LNF Beam Test Facility (BTF)

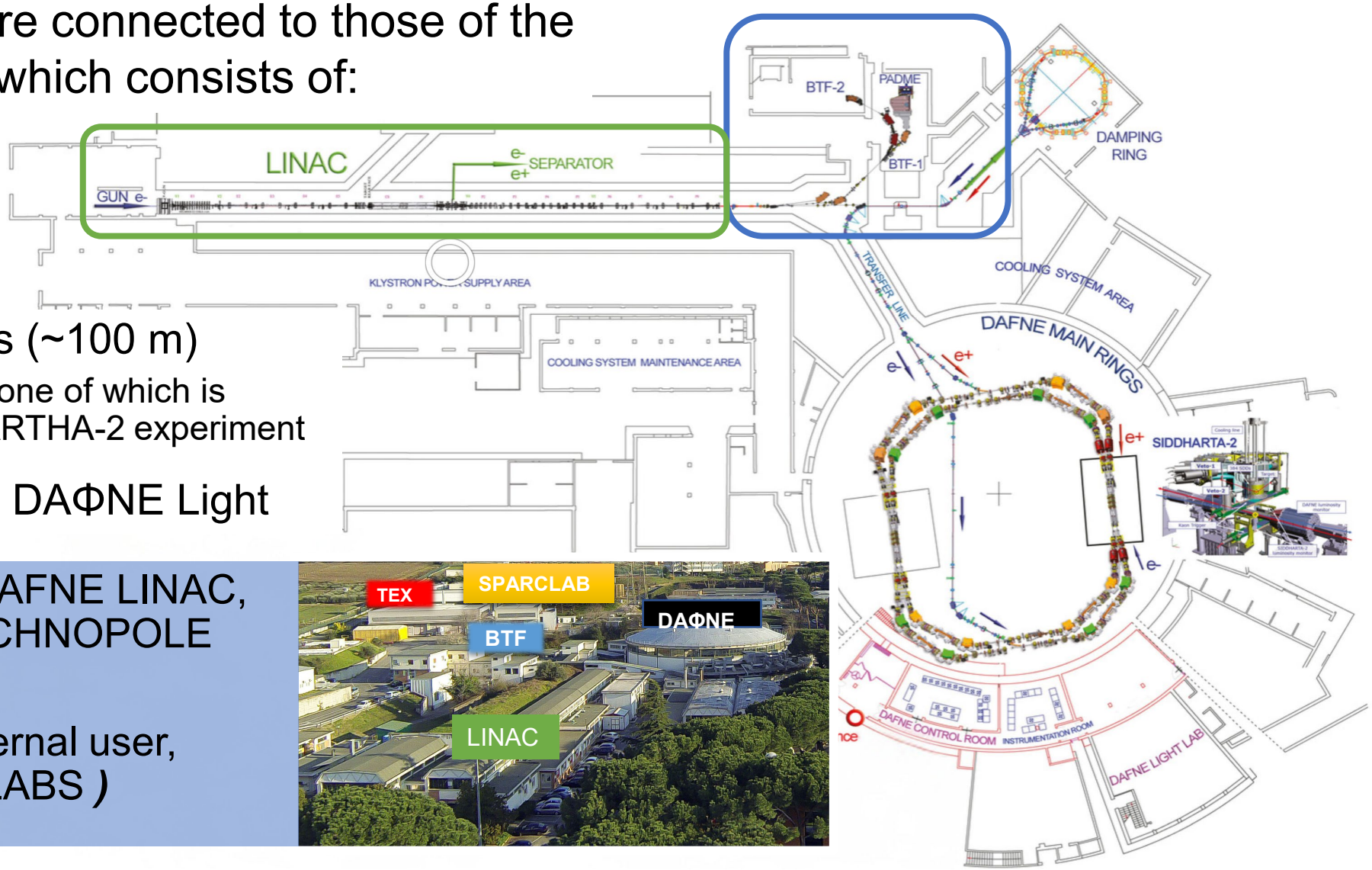
L. Foggetta on behalf of LINAC and BTF Groups

Fundamental research and applications with the EuPRAXIA facility at LNF Workshop
LNF- INFN Dec 04th 2024

The DAΦNE accelerator complex

The activities of BTF are connected to those of the e^+/e^- collider DAΦNE, which consists of:

- A ***LINAC*** (e+/e-)
- A damping ring
- Two accumulation rings (~100 m)
  - Two interaction points, one of which is occupied by the SIDDARTHA-2 experiment
- Two facilities: ***BTF*** and DAΦNE Light



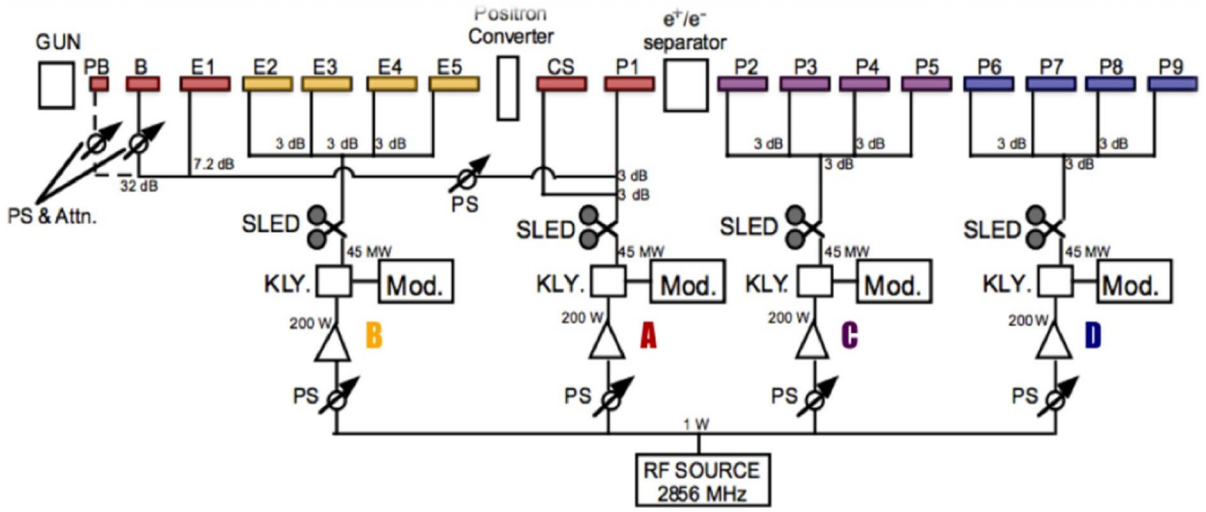
LINAC Group (10FTE: DAFNE LINAC, TEX, SPARC, ROME TECHNOPOLE and other***)***

BTF Group (3.2FTE: external user, PADME, ASIF2 & EUROLABS ***)***

DAΦNE LINAC

- Pulsed machine with **10ns** bunch envelope, **repetition rate = 50/25 Hz.**
  - **Highly charged electron and positron "primary" beams**
  - Commissioning: 25 years ago
  - **Initially developed for a few hours of uptime per day with a 10 ns pulse length**.
- Extended capabilities of the LINAC includes:
  - **Continuous operation - 24/7**,
  - macrobunch length of up to 320 ns (on positrons).
  - Primary electron beam energy spans from **160 MeV to 780 MeV.**

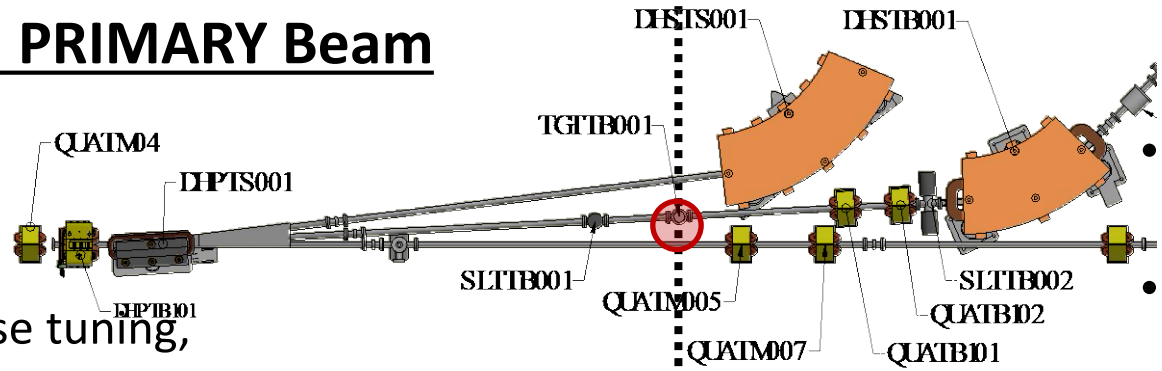
When used for DAΦNE, BTF spare pulse injections
When DAΦNE shutdowns, BTF in dedicated mode.



	Design	Operations (top)
Final energy e^-	800 MeV	510 MeV (780)
Conversion energy e^+	250 MeV	220 MeV
Final energy e^+	550 MeV	510 MeV (535)
Radiofrequency	2856 MHz	
Accelerating structure	SLAC-type, CG, $2\pi/3$	
RF amplifiers	4×45 MW klystron with TH2128C sleds	
Repetition frequency	1 Hz ÷ 50 Hz	1 Hz ÷ 50 Hz
Pulse duration	10 ns	1.4 ns ÷ 320 ns
Beam size on e+ converter	1 mm	1 mm
Normalized emittance (mm mrad)	1 (e^-) / 10 (e^+)	1 (e^-) / 10 (e^+)
Energy spread (RMS)	0.5% (e^-) / 1.0% (e^+)	0.5% (e^-) / 1.0% (e^+)
Output current e^- (510 MeV)	>150 mA	180 mA (>500)
Output current e^+ (510 MeV)	36 mA	50 mA (>85)

Primary and secondary beam in EH

LINAC Conditioned PRIMARY Beam

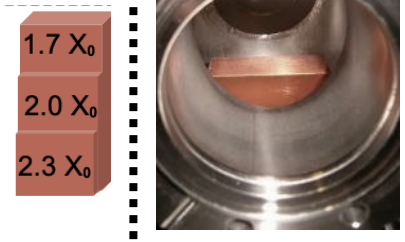


Fixed energy:

- Steering and transverse tuning,
- Longer implementation for energy setup (tuning LINAC and BTF)

High current up to ~10^{10} particle/shot:

- Scrapering injection current
- Tunable in **10 order of magnitude**

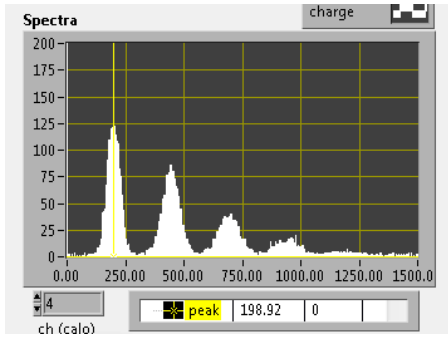


- Parameters setup via target/scrapers/magnets
- Final focus user dependent
- All parameters manageable during data

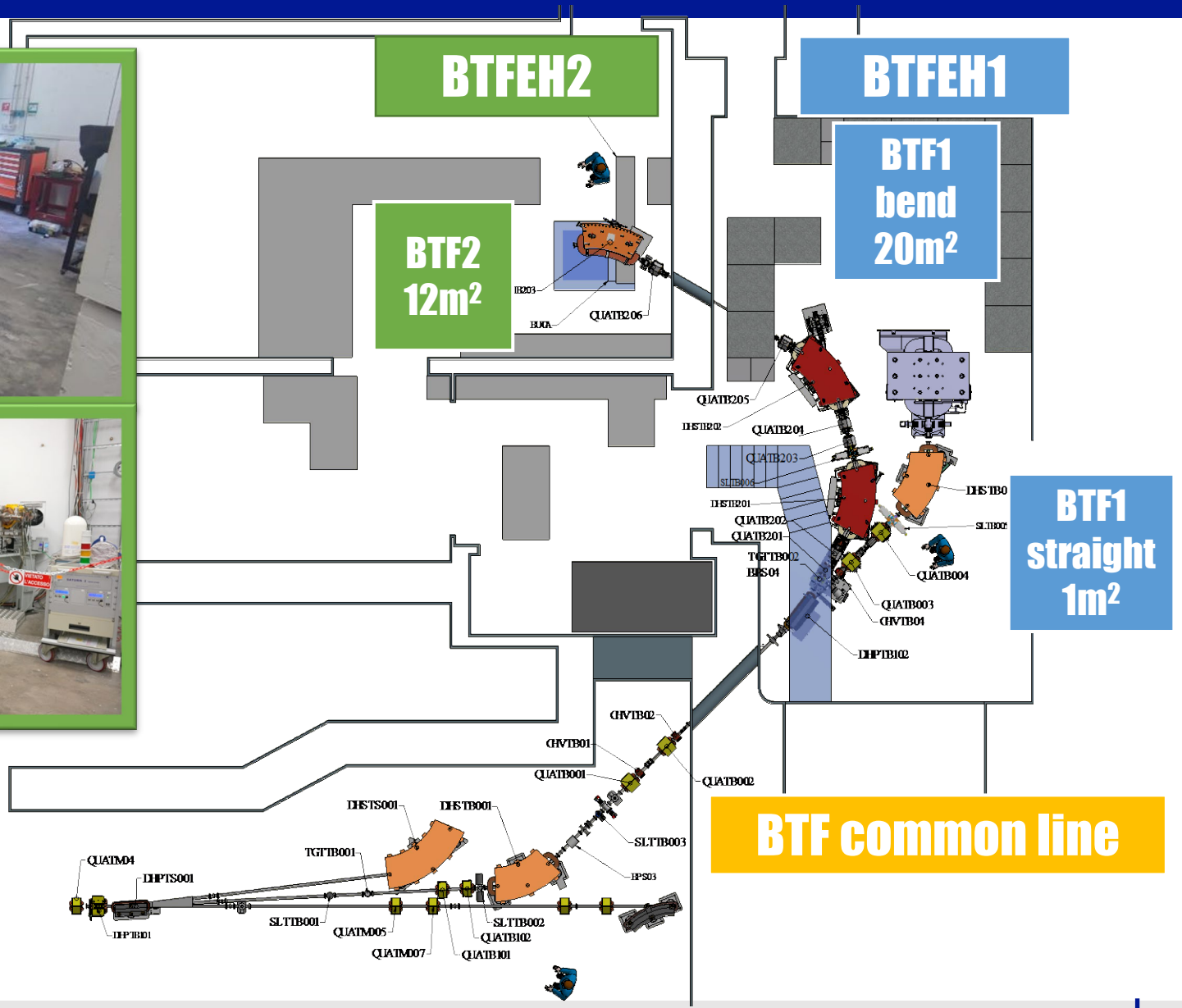
BTF SECONDARY beam

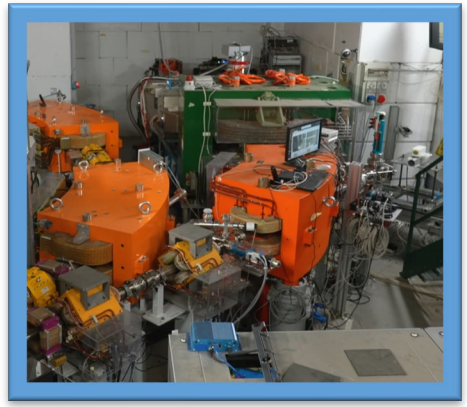
- **RUN time Tunable energy**
  - All energies from $E_{primary}$ to ≈25 MeV
- **RUN time precise multiplicity**
  - **From ~10^4 to single particle per shot**
  - **More way to adapt multiplicity set**

- Particle type **decoupled** from LINAC production
- Both energy and intensity setup with faster implementation (only BTF tuning)
- High quality single particle measurements



Overview of the experimental hall

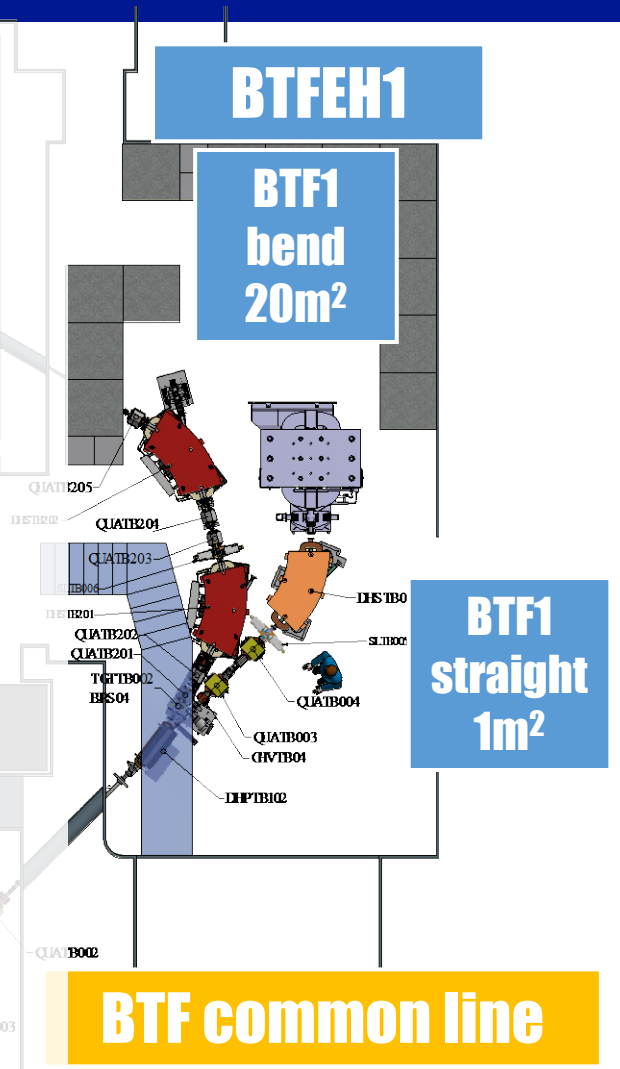


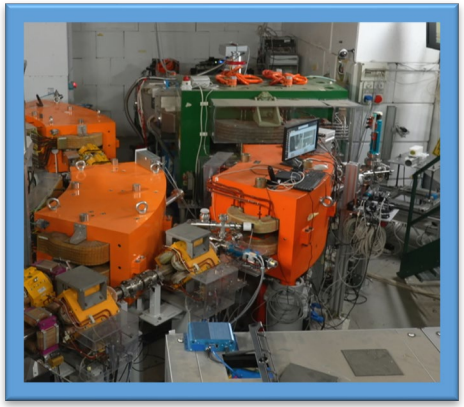


Overview of the experimental hall

BTFEH1 – BTF1 (2 lines)

- Primary beam experiments, secondary ones too
- Foreseen activity for in 2025 H1
- Hosting big experiment layout
- Now in mostly in standby due to PADME/X17 installation
- Involved in internal/opportunistic INFN runs
- FLASH VHEE community expressed high interests for beam quality and structure



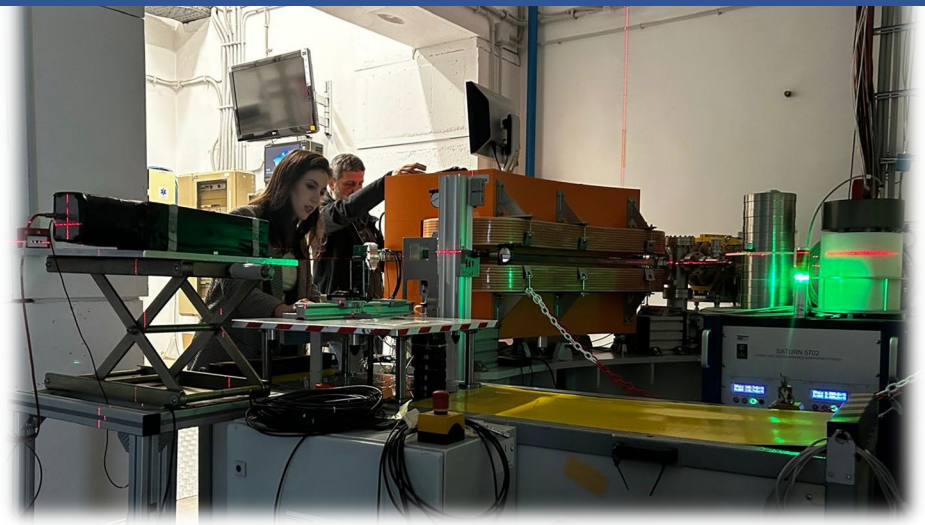


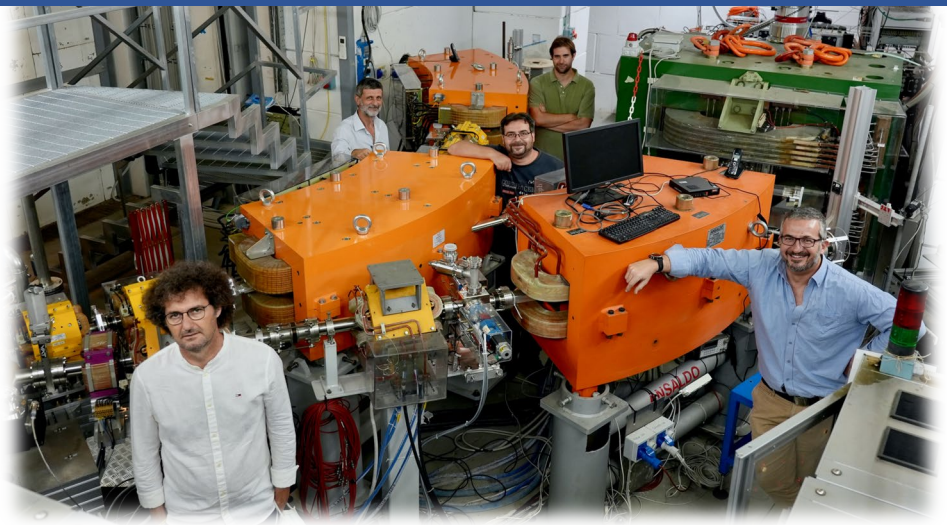
Overview of the experimental hall

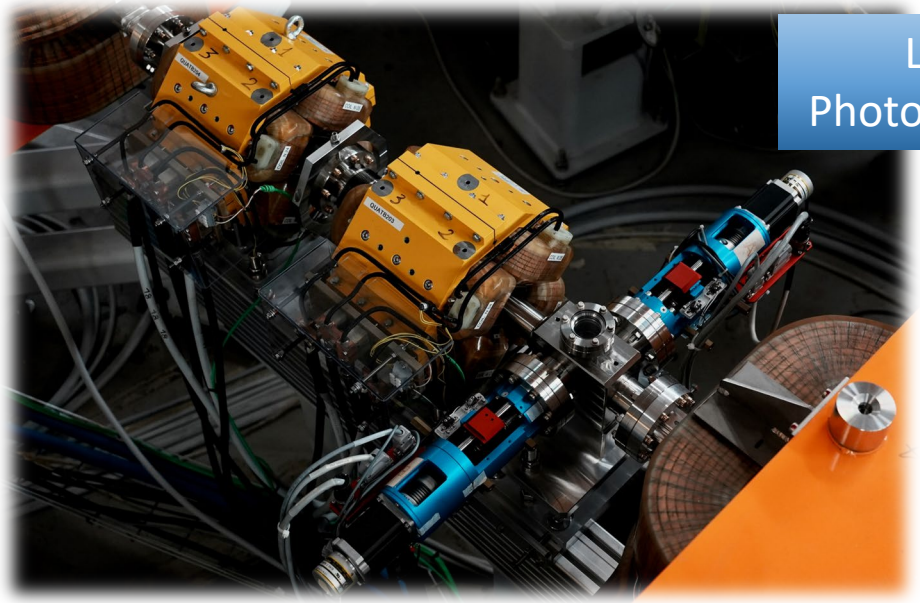
BTFEH2 – BTF2 (1 line)

- **Only secondary beam**
- Hall operative from 2022
- Currently BTF2 line to external users
- Intended for weekly based users
- Upgraded performances – 0.4x0.4mm² at BTF2 Exit window
- Now around 90% beam time
- Programmed user call for 2025 Q4

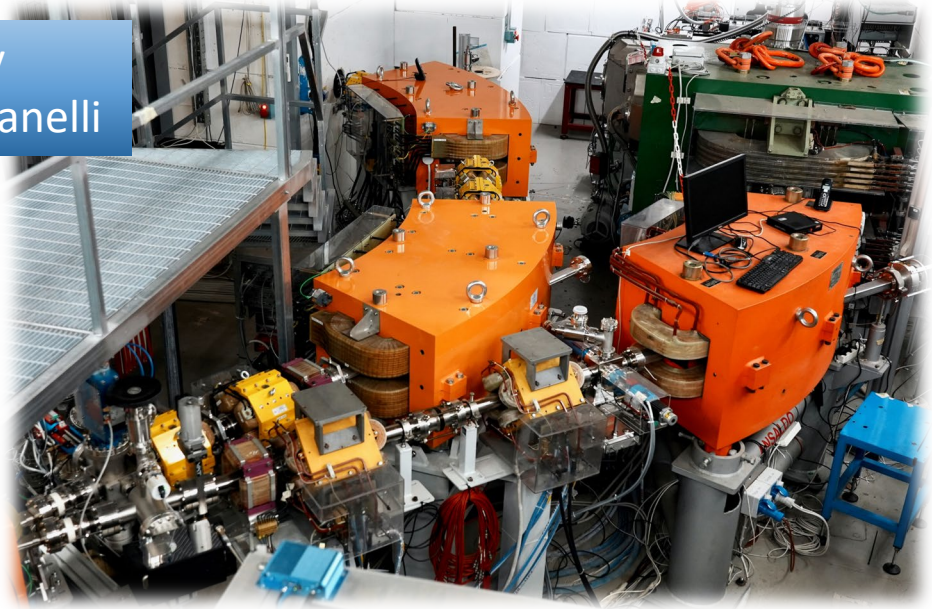
Overview of the experimental hall



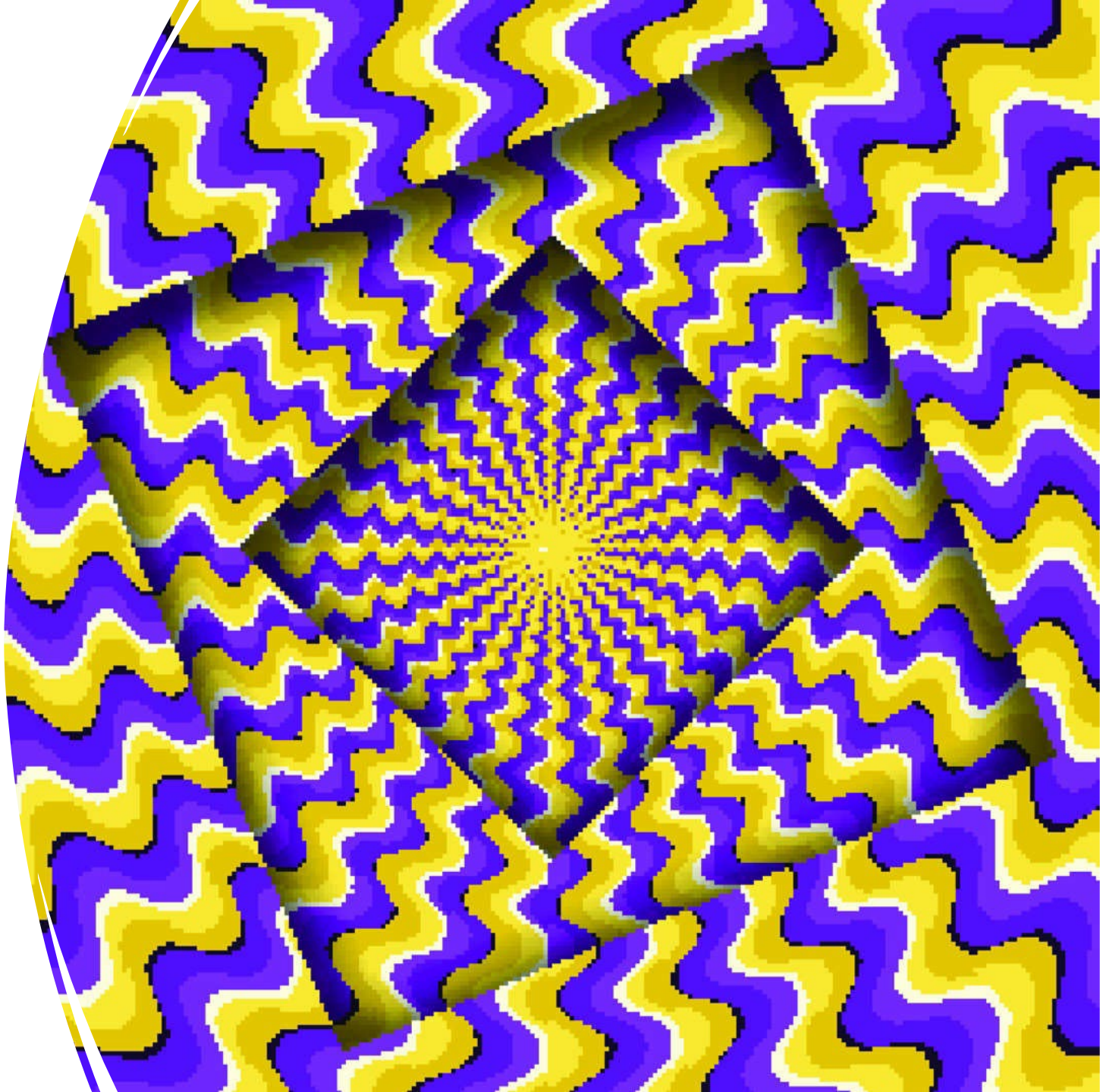




LNF SIDS Courtesy
Photo by Elena Patrignanelli



BTF STATUS

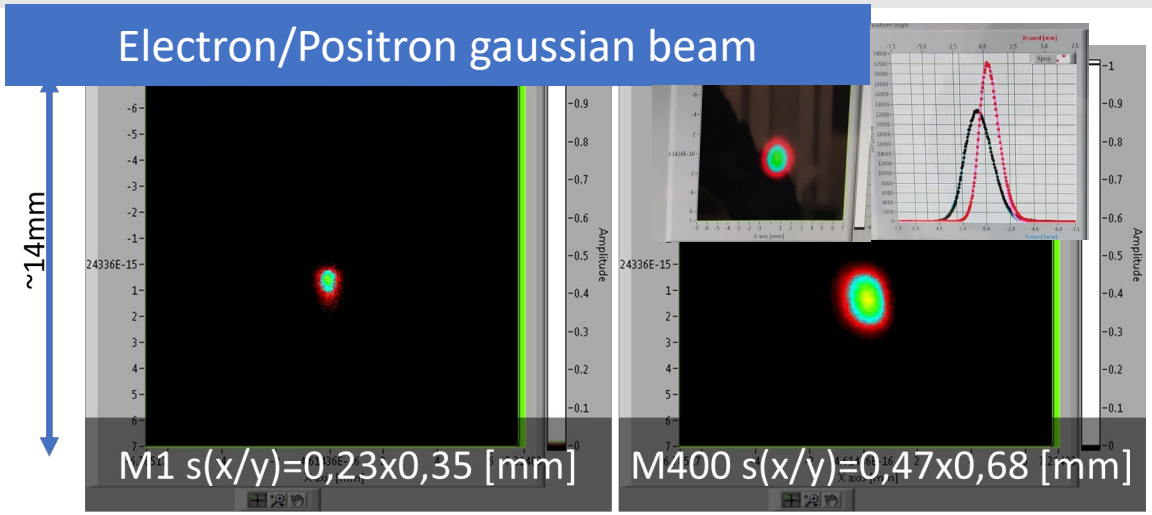


The BTF beam parameters

Parameters	BTF1 Time sharing		BTF1 Dedicated		BTF2 Time sharing	BTF2 Dedicated
	With Cu target	Without Cu target	With Cu target	Without Cu target	With Cu target	With Cu target
Particle	e^+ / e^- (User)	e^+ / e^- (DAΦNE status)	e^+ / e^- (User)		e^+ / e^- (User)	
Energy (MeV)	25–500	510	25–700 (e^-/e^+)	160–700 (e^-) 250–550 (e^+)	25–500	25–700
Best Energy Resolution at the experiment	0.5% at 500 MeV	0.5%/1%	0.5%(Energy/mult dependent)		1% at 500 MeV(Energy/mult dependent)	
Repetition rate (Hz)	Variable from 1 to 49 (DAΦNE status)		1–49 (User)		Variable from 1 to 49 (DAΦNE status)	1–49 (User)
Pulse length (ns)	10		1.5–320 (User)		10	10
Intensity (particle/bunch)	1–10^5 (Energy dependent)	10^3 to 10^{10}	1–10^5 (Energy dependent)	1 to 10^{10}	1–10^4 (Energy dependent)	
Max int flux	3x10^{10} part./s				1x10^6part./s	
Exit Beam waist size (m1, mm)	0.5–55 X / 0.35–25 Y (vacuum window dependent)				0.4x0.4(Energy/mult dependent)	
Divergence (mrad)	Down to 0.5				Down to 0.5	

BTF2 NOT/GAUSSIAN BEAM

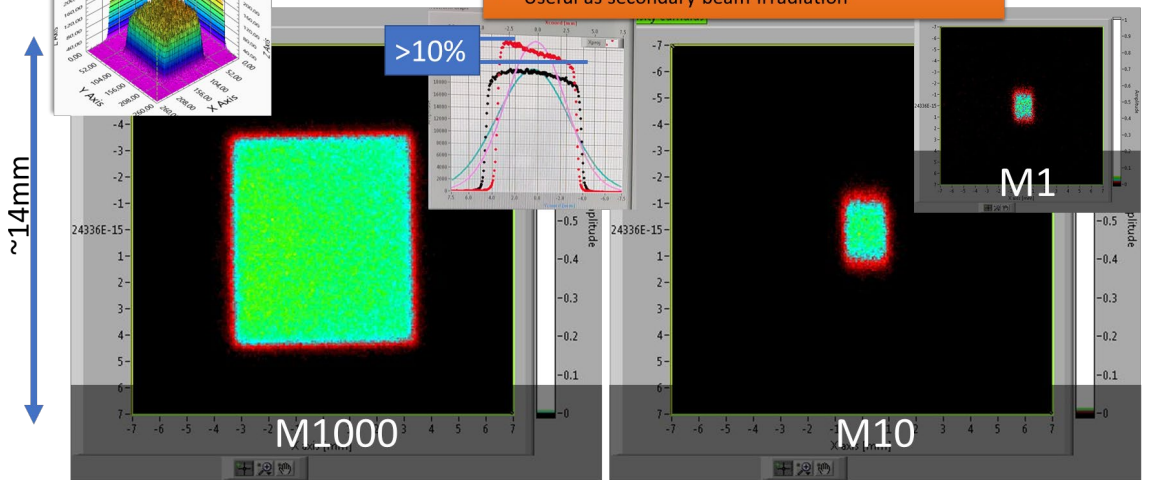
Electron/Positron gaussian beam



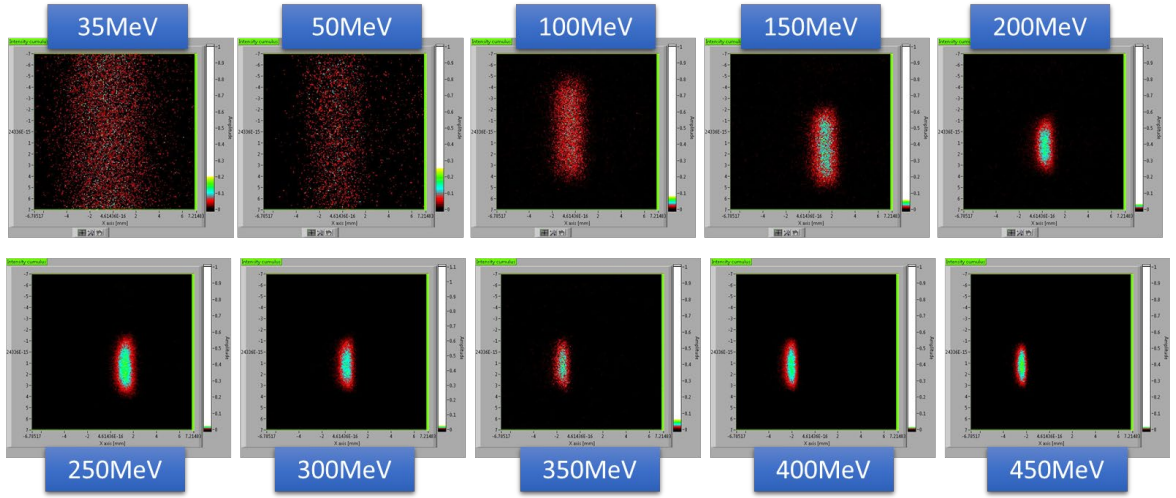
BTF1S – BTF2

450MeV electrons in linear scraping
- Very sharps edges
- Improved 10% error on uniformity
- Useful as secondary beam irradiation

Timepix Detector
Pixels = 256x256
Pixel = 0,055um

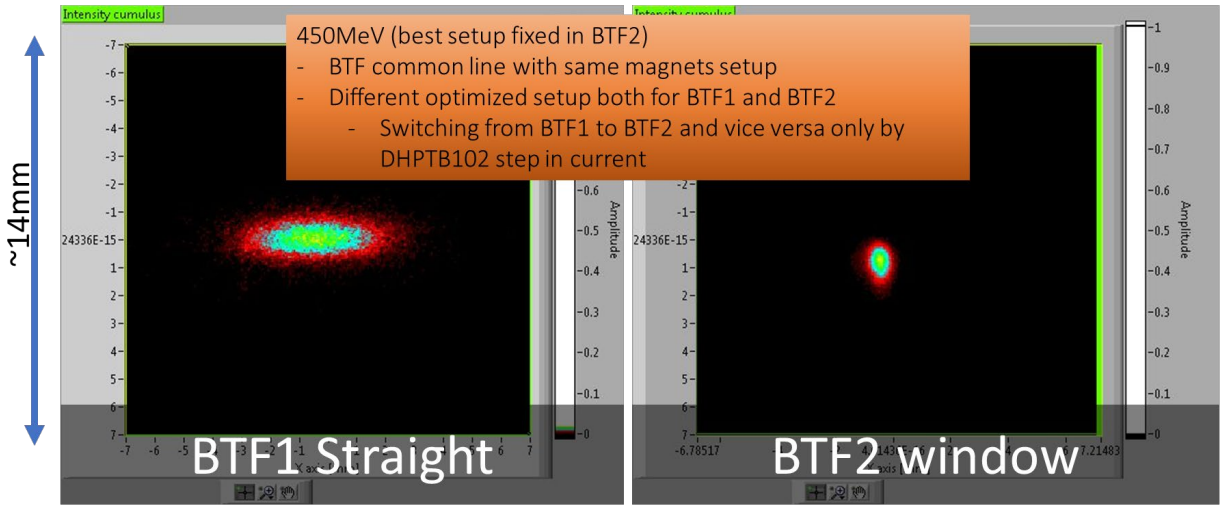


Beam BTF2 – Electron Beam energy set



Best Beam Common transport BTF1/BTF2

450MeV (best setup fixed in BTF2)
- BTF common line with same magnets setup
- Different optimized setup both for BTF1 and BTF2
  - Switching from BTF1 to BTF2 and vice versa only by DHPTB102 step in current

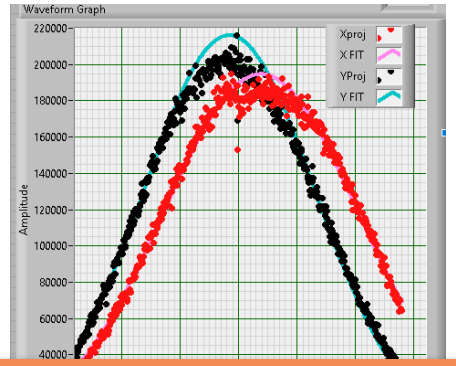


BTF HI FLUX LOW ENERGY BEAMS

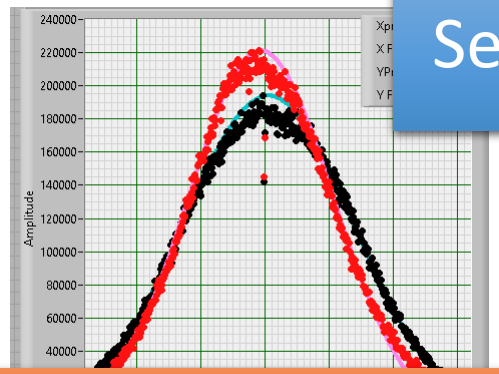
FCC – PCUBE injector (P. Craievich, G.L. Orlandi, R. Zennaro – PSI)
N – TOF (G. Claps et al. ENEA)

Secondary e- Long focus

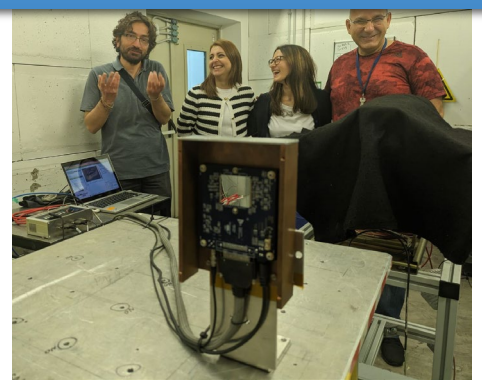
thanks to new vacuum window

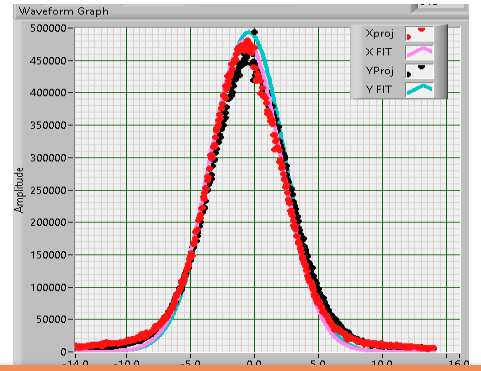


25MeV – m=2,5K
σx/σy=8,4/7,3[mm]



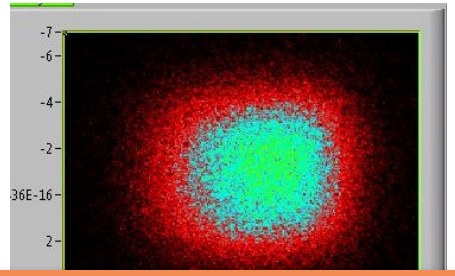
50MeV – m=5K
σx/σy=5,5/6,5[mm]



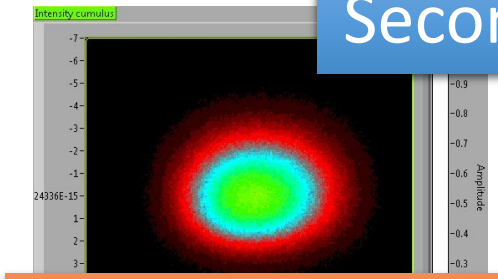


100MeV – m=6K
σx/σy=2,8/2,8[mm]

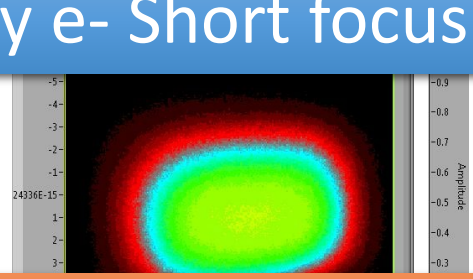
Secondary e- Short focus



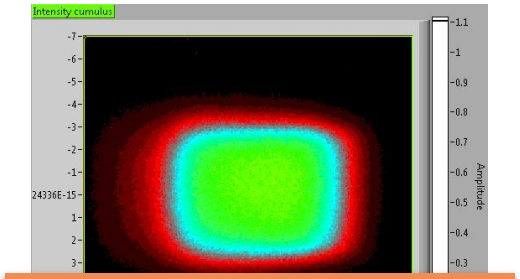
25MeV – m=1K
σx/σy=2,5/2,4[mm]



50MeV – m=5K
σx/σy=2,3/1,7[mm]



75MeV – m=18K
σx/σy=3,2/2,3[mm]



100MeV – m=30K
σx/σy=3,2/2,3[mm]

BTF SERVICES TO USERS

BTF Services at user disposable (following an handshake) in Experimental Halls/Control Room

Networking
- BTF dedicated VLAN at 10Gb-1Gb single endpoint
- DHCP Server (on DHCP auto endpoint)
- Proxy for web access
- LNF INFN VPN External connection (for registered users)
- BTF Live Diagnostics on:
  - MemCached (key-value)
  - EPIX8 (PV)

GAS feeding pipelines and related safety system
- BTFEH1, standby, 4 lines (2x inflamm, 2x inert)
- BTFEH2, 2 lines (2x inert)

Power supply, crates, boards
- CAEN5527 crates and multiple HV boards type
- VME/NIM crates and commonly used boards on pool

Logistics
- Trolley tables (100um rep., 200kg max load)
- Sliders, mounting kits

DAQ, Data delivery
- VME based (QDC, TDC, Scalers…)
- LC8108 scope (8Ch's,5Gsam/s, 1GHz BP)
- EPIX8 triggered cams online data analysis
- EPIX8 Grafana online data monitoring
- C/C++/Python BTF API for users DAQ integration

Triggering
- Digital delay, particle type latching, finger triggering

Related Lab Services

Electrical, Fluids, Compressed Air, Safety, Logistics, Engineering

BTF SERVICES TO USERS

BTF Services at user disposable (following an handshake) in Experimental Halls/Control Room

Networking
- BTF dedicated VLAN at 10Gb-1Gb single endpoint
- DH
- Pro
- LNF
- BTF
  -
  -

GAS fe
- BTF
- BTFEH2, 2 lines (2x inert)

Power supply, crates, boards
- CAEN5527 crates and multiple HV boards type
- VME/NIM crates and commonly used boards on pool

Logistics
- Trolley tables (100um rep., 200kg max load)

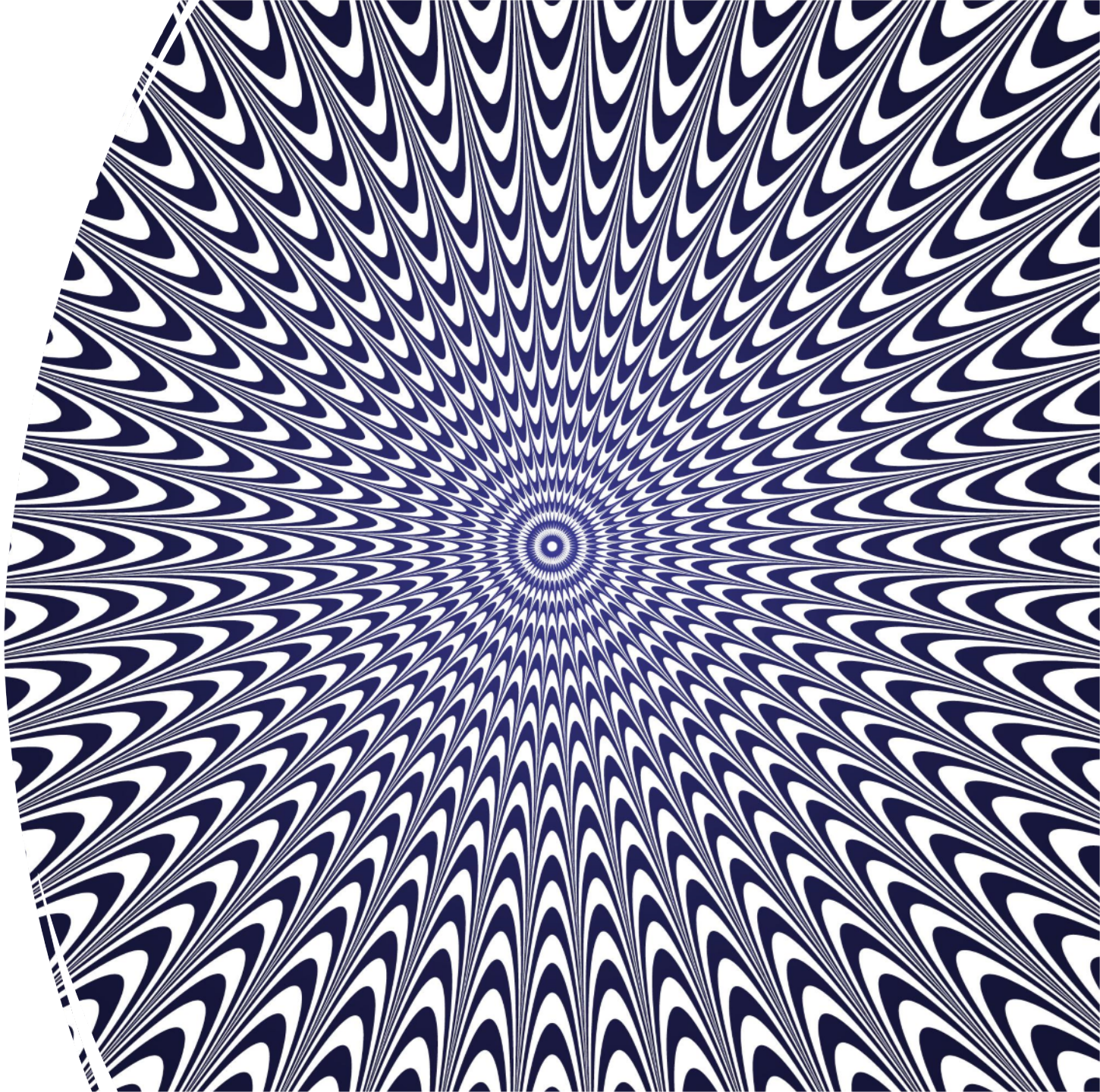
Most important: keep in touch with users
- Pre-run experiment developing
- Run-time 24/7 beam line scientist
- Post-run assistance

Triggering
- Digital delay, particle type latching, finger triggering

Related Lab Services

Electrical, Fluids, Compressed Air, Safety, Logistics, Engineering

BTF CALL FOR USERS



2024 BTF CALL

2024 BTF mostly used for:
- Space detectors test and calibration
- HEP detector developing
- FLASH-VHEE detector calibration

2024 Foreseen ~240 days for active call completed

Increased number of beam time from VHEE Dosimetry/particle counting mainly

DIAMOND for VHEE

FLASH DC

MORSEPET

FRIDA interests

First run of newly developed detector, New material developing

NANOCAL, NOVA RD Mucol,CRILIN,

MICROPEROV

FLASH-DC

THICK-SDD

BEeR

(Big) detectors in big experiment

WC – CUPID (LNGS) collaboration

Zirettino - ZIRÈ Satellite, NUSES mission.

FCC

N-TOF

CSES LIMADOU

HERD

FOOT

INVOLVED international coll's and national project (PRIN, PNRR…)

CUPID, PRIN, FOOT, MICROPEROV, Zirettino, ASIF2, EUROLABS, LUXE and other

Argument of Grad and PHD thesis discussion and with undergrad group

INSULAB, NANOcal, RDMucol, FLASHDC, MICROPEROV and other

Week occupation fulfilled with 3 backup week (in scheduled maintenance for LINAC, BTF DAFNE services)

BTFEH2 GAS installation (1 w +1w contingency **used**)

BTF crane

BTFEH2 gas safety upgrade

BTFEH1 gas commissioning

LINAC and DAFNE

STILL suffering technical limitation in:

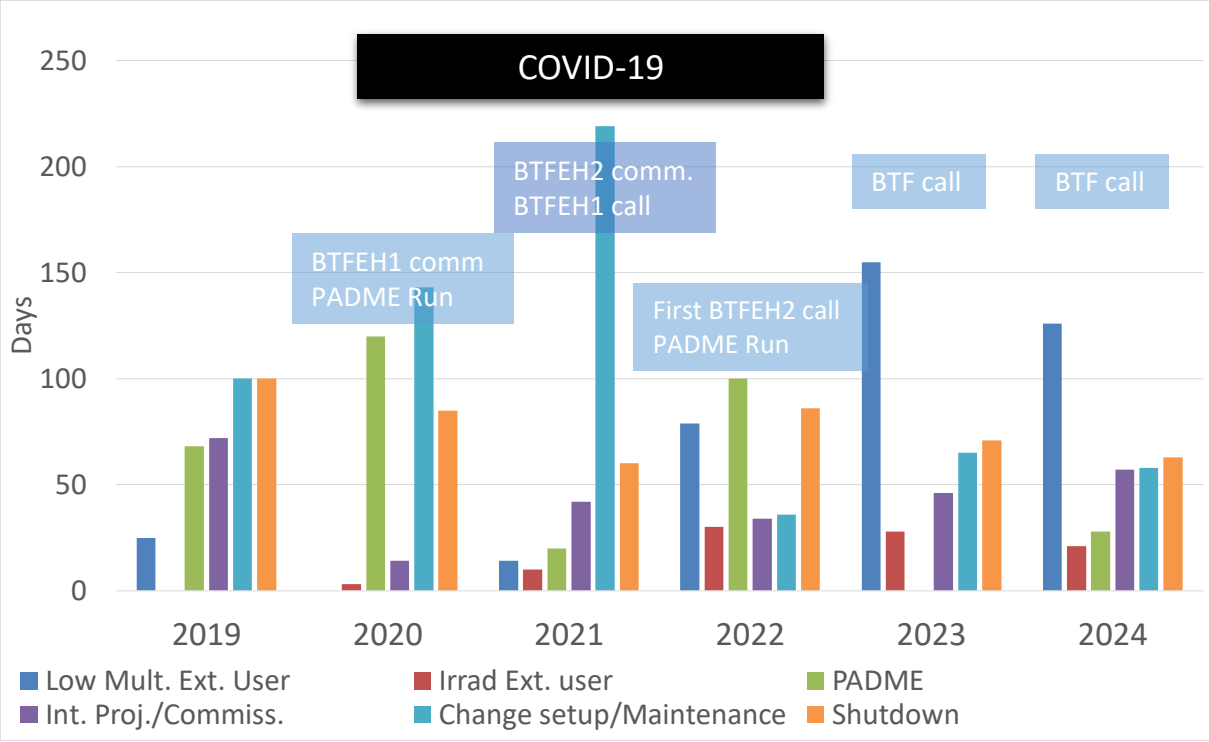
Systematic High intensity beam time: PADME installation

Large volume experiment, BTFEH1: PADME installation

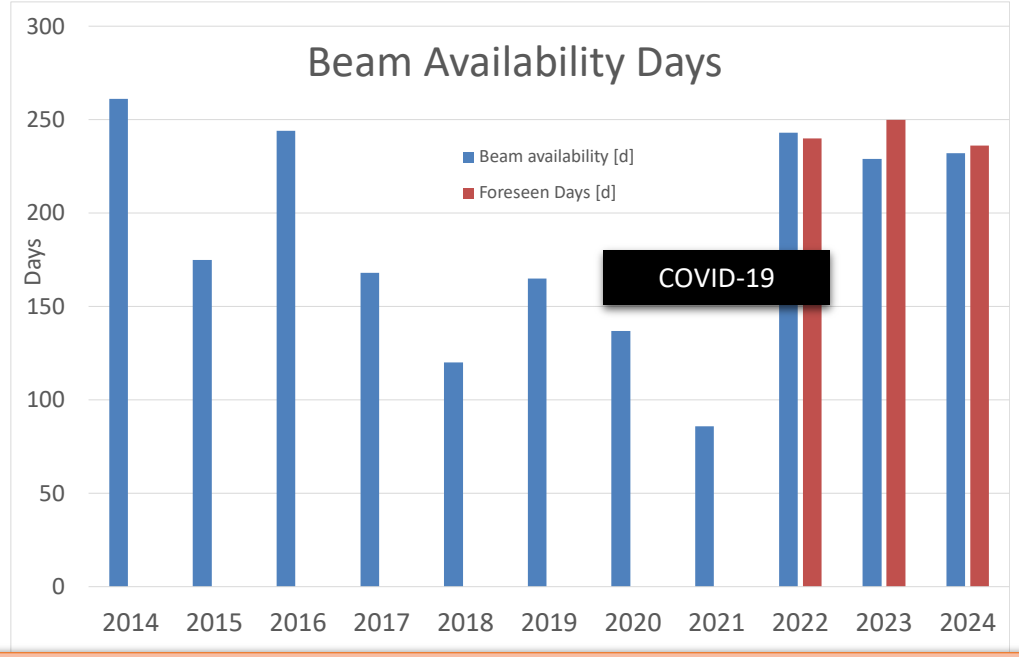
LNF – BTF NUMBERS

Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati

2019-2024 Activities



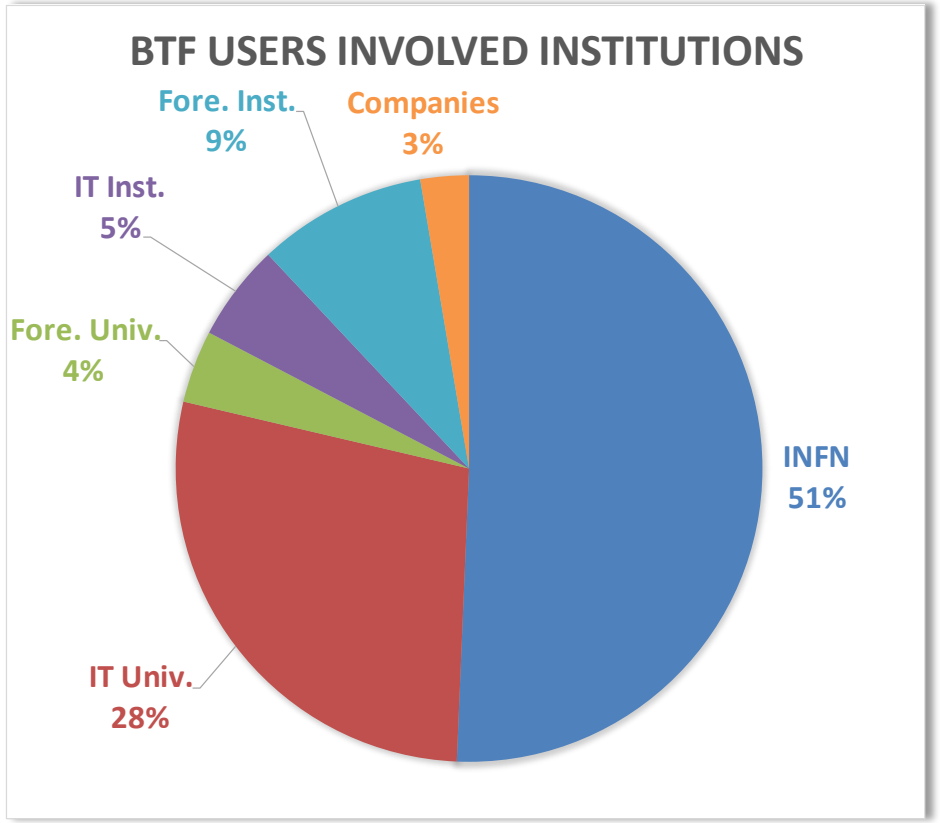
Beam Availability Days (up to 20/11/2024)

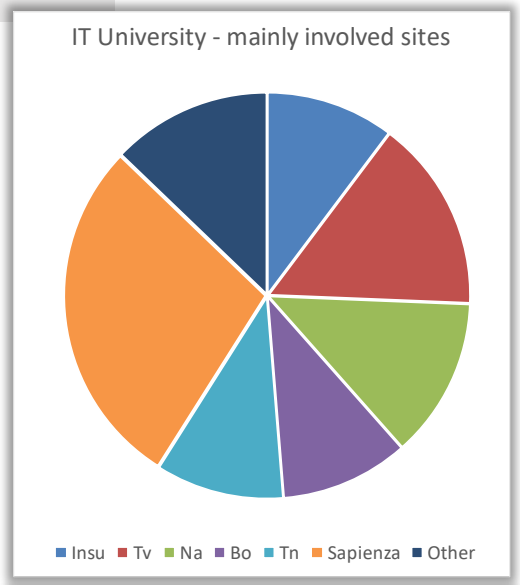


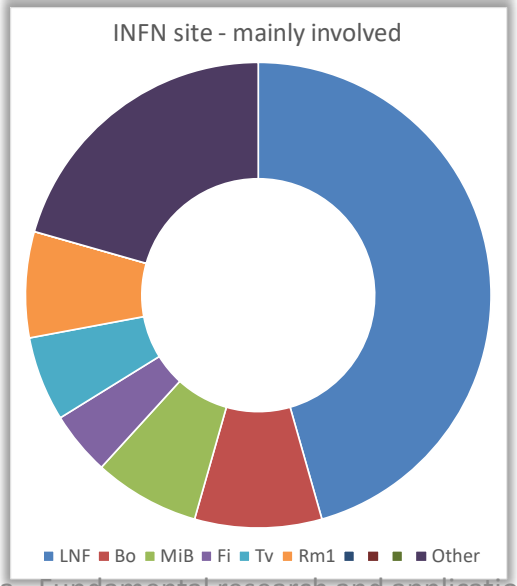
2024 Expected Beam availability days = ~240 fully done
Shift average time = 6,5d
Average team member number = 7

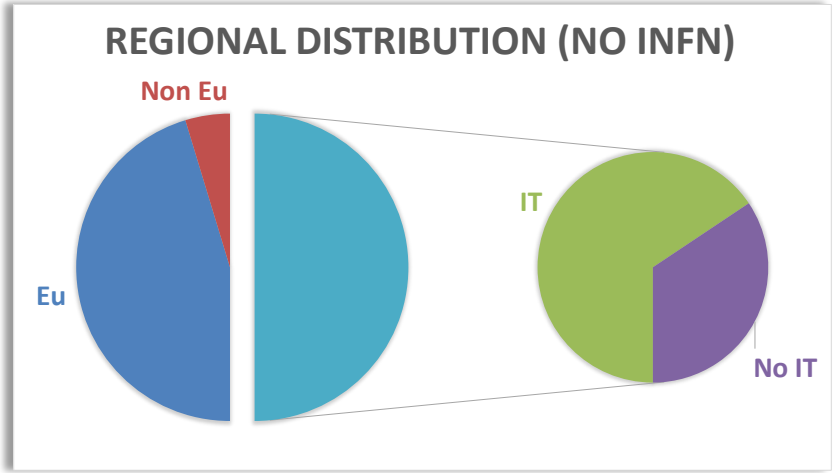
LNF – BTF NUMBERS

2022-2024 Involved Institutions









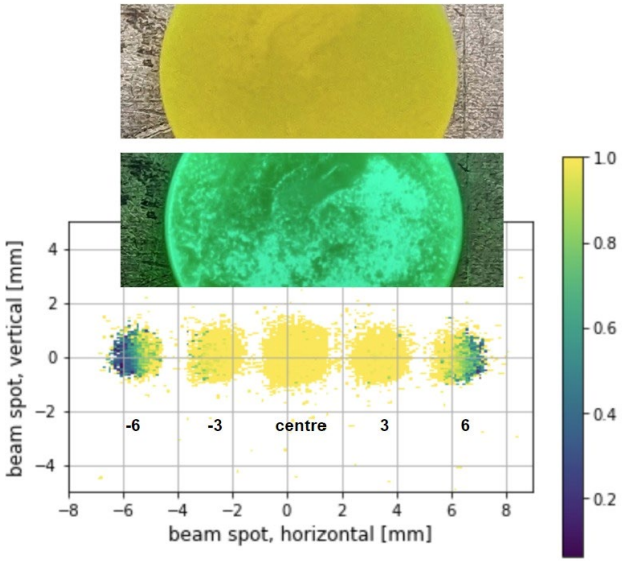
- Good Regional Equalization Between IT Institutions
- Increased prevalence of non IT University

2024 BTF2 SP BEAM STABILITY

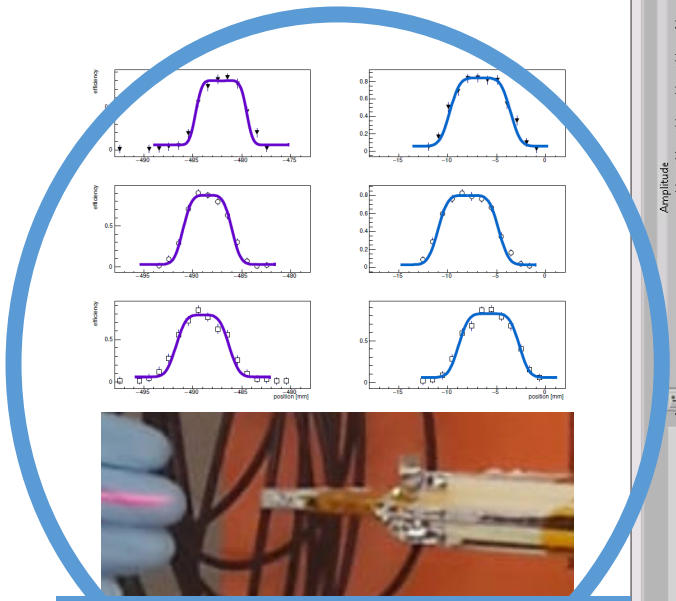
NANOCAL – Nano Crist Scintillator developing

(M. Soldani (LNF-INFN) et al.)

NanoCal aims to develop fine-sampling, large-volume calorimeters for next-generation experiments using innovative scintillating materials made from perovskite or chalcogenide nanocrystals in a plastic matrix to create a nanocomposite scintillator



- Study charges collected by SiPM coupled with samples

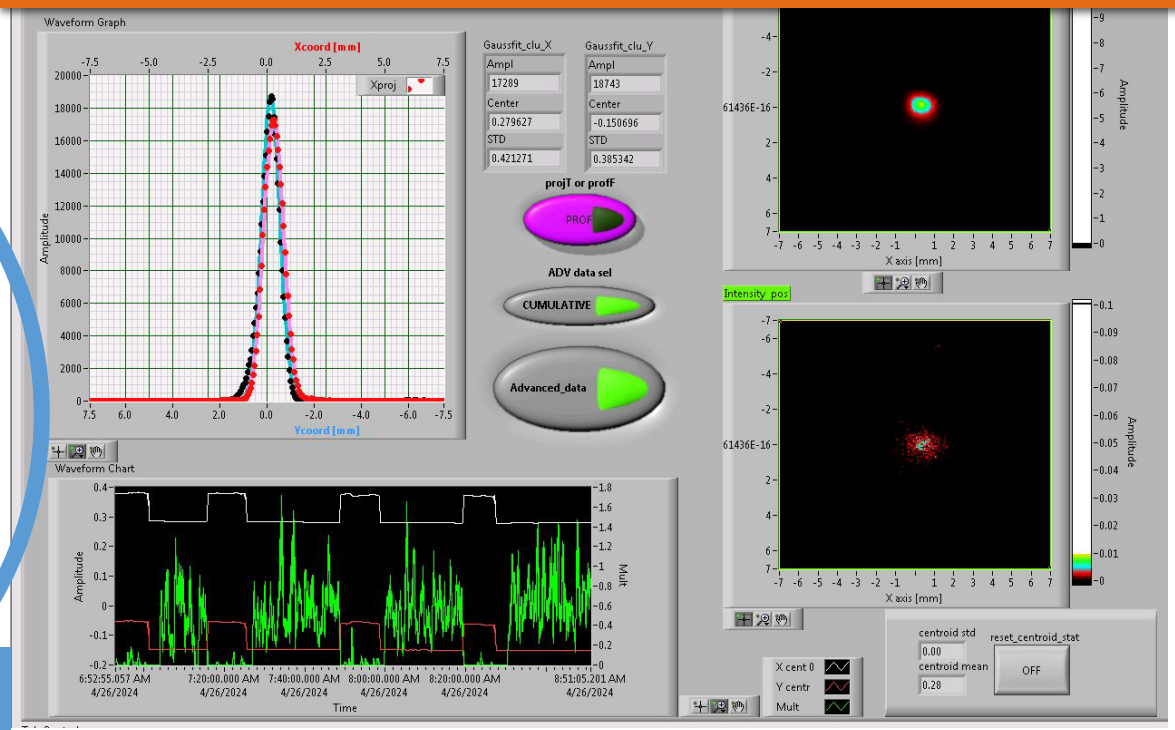


2023 KLOE2-HET (C. Bloise et al.) 100um sensitivity sampling

BTF BEAM single particle STABILITY

5 days long measure

- >600k events single particle (l poiss=0.8) for single run
- $3x10^6$ SINGLE PARTICLE EVENTS – 15 hall entrances with full dipoles cycling



BEAM sigma is actually shot precision

450MeV , m1, electrons

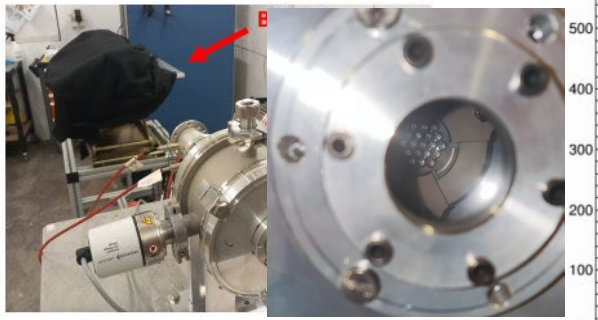
BTF beam for **sub mm detector spatial sensitivity reconstruction**

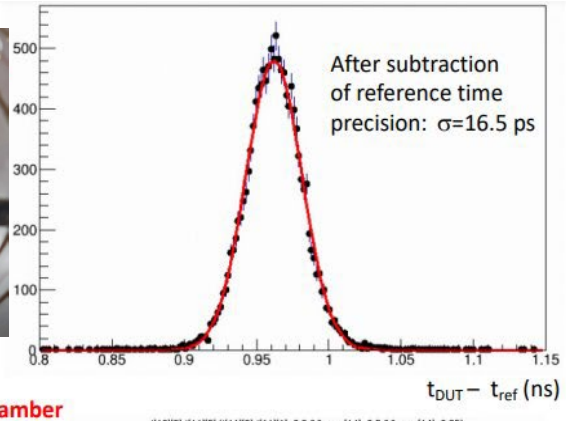
2024 BTF2 SINGLE PARTICLE MEASUREMENTS

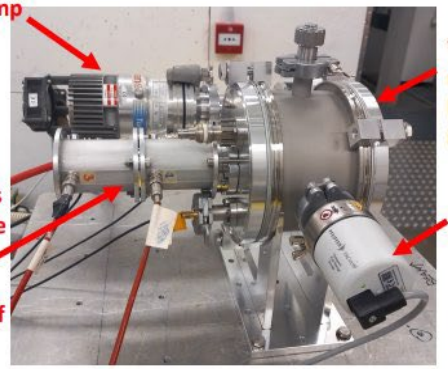
NOVA – MPC Devel - HEP Physics

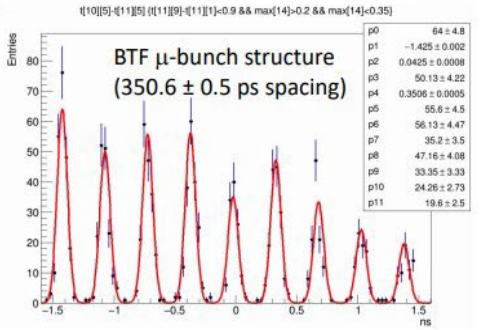
T. Spadaro (LNF-INFN), V. Vagnoni (INFN-Bo) et al.

- New generation MCP detector with new anode design,
- impressive prompt σ_t ~ **16ps**







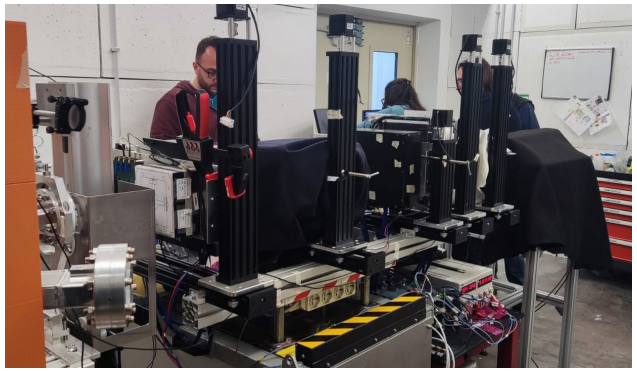


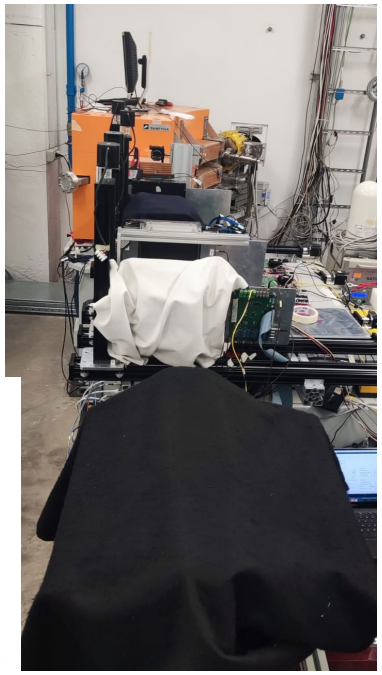
Machine measurement of LINAC bunched structure with a single particle, off energy, secondary beam (450MeV, m1, electrons)

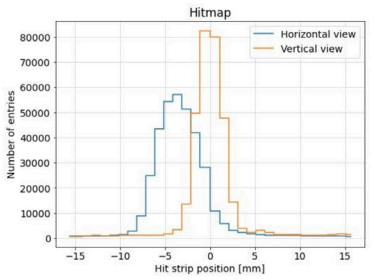
ZIRETTINO – Fiber Tracking detect – Space and Earth Physics

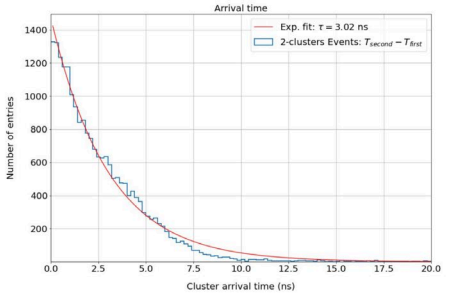
N.M. Mazziotta (INFN-Ba) et al., Nuclear Instrument corp.

- Zirettino is a prototype of Ziré which is parte of **the NUSES space mission** and will detect Cosmic Rays with energies from few up to hundreds of MeVs
  - Beam from 450 to 50 MeV few particles regime in a impressively dense setup









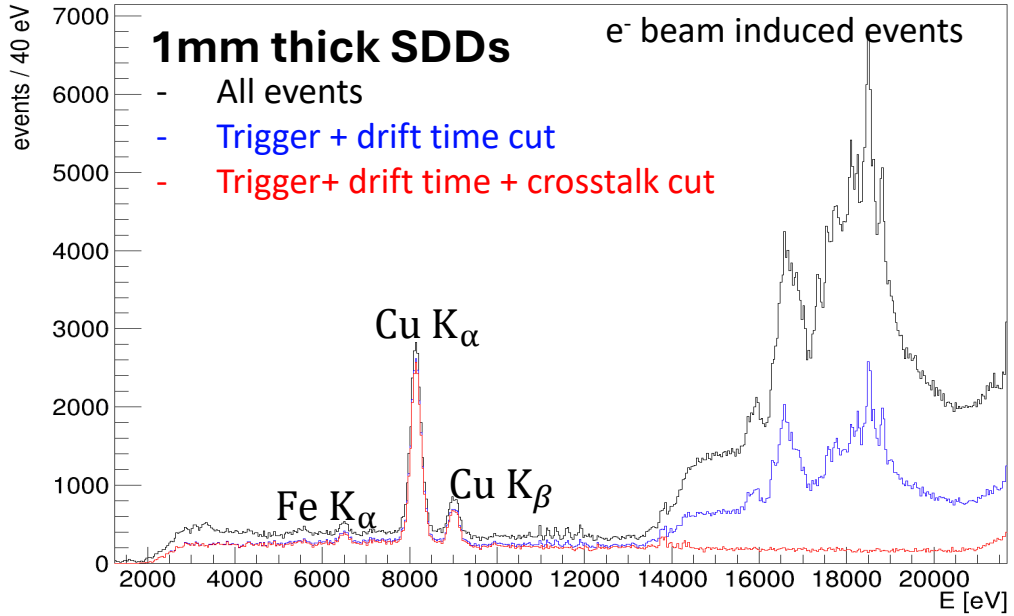
Firsts operative test with FTK+LYSO cubic crystals @ lower energies (different energies, m1, electrons)

BTF2 HI FLUX CONTINUOUS OPERATIONS

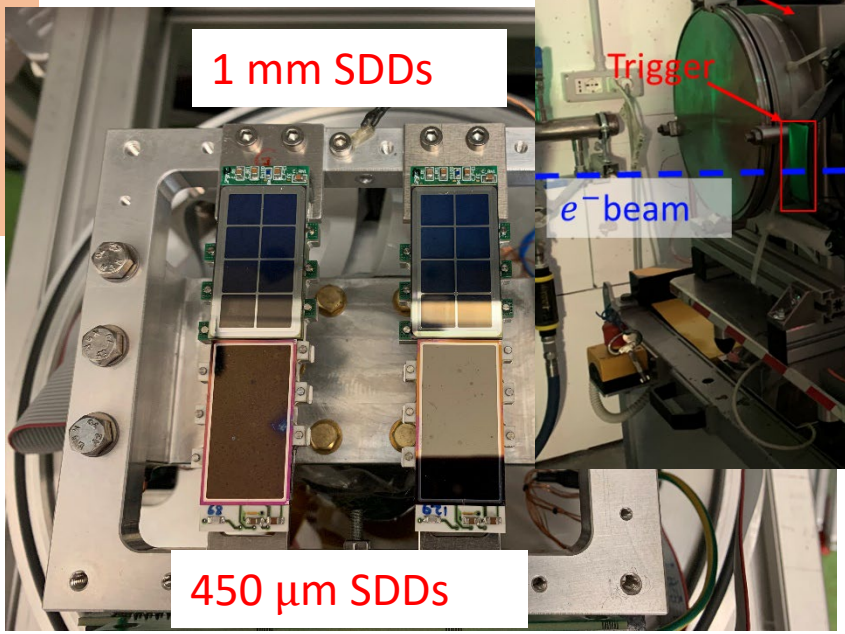
THICK_SDD – Silicon Drift Detectors (Cryogenics)

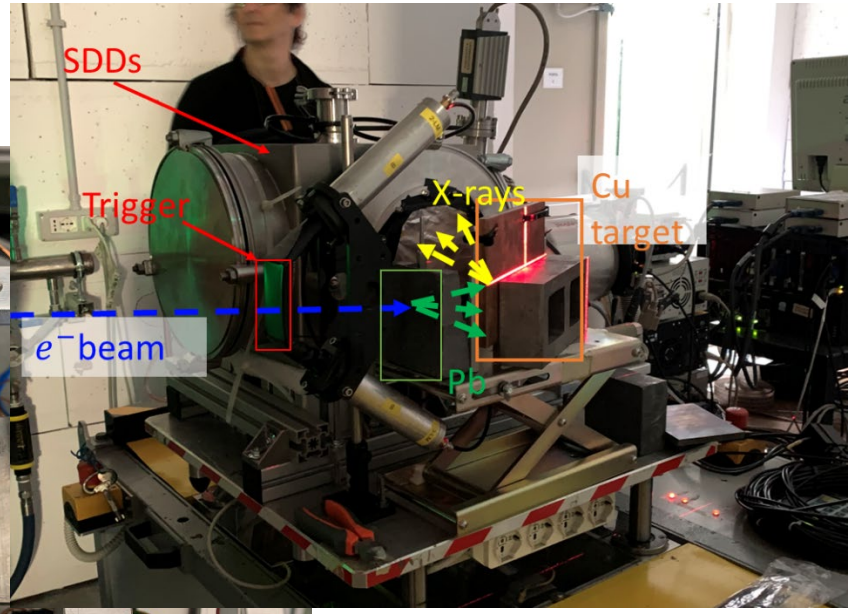
(F. Sirghi (LNF-INFN) et al.)

Spectroscopic measurement with first module by LNF group
Dedicated beam time in June and October 2024 at BTF
Irradiation with e- beam (on target, then X ray on detector) and X-ray sources. **Characterization of the 1 mm SDDs** time response as function of the temperature
Characterization of the energy response:
- new energy range 50 keV
Study of the **energy response in a high background environment**



BTF BEAM high flux STABILITY
6 days long measure without stop, very clean setup





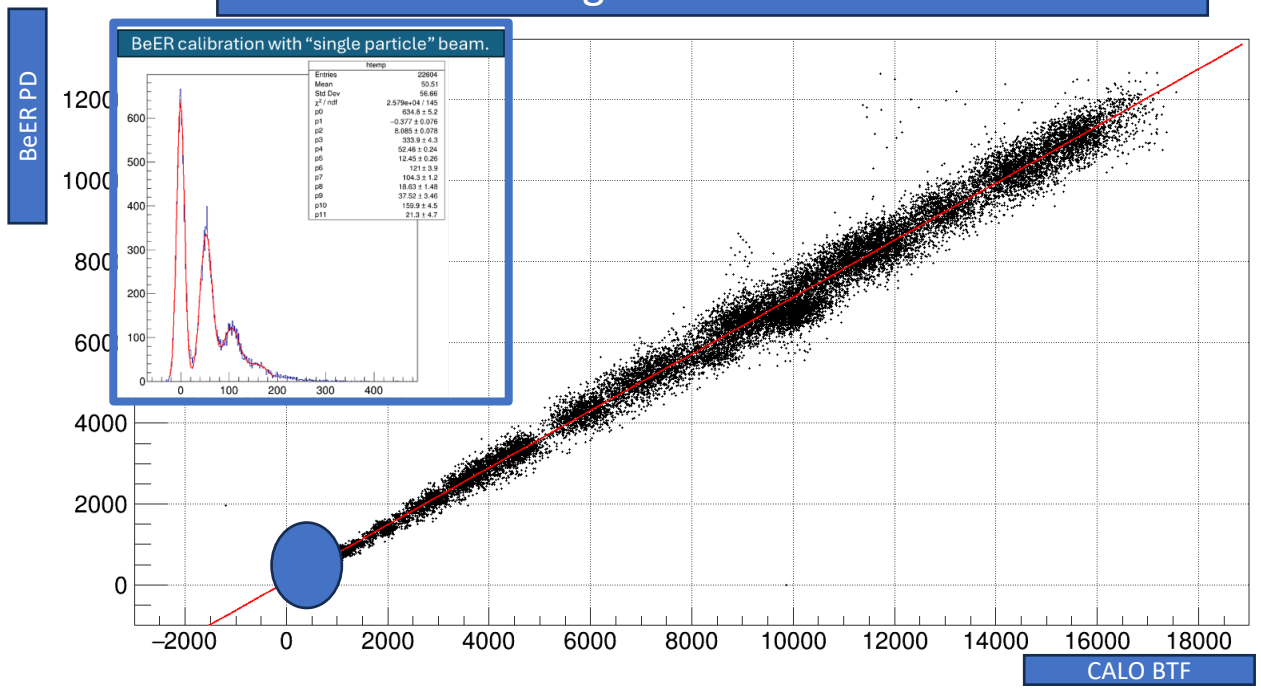
Dedicated beam time in June and October 2024
Different energies and multiplicities (June)
302MeV , m16k, electrons

BTF2 HI RANGE SCANS W SEC. BEAM

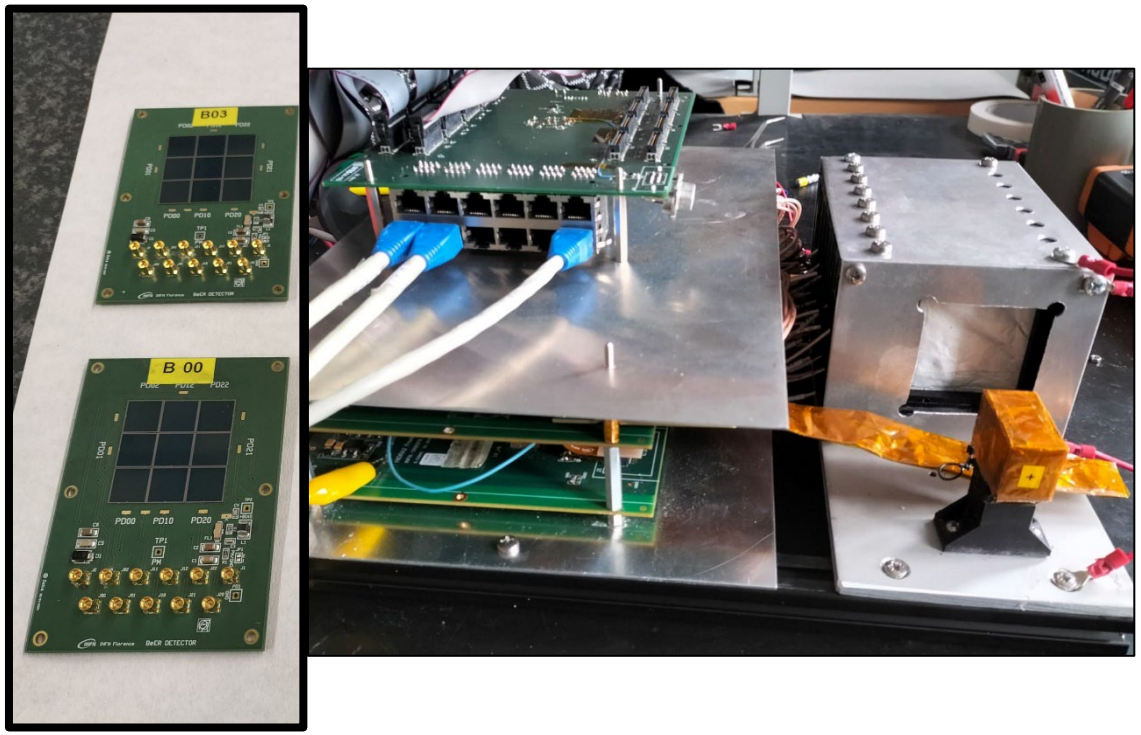
BeER (Beam-monitor with Extreme Range)
Photo Diodes (Pr. L. Pacini (FI-INFN) et al.)

BeER consists of 6 layers made of 3x3 blind PDs (active area of each PD = 1 cm2): Excelitas VTH2110 PDs are silicon PIN diode which are used as ionization detector.
BeER main goals: **easy to use online monitor of high energy nuclei (e.g. SPS ion) and high multiplicity (BTF electron) beams, easy to integrate in users DAQ** to provide event per event information of charge (or number of particles.)

BeER single sensor vs BTF Calo



BTF BEAM FROM SINGLE PARTICLE TO 20k Multi days scan
Large dynamic range confirmed with high multiplicity runs by using BTF CALO information: the detector is capable to count more than 10k electrons. Non-linearity estimation is ongoing.



Pulse sharing beam time in June 2024
302MeV, m1->16k, electrons

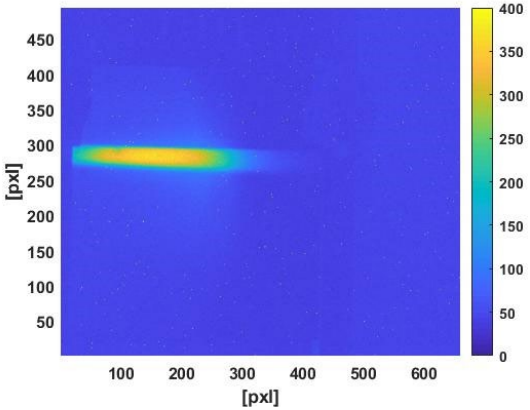
SPARC-ULENS

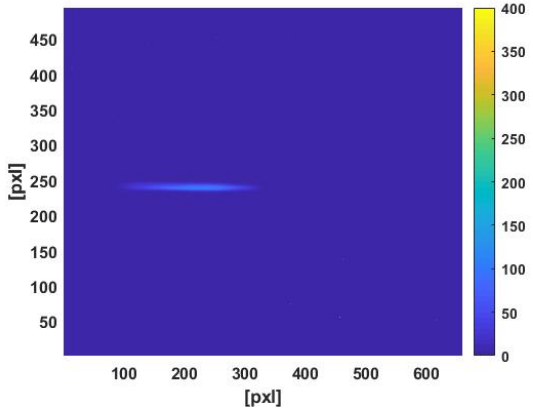
Synergistic emittance measurement system both for SPARC and BTF team.
Single-shot beam emittance via a pepper-pot-like method:
-> microlens array beamlets from the beam OTR radiation produced by the OTR radiator. Single shot measurement of **beam size (OTR beam image), beam divergence (from OTR ang. distr. image), beam correlation (from microlens)**

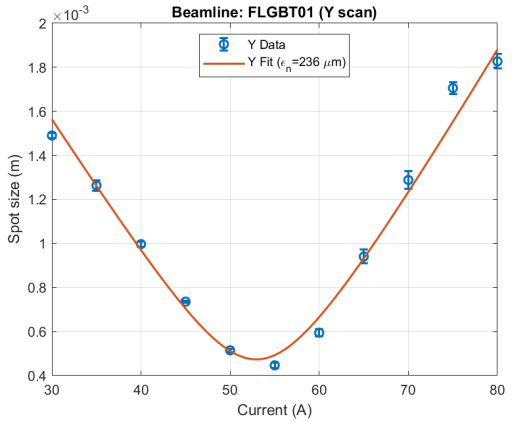
BTF USER run (New Diagn.): Jan 2023 – NEW SETUP

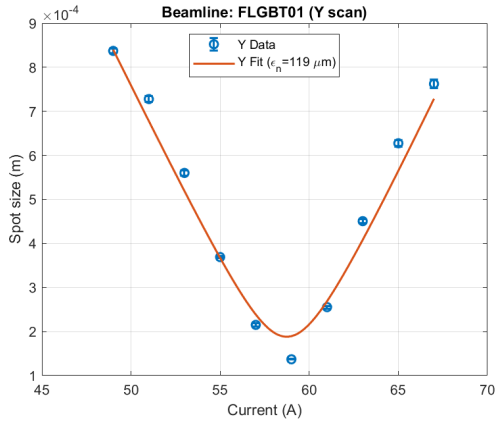
BTF beam 503 MeV, 1 Hz, ~10^7 e+/s, ~10^9 e-/s, optimized spot diameter for vertical measurement

ELECTRON Beam = 503 MeV/10ns/300pC
Vertical emittance (rms) 0,2±0,05 mm x mrad

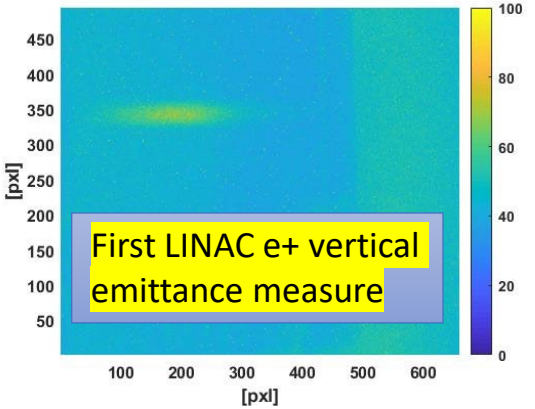


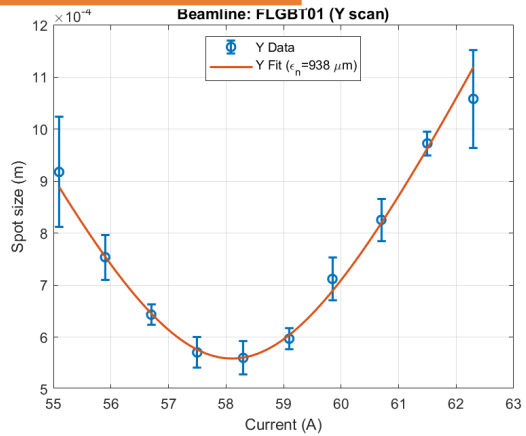


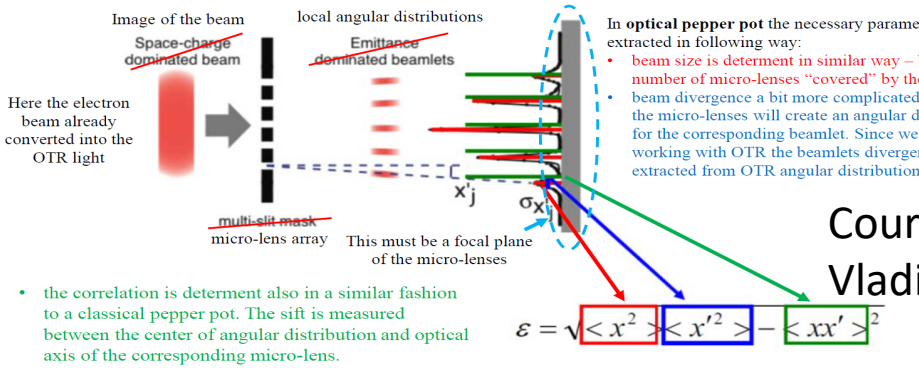




POSITRON Beam = 497 MeV/10ns/4,7pC
Vertical emittance (rms) 0,93±0,32 mm x mrad







Courtesy of Vladimir Shpakov

BTF RUNS FLASH VHEE REGIME

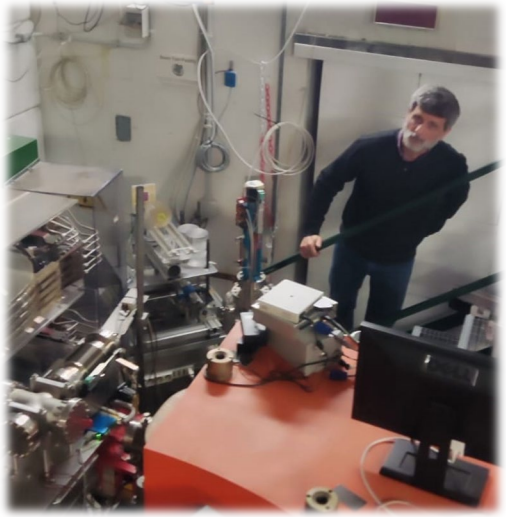
FLASH Effect in Radiotherapy :

Foreseen Therapeutical Advantages: spares healthy tissues while maintaining therapeutic efficacy.

Experimental Verification: Mostly in-vivo with low energy (4-7 MeV) electrons, delivering doses in less than 100 ms at rates over 40 Gy/s.

Requirements: Further basic research and advanced technological solutions.

=> Paradigm Shift in Radiotherapy: evidence suggests a potential use of the FLASH effect.



Following SIR meeting in winter
Thanks to V.Patera for the scientific liaison

- **Research Focus:**

  VHEE FLASH LINAC: Aiming to treat deep-seated tumors with Very High Energy Electrons (50-200 MeV).

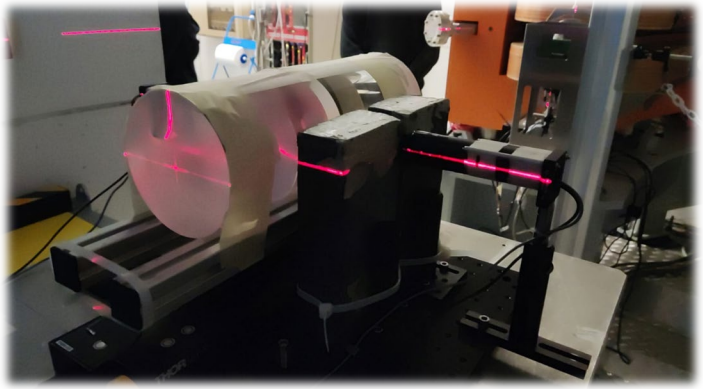
- **Scientific Needs explored in BTF:**

  Control Imaging Systems - MORSEPET

  Certified dosimetry in FLASH regime – DIAMONDS for VHEE

  New beam charge measurement in air – FLASHDC

  Currently BTF is a place of interest for many communities (FRIDA)

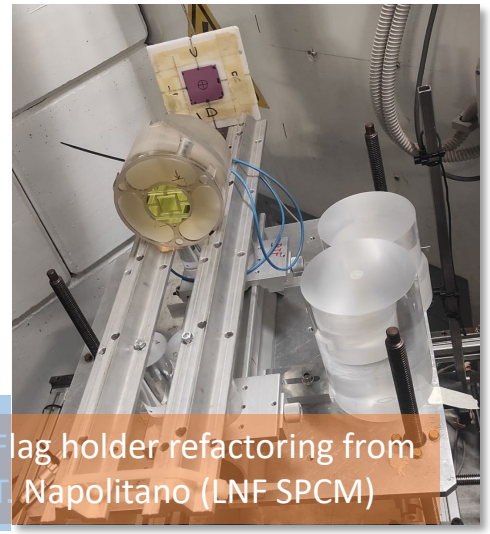


BTF RUNS FLASH VHEE

DIAMONDS for VHEE – new dosimetry - Medical Physics

M. Marinelli, **G. Rinati(Uni Roma TV),** L. Palumbo, L. Giuliani (Uni Sapienza)

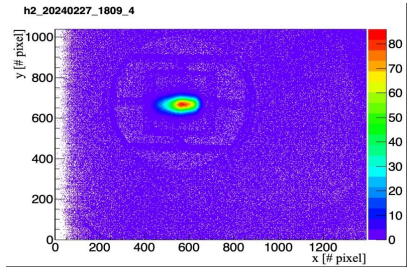
Dose measurement at high energy in FLASH regime, measure with Synthetic diamond based Schottky diodes operated at zero bias voltage



Shower n.1
510MeV, m1E9

Flag holder refactoring from T. Napolitano (LNF SPCM)

BTF triggered cams on Nd:YAG flags, in optical lock in regime

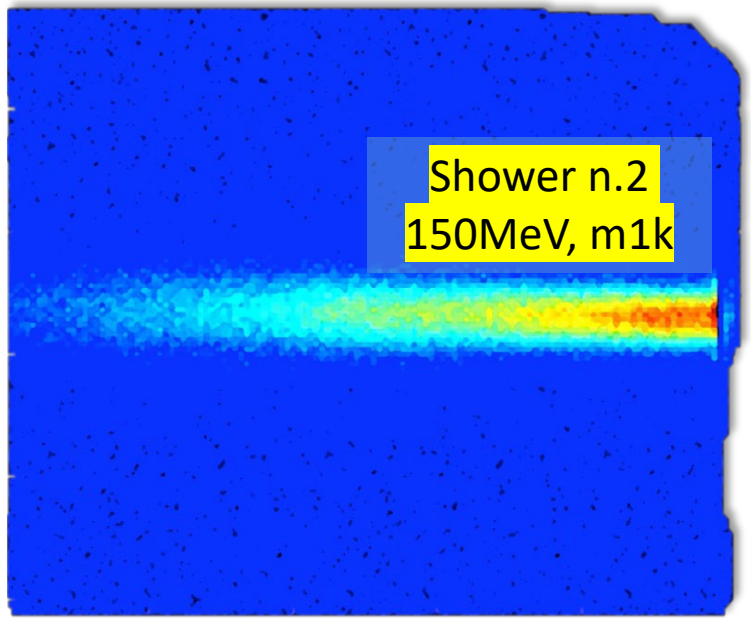


510MeV electrons primary beam, shot by shot dose measurement
Reproducing ELMA shower dose release in PMMA in different depths
Diamond active dose comparison with EBT3 GAFCHROMIC film
FIRST TRIAL ever MADE!!!

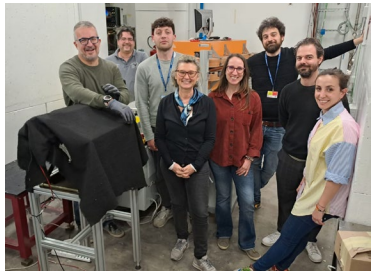
MORSEPET – Dose monitorng in real time - Medical Physics

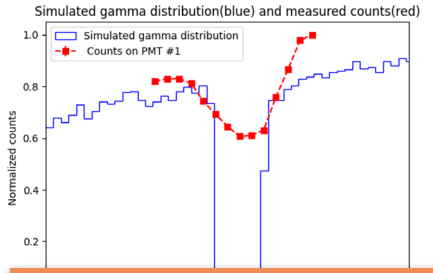
(M.G Bisogni et al. – Univ. Pisa)

a novel method to verify the dose delivered to a tissue or a phantom by a VHEE beam based on the detection of the Bremsstrahlung radiation emitted by the beam while crossing the tissue/phantom



Shower n.2
150MeV, m1k





150MeV electrons secondary m=1k, single shot, PMMA hollow

150MeV electrons secondary beam, m=1k, single shot
EJ212 plastic scintillator foil parallel to the beam direction
Cooled CCD camera to collect emitted peaked blue light

LIMADOU

CSES - LIMADOU is part of a scientific program that studies natural and anthropogenic electromagnetic fields, their emissions and possible correlations with seismic events.
https://w3.lnf.infn.it/una-pioggia-di-elettroni-per-lhigh-energy-particle-detector-di-cses-limadou/

Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati

BTF USER run (SPACE Appl) : 11 Jun -> 20 Jun

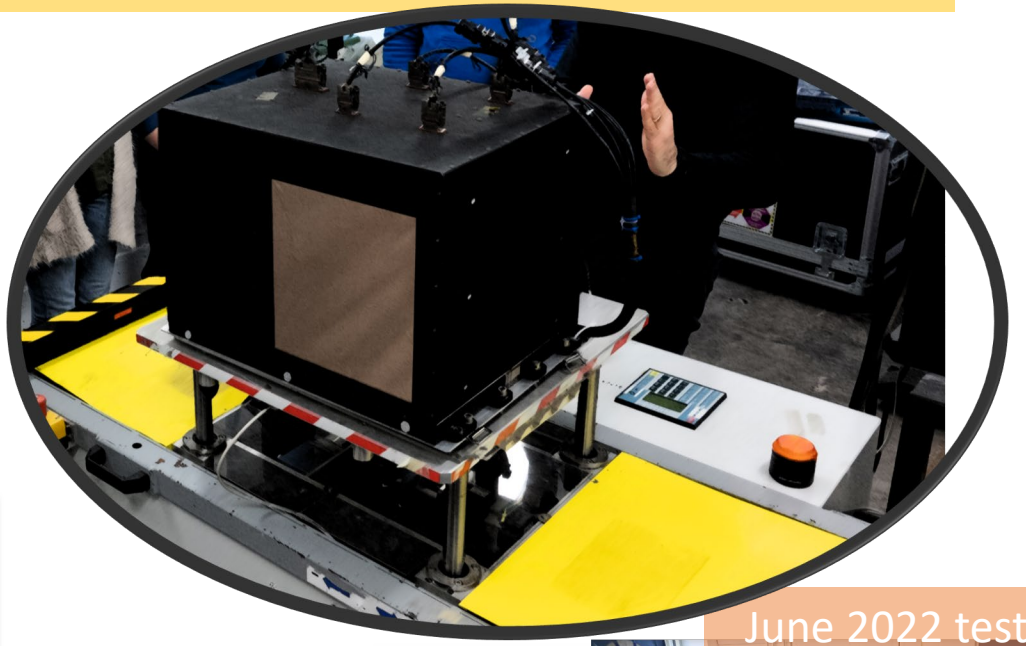
The main purpose of the test:
Check before flight HEPD with different BTF configuration set:

- from 30MeV to 120MeV in 15MeV steps,
- different multiplicity (mostly single particle for all energy sets)
- Large spot area up to 30 cm^2
- Collision angle

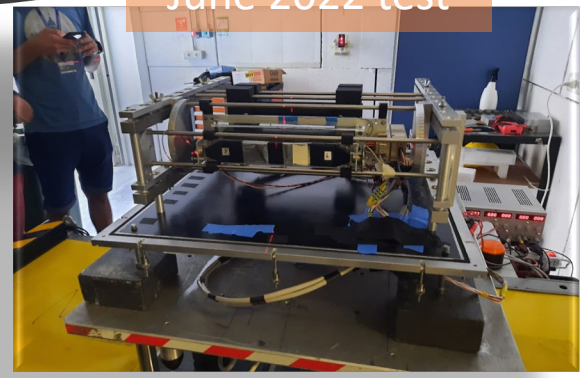
Flight model High-Energy Particle Detector (HEPD-02)

HEPD-02 comprises a tracker made of CMOS Monolithic Active Pixel Sensors (MAPS), a double layer of crossed plastic scintillators for trigger and a calorimeter, made of a tower of plastic scintillators and a matrix of inorganic crystals, surrounded by plastic scintillator planes for containment tagging.

All the HEPD subsystem was tested as programmed



June 2022 test

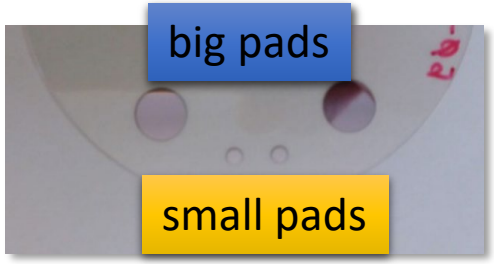


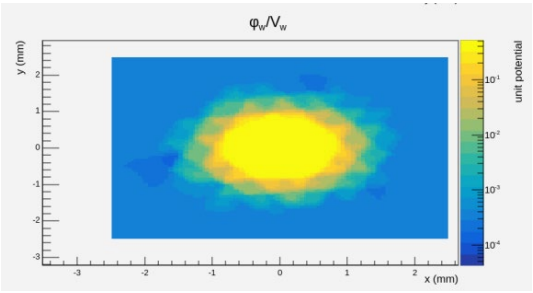
LUXE 2022

(Laser Und XFEL Experiment) is a new experiment proposed at DESY and the European XFEL to study QED in the strong-field regime where QED becomes non-perturbative

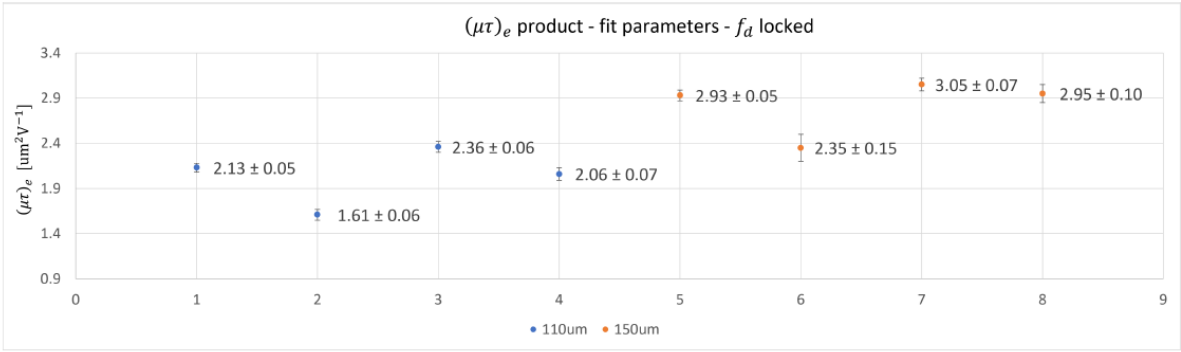
BTF USER run (New Detector dev.): 9 May-> 13 May

BTF beam 300MeV, m=10K scan, completely contained -> sim over E field fringing effects

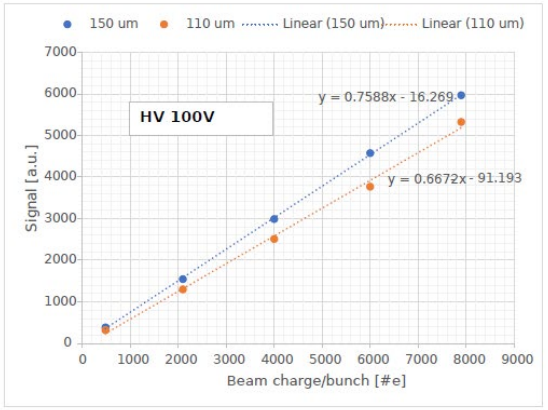




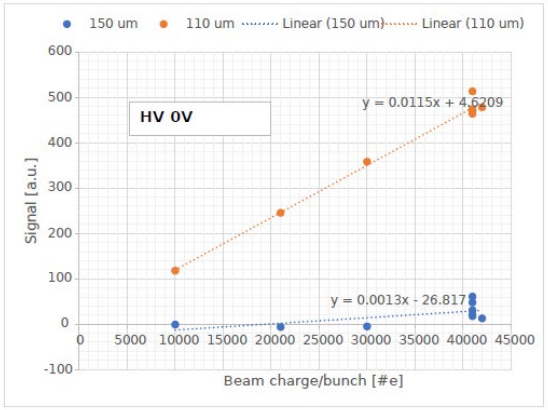
(**L**aser **U**nd **X**FEL **E**xperiment) is a new experiment proposed at DESY and the European XFEL to study QED in the strong-field regime where QED becomes non-perturbative
2 x Sapphire wafer(2in) Thick d2=0.15 mm
2 x Circular Pads R1= 0.8 mm and R2=2.75 mm



		Forward		Reverse		Forward		Reverse		
		LargePad	SmallPad	LargePad	SmallPad	LargePad	SmallPad	LargePad	SmallPad	
110	\mu\tau	2.13	1.61	2.36	2.06	2.93	2.35	3.05	2.95	150
	err	0.05	0.06	0.06	0.07	0.06	0.15	0.07	0.1	
		1	2	3	4	5	6	7	8	



(a) $V_{\text{bias}} = 100\text{V}$

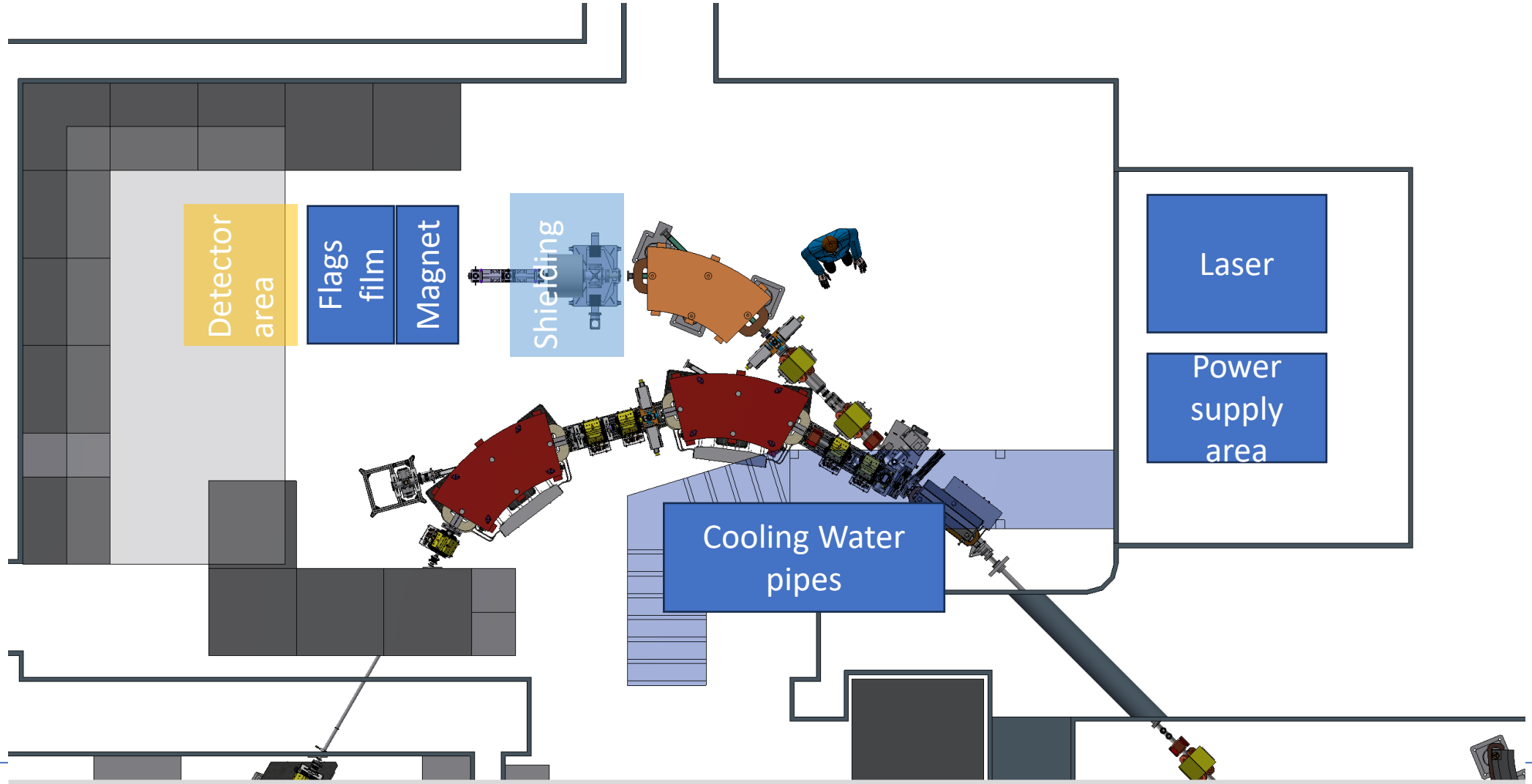


(b) $V_{\text{bias}} = 0\text{V}$

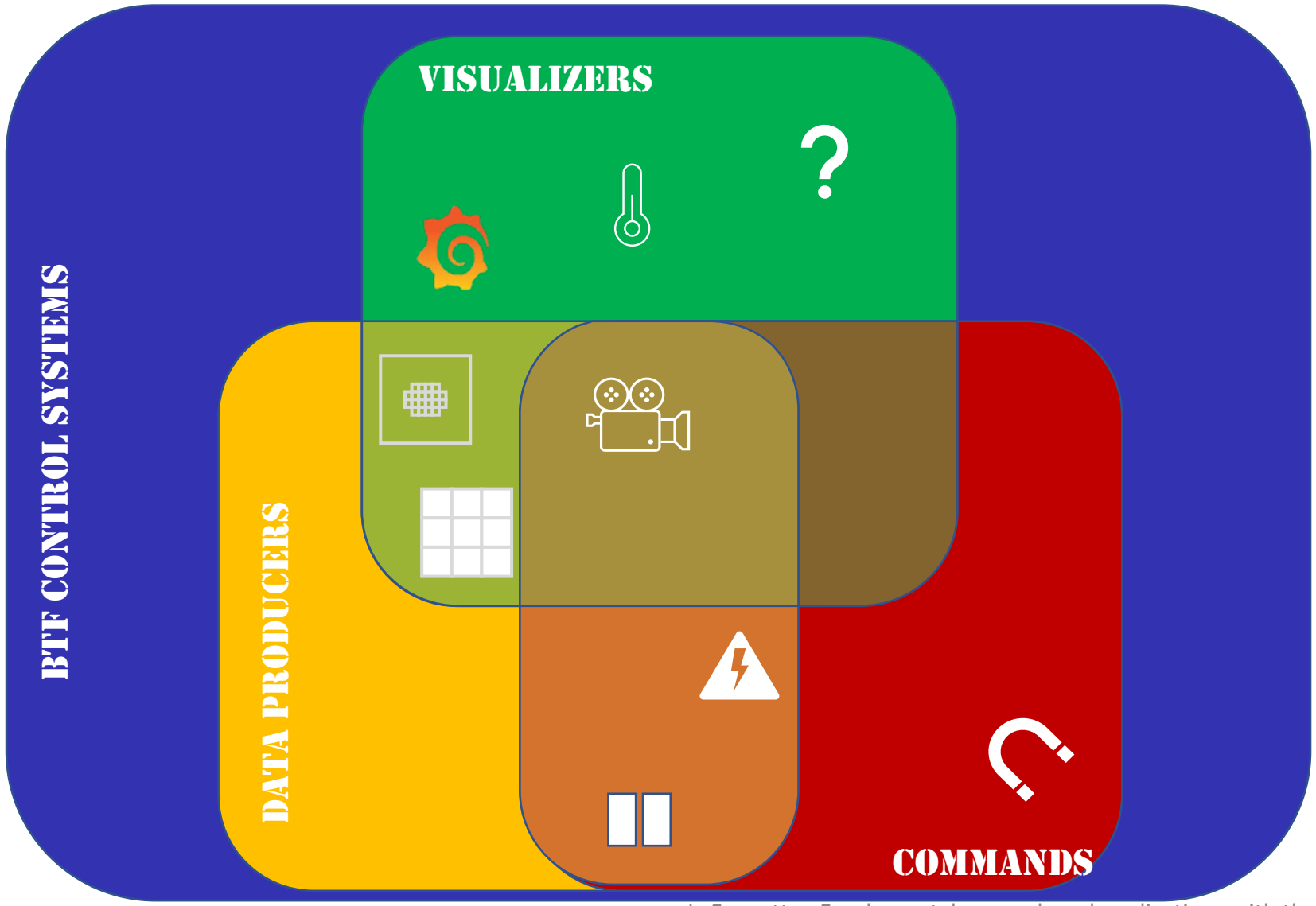
- **First test as Sapphire photon current integrator for LUXE experiment**
- As a preliminary response, impressive linearity in wide range in multiplicity and voltage scan
- Team reached the goal to be first in detect such Sapphire Charge Collection Efficiency

Courtesy of P. Grutta and M. Morandin

FIREBALL@BTF



SUMMARY OF THE UPGRADES



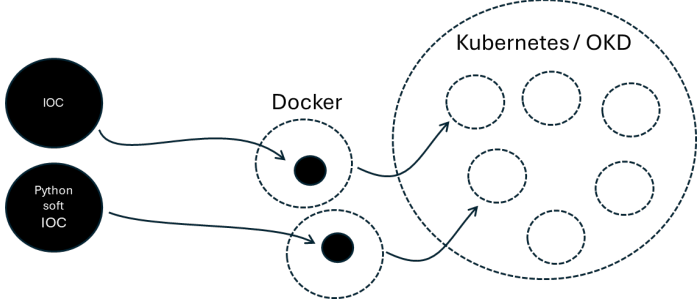
EPICS

- Magnets
- Scrapers
- Cams
- HV
- PTU+Vacuum

PYTHON

- PyFitPix
- PyStatus
- PyGenny

BTF NEW DCS DEVELOPING – EPIK8S



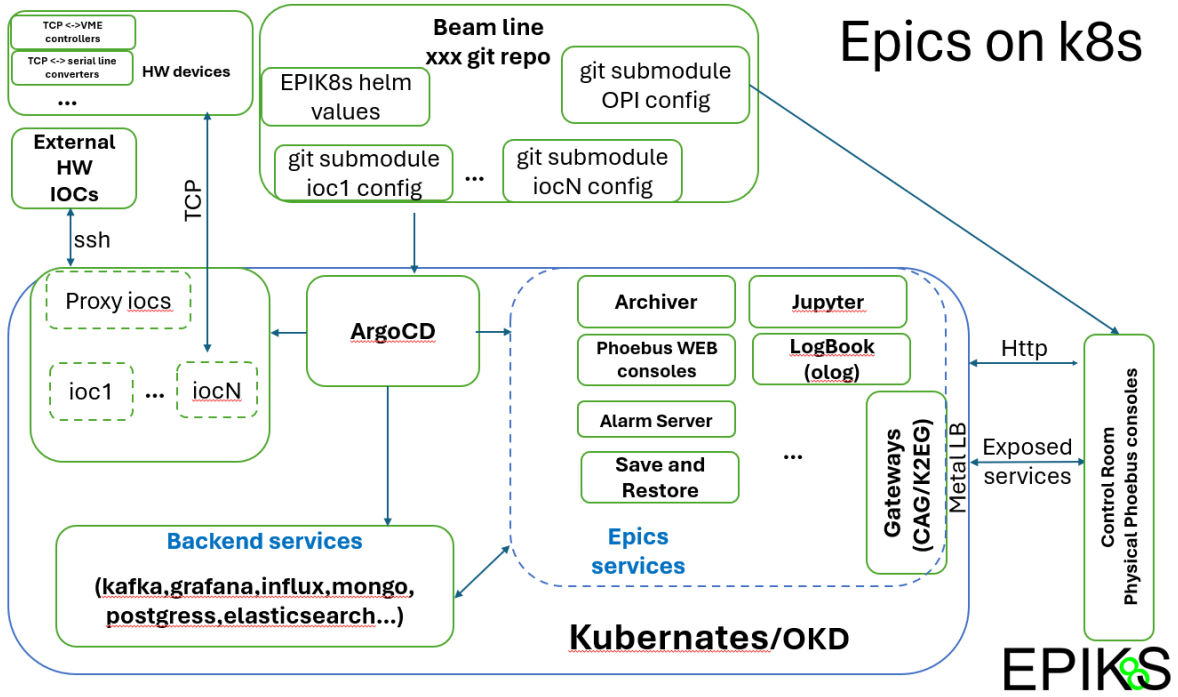
- BTF was fundamental for !CHAOS developing (still in use) starting from 2011
- New standard with EPIK8S standard
- For EUPRAXIA and ELI-NP DCS implementation
- EPICS based **but huge improvement in cutting-edge technologies for systems management** (dockerization and orchestration, even on the cloud) **and tools for users** derived from !CHAOS development

Current tests on:

- MAGNET,
- MOTOR (scrapers),
- TRIGGERED CAMS (flags)
- O-LOG
- SNAPSHOTS

ADDED developing for BTF needs:

- HV crates control,
- PTU sensors,
- LABVIEW to EPIK8S channels (via json)



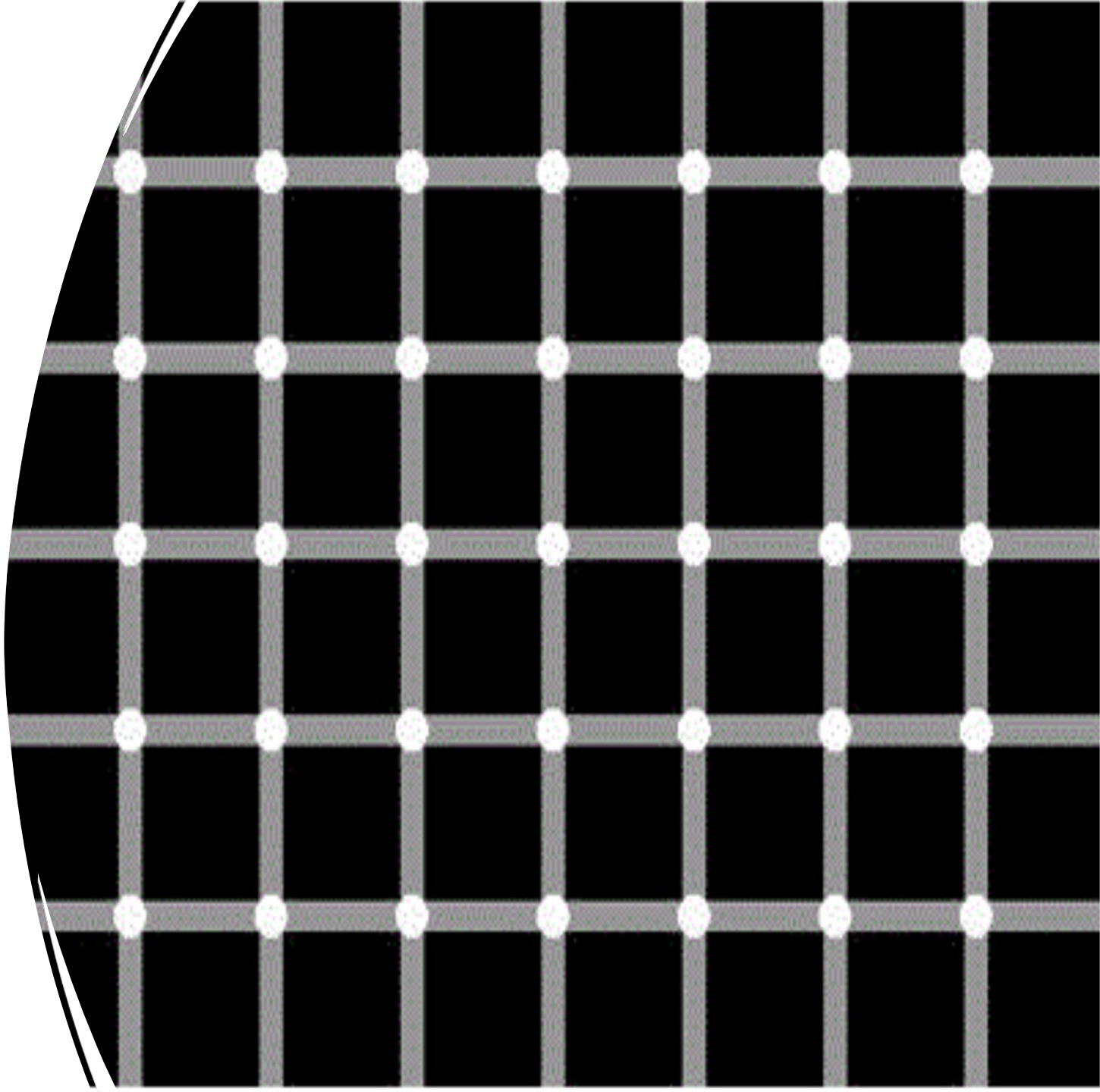
2024 SOME CONTRIBUTION CITING BTF

Cantone, C., Ceravolo, S., Colao, F., Di Meco, E., Diociaiuti, E., Frank, I., ... & Tagnani, D. (2024). R&D status for an innovative crystal calorimeter for the future Muon Collider. *IEEE Transactions on Nuclear Science*.	MUON COLLIDER
Chiti, M., Chiti, D., Chiarelli, F., Donghia, R., & Esposito, A. (2024). Photon and neutron dose evaluation at the Beam Test Facility of the INFN-National Laboratory of Frascati. *Radiation Measurements*, *176*, 107216.	NEUTRON DOSE MEASUREMENT
Antonelli, A., Auffray, E., Brovelli, S., Bruni, F., Campajola, M., Carsi, S., ... & Vallazza, E. (2024). Development of nanocomposite scintillators for use in high-energy physics. Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 1069, 169877.	NANOCOMPOSITE Scintillator, MUON COLLIDER, CRILIN
Avoni, G., Benettoni, M., Bruschi, M., Cian, A., Dal Corso, F., Dosselli, U., ... & Zuffa, M. (2024). Development of a sapphire microstrip detector for gamma beam monitoring. Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 1068, 169752.	LUXE
Testa, M., De Santis, A., Tinti, G., Paoloni, A., Papalino, G., Felici, G., ... & Rovelli, C. (2024). Direct detection of minimum ionizing charged particles in a perovskite single crystal detector with single particle sensitivity. Nanoscale, 16(27), 12918-12922.	PEROSKIVITE
der Maur, M. A. PEROV: R&D for photodetectors based on Organo-Metal Halide Perovskite materia. LNF NOTE	PEROSKIVITE
Borra, F. Study of the PMTs signals during the first underground run of the LIME prototype for the CYGNO experiment (No. CERN-THESIS-2023-323).	DM SEARCHES, CYGNO, THESIS
Bertelli, S., Bossi, F., Ceravolo, S., Corradi, G., Di Giulio, C., Di Meco, E., ... & Padme Collaboration. (2024). Design and performance of the front-end electronics of the charged particle detectors of PADME experiment. Journal of Instrumentation, 19(01), C01051.	PADME
Cantone, C., Cemmi, A., Ceravolo, S., Ciccarella, V., Colao, F., Di Meco, E., ... & Zuliani, D. (2024). Developing an alternative calorimeter solution for the future Muon Collider: The Crilin design. Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 169973.	CRILIN, MUON COLLIDER
Bertelli, S., Bossi, F., Di Giulio, C., Di Meco, E., Dimitrova, K., De Sangro, R., ... & Variola, A. (2024). Beam diagnostics with silicon pixel detector array at PADME experiment. Journal of Instrumentation, 19(01), C01016.	PADME
Mancini, M. (2024). Searching for X17 using resonant production at PADME. IL NUOVO CIMENTO, 100(254), 47.	PADME
Bertelli, S., Bossi, F., Buonomo, B., De Sangro, R., Di Giulio, C., Di Meco, E., ... & Vilucchi, E. (2024). Characterization of the PADME positron beam for the X17 measurement. arXiv preprint arXiv:2405.07203.	PADME
Carsi, S. (2024). Advanced Tracking System for Crystal Physics (No. CERN-THESIS-2024-017).	BENT CRYSTAL, THESIS
d'Elba, L. B. I. PM2021-15th Pisa Meeting on Advanced Detectors-Edition.	VHEE, Conference

Around 20 paper citing BTF (Jan. 2024, Nov. 2024)

- Others in the ARXIV or different channels
- Positive feedback to users via sharing BTF live data
- Some detectors are directly developed at BTF in different runs
- BTF beamline scientists provide significant support during the experiment project phase and in understanding data

BTF Facility User Management



ASIF 2

Project lasting 2025-2027

ASIF – an ASI, ENEA, INFN, UniMiB project with INFN TT

Goal

- Create a national network to support customers and scientific research on radiation hardness assessment for space projects

Exploits

- Top-notch research labs and irradiation facilities
- Shared strategic vision from ASI, ENEA, INFN, UniMiB
- Dedicated professionals

Commitments on WP1500

Calibration activities of space detectors with electron beams, exploiting the specific temporal and energetic properties of the BTF.

Feasibility study of irradiation campaigns and radiation damage measurement with electron beams on space components (electronics and sensors).

Maintenance and updating of the test facility and systems for measuring the intensity and fluence of test beam particles

Funding of 83k(personnel, CTER), 32k (infrastructure)

PROJECTS

- **ASIF-2**
  - Just started
- **PNRR - Rome Technopole**
  - C. Taruggi in BTF group as synergy with TEX facility
- **EUROLABS**
  - 86k for funding, up to 2026
  - Good levelling in 2024, 4 over 7 week slotted

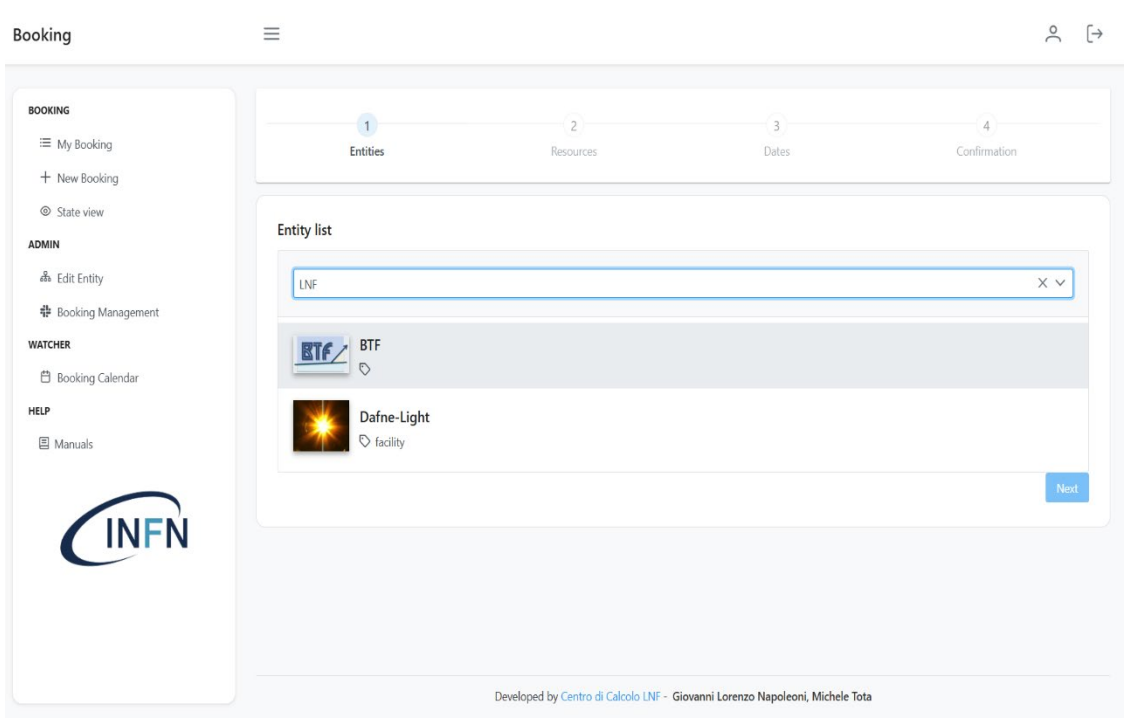
Projects/users want to involve LINAC/BTF for long term collaboration

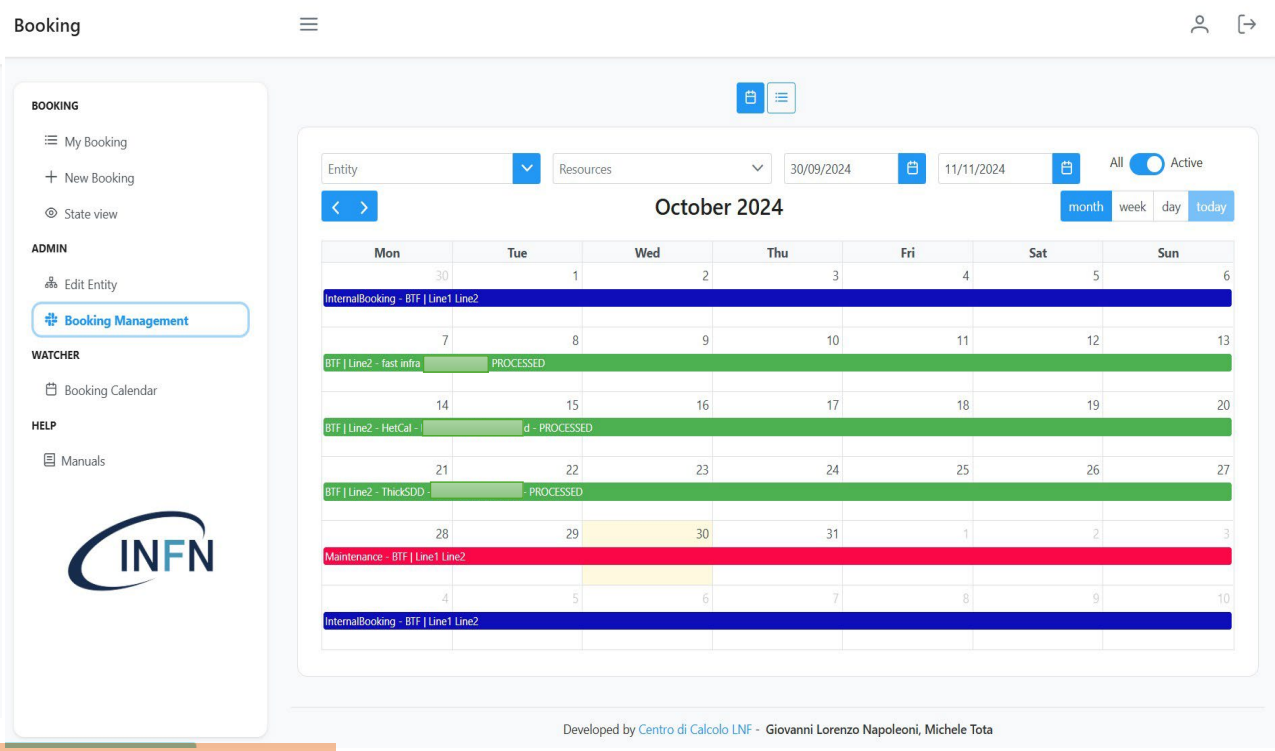
- Long term plan
- Funding
- People

BOOKING SW

Booking BTF: BTF booking management software based on an automated approval workflow software. Call management.

Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati





Implemented New GUI
Three versions with different capabilities in currently in production

Tech note
https://www.openaccessrepository.it/record/143679

Developed G. L. Napoleoni (LNF Computing Center, main dev.), R. Orrú, M. Tota, G.Papalino
BTF group and LNF Secretariats (and bug-finder group):

- AD-Secretariats (M.R. Ferrazza, G. Vinicola, V. Rosicarelli)
- Personnel-Secretariats (G. Dalla Vecchia, F. Triolo, L. Occidente, A. Mininni)

Typical developing time ~3 person-month
(full customization, design-devel-test-debug)
Definitely simple to use, as reported by users

BOOKING SW

Booking BTF: BTF booking management software based on an automated approval workflow software. Call management.

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CURRENT ONLINE Version

Beam Test Facility(BTF)

- **More than three years of continuos developing**
- **Almost Two years of continuous operation with users**

DAϕNE-L Facility

- **Software released**
- **In test for final bug correction for Call type**
- **Final release for on demand type**

PLC/UTA remote control

- For Conference room booking related automation control
- Developed for LNF Techical Division, yet to be evaluated

INFN-LABEC developing

- **Released** few month ago
- Collaboration born on INFN-A

REQUESTED Development

FISMEL (LNF)

- **Reservation for radioactive sources**
- Software development in progress

CHNET(Cultural Heritage Network)

- Use booking software for booking facilities and resource for CHNET
- Proposal under evaluation

ASIF-2 (TIFPA-LNS)

- Needs BTF like or extended version

GGI (Galileo Galilei Institute)

- Needs BTF like version

SPARCLAB-EUPRAXIA

- Needs BTF like or extended version

BOOKING SHARED INFO

Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati

[BTF site]
https://btf.lnf.infn.it/

https://btf.lnf.infn.it/schedule-beam-request/

[BTF wiki]
https://wiki.infn.it/strutture/lnf/da/btf/home/

Technical, Call for submission information and documentation

[INFN User Portal guide]
http://btf.lnf.infn.it/wp-content/uploads/sites/75/2023/03/Instruction_INFN_USER_Portal.pdf

INFN Identity management guide (for getting BTF beamtime and access)

[Booking Call for beam time guide]
https://btf.lnf.infn.it/wp-content/uploads/sites/75/2023/03/Booking_BTF_Call_Guide.pdf

[Booking guide for Team Leader]
http://btf.lnf.infn.it/wp-content/uploads/sites/75/2023/03/Booking_guide_team_LEADER.pdf

[Booking guide for Team Members]
http://btf.lnf.infn.it/wp-content/uploads/sites/75/2023/03/Booking_guide_team_MEMBER.pdf

Call for proposal submission guide

[BTF submit proposal software]
https://booking.dsi.infn.it/

INFN Identity management guide (for getting BTF beamtime and access)

BOOKING SHARED INFO

Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati

BTF - INFO

To get informed about BTF experimental call opening, please check:

- BTF site and/or
- Subscribe to BTF Newsletter

Next call foreseen in early 2025 for 2025 Q4 beamtime, stay tuned

https://mediawall.infn.it/v/1030

If you need more information or help, please contact btf@lists.lnf.infn.it

LINAC/BTF results have to be shared with all the LNF people involved

- DT and DA services, secretariats and administrations
- Especially the DAΦNE OPERATORS

And, why not, also to users that share knowledge about the cutting edge detector physics and technology

BTF - Transnational Access

BTF is part of the EURO-LABS (EUROpean Laboratories for Accelerator Based Science) project that has received funding from the European Union's Horizon Europe Research and Innovation programme under Grant Agreement no. 101057511.

https://web.infn.it/EURO-LABS/
https://web.infn.it/EURO-LABS/transnational-access/