05-16	VIRHIS	Massimo Zambelli	6	7	0.0	27.0	27.0	Electron	1.0	1000.0		Main user
2016-05-16	2016-05-23	3D-SOD	Leonello Servoli	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	Test of Silicon-On-Diamond devices.	Main user
2016-05-23	2016-05-30	BTFstaff	Paolo Valente	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	Maintenance	Main user
2016-05-30	2016-06-06	IMCP	Paolo Meridiani	6	7	50.0	500.0	500.0	Electron	1.0	100.0		Main user
2016-06-06	2016-06-13	FIRB_CluCount	Francesco Renga	6	7	50.0	500.0	500.0	Electron	1.0	1000.0		Main user
2016-06-13	2016-06-20	BTFstaff	Paolo Valente	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	Reserved	Main user
2016-06-20	2016-06-27	SIDDHARTA/AMADEU	Catalina Petrascu	6	7	0.0	500.0	500.0	Electron	1.0	1000.0		Main user
2016-06-27	2016-07-11	PADME	Mauro Raggi	6	14	0.0	100.0	600.0	Positron	1.0	1000.0	Test of the PADME target and ECAL	Main user
2016-07-04	2016-07-11	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 ***CANCELLED, to be rescheduled***	Main user
2016-07-11	2016-07-16	BTFstaff	Paolo Valente	6	5	0.0	500.0	500.0	Electron	1.0	1000.0	Reserved for BTF	Main user
2016-07-17	2016-09-11	BTFstaff	Paolo Valente	6	56	0.0	500.0	500.0	Electron	1.0	1000.0	Summer shutdown	Main user

BTF 2016

September-December:

- 2 pre-booked shifts
- 1 safety qualification week
- 1 development shift
- **18 weeks new requests**

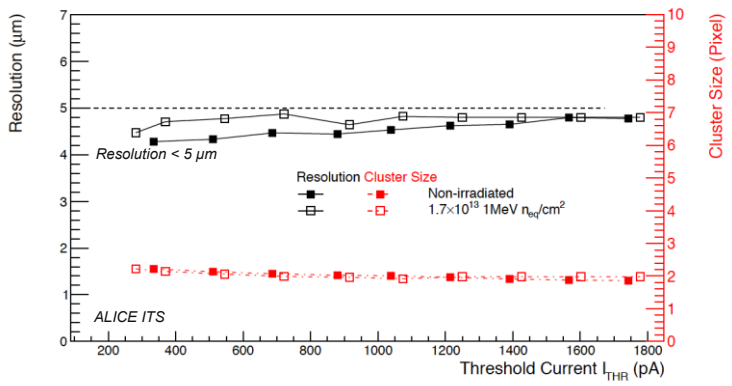
Start	End	User	Group Leader	Rollin/out (h)	beam (days)	dose	Min. Energy	Max. Energy	Particle	Min. Mult.	Max. Mult.	Info	Priority
2016-07-17	2016-09-11	**BTFstaff**	Paolo Valente	6	**56**	0.0	500.0	500.0	Electron	1.0	1000.0	Summer shutdown	**Main user**
2016-09-05	2016-09-12	**MEGII**	Paolo Walter Cattaneo	6	7	0.0	50.0	100.0	Electron	999.9	1.e+7		Main user
2016-09-06	2016-09-13	**CALOCUBE**	Oscar Adriani	6	7	999.9	200.0	500.0	Electron	1.0	1000.0	CALOCUBE can work also with positron in case of necessity We can perform our beam test also with different start period.	Main user
2016-09-09	2016-09-16	**3D-SOD**	Leonello Servoli	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	test of 3D diamond detectors.	Main user
2016-09-12	2016-09-19	**BTFstaff**	Paolo Valente	6	**7**	0.0	500.0	500.0	Electron	1.0	1000.0	Restart BTF and test	**Main user**
2016-10-01	2016-10-15	**PADME**	Mauro Raggi	6	**14**	0.0	100.0	500.0	Positron	1.0	1.e+4	Test of the PAMDE Ecal target and Vetos	Main user
2016-10-02	2016-10-09	**OptoTracker**	Andrea Celentano	6	7	0.0	500.0	500.0	Electron	1.0	1.0		Main user
2016-10-03	2016-10-10	**CRYSBEAM**	G.Cavoto	6	7	0.0	500.0	500.0	Electron	1.0	1.e+4	Test and calibration of new Cherenkov radiators	Main user
2016-10-03	2016-10-10	**IDF**	Paolo Valente	6	**7**	0.0	100.0	500.0	Electron	100.0	1000.0	Incontri di Fisica	**Main user**
2016-10-03	2016-10-10	**DCaNT**	G.Cavoto	6	7	0.0	100.0	500.0	Electron	100.0	1000.0		Main user
2016-10-09	2016-10-16	**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	Main user
2016-10-10	2016-10-17	**CMS-UP**	Livio Fano	6	7	0.0	500.0	500.0	Electron	1.0	1000.0		Main user
2016-10-10	2016-10-17	**JLAB12-Rome**	Guido Maria Urciuoli	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	The beam is requested to test silcon microstrip detectors to be installed as front part of the tracker of the SBS spectrometer to be installed in the experimental Hall A of JLab in Newport News, Virginia USA.	Main user
2016-10-10	2016-10-17	**QWLS**	Pasquale Lubrano	6	7	0.0	500.0	500.0	Electron	1.0	1000.0		Main user
2016-10-31	2016-11-07	**CESR-dark**	Jim Alexander	6	7	0.0	500.0	500.0	Electron	1.0	1000.0		Main user
2016-11-14	2016-11-21	**NITEC**	Elisabetta Baracchini	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	We are going to test the response, calibrate and characterize a full length TPC with 20 cm drift length equipped with GEMPix readout with different gas mixtures at various pressure below 1 atm, both in conventional electron-carrier configuration and ne	Main user
2016-11-28	2016-12-05	**MIMOSA**	Spiriti Eleuterio	6	7	0.0	500.0	500.0	Electron	1.0	1000.0	Test of a Plume ladder (about 12x2cm square double plane pixel tracker) and a Pegasus (pixel sensor for spectrometer application) prototype. For application in Hadrontherapy fragmentation measurements.	Main user
2016-11-28	2016-12-05	**FIRB_CluCount**	Francesco Renga	6	7	50.0	500.0	500.0	Electron	1.0	1000.0		Main user
2016-12-12	2016-12-19	**ITS**	Paolo Martinengo	1	7	0.0	500.0	500.0	Electron	1.0	1000.0		Main user
2016-12-12	2016-12-19	**DCaNT**	G.Cavoto	6	7	0.0	100.0	500.0	Electron	100.0	1000.0		Main user

- **Projected overall 2016: 40 requested/26 delivered**
- **≈240 beam-days**
- **150% request/delivered ratio**

Highlights 2016: ALICE ITS

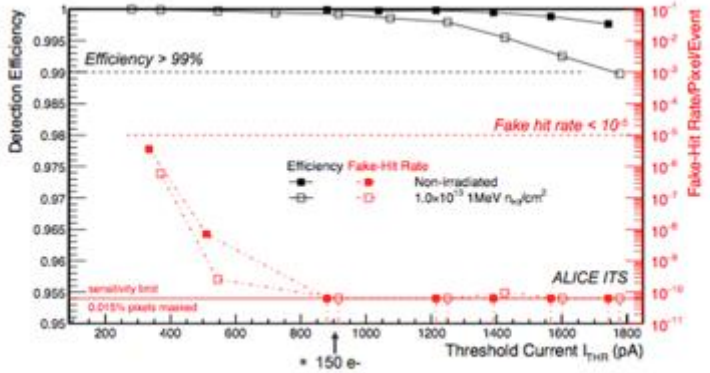
pALPIDE chip for ALICE ITS upgrade
complete characterization

ALPIDE2 testbeam measurement, 30 µm epitaxial layer, -6V back bias, before and after irradiation



- **Space point resolution <5 µm over wide threshold range**
- **Excellent performance also after irradiation to 1.7 x 10^{13} (1MeV n_{eq})/cm²**

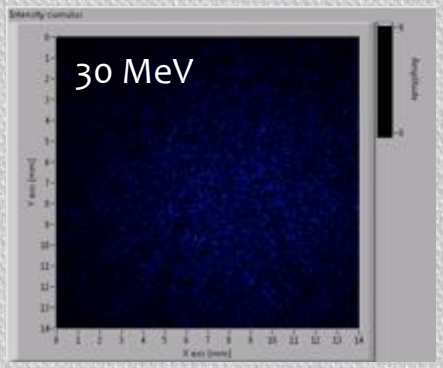
ALPIDE2 testbeam measurement, 25 µm epitaxial layer, -6V back bias, before and after irradiation

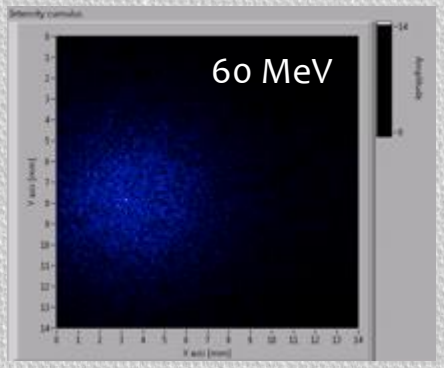


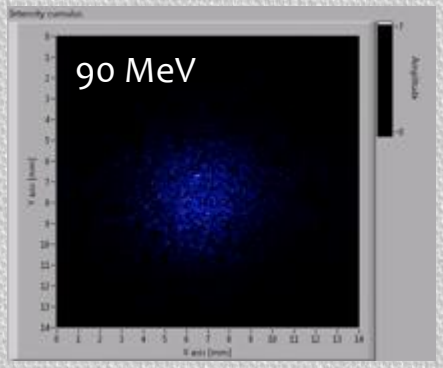
- **Efficiency > 99.5% and fake hit rate << 10^{5} over wide threshold range**
- **Excellent performance also after irradiation to 10^{13} (1MeV n_{eq})/cm²**

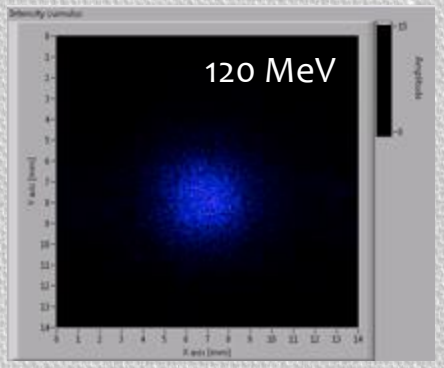
Highlights 2016: LIMADOU

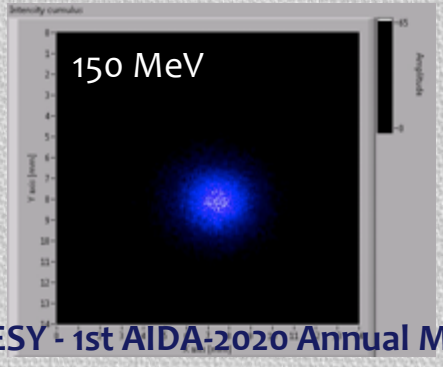
Test of High Energy Particle Detector (HEPD), for low energy electrons (3-100 MeV), protons (30-200 MeV) and light nuclei with high angular and energy resolution: LYSO calorimeter + Si micro-strip detectors

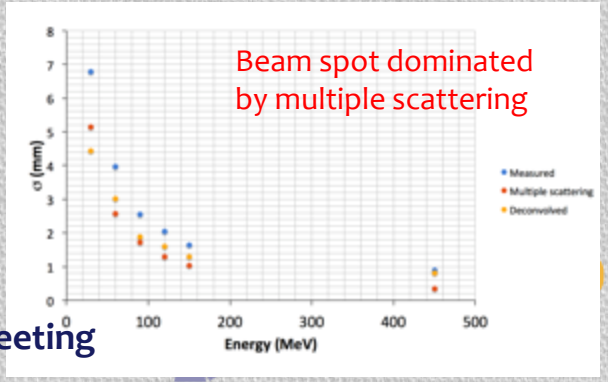






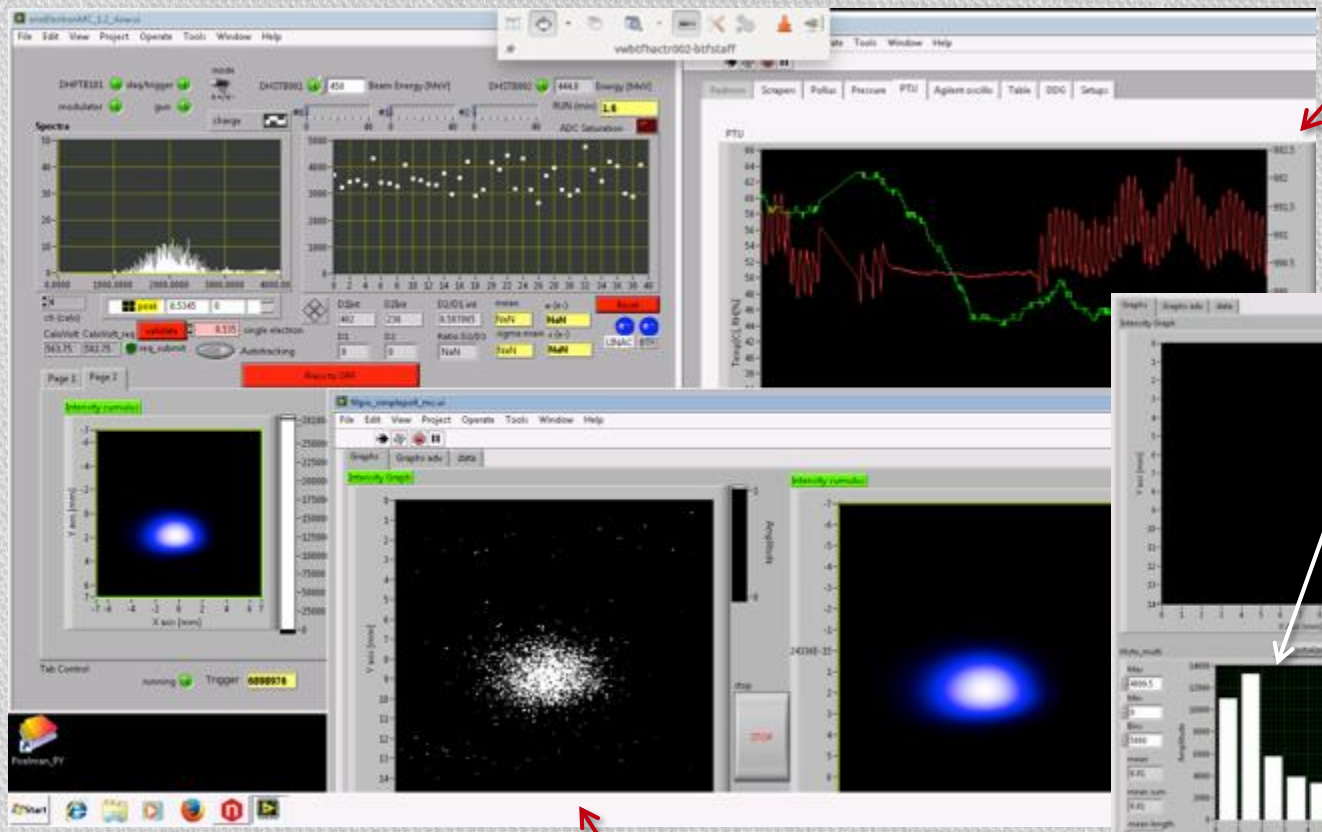




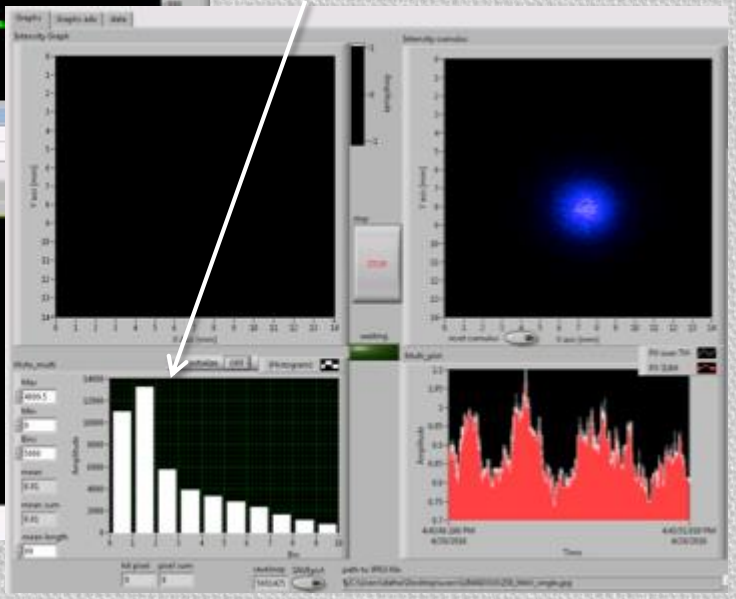


Highlights 2016: improved diagnostics

Calorimeter **automatic calibration & range adjustment**



Multiplicity distribution from FitPIX



FitPIX data **real-time retrieval** in Memcached distributed memory

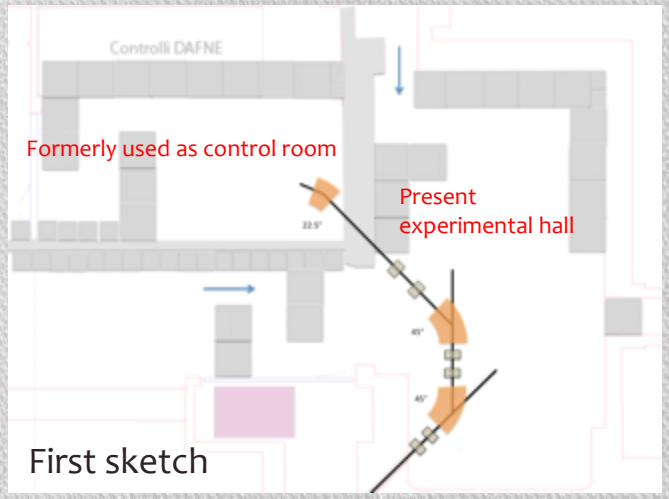
BTF upgrades Conceptual Design Report released

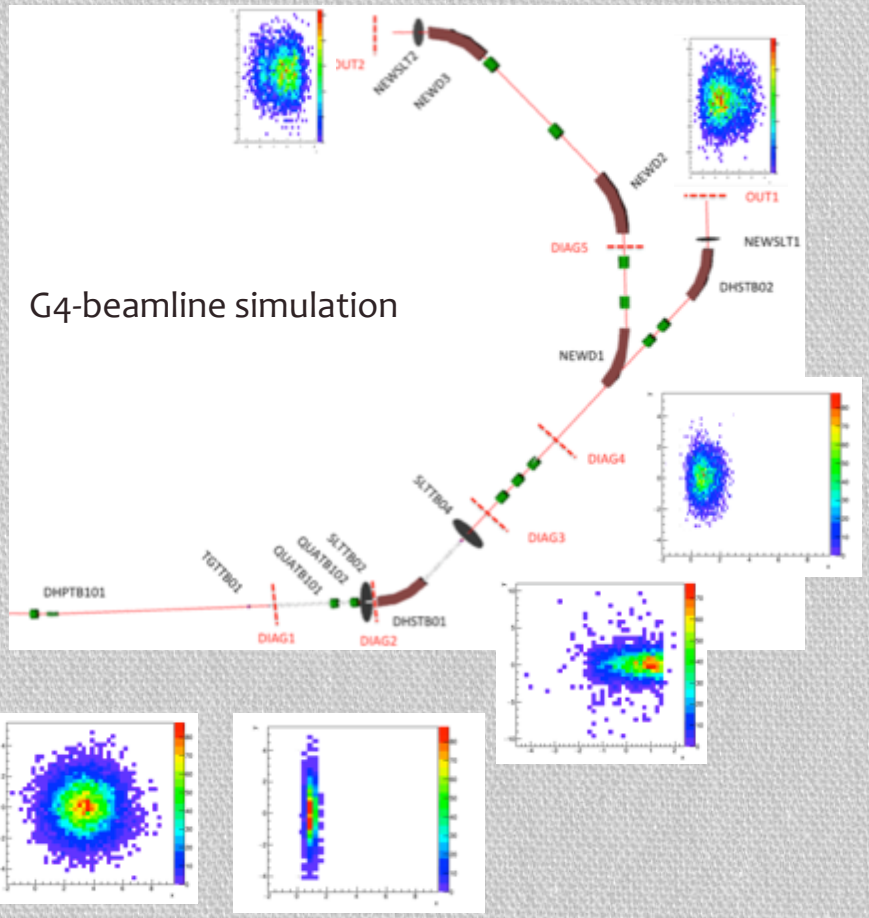
Linear Accelerator Test Facility

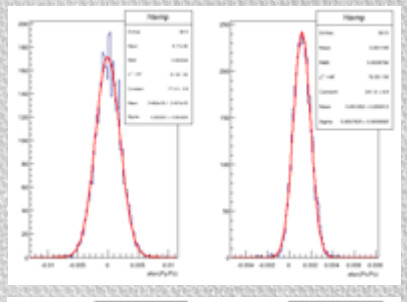
Conceptual Design Report

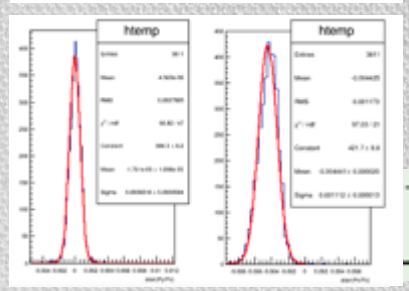
arXiv:1603.0565 [physics.acc- ph]

Second line: from idea to optics









- Beam quality in the new beam-lines
- A new control room needed…

Shielding and control room

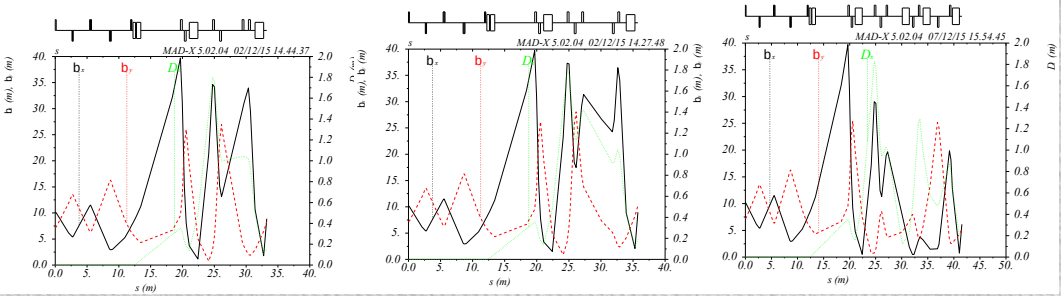
BEFORE

Formerly used as IP-2 (FINUDA) experiment control room

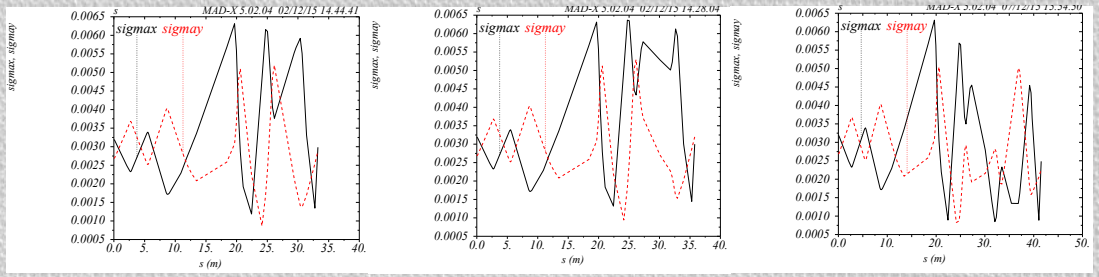
AFTER

Second line: from idea to optics

present BTF "BTF1" "BTF2"

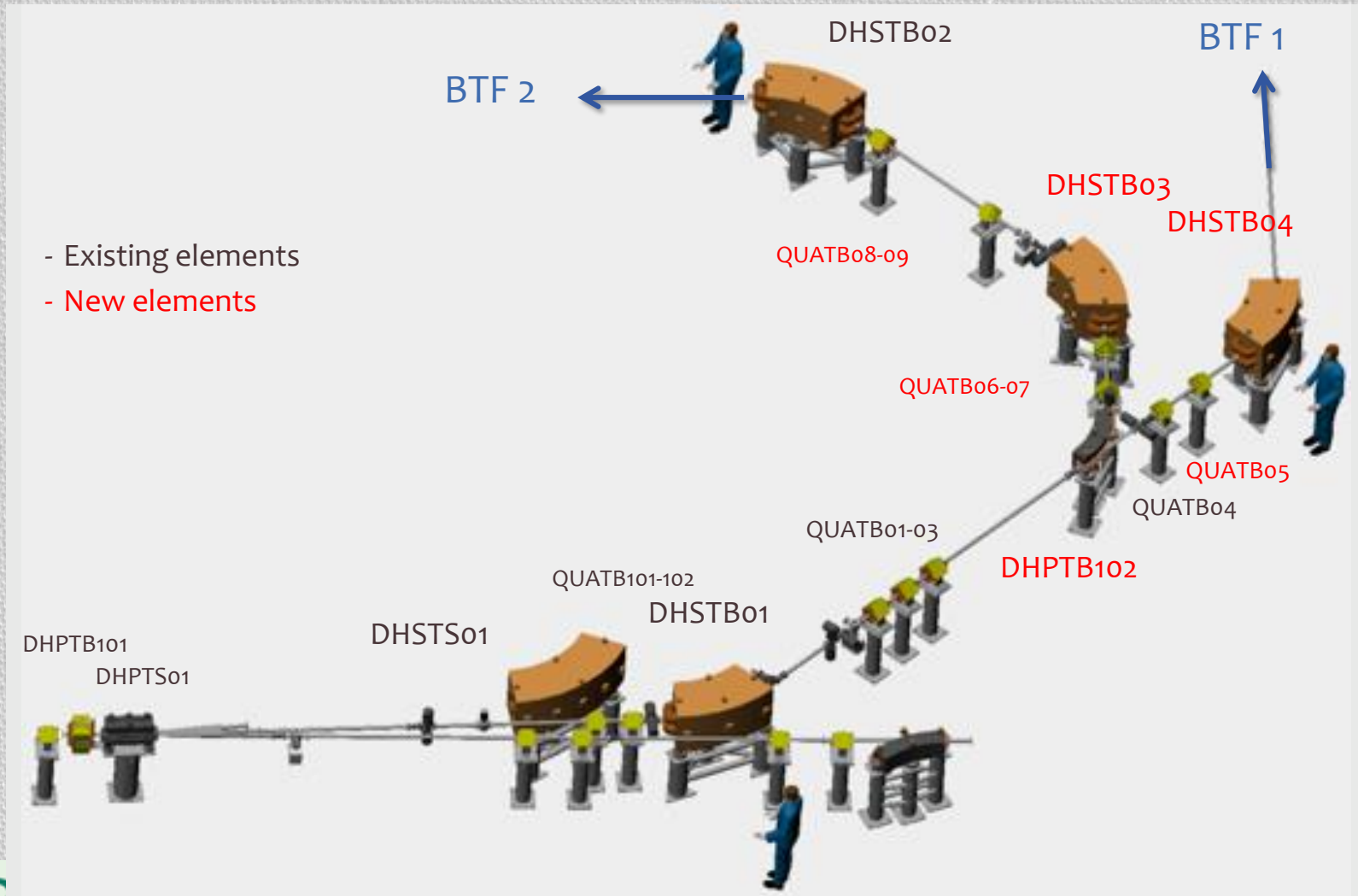


β function and dispersion

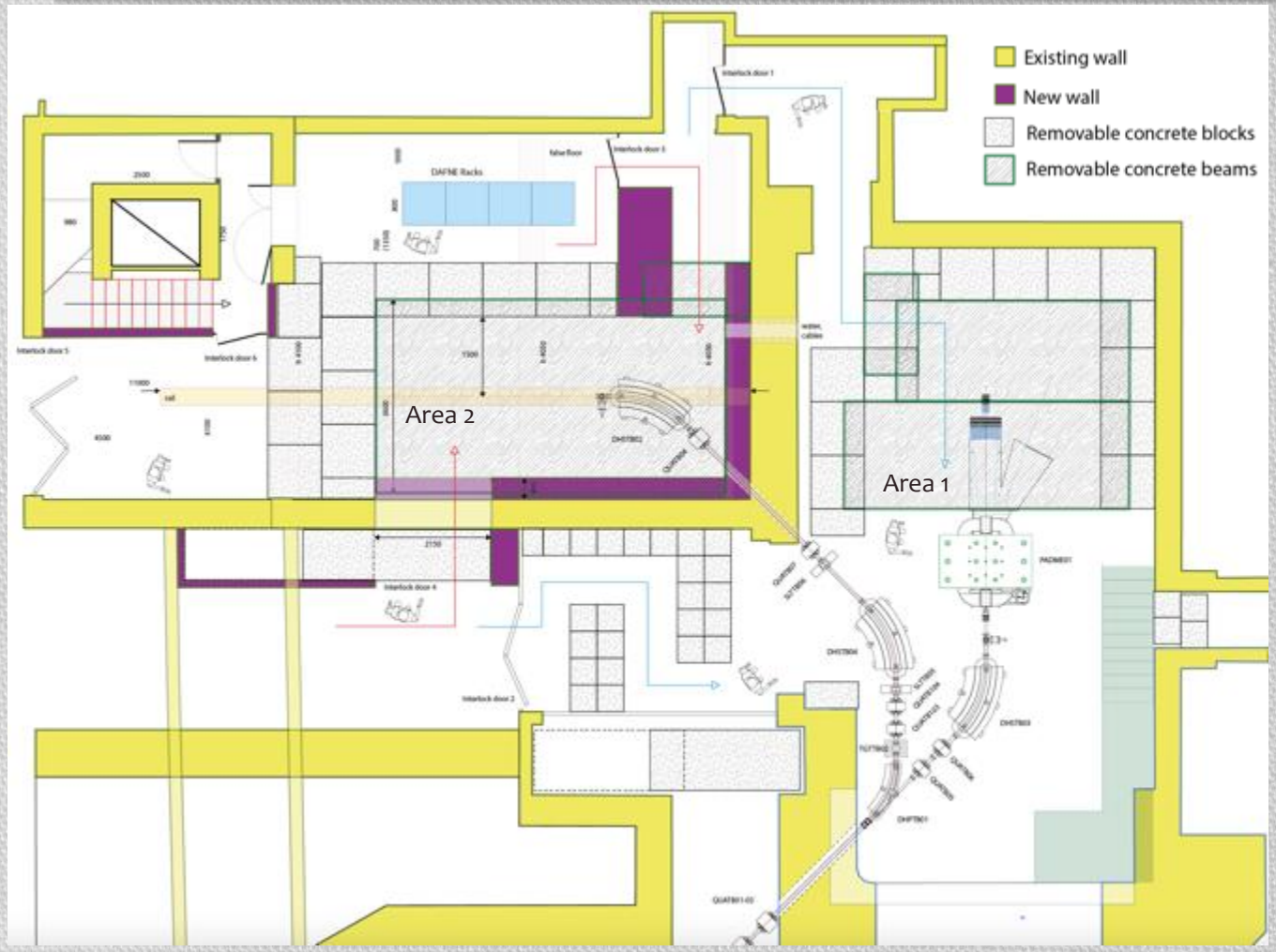


envelope (σ_x and σ_y)

Second beam-line: layout



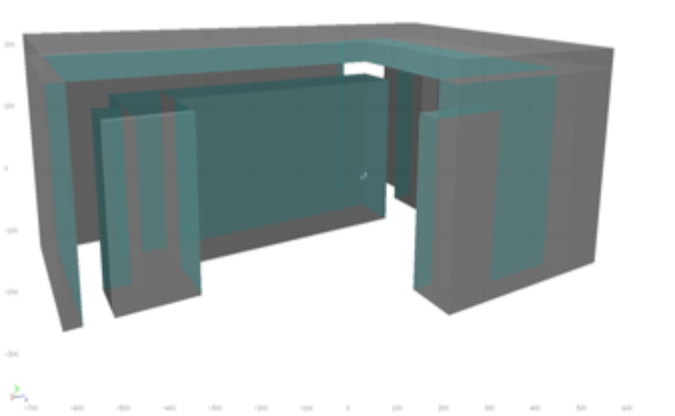
Second beam-line layout

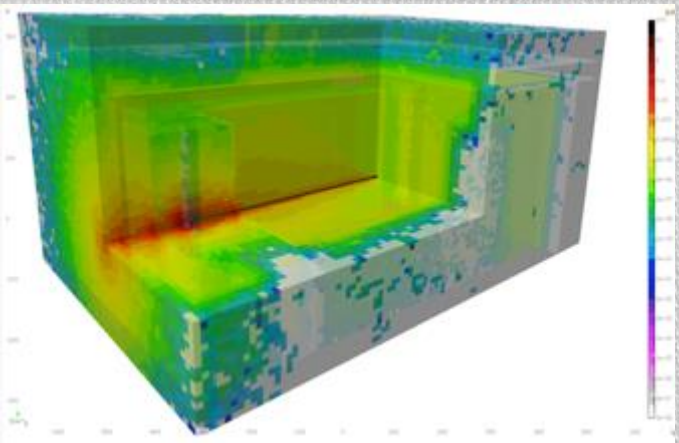


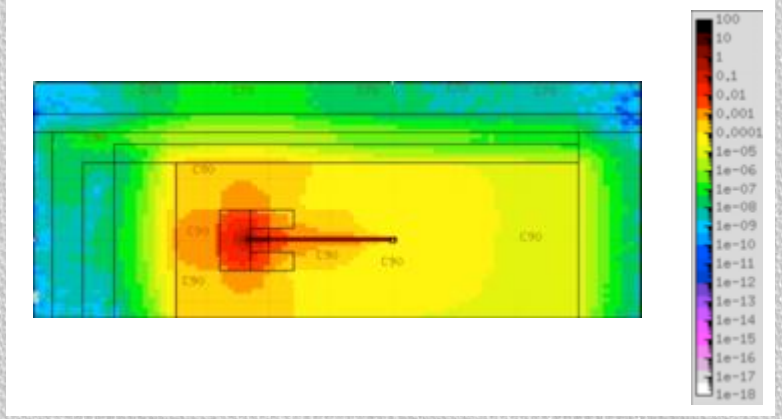
Very little or no impact on DAFNE collider operations:

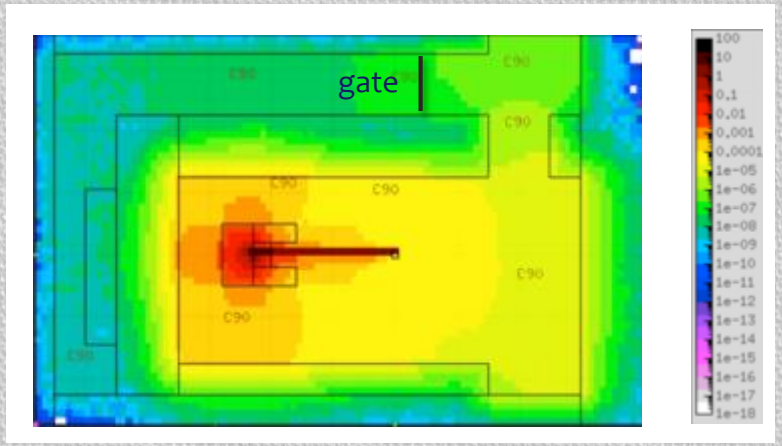
- DAFNE damping ring and timing racks stay untouched
- Minimal intervention in LINAC tunnel

Second beam-line: radiation studies









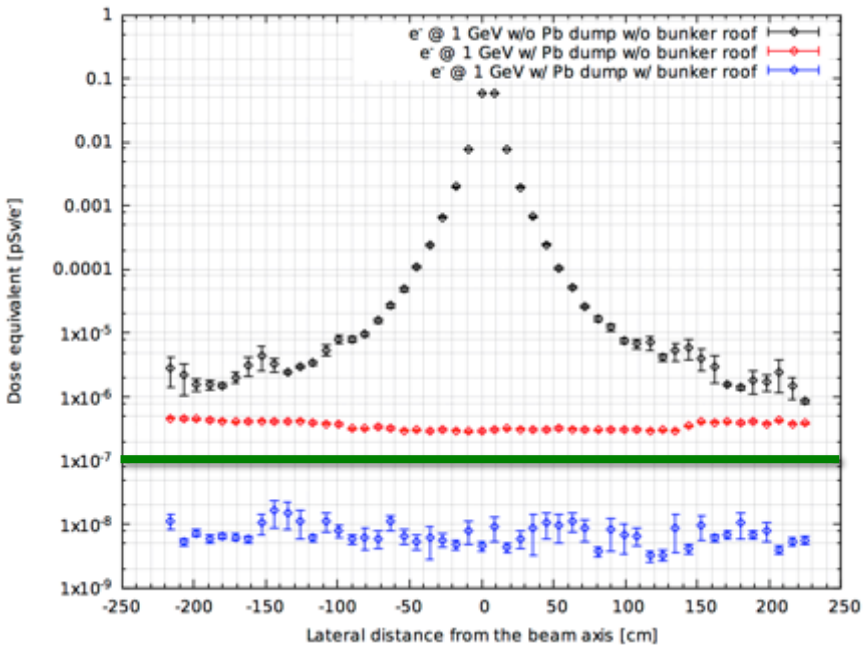
O. Frasciello

Add **beam-dump** and 30 cm concrete **roof**

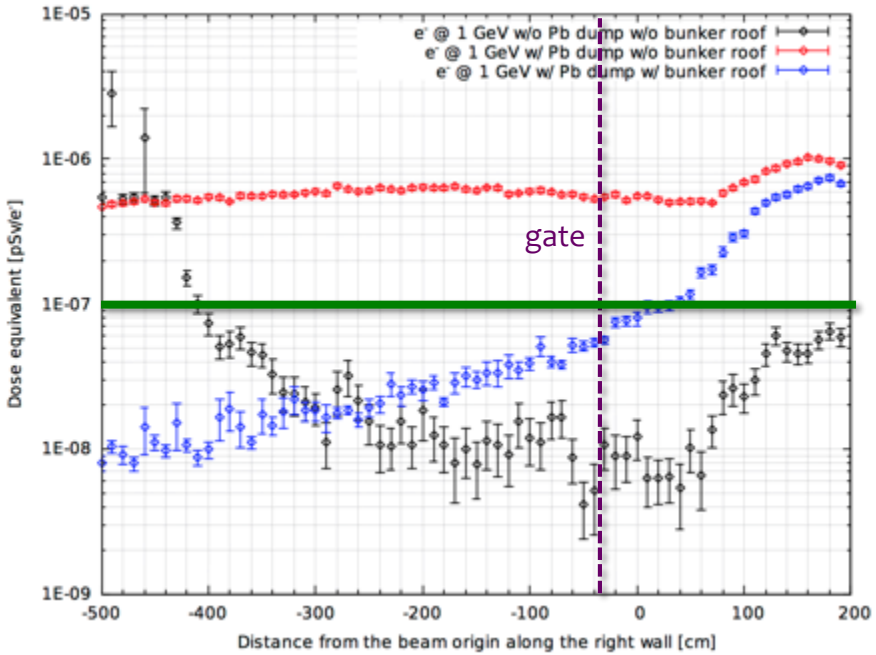
Second beam-line: radiation studies

10^{-7} pSv/e– correspond to 10 μSv/year at **10^5 e–/bunch × 50 Hz × $2 \cdot 10^7$ s**

Front



Side



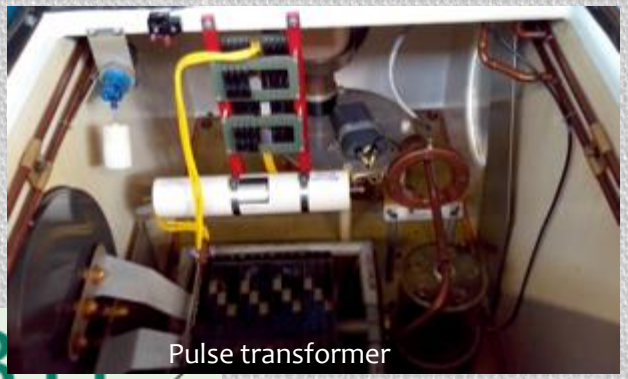
O. Frasciello

Upgrade(s): LINAC consolidation

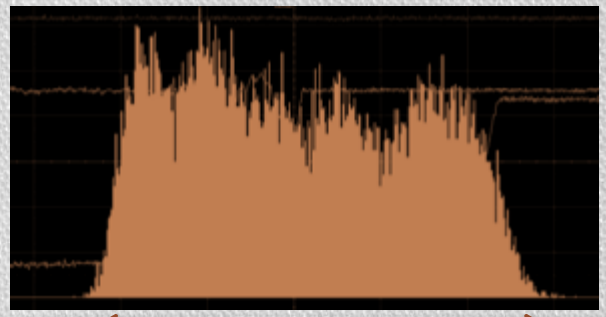
Aiming at general consolidation of the LINAC, in order to allow safe and efficient operations in the next 5-10 years, in **particular updating the RF power stations (modulators).**
More specifically:

- Upgrade of the PFN charge circuit with new generation HV PS
- New supplies for core bias & filament
- Replace (simplify and improve) the interlock system, now totally analogic (with some home-made components and frequent faults); new FPGA-based system, tailored to our modulator
- New signal readout and digital I/O, now on CAMAC bus
  - As a consequence, new control system
- Diagnostics upgrade: digitizer & DAQ for the BPM's
- Upgrade gun pulser
- Consolidations of thermalizing circuits

Interlocks and CAMAC readout

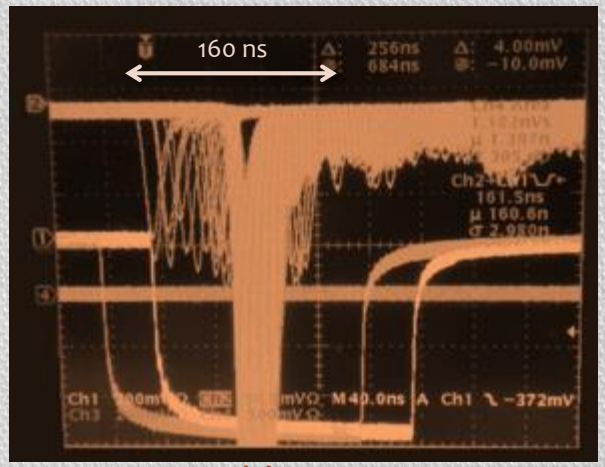


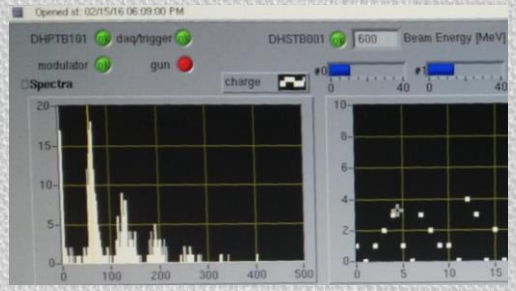
Upgrades(s): pulse width extension



10 ns pulse

- New pulser for LINAC gun ordered in 2015. Delivery due in May
- **Adds** to 1.5 – 40 ns (0.5 ns steps) the range **50-5000 ns** (50 ns steps)
- **Fully compatible with existing hardware** and only minor modifications to software
- Installation and tests by restart of the LINAC in **September**
- Crucial for PADME! **Luminosity increases linearly with pulse duration**, since it increases the number of positrons in the beam while keeping the pile-up probability in the detector constant



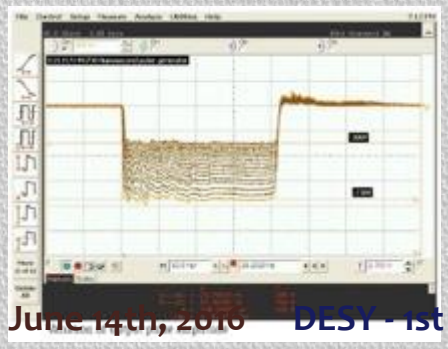


Electrons at nominal energy emitted from the gun without pulsing, detected in the BTF calorimeter

- Indication that phase differences among the four modulators allow accelerating with good energy spread in the **150-200 ns** range already in the present configuration, **without modifying** the RF system.
- In addition, with **multiple phase inversions** of PSK, it should be possible to **further extend** the pulse

New electron gun pulser specs

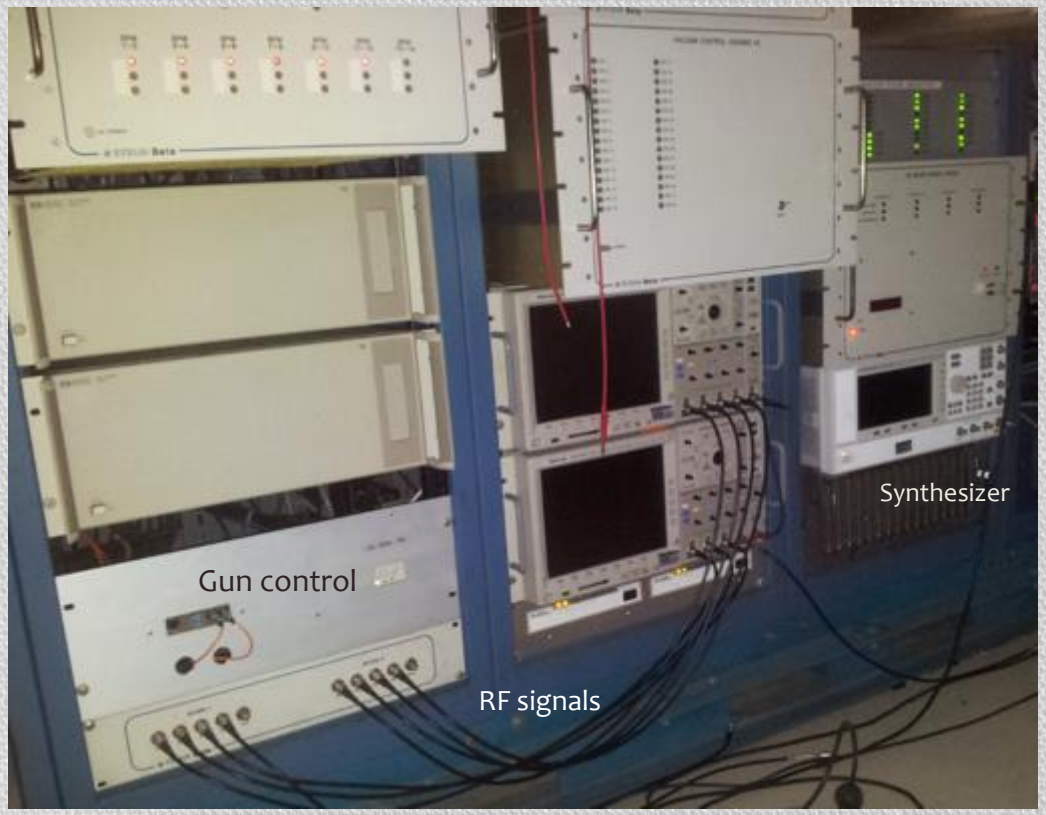
Kentech Special Pulser	
Amplitude	from -300 to -1000V in steps of 50V
Pulse shape	Rectangular
Pulse width	1.5ns to 5 µsecs, FWHM
Rise time	<1ns (both modes)
Fall time	<1.5ns for PW <=45ns (short pulse mode) 8ns for PW >45ns (long pulse mode)
Maximum rep rate	>= 50Hz
Start jitter	20ps rms
PW jitter	20ps rms for PW <=45ns 500ps for PW > 45ns
Flatness	+/-10%
Post pulse noise	+/-10%

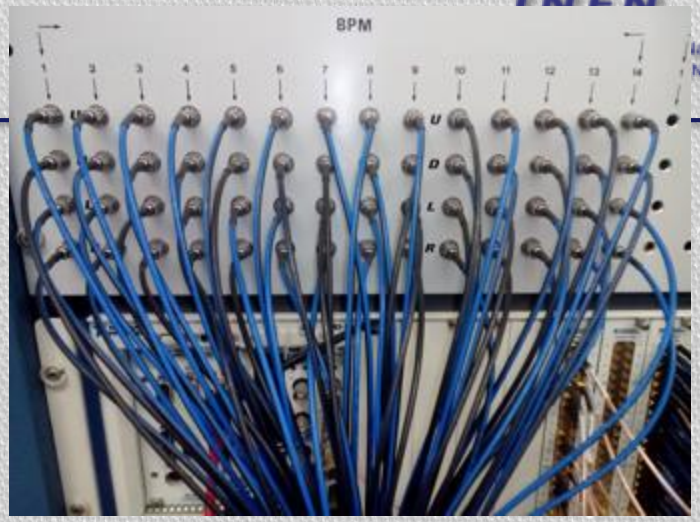


Upgrade(s): control & timing

Hardware and software refurbishing already under way:

- New digitizer and multiplexer (PXI) for BPM readout
- New timing (pulse delay generator)



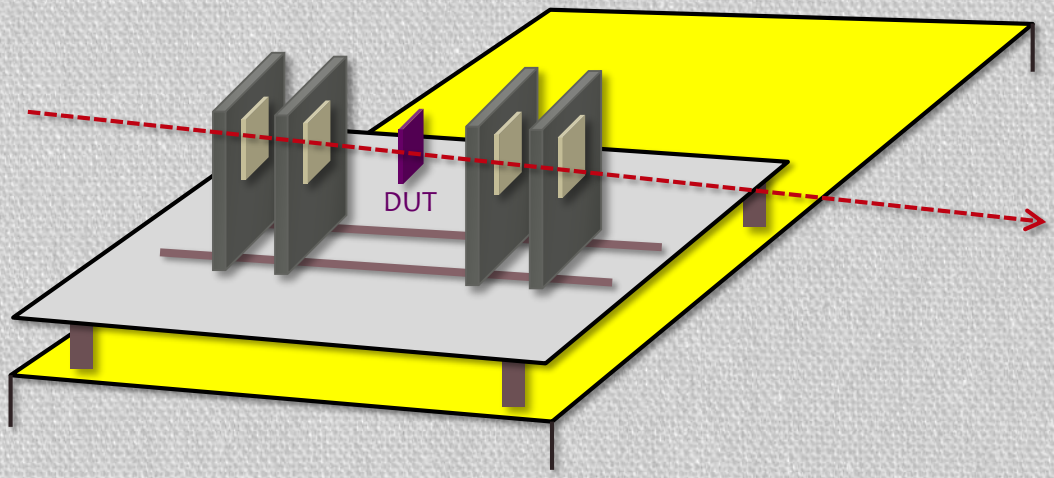


New pulse delay generator

BTF upgrade(s): high resolution telescope

Three main goals:

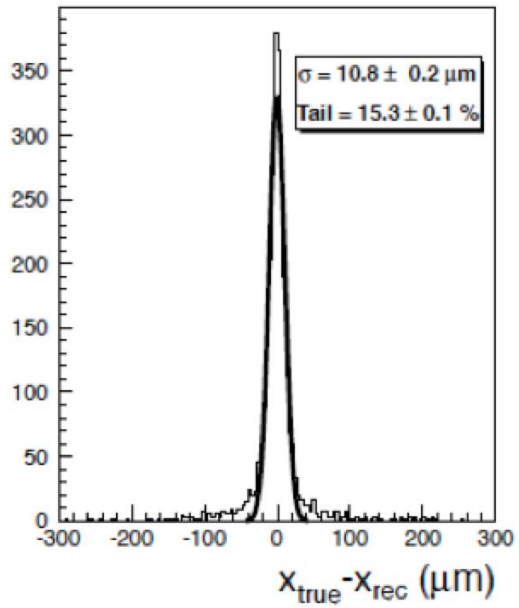
- Provide the BTF users with a **high granularity tracker** with "negligible" material (to minimize multiple scattering at 500MeV electrons) as a **reference detector** for testing purposes.
- Provide the BTF with a **tool for easily tuning the beam** parameters.
- Characterization of the beam **bunch time structure** and composition (essential information for experiments like PADME).



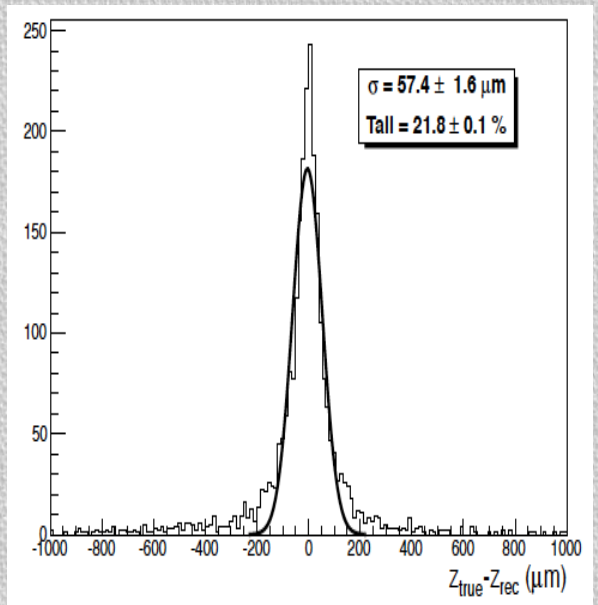
Starting experience

FIRST (Fragmentation of Ions for Space and Therapy)

Vertex performance for tracking and dE/dx

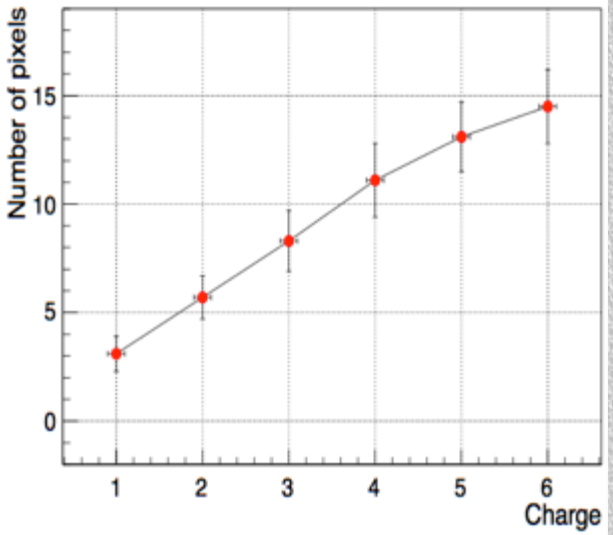


Resolution on orthogonal plane ≃ **10 μm**



Resolution along beam ≃ **60 μm**

Number of pixels per cluster



dE/dx performance: z disantangle poor but possible

Sensors choice

M28 pixel sensor

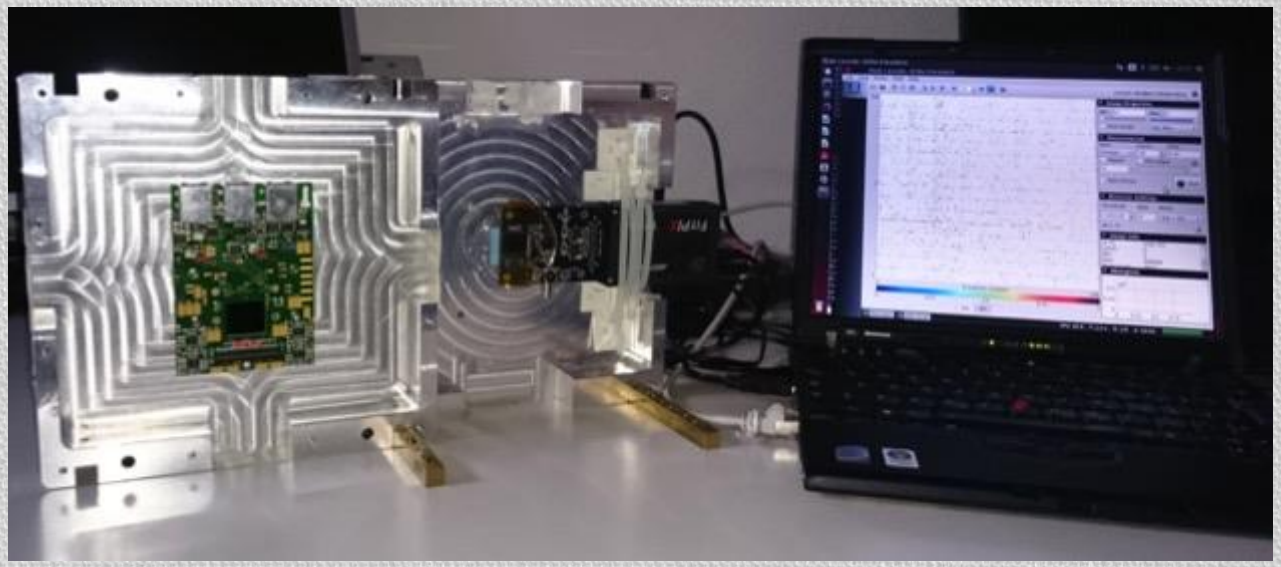
- MAPS (15 µm epitaxial layer)
- 50 µm thickness
- 928 (rows) x 960 (columns) pixels
- 20.7 µm pitch
- Size 20.22 mm x 22.71 mm
- chip readout time 185.6 µs
- Digital Zero Suppressed Output

By IPHC – IN2P3 Strasbourg

Timepix3 pixel sensor

- Fully depleted bump-bonded sensor
- 256 (rows) x 256(columns) pixels
- 55.0 µm pitch
- Size 14.08 mm x 14.08 mm
- TOT (Time Over Threshold) 10 bits
- TOA (Time of Arrival) 1.56 ns LSB
- Fast Zero Suppressed output

By CERN (Medipix3 collaboration)



BTF ready supports

Telescope readout

Simulated serial output of the M28 Mimosa sensor

Pixel sensors readout based on SoC (System on Chip) boards (Altera FPGA based)

- Preliminary DAQ version (Firmware/Software) based on **Terasic Deo-Nano-SoC** board running Linux
- Final version based on **Terasic SoCKit Development Kit** hosting the Altera FPGA **Cyclone V SX SoC-5CSXFC6D6F31C6N** (much larger resources available).

Gigabit Ethernet link

BTF upgrade plan

Plan for 2016-2017 and 2018 sent to INFN management with priority for line doubling and modulator consolidation

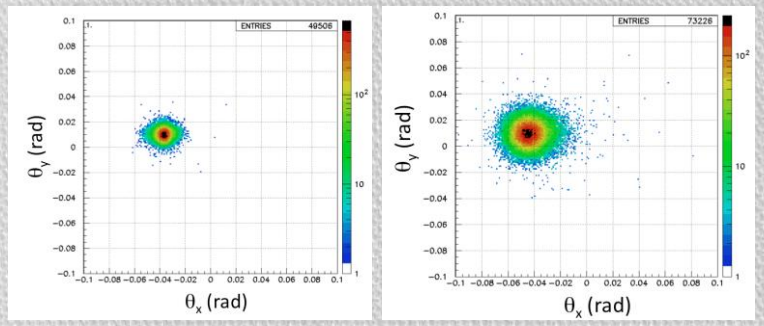
Item	N.	Unit cost (k€)	Cost (k€)
New supplies for PFN charging	3	40	120
New supplies for PFN charging (existing modulators)	8	40	320
New readout system for LINAC signals	1	50	50
New modulator control system	1	100	100
New readout and DAQ for BPMs	1	50	50
New gun pulser 1 ns - 4.5 us	1	70	70
Secondary cooling upgrade for RF structure and SLED	1	100	100
Modulator	1	600	600
Klystron filament and core bias supplies	10	6	60
Total WP1			**1470**

Item	N.	Unit cost (k€)	Cost (k€)
SLED	1	200	200
Klystron	1	200	200
Accelerating sections	4	100	400
Waveguide network	1	150	150
Quadrupoles (LINAC)	4	75	300
Correctors (LINAC)	8	10	80
Totale WP2			**1330**

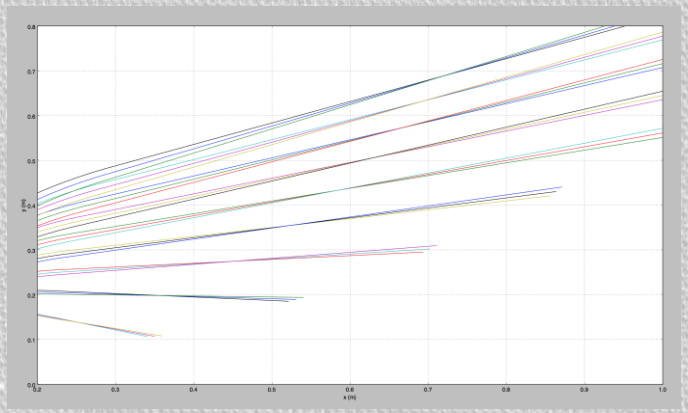
Item	N.	Unit cost (k€)	Cost (k€)
45° dipoles and power supplies	4	100	400
Quadrupoles (new line)	6	70	420
Correctors (new line)	3	10	30
New shielding, civil engineering			160
New collimators, supports, pipes			40
Electrical systems upgrade			100
Cooling systems upgrade			260
Total WP3			**1410**

Photon tagging upgrade

- Simulation porting to Geant4 ongoing
- Full (electron) beam characterization (divergence, beam spot) needed for realistic design of photon beam



θ_x vs θ_y (450 MeV, 200 MeV)



- Detector studies on scintillation bars, with SiPM readout under way
  - Magnetic field effect on readout electronics under way

Summary

- The BTF upgrade program is proceeding **in parallel** with the operation of the facility
- Final details in the **Conceptual Design Report**
- The studies for the new beam-lines have been **completed**
  - **Now releasing the specifications for magnet procurement**
- Due to some delay in the overall funding, and the time needed for purchasing all the new line elements (in particular, new magnets)

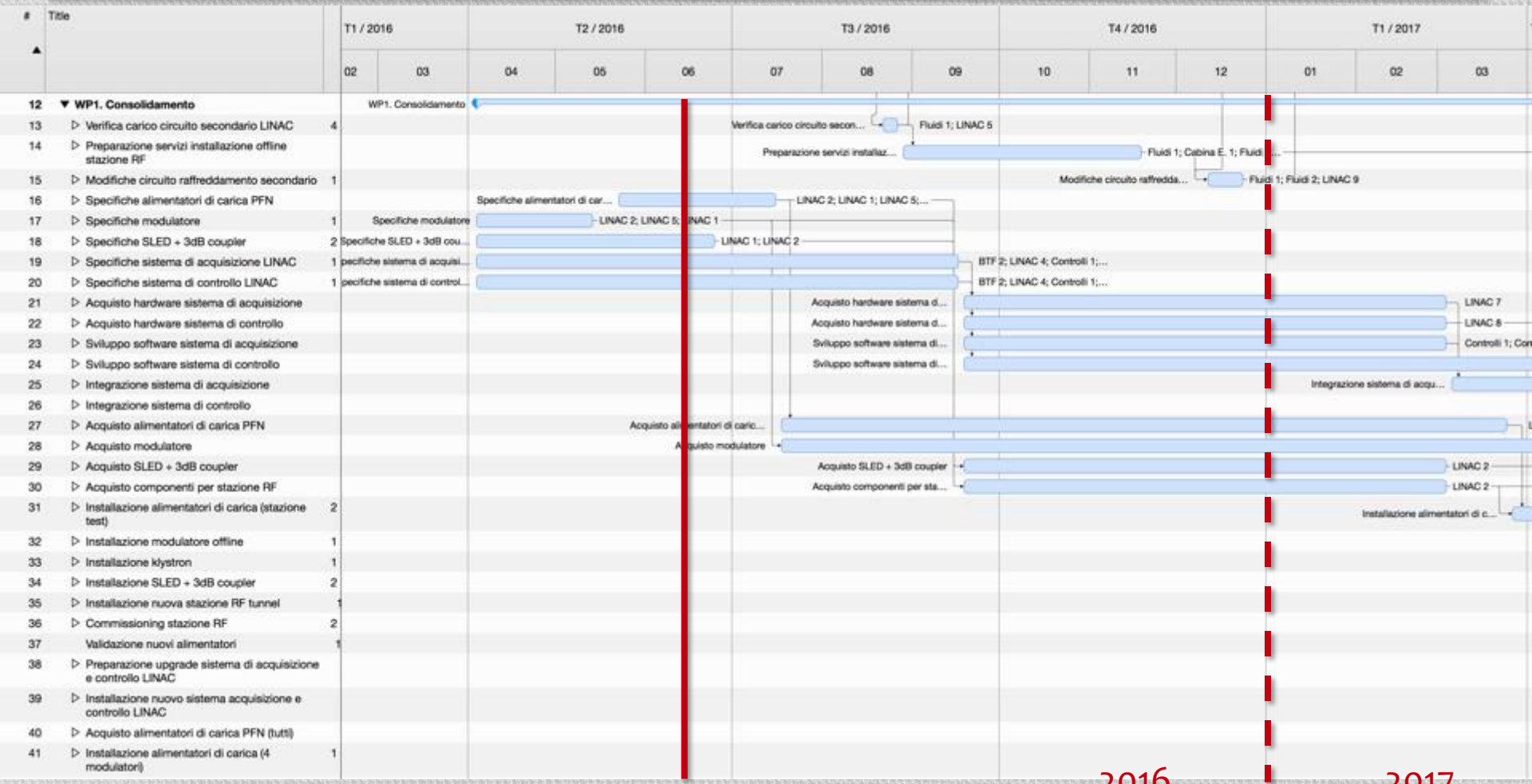
  MS-34: New Frascati beam line components installed – M18

  has to be moved forward (from M18 to M27)

- Photon tagging upgrade progressing well

Spares

Revised plan (modulators consolidation)

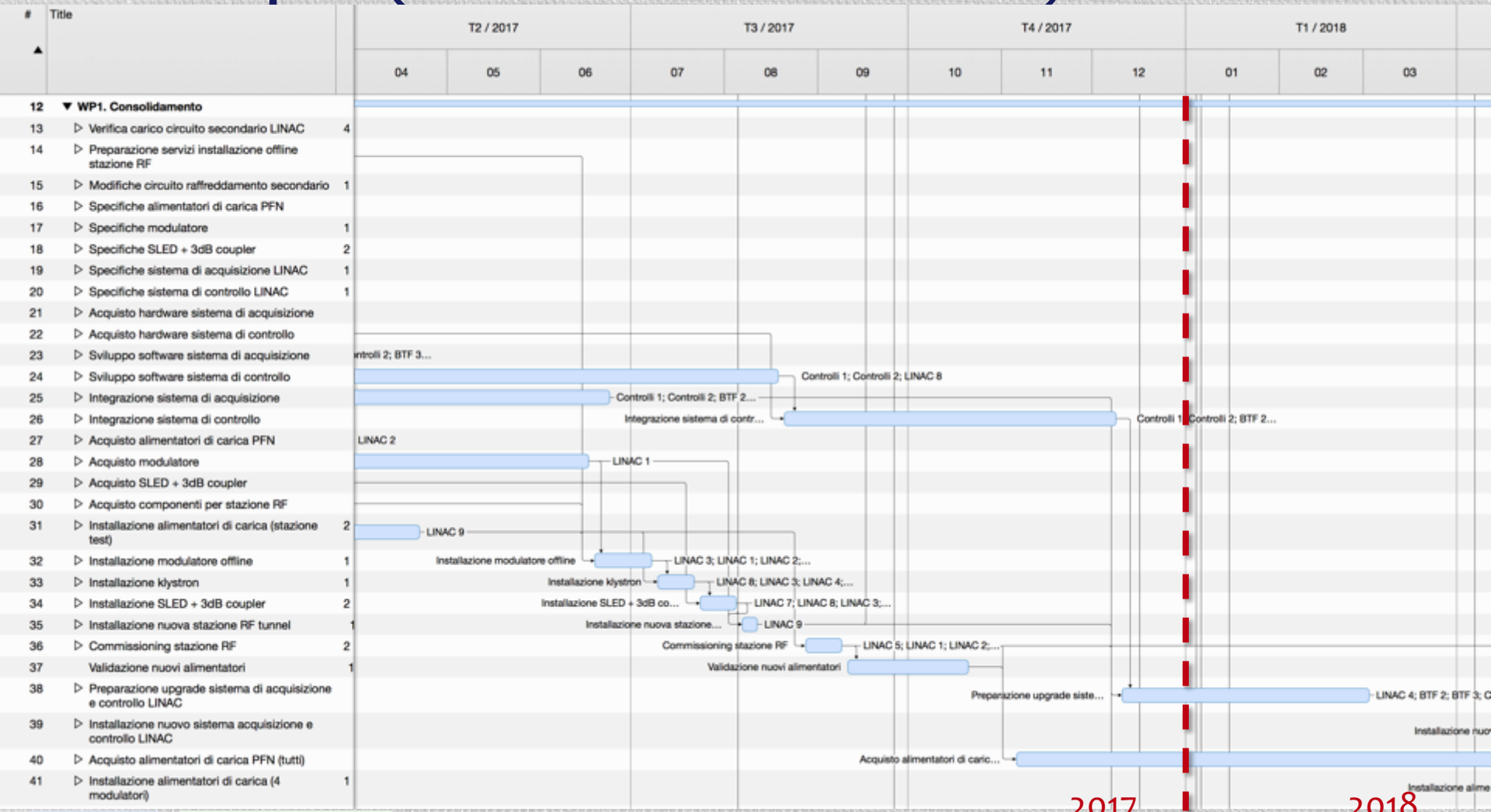


today

2016

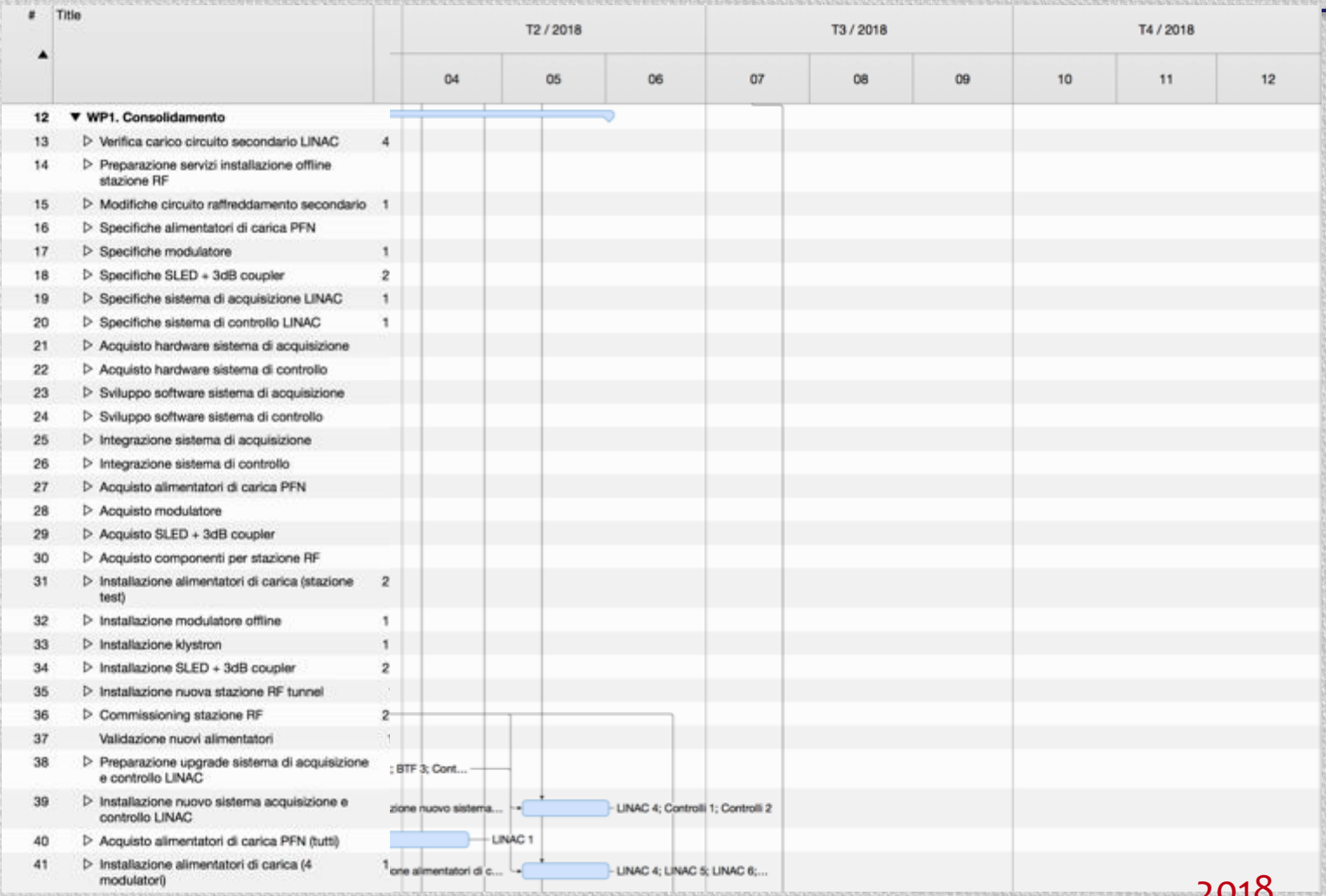
2017

Revised plan (modulators consolidation)



#	Title	
12	WP1. Consolidamento	
13	Verifica carico circuito secondario LINAC	4
14	Preparazione servizi installazione offline stazione RF	
15	Modifiche circuito raffreddamento secondario	1
16	Specifiche alimentatori di carica PFN	
17	Specifiche modulatore	1
18	Specifiche SLED + 3dB coupler	2
19	Specifiche sistema di acquisizione LINAC	1
20	Specifiche sistema di controllo LINAC	1
21	Acquisto hardware sistema di acquisizione	
22	Acquisto hardware sistema di controllo	
23	Sviluppo software sistema di acquisizione	
24	Sviluppo software sistema di controllo	
25	Integrazione sistema di acquisizione	
26	Integrazione sistema di controllo	
27	Acquisto alimentatori di carica PFN	
28	Acquisto modulatore	
29	Acquisto SLED + 3dB coupler	
30	Acquisto componenti per stazione RF	
31	Installazione alimentatori di carica (stazione test)	2
32	Installazione modulatore offline	1
33	Installazione klystron	1
34	Installazione SLED + 3dB coupler	2
35	Installazione nuova stazione RF tunnel	1
36	Commissioning stazione RF	2
37	Validazione nuovi alimentatori	1
38	Preparazione upgrade sistema di acquisizione e controllo LINAC	
39	Installazione nuovo sistema acquisizione e controllo LINAC	
40	Acquisto alimentatori di carica PFN (tutti)	
41	Installazione alimentatori di carica (4 modulatori)	1

Revised plan (modulators consolidation)



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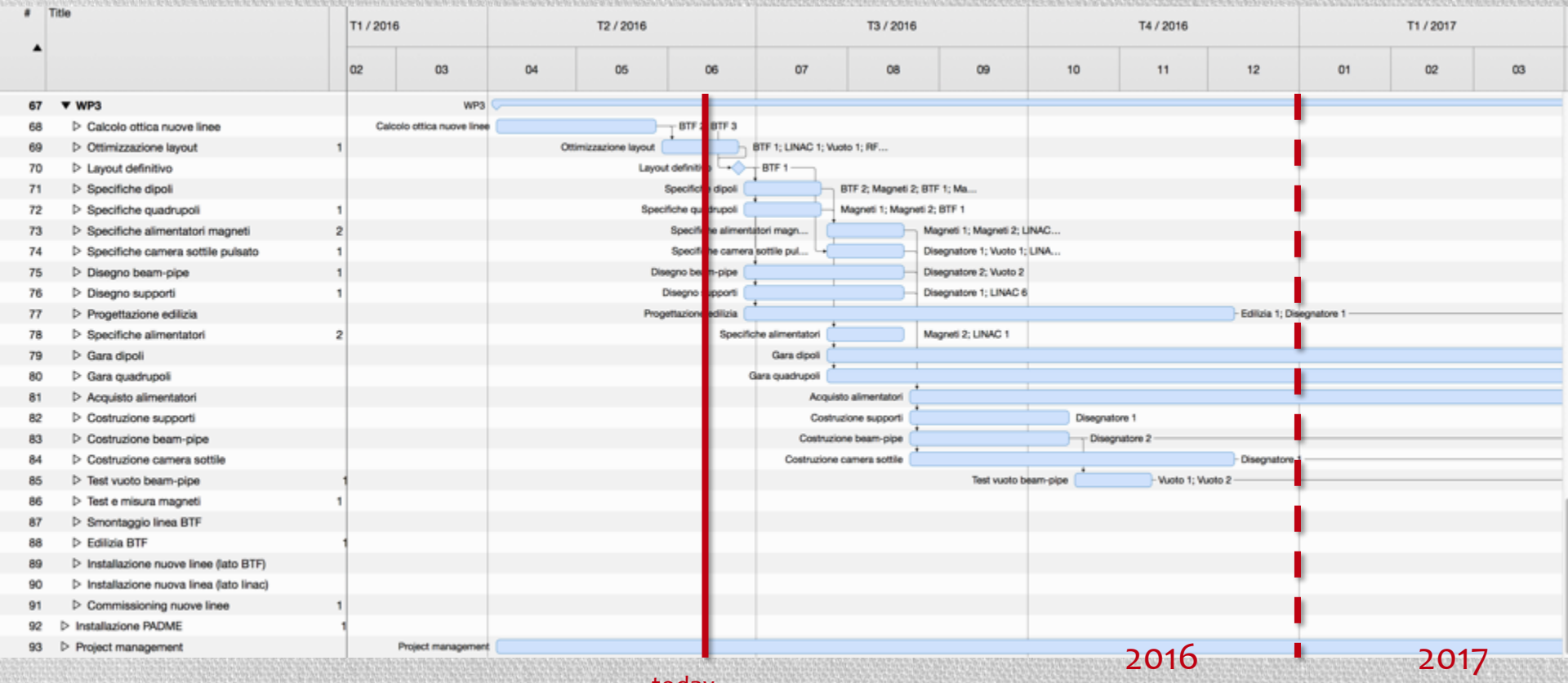
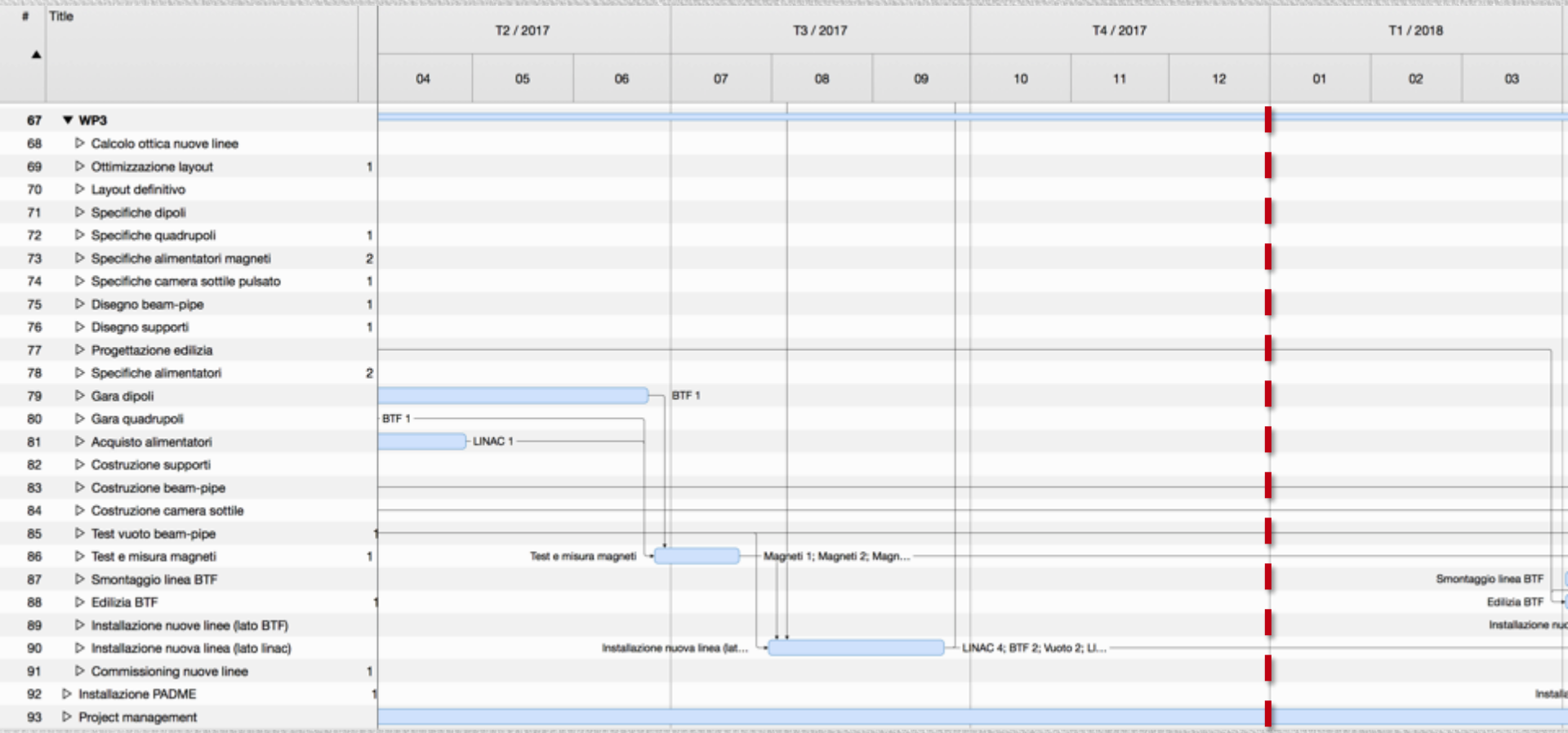
2018

Revised plan (new beam-lines)



Revised plan (new beam-lines)



Revised plan (new beam-lines)