

BTF

OPEN DAY

Il trasferimento tecnologico dalla ricerca alla rete imprenditoriale

INFN- Laboratori Nazionali di Frascati
15 giugno 2017



INFN
Istituto Nazionale
di Fisica Nucleare
Laboratori Nazionali di Frascati

Studio di resistenza alle radiazioni di componenti elettronici per applicazioni in aerospazio

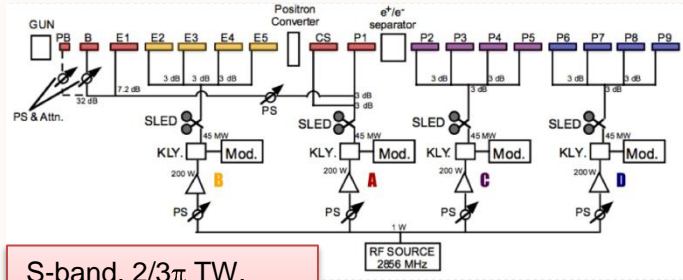
L. Foggetta - INFN LNF

G. Cucinella - IMT srl

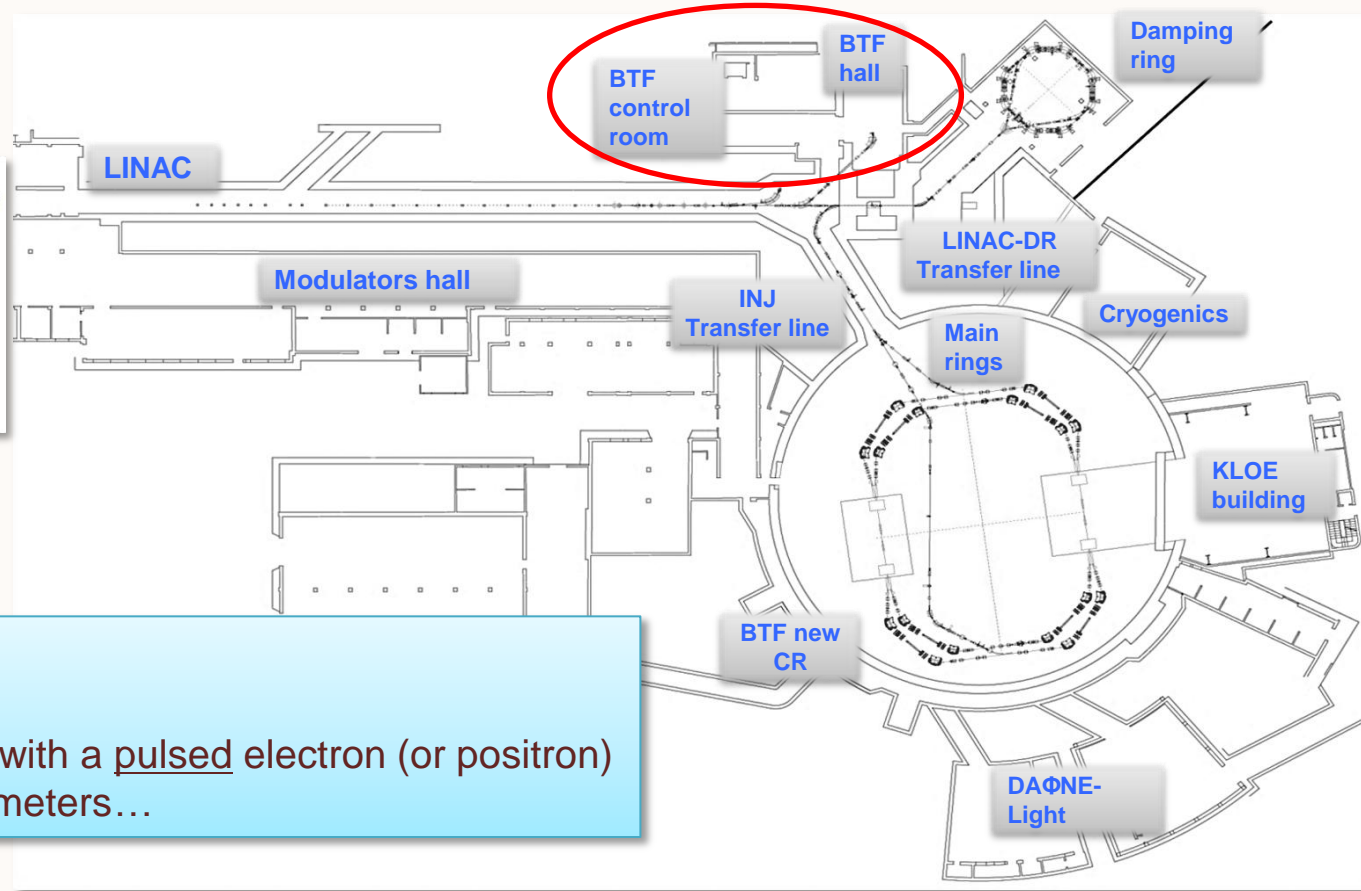


The **BTF** is part of the **DAΦNE** accelerator complex:

it can extract and manipulate the high intensity **LINAC** beam

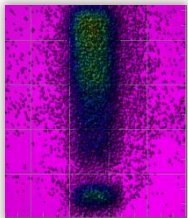


S-band, $2/3\pi$ TW, SLAC-type, SLED compression, thermo-ionic gun



BTF is a facility optimized for

- **calibration and test**
- with the possibility of **irradiation** with a pulsed electron (or positron) beam, in a definite range of parameters...



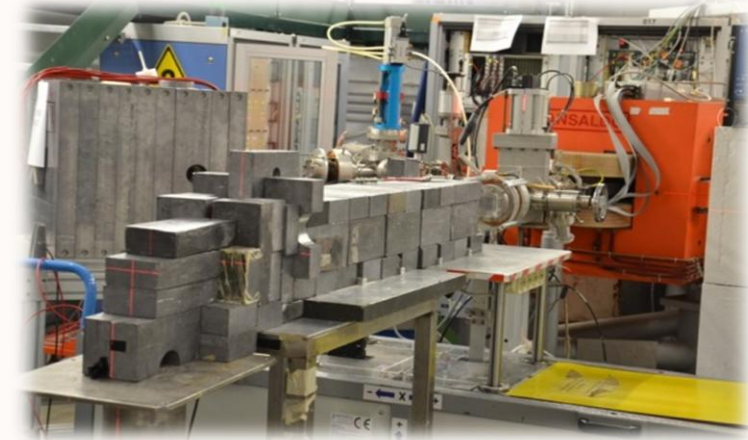
Detailed information and contacts

- Main web site: <http://www.lnf.infn.it/acceleratori/btf>
- Technical information and documentation: <http://wiki.infn.it/strutture/lnf/da/btf/home>
- Scientific contact: paolo.valente@roma1.infn.it, Technical contact: btf@lnf.infn.it,
- Administration and access contact: btfsupport@lnf.infn.it

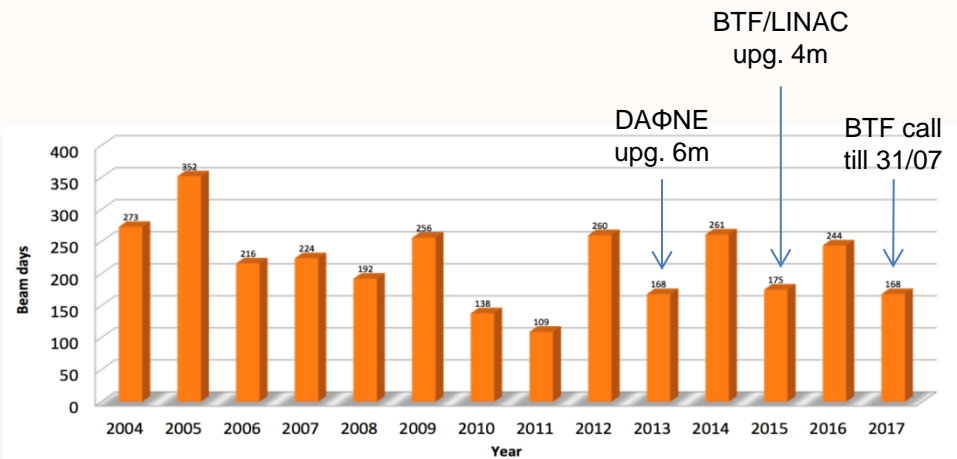
The BTF (Beam Test Facility) is composed of:

- a transfer line
 - driven by a pulsed magnet
 - can steer primary electrons or positrons coming from LINAC,
 - or create secondary beams from electromagnetic shower
 - electrons or positrons are selected in energy, multiplicity and transverse dimensions

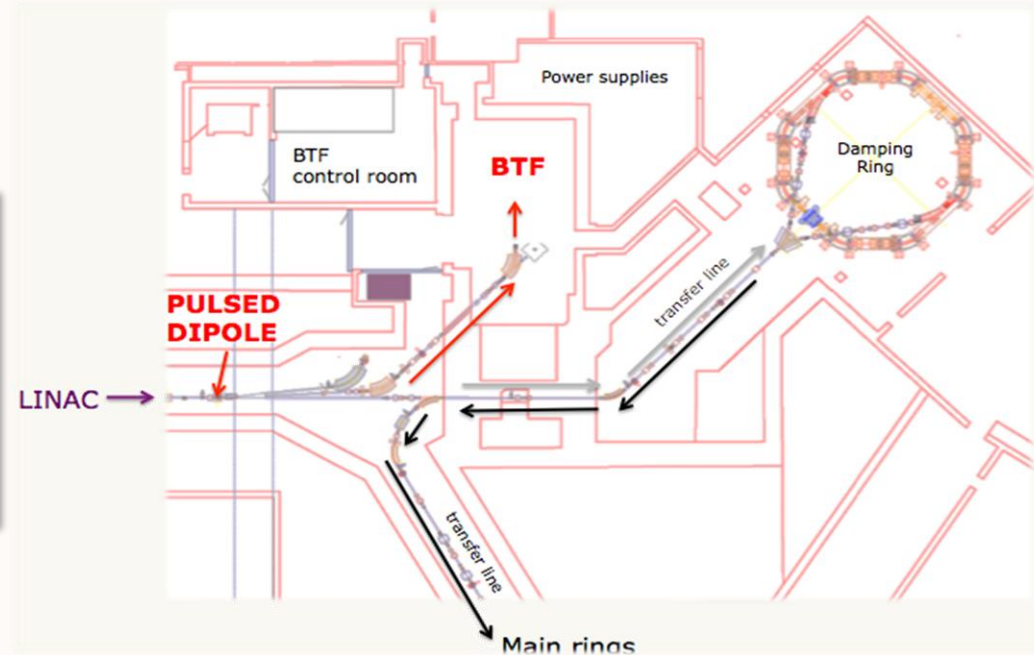
- a 100 m² experimental hall,
 - good availability of services/detectors
 - open to external users
 - fully booked!

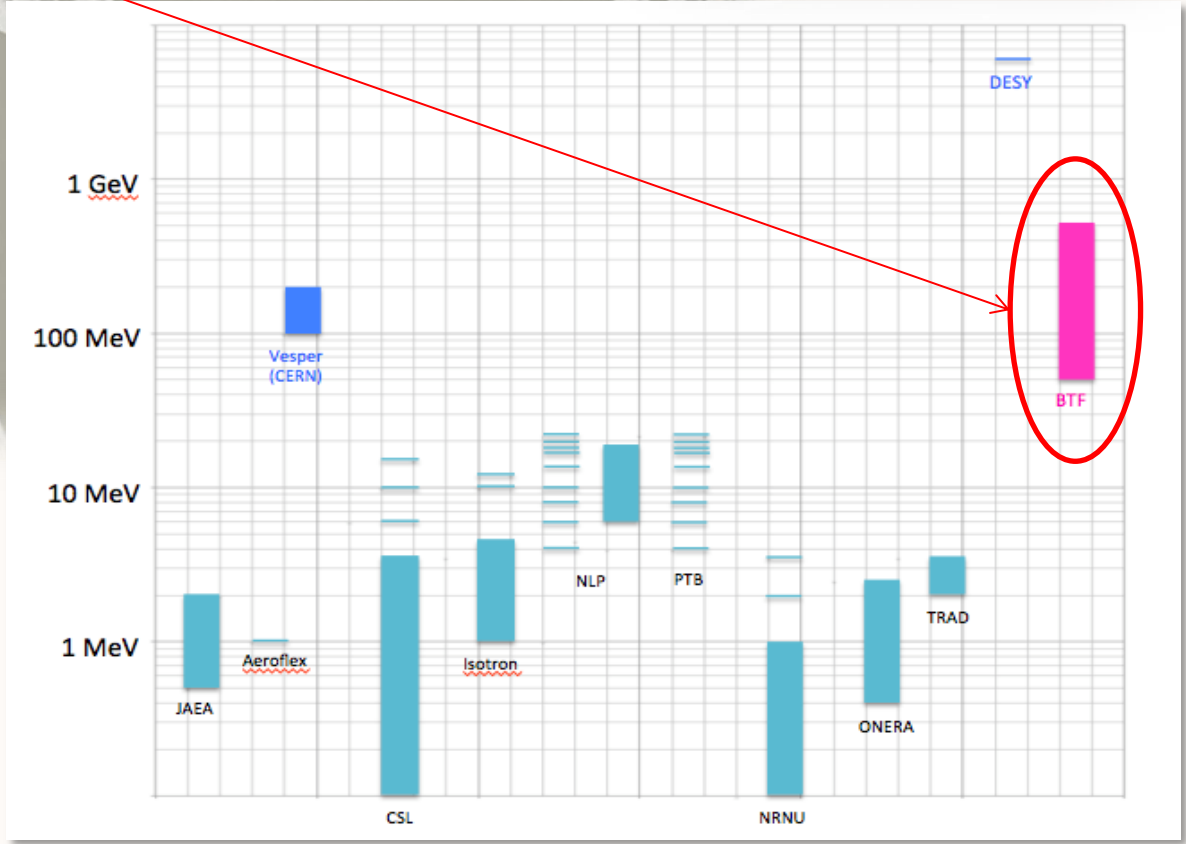
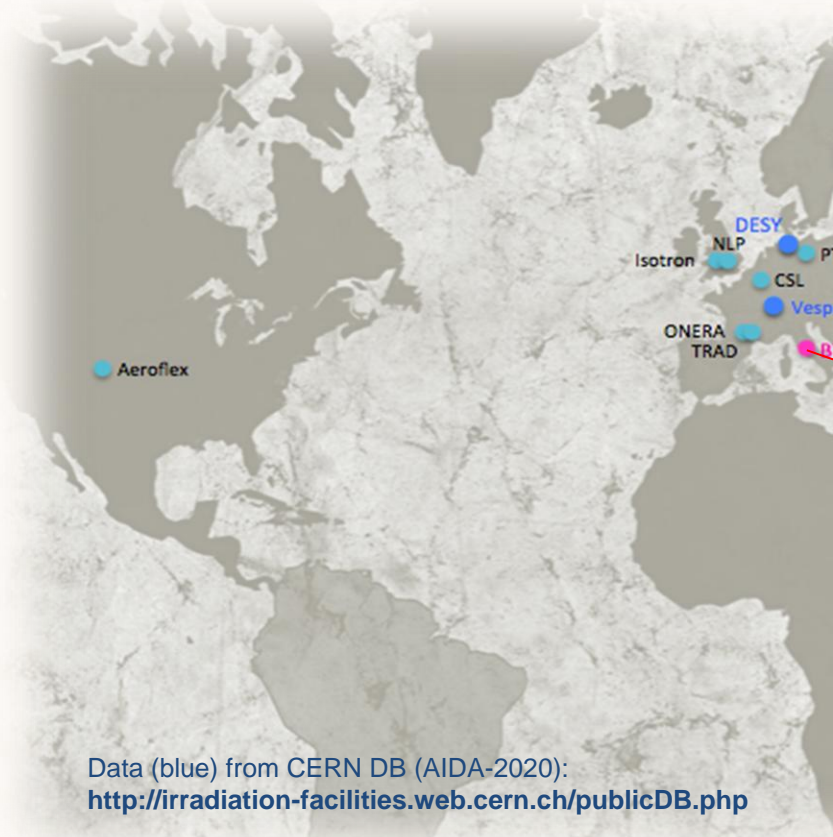


CVD beam-loss monitor for LHC



→ External users, beam on, days





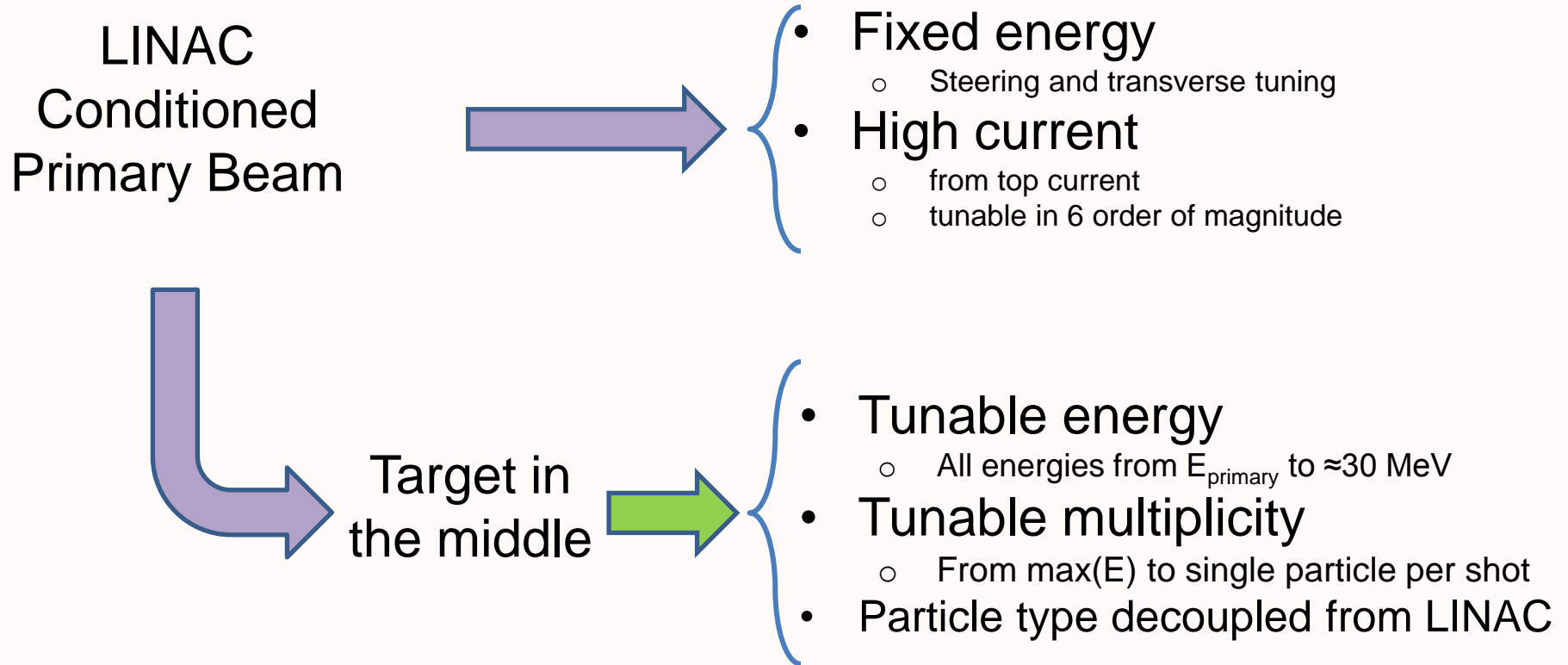
Data (blue) from CERN DB (AIDA-2020):
<http://irradiation-facilities.web.cern.ch/publicDB.php>

Different parameters:

- Source type
- Radiation field
- Energy
- Flux and fluence

Beam parameters

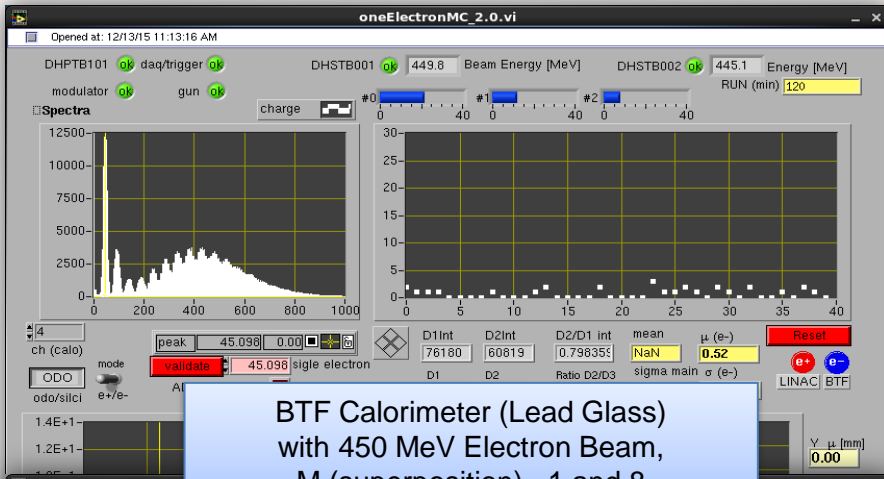
The beam can be delivered in different modes: **dedicated** or **opportunistic** operations and **with** or **without** attenuating target. Different ranges of beam parameters can be achieved:



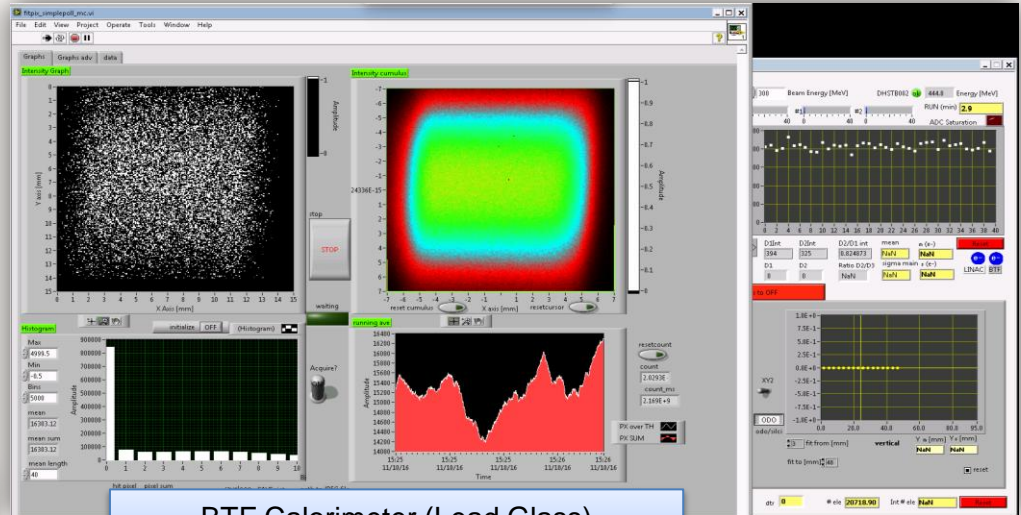
Parameter	Opportunistic mode		Dedicated mode	
	With target	Without target	With target	Without target
Particle species	e ⁺ or e ⁻ Selectable by user	e ⁺ or e ⁻ Depending on DAFNE mode	e ⁺ or e ⁻ Selectable by user	
Energy (MeV)	30–500	510	30–700 (e-) 25–500 (e+)	250–750 (e+) 250–530 (e-)
Energy spread	1% at 500 MeV	0.5% (e-) 1% (e+)	0.5%	0.5% (e-) 1% (e+)
Repetition rate (Hz)	10 - 49 Depending on DAΦNE mode	2 Hz	1–49 Selectable by user	
Pulse duration (ns)	10		1.5–200 Selectable by user	
Intensity (particles/bunch)	1–10 ⁵	10 ³ –1.5 10 ¹⁰	1–10 ⁵	10 ⁵ –3 10 ¹⁰
Maximum average flux	3.125 10 ¹⁰ particles/s			
Spot size (mm)	1–55 (x) × 1–25 (y)			
Divergence (mrad)	>1.5			

OK, no need to read the full table
in spare slides available fluence vs. energy for irradiation

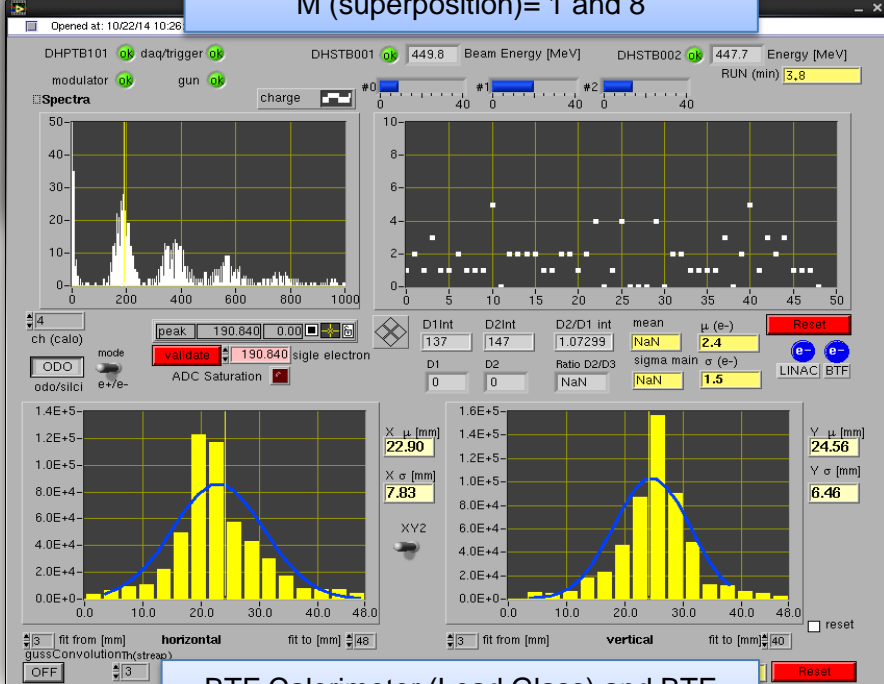
The run-time diagnostics (some of)



BTF Calorimeter (Lead Glass) with 450 MeV Electron Beam, M (superposition)= 1 and 8



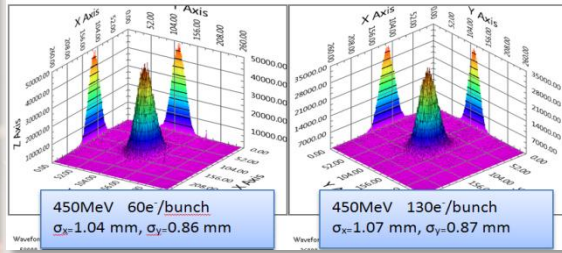
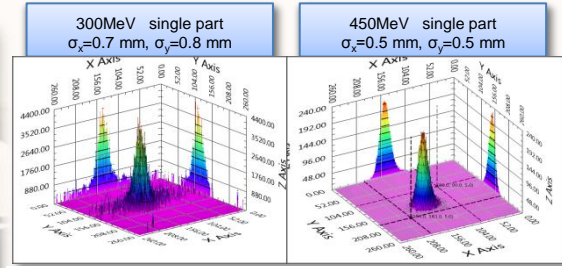
BTF Calorimeter (Lead Glass) vs Fitpix, ToT comparison run



BTF Calorimeter (Lead Glass) and BTF Fiber Hodoscope with Electron Beam, m=1



Fitpix v2



Is time already up?

More info in the spare slides



Visita nel pomeriggio

Grazie!



LINAC and BTF team

Maurizio Belli, Bruno Buonomo, Riccardo Ceccarelli, Alberto Cecchinelli,, Renato Clementi, Claudio Di Giulio, Luca Foggetta, Graziano Piermarini, Luis Antonio Rossi, Serena Strabioli, Raffaele Zarlenga – LNF

Paolo Valente – Roma

BTF support

Federica Triolo, Maria Rita Ferrazza, Manuela Giabbai, Francesca Casarin

+ for the BTF upgrade

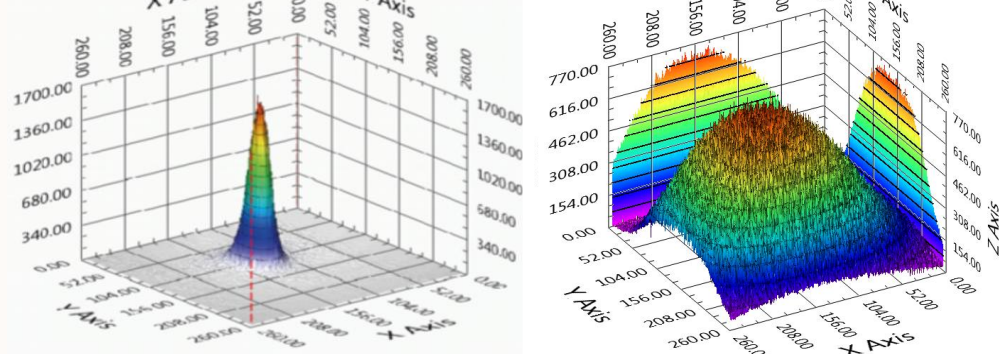
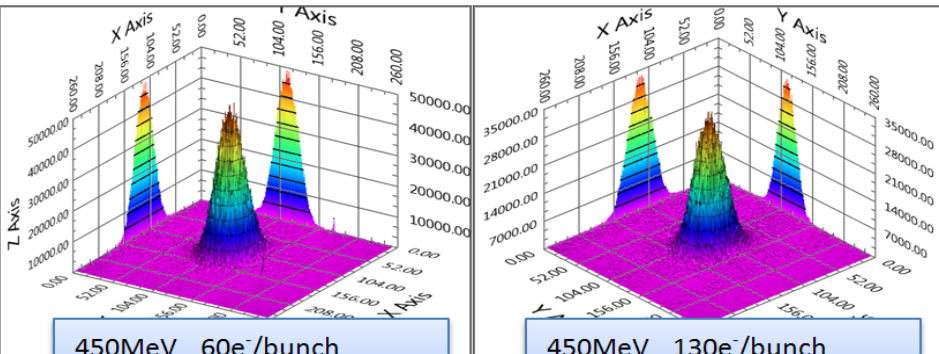
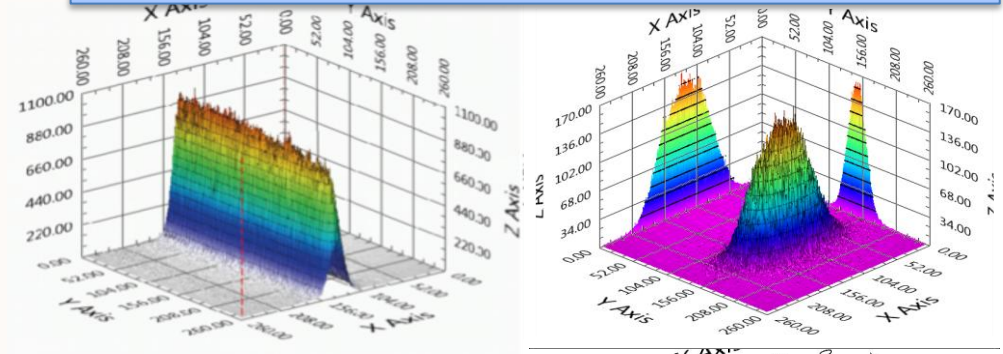
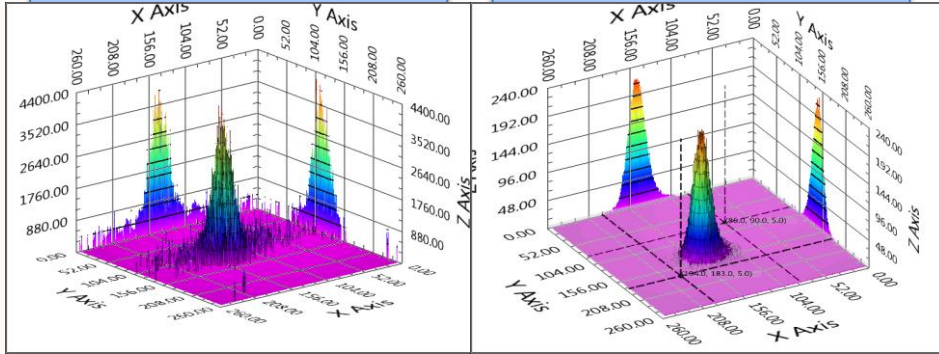
Oreste Cerafogli, Enrico Di Pasquale, Alessandro Drago, Adolfo Esposito, Oscar Frasciello, Andrea Ghigo, Simona Incremona, Franco Iungo, Stefano Lauciani, Roberto Mascio, Giampiero DiPirro, Luigi Pellegrino, Ruggero Ricci, Lucia Sabbatini, Claudio Sanelli, Franco Sardone, Giancarlo Sensolini, Ugo Rotundo, Alessandro Stecchi, Angelo Stella, Bruno Bolli, Sergio Cantarella, Oscar Coiro, Valerio Lollo, Stefano Martelli, Alessandro Vannozzi

Multiplicity and transverse tuning

300MeV single part
 $\sigma_x=0.7$ mm, $\sigma_y=0.8$ mm

450MeV single part
 $\sigma_x=0.5$ mm, $\sigma_y=0.5$ mm

300MeV m1000
 Different Geometries



450MeV 60e⁻/bunch
 $\sigma_x=1.04$ mm, $\sigma_y=0.86$ mm

450MeV 130e⁻/bunch
 $\sigma_x=1.07$ mm, $\sigma_y=0.87$ mm

Waveform
 ...

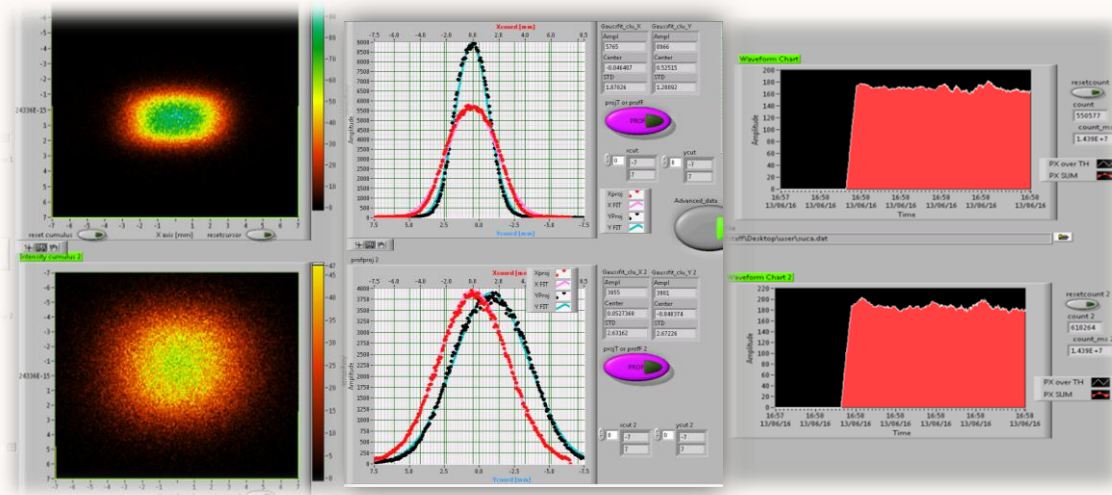
ADVACAM FITPIX detectors

- 256x256 pixels, 55 μm pitch,
- 300 μm thickness sensor
- 14x14 mm^2 active area

Three FitPIX devices **operational**

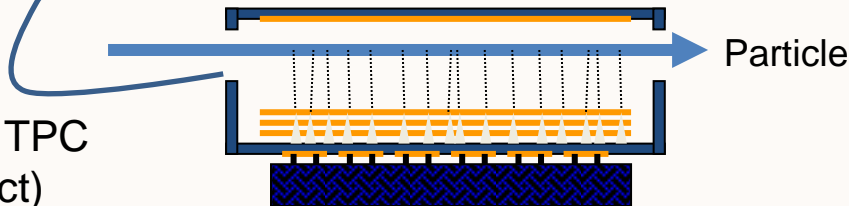
Integrated in MEMcached based readout and control system

- >> 50 frames/s achieved

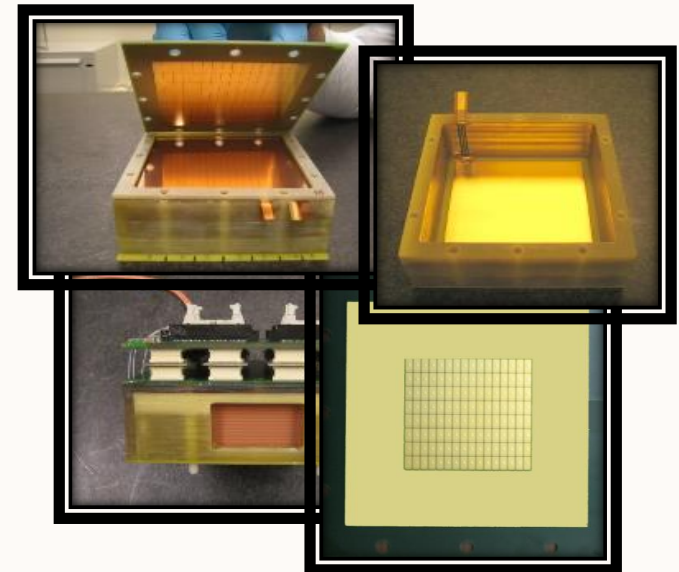


BTF GEM

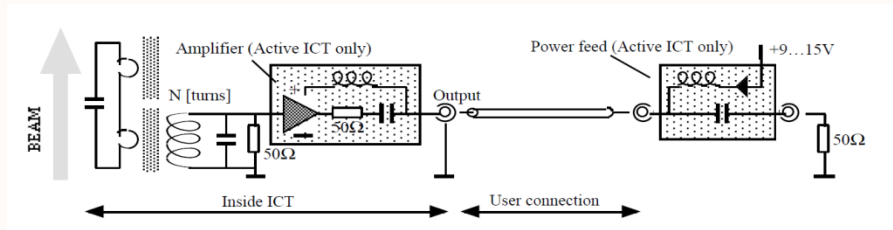
two kapton foils ($<0.2\%X_0$) => less multiple scattering



Triple GEM TPC
(AIDA project)

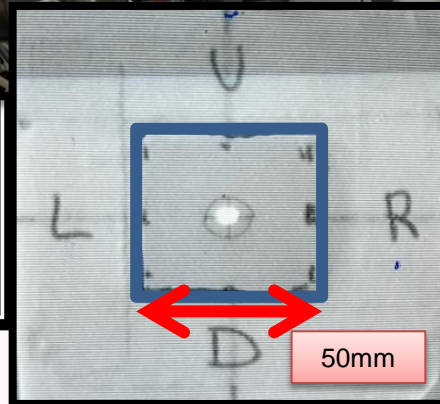
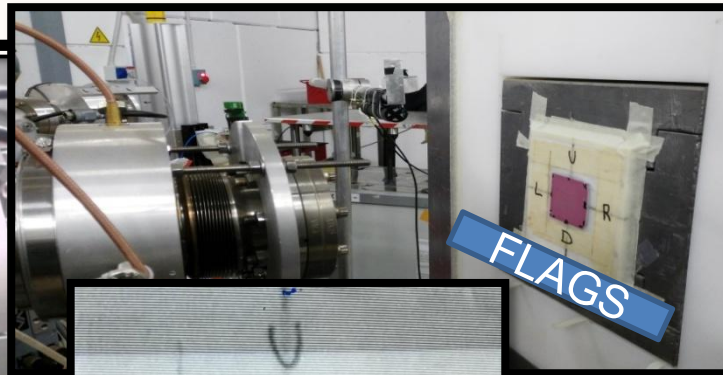
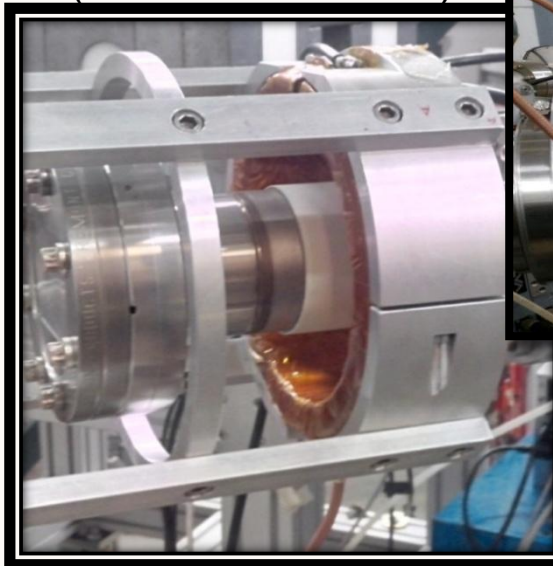


BTF Layout – Primary Beam Diagnostics & Experiments

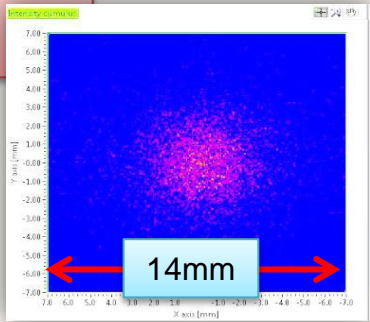


Bergoz Integrating Current Transformer

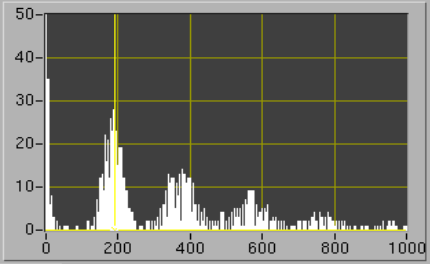
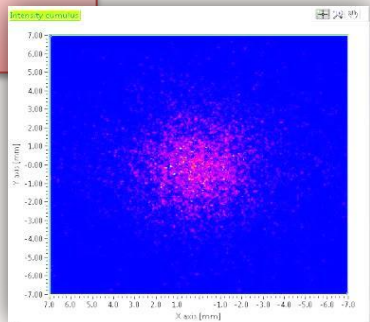
- (ICT-122-070-05:1)



E= 100 MeV
m= 1
Type= e-

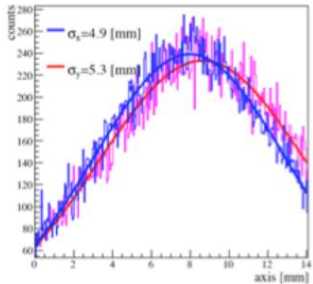
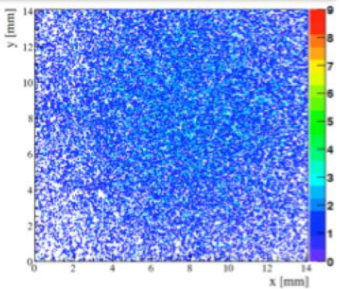


E= 100 MeV
m= 1
Type= e+

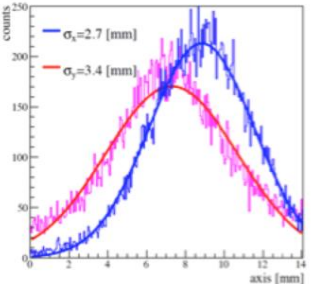
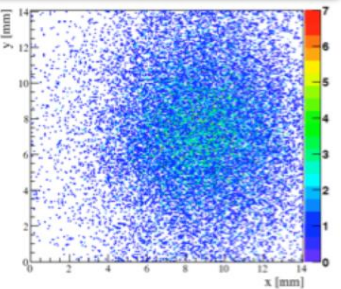


No significant difference from positron to electron secondary beam parameters

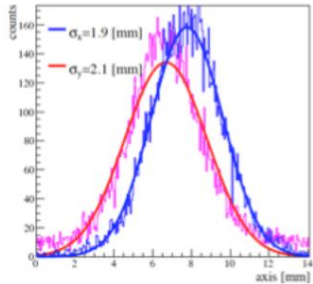
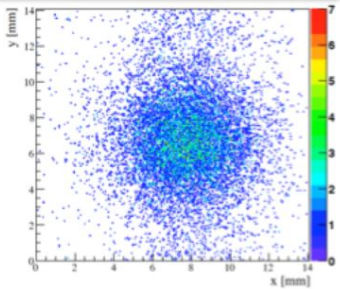
30MeV - single part
 $\sigma_x=4.9, \sigma_y=5.3$ [mm]



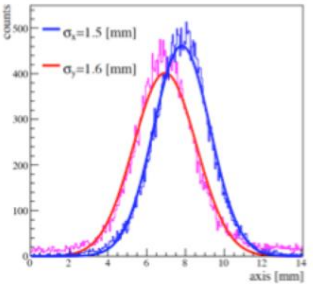
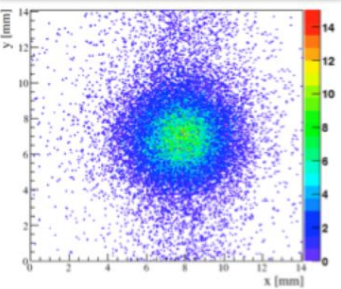
60MeV - single part
 $\sigma_x=2.7, \sigma_y=3.4$ [mm]



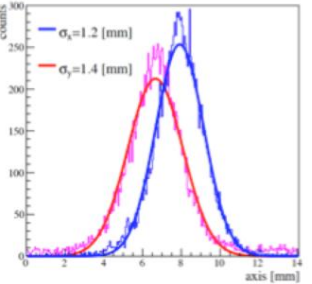
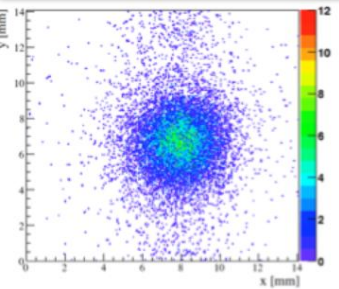
90MeV - single part
 $\sigma_x=1.9, \sigma_y=2.1$ [mm]



120MeV - single part
 $\sigma_x=1.5, \sigma_y=1.6$ [mm]



150MeV - single part
 $\sigma_x=1.2, \sigma_y=1.4$ [mm]



Secondary Beam Parameters

Energy [MeV]	Max mult e- per bunch [# , 10 ³]	Max mult e- with DAFNE[#/s, 10 ³]	Max mult e- only BTF (e-mode) [# /s, 10 ³]	Transverse Dimensions * [mm]
450	5	50	250	1
350	30	300	1500	2
300	60	600	3000	2,5
200	80	800	4000	3
150	100	1000	5000	4
100	40	400	2000	5
50	2	20	100	8

- For nominal electron LINAC exit charge (1.5nC @ 510MeV)
- Average bunch/s = 10 (not counting e+ LINAC mode, normal timing in DAFNE injections)
- Conservative values, strongly dependant on DAFNE requirements
- Not consider: machine uptime/vacation...

* Best transverse Dimensions (σ at 400 mm from Be-window exit) for a round gaussian beam plane

Secondary Beam Parameters

Energy [MeV]	Best Transverse * Dimensions round beam (σ_{plane}) [mm]	Multiplicity
500	0,45	1
400	0,6	1
300	0,8	1
200	1,2	1
100	1,8	1
50	3,1	1
30	4,9	1

* Best transverse Dimensions (σ_{plane} at 400 mm from Be-window exit) for a round gaussian beam $\pm 10\%$

BTF - Future

