



# Beam Test Facility (BTF)

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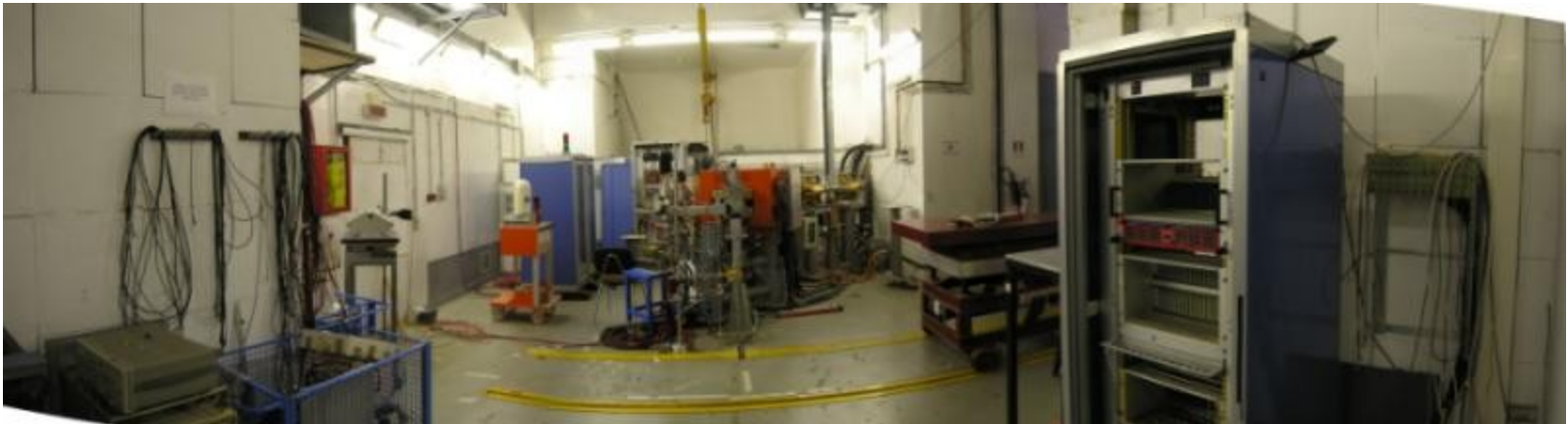
*UA9 Crystal Collimation Workshop, La Sapienza 25  
February 2011*

# Beam Test Facility(BTF) Infrastructure

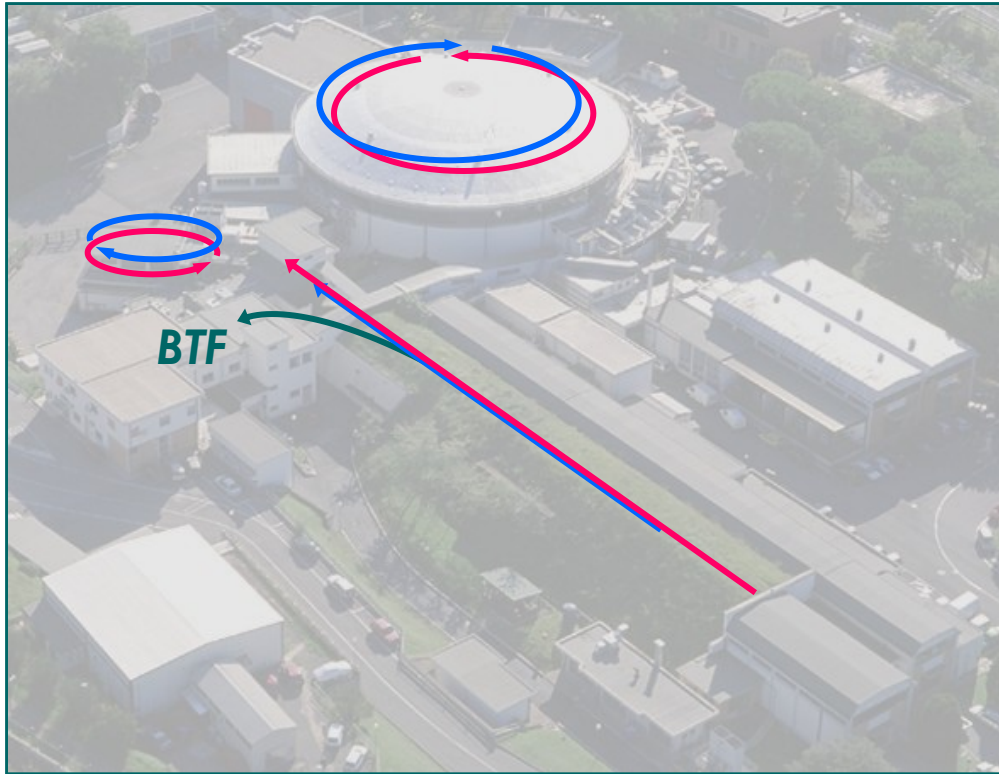


The Frascati BTF infrastructure is a beam extraction line optimized to produce electrons, positrons, photons and neutrons mainly for HE detector calibration purpose.

The aim of the task 8.2.2 is to improve and further qualify the BTF facility



# The DAΦNE BTF



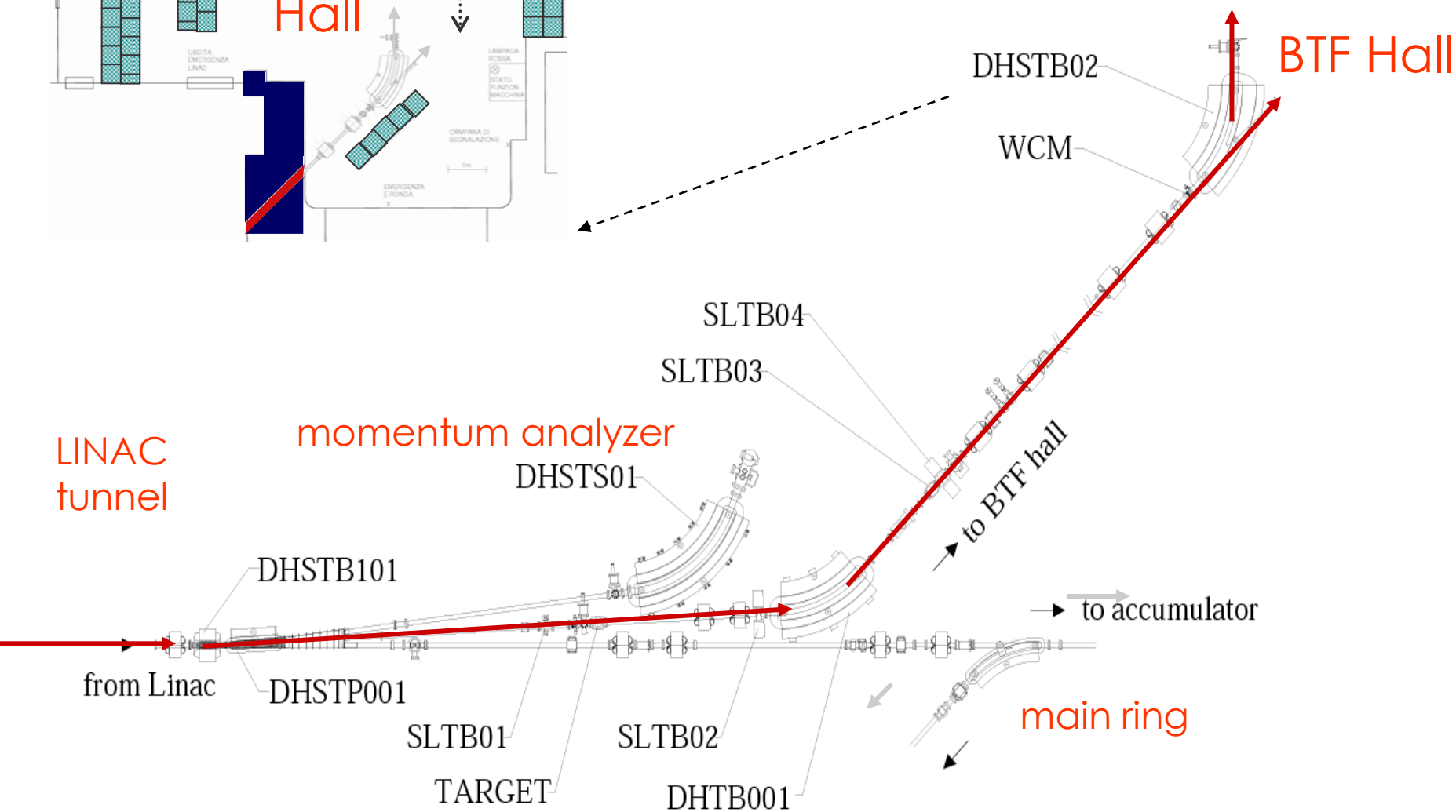
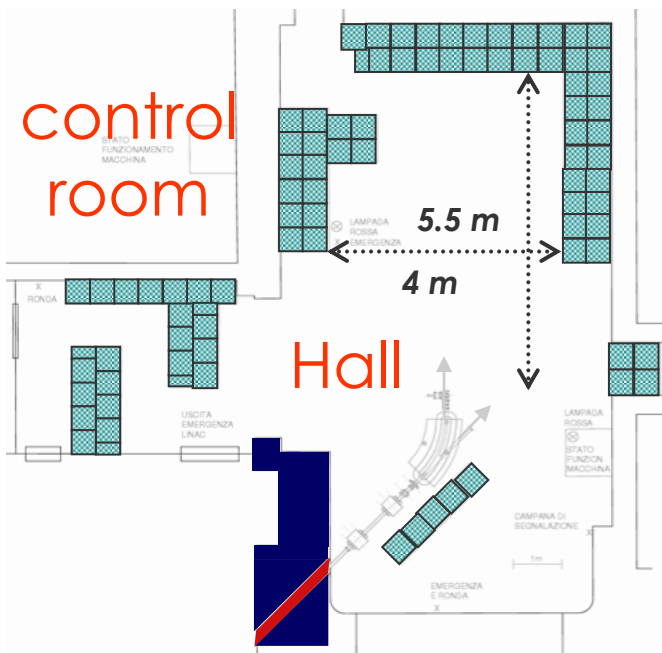
The **BTF** is a  $e^-/e^+$  **test-beam facility** in the Frascati DAΦNE collider complex

**high current** Linac:

- 1 – 500 mA  $e^-$  100 mA  $e^+$ ,
- 1 - 10 ns pulses, at least  $10^7$  particles

**Need to attenuate the primary beam:**

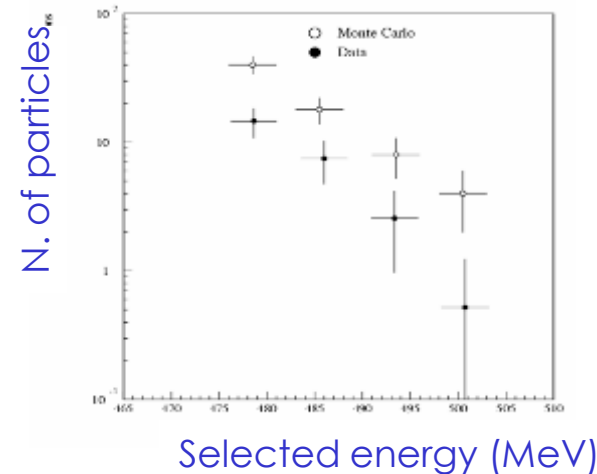
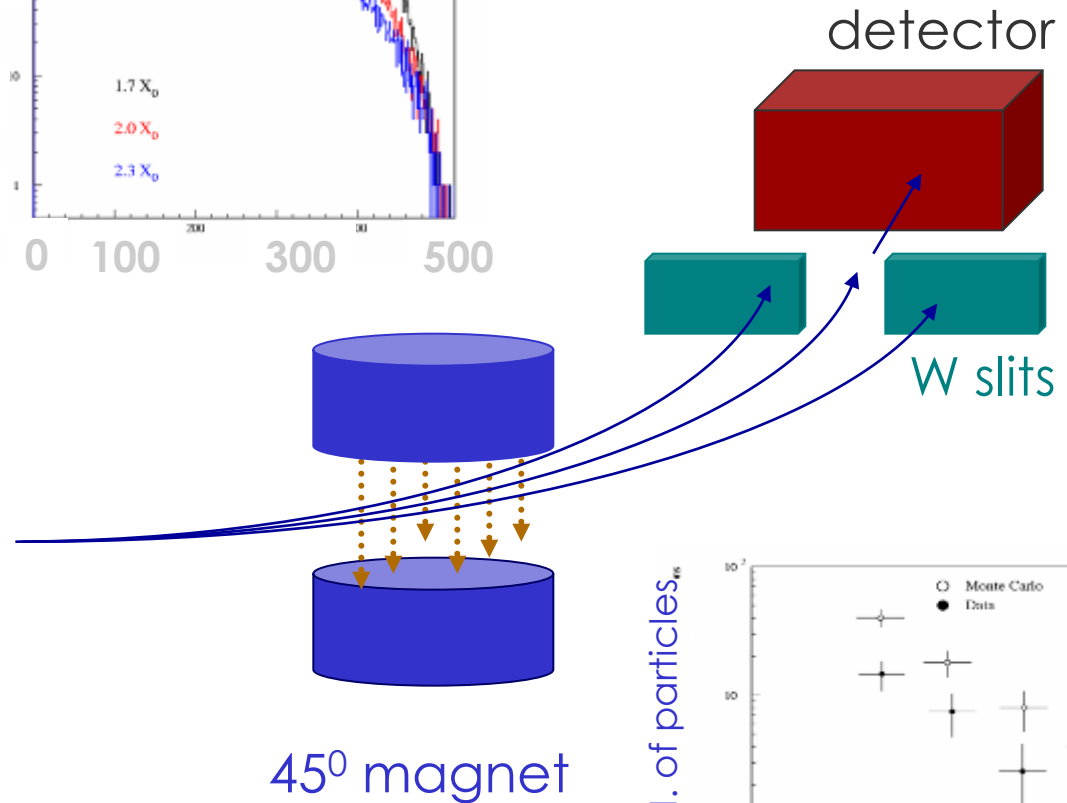
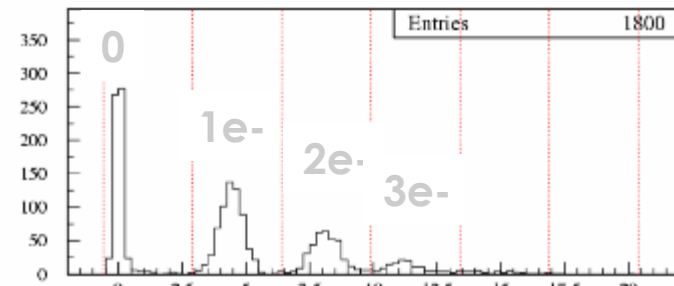
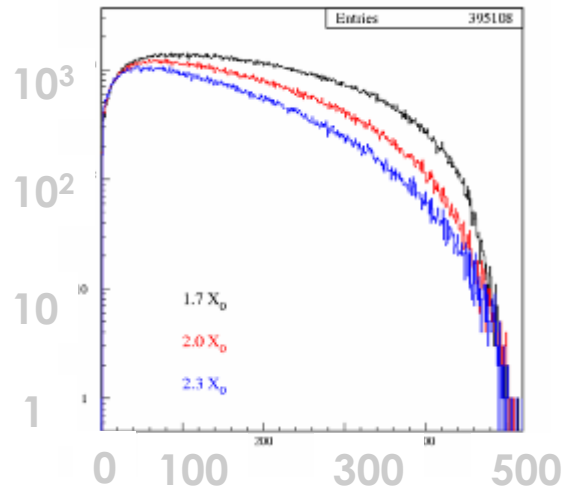
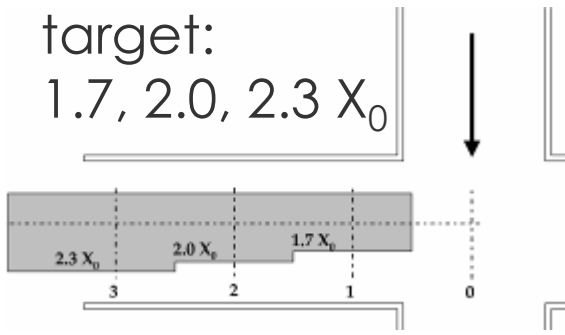
- **Single particle** regime is ideal for detector testing purposes
- Allows to tune the beam intensity
- Allows to tune the beam energy



# LINAC beam attenuation

LINAC Beam 1-500  
mA

tunable Cu  
target:  
1.7, 2.0, 2.3  $X_0$



# BTF beam characteristic

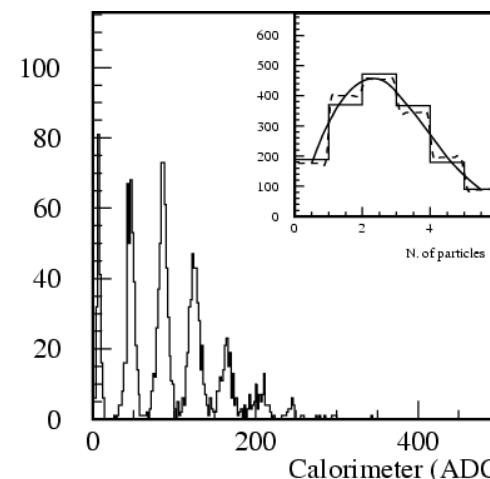


Beam ( $e^-$  or  $e^+$ ) intensity can be adjusted by means of the **energy dispersion** and **collimators**, down to **single particle** per pulses

<b>Number</b> (particles/pulse)	$1 \div 10^5$	$1 \div 10^{10}$
<b>Energy</b> (MeV)	25-500	25-750
<b>Repetition rate</b> (Hz)	20-50	50
<b>Pulse Duration</b> (ns)	10	1 or 10
<b>p resolution</b>	1%	
<b>Spot size</b> (mm)	$\sigma_{x,y} \approx 2$ (single particle) up to $10 \times 10$ (high multiplicity)	
<b>Divergence</b> (mrad)	$\sigma'_{x,y} \approx 2$ (single particle) up to 10 (high multiplicity)	

## Multi-purpose facility:

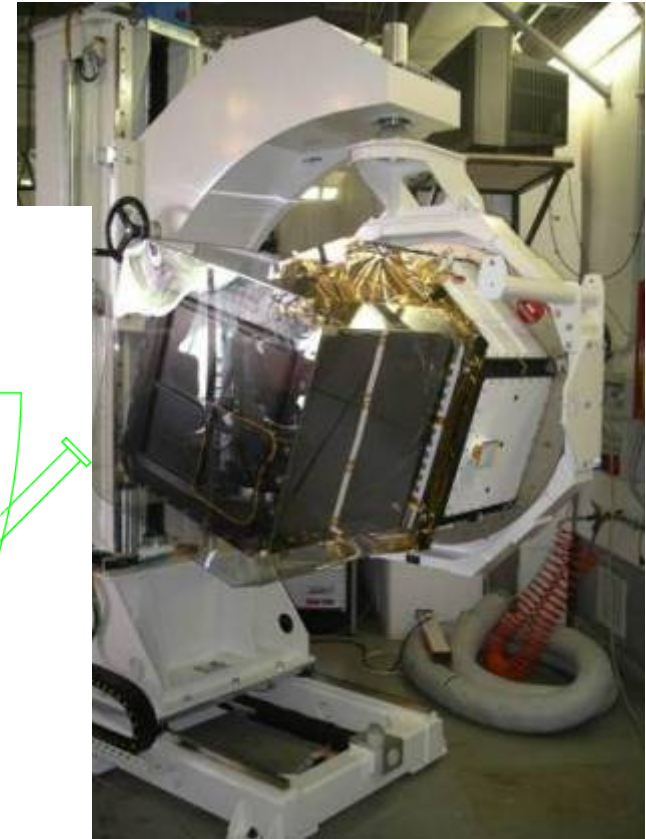
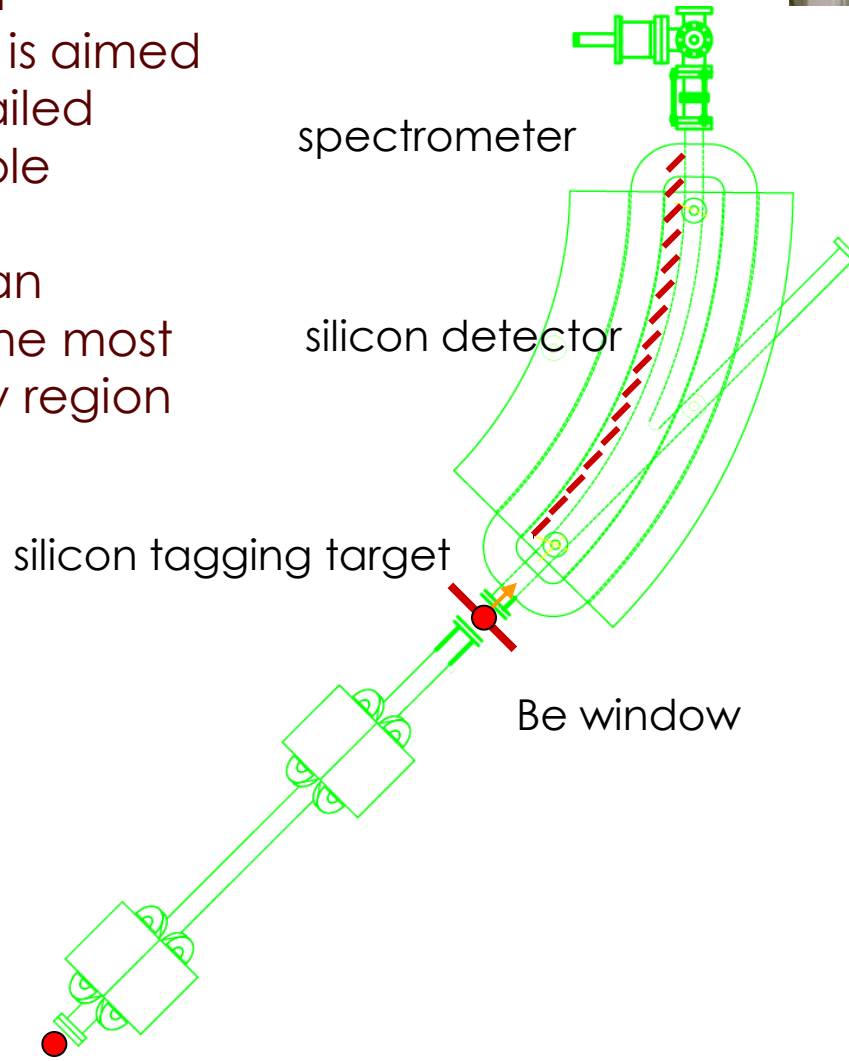
- H.E. detector calibration and setup
- Low energy calorimetry & resolution
- Low energy electromagnetic interaction studies
- High multiplicity efficiency
- Detectors aging and efficiency
- Beam diagnostics



# BTF photon tagged source

## AGILE GRID photon calibration

The AGILE Gamma Ray Imaging Detector calibration at BTF is aimed at obtaining detailed data on all possible geometries and conditions. BTF can provide data in the most significant energy region (20-700 MeV)



**AGILE  
GRID**

# Neutron production @ BTF

Photonuclear neutron production

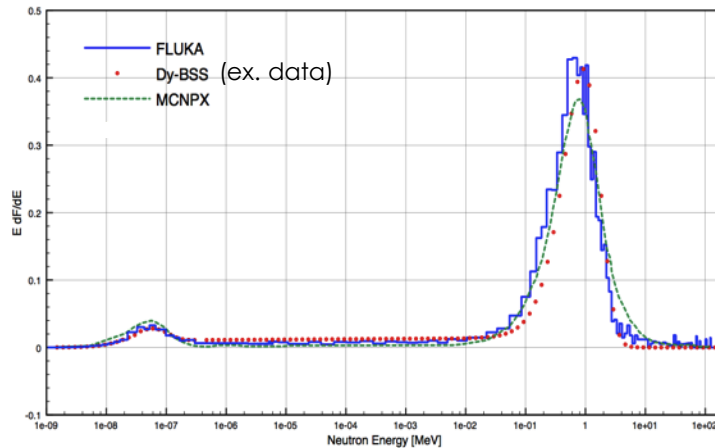
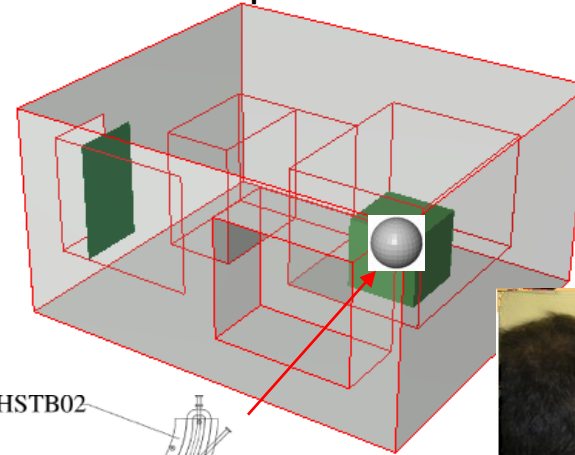
Beam power 40 W

Neutron flux@1m from target

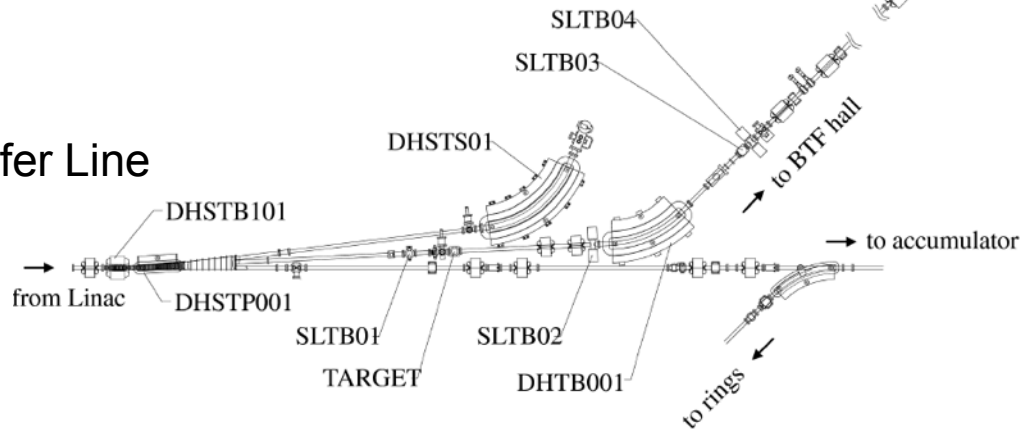
$4E+5$  n/cm<sup>2</sup>/s; 45 mSv/h



BTF Experimental Hall



Transfer Line

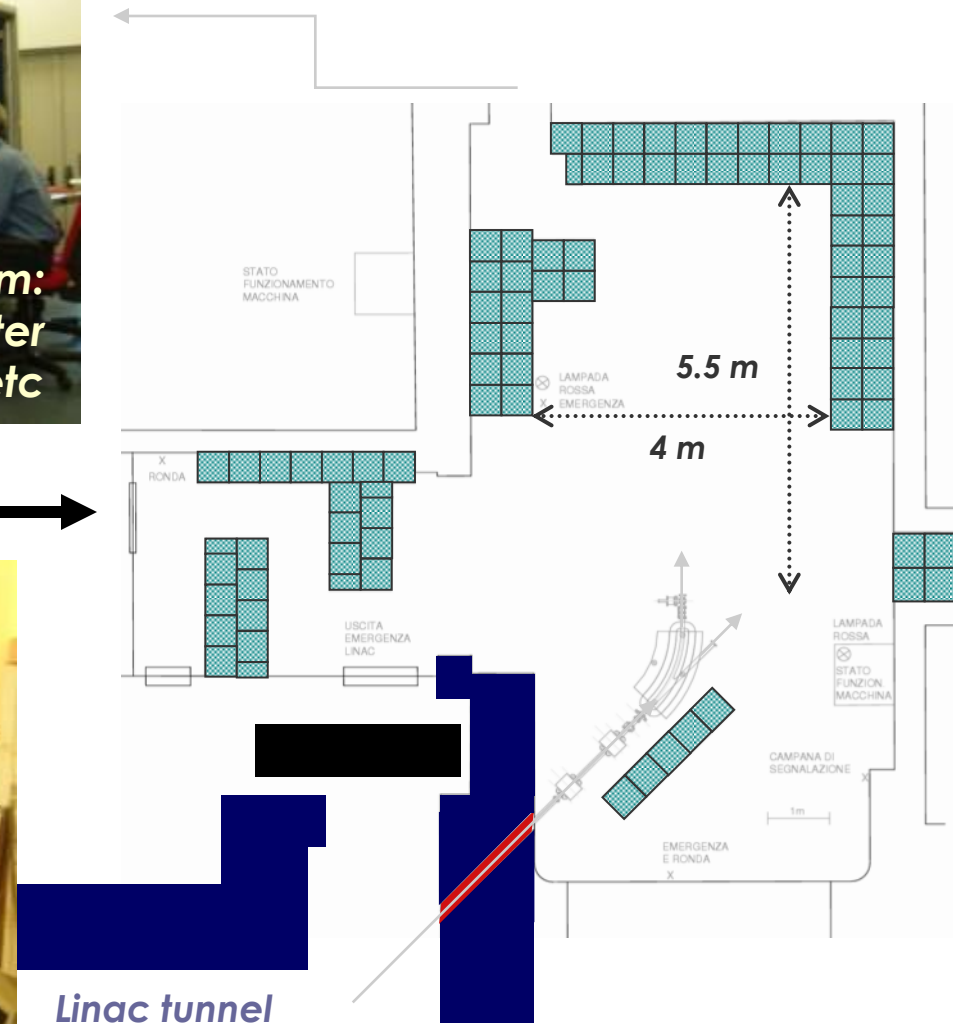
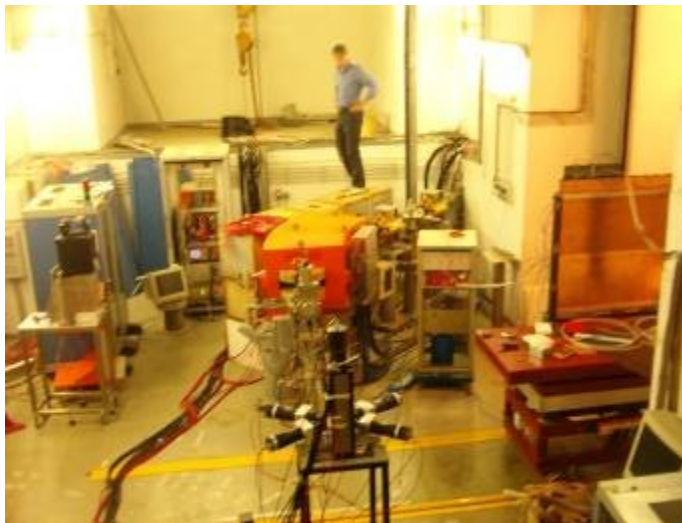


# Facility equipment



- one meeting room (WiFi)
- one guest office (LAN-WiFi)

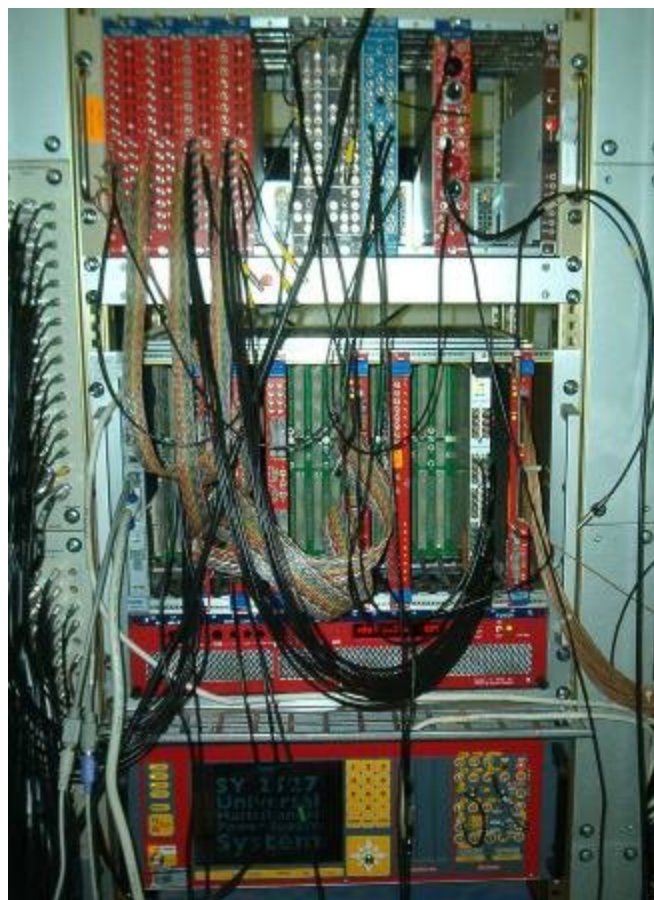
main entrance: radioprotection wall  
can be removed on demand



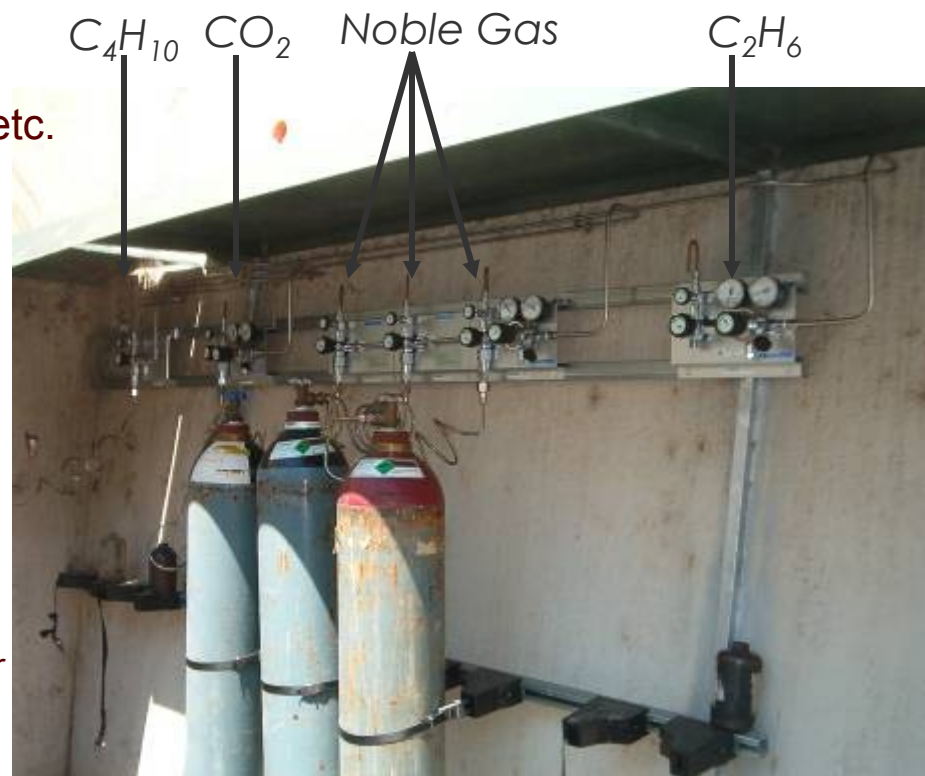
# Facility equipment



- permanent **DAQ**  
TDC/QDC/ADC/scaler/disc. available
- NIM, VME, CAMAC Branch, VME controllers
- 'Devil'/VMIC **VME** and **CAMAC** controller, **NIM** modules
- Remotely controlled **trolley**
- **Gas** system
- **HV** system...
- crates, rack, etc.

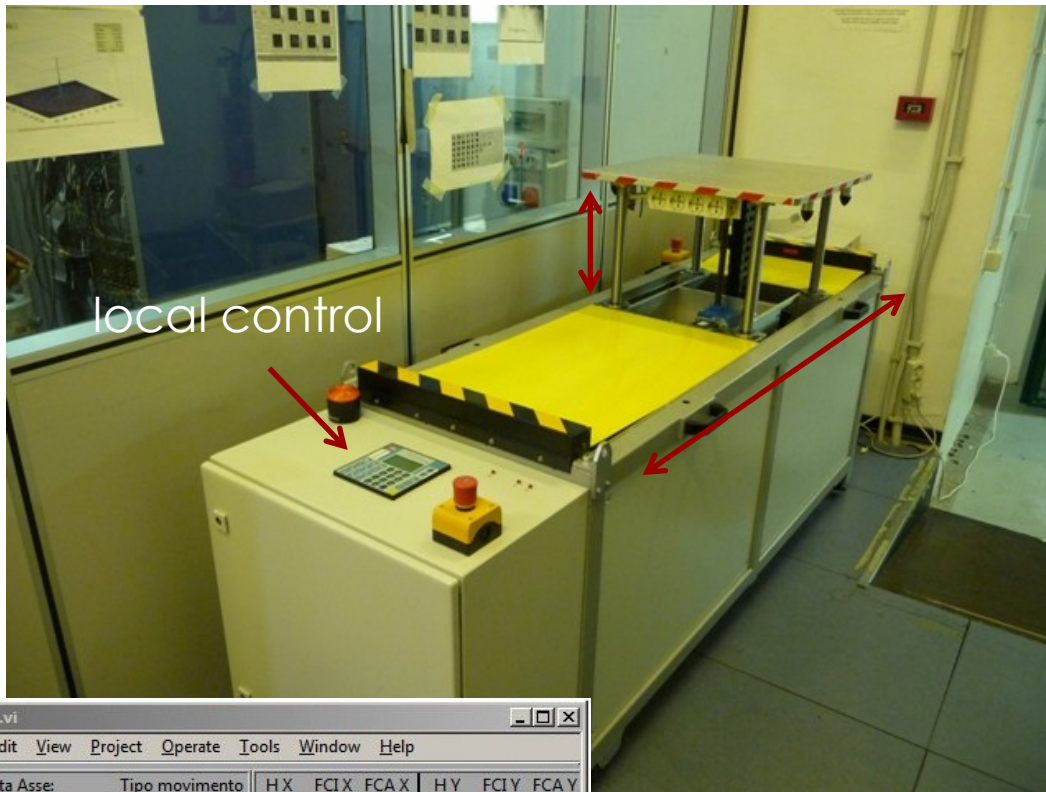


- HV SY2527 (3/4KV neg, 3/4KV pos, 15KV pos)
- **low attenuation Cabling** BTF HALL-BTF CR
- **Network:** Wi-Fi, dedicated-LAN, WAN, printer  
<http://www.Inf.infn.it/acceleratori/btf/>



# New remote trolley

(7 Feb 2011)



plane	600x600 mm
min height	915 mm
max height	1250 mm
horiz. excursion	1000 mm
max load	200 Kg
accuracy	< 1 mm <sup>2</sup>

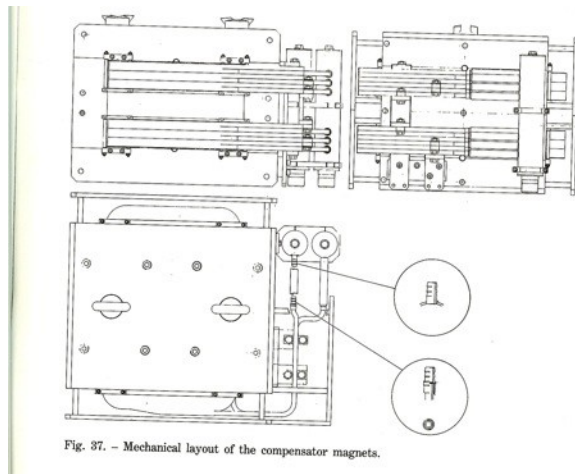


LNF-DR - Reparto Automatismi e Controlli:  
Ubaldo Denni, M. Antonietta Frani,  
Giuseppe Papalino

# equipment

- new flag and beam current monitor are going to be installed in the two exit line

- user bending magnet remotely controlled



Gap  
 Pole width  
 Return leg width  
 Nominal field on axis  
 Maximum field on axis  
 Number of coils  
 Nominal ampere-turns per coil  
 Maximum ampere-turns per coil  
 Nominal current density  
 Maximum current density  
 Number of turns per coil  
 Conductor: copper  
 Useful conductor area  
 Nominal current  
 Maximum current  
 Nominal power per magnet  
 Maximum power per magnet  
 Nominal voltage  
 Maximum voltage  
 Magnet resistance  
 Magnet inductance

50	mm
200	mm
70 (·2)	mm
5.74	kG
8.5	kG
2	—
11 474	A-turn
18 000	A-turn
16.35	A/mm <sup>2</sup>
25.65	A/mm <sup>2</sup>
18	—
8·8 Ø 5	mm <sup>2</sup>
39	mm <sup>2</sup>
637.5	A
1000	A
8.9	kW
22.0	kW
14	V
22	V
0.022	Ω
2.6	mH

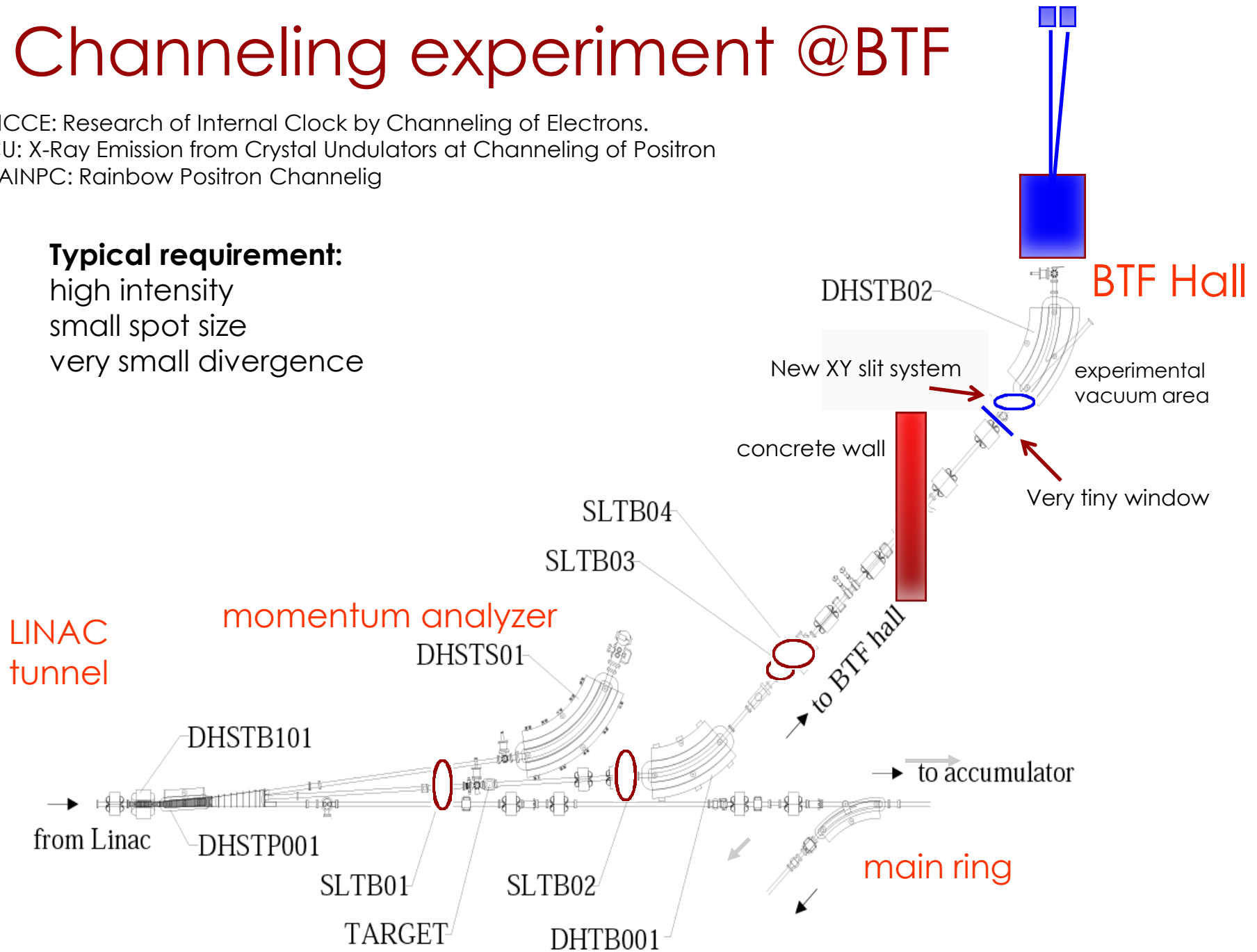
- GEM tcp tracker, silicon chamber tracker, calorimeters, scintillators etc are available and integrated in the DAQ

# Channeling experiment @BTF

RICCE: Research of Internal Clock by Channeling of Electrons.  
CU: X-Ray Emission from Crystal Undulators at Channeling of Positron  
RAINPC: Rainbow Positron Channeling

## Typical requirement:

high intensity  
small spot size  
very small divergence



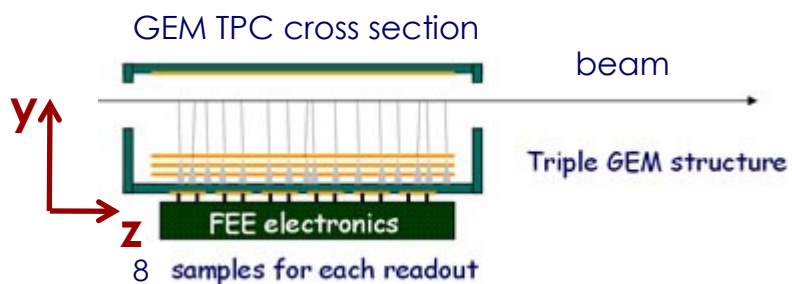


# conclusion

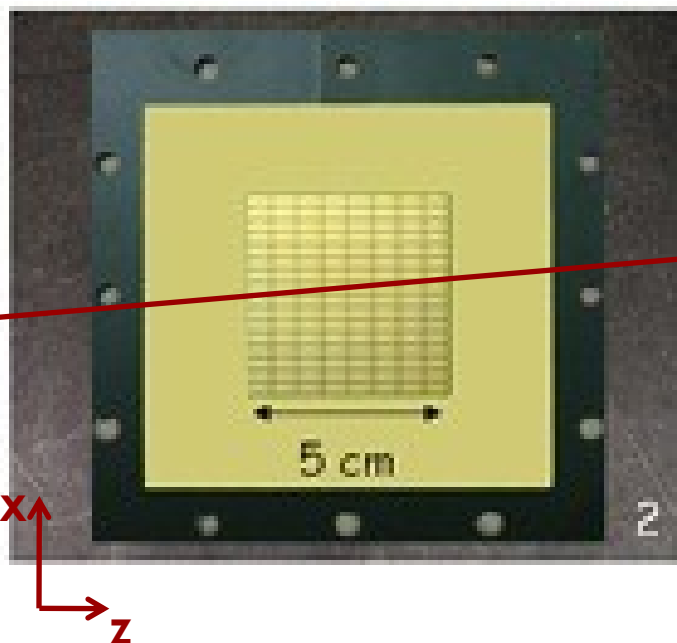
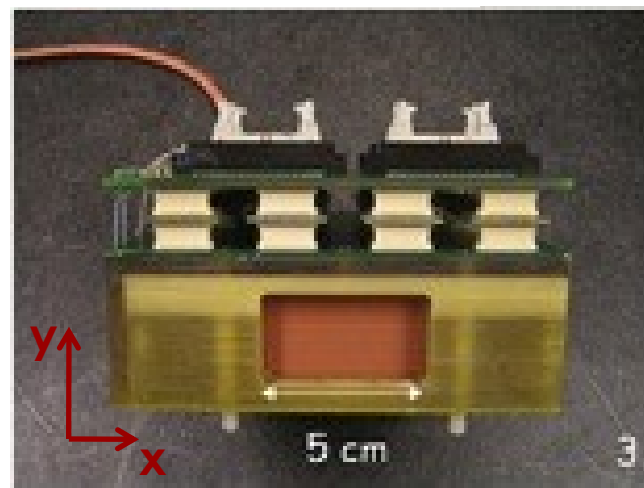
- no modification inside LINAC tunnel are permitted
- expected rate **have to be simulated** in order to understand how long time have to be allocated to experiments in order also to understand **feasibility** of measurement
- because of full LINAC beam intensity is needed a special request have to be done to the LNF director



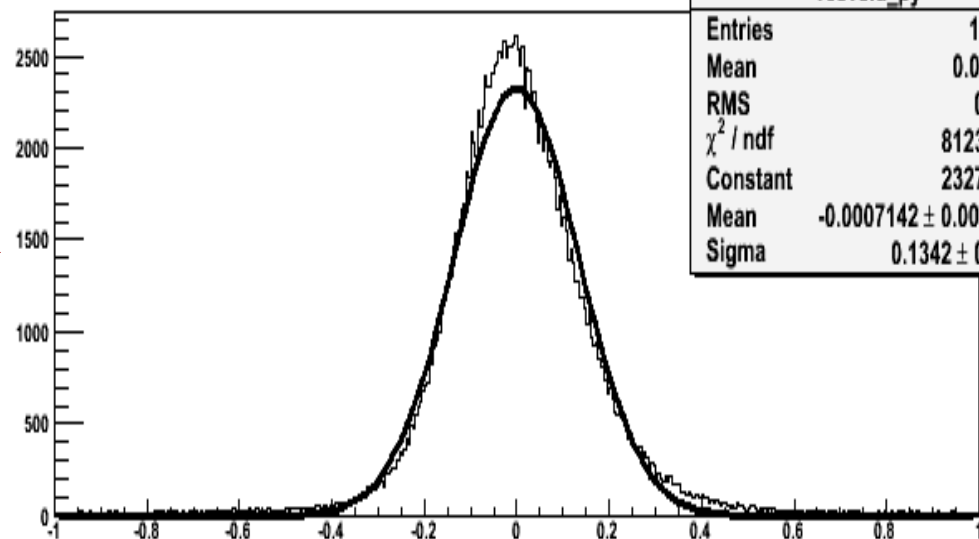
# GEM-TPC Tracker



GEM TPC prototype



residual vs. pad



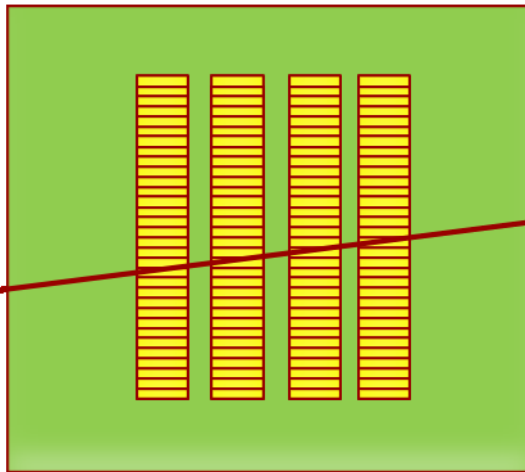
resvsid\_py

Entries	199406
Mean	0.001878
RMS	0.1834
$\chi^2 / \text{ndf}$	8123 / 397
Constant	2327 $\pm$ 8.0
Mean	-0.0007142 $\pm$ 0.0003479
Sigma	0.1342 $\pm$ 0.0003

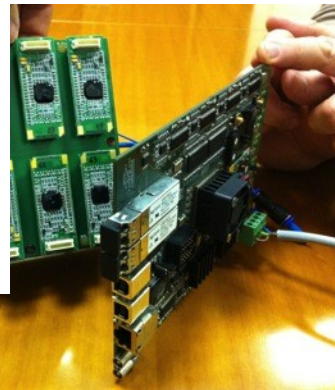
Y resolution  $\sim 50 \mu\text{m}$  (limited by drift time)  
X resolution  $\sim 1 \text{ mm}$  (limited by pad pitch)

# new design (pad $500\mu\text{m}$ )

128 ch electronic



z



## new design goal:

Y resolution	$O(100 \text{ micron})$
X resolution	$O(300 \text{ micron})$
Angular res.	$O(10 \text{ mrad})$

## development:

limitation due to minimal pad dimension  $300\mu\text{m}$  and design and implementation of high density front end electronics

compact design: fpga based ethernet/opt/usb output