Test beams infrastructure at CERN and Frascati

Task 8.2.2

Test beam infrastructure in Frascati

LNF, Ferrara & Perugia INFN structure
and University of Bergen

AIDA Task 8.2.2 Status Report

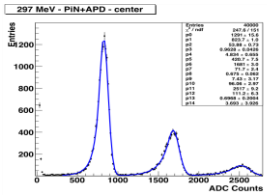
- **remote trolley**

May 2012 annual meeting

✓ **done**

- equip the BTF with a **GEM** chambers for monitoring with a resolution of about 100 μm

➡ **in progress: HVGEM module will be ready in April. The test of two profile chamber prototypes is foreseen for the end of the 2012**



- equip the BTF with **LYSO** calorimeter as monitor the beam energy

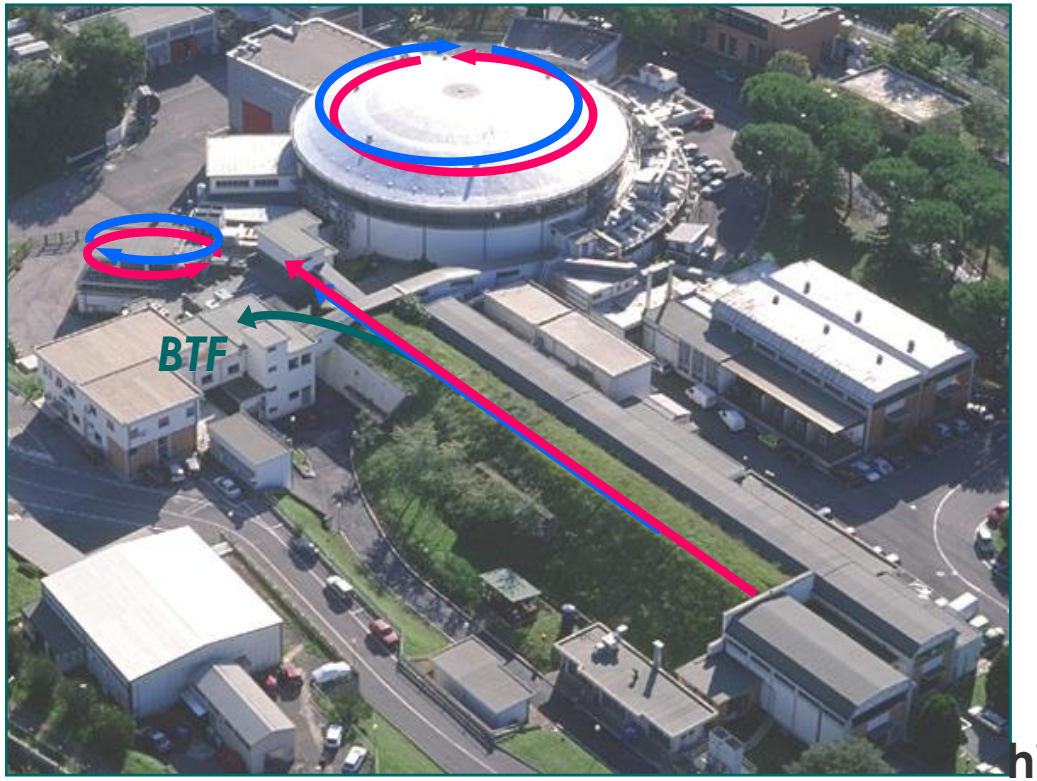
➡ **in progress: new measurement started on the 25/3. A cross calibration of LYSO is foreseen at Maintz in October.**

- muti purpose **DAQ** system

➡ **in progress: we are working on the integration on new diagnostics and the porting under !CHAOS freimwork**

AIDA Beam Test Facility(BTF)

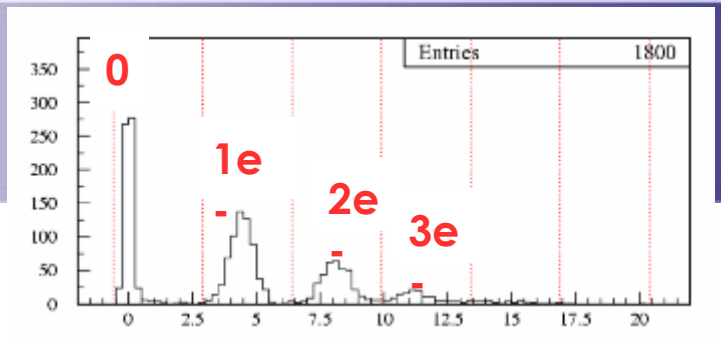
The Frascati **Beam Test Facility** infrastructure is a beam extraction line optimized to produce **electrons**, **positrons**, **photons** and **neutrons** mainly for HEP detector **calibration** purpose. The quality of the beam, energy and intensity is also of interest for **experiments** (~ 20% of the users) studying the **electromagnetic interaction with matter**

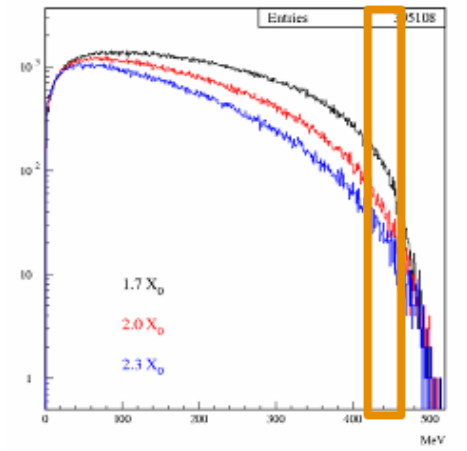


The **BTF** is a e□/e+ **test-beam facility** in the Frascati DA√NE collider complex

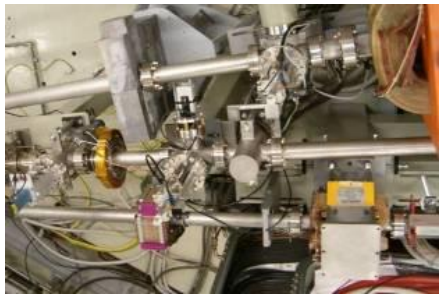
high current Linac:
1 □ 500 mA e□ 100 mA e+,
1 - 10 ns pulses, at least 10^7 particles

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





Spectrum@target output



BTF Hall

AIDA Beam line summary parameters

Operation mode	e^+ / e^- beam	γ beam	Neutrons beam
Energy range [MeV]	25-500 25-750(*)	100-500 100 -750 (*)	10^{-9} → 200
Bunch Rate [Hz]	User triggered (*) 1 → 24 49 (*)		
Bunch length [nsec]	10 1 or 10 (*)		
Multiplicity [#/bunch]	1 → 10^5 1 → 10^{10} (*)		4.9 10^{-5} (@1.5m) [n/cm^2/electron]
Duty cycle [%]	~80% ~96% (*)		4 10^5 (@1.5m) n/s/cm^2
Spot size ($б_x \cdot б_y$) [mm]	~ 2x2 ~5.5x5.5	>20	N.D.
Divergence [mrad]	~ 1 – 1.7	>15	N.D
Energy spread	1.00%	7.00%	N.D.

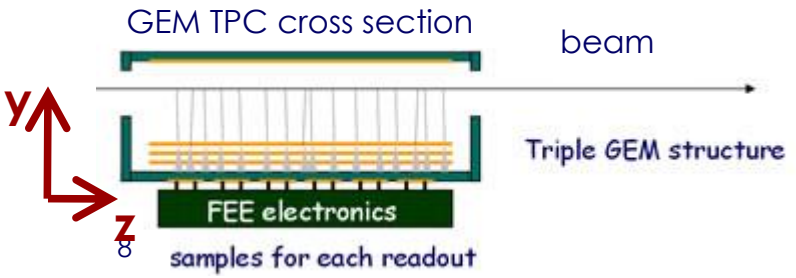
BTF Operations

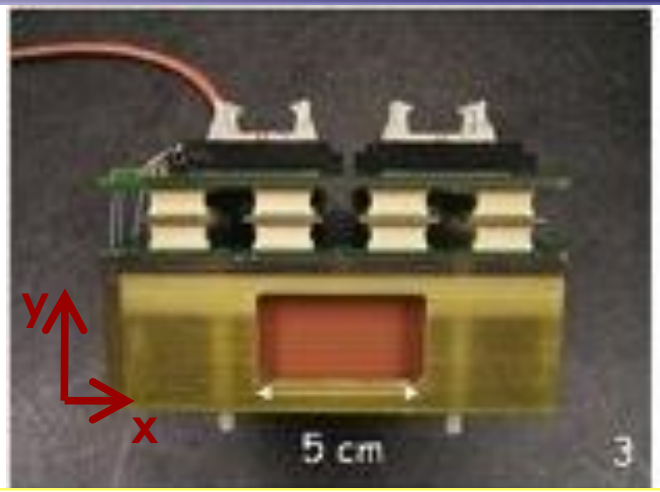
During 2012 the Frascati Beam Test Facility (BTF) allocated **316 days** of shift dedicated to HEP detectors test and calibration, and study of electromagnetic interaction (see http://www.lnf.infn.it/acceleratori/btf/ for details).

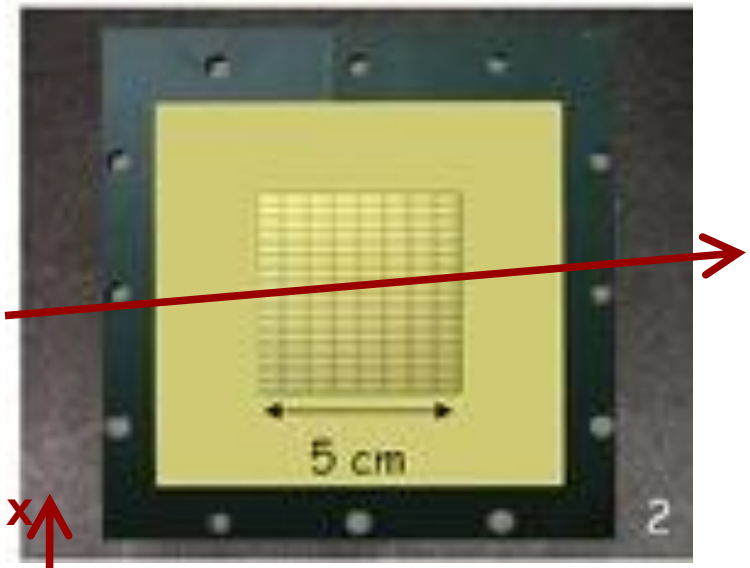
Part of the beam time has been dedicated also to the improvement of the facility and equipment, test of neutron beam line and diagnostics detectors for the beam quality monitor.

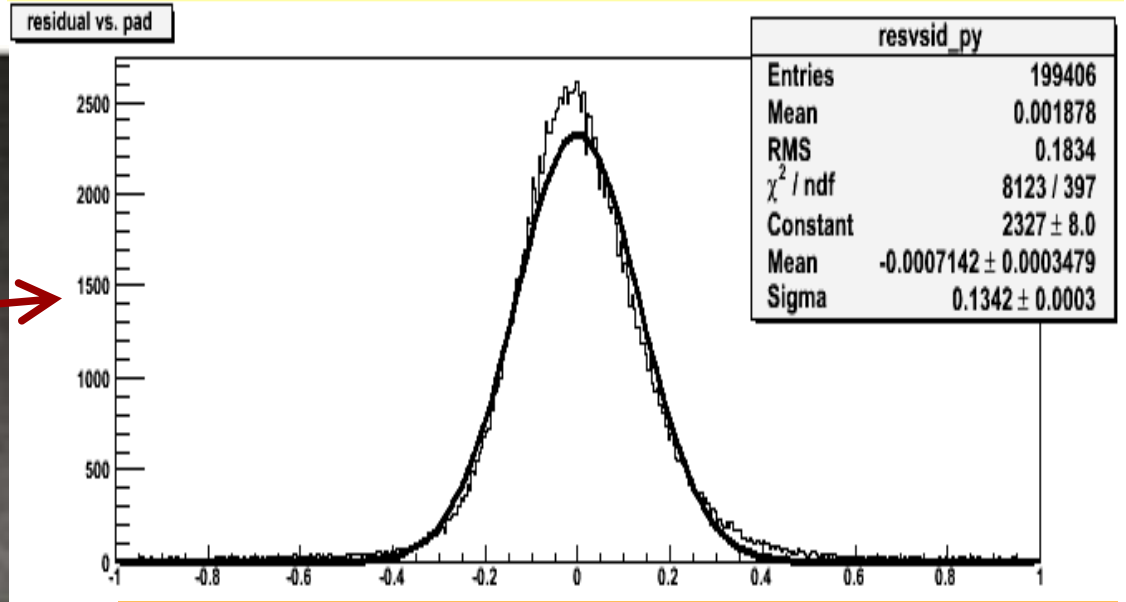
The BTF has been shutdown for Christmas due to DAFNE and LINAC systems exceptional maintenance and is expect to **restart in summer 2013**

AIDA GEM-TPC Traker









Y resolution ~ 50 ⌈m (limited by drift time)
X resolution ~ 1 mm (limited by pad

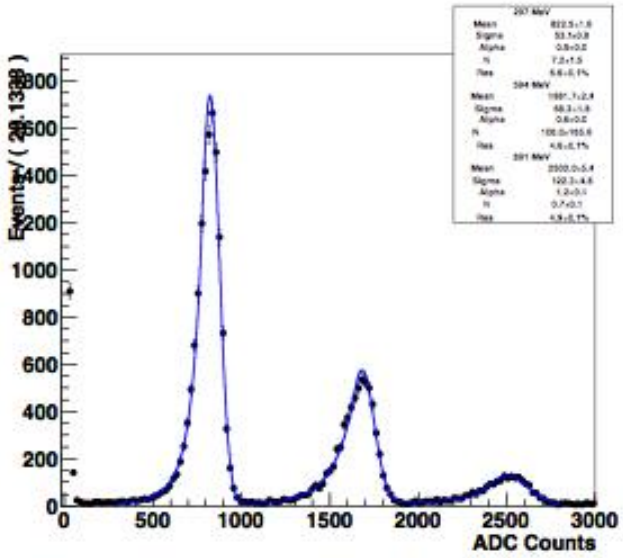
TPC GEM tracker

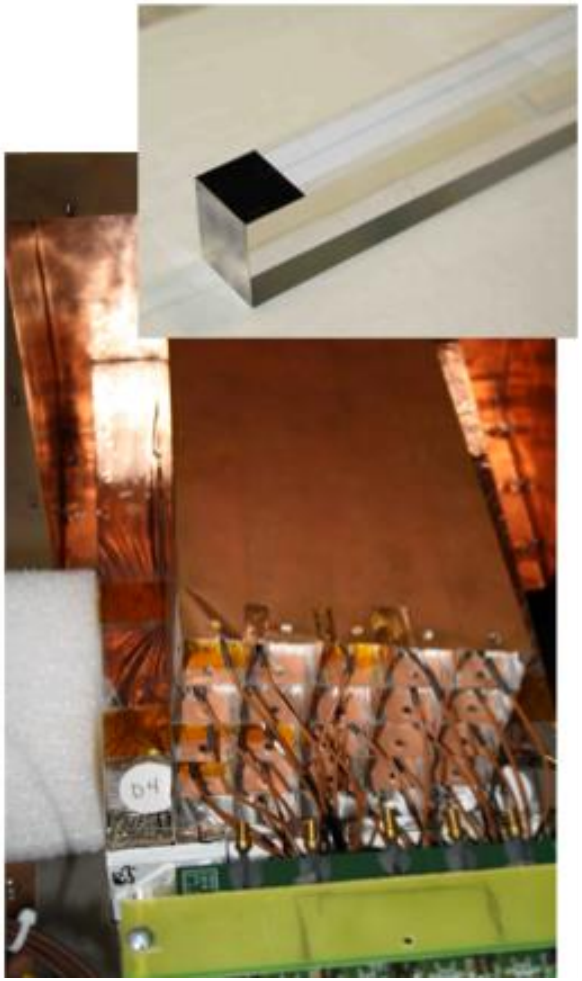
- ✓ A prototype for a 3D track system, consisting of a compact TPC with 4 cm drift and the final read out electronics, has been **tested in three different runs at the BTF**.
- ✓ A specific run has been done to determine the future operating modes of the GEM and we started and completed the tests in July. The **instrument seems appropriate to the specific experimental beam parameters in the three axes**.
- ✓ It means, however, another series of tests for the **integration of the readout with the DAQ BTF**, to study a data link between the old DAQ to the GEM dedicated DAQ software. This is very relevant especially for timing purposes.
- ➡ The test of two profile chamber prototypes in **high intensity beam** foreseen in past year has been delayed to the forthcoming BTF run.
- ➡ All the GEM layers, electronics and acquisition boards of the final track detectors have been **committed and will be installed in 2013**.

LYSO Calorimeter

Prototype mechanical structure has been designed and built
Front-end electronics has been designed and developed

25 Crystals in the matrix tested at the BTF facility in 2011.

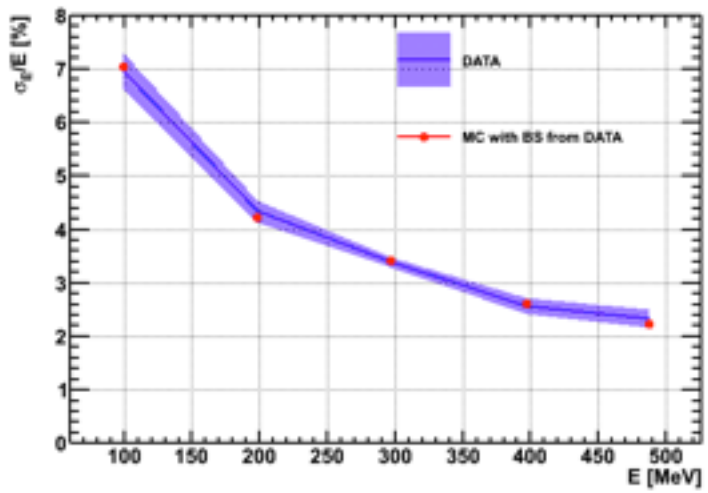




LYSO Calorimeter

✓ **Analysis** of the data collected during the test beam has been performed. A reasonable **agreement between data and Monte Carlo** has been obtained. But we decided to investigate more deeply the **discrepancy observed**.

Main contribution to our **resolution is coming from the beam energy spread**.



➡ Due to the very low light yield of the pure CsI crystal another possibility is trying to use Silicon Photomultipliers (SiPM) as photodetectors for the readout. **New devices reading in the UV part of the spectrum are under prototype version**.

Next year (2013-2014) activity will be the study of **the possibility of using such kind of photodetectors** in order to have a better signal to noise.

DAQ improvements

- ✓ During last year the job on DAQ has been dedicated to **optimize the data format, improving time correction routines and testing** it in various triggering and experimental conditions.
- ✓ time has been spent to develop, **test and debug of the standalone diagnostics:** user-friendly BTF environmental sensors (temperature, pressure, humidity, screen monitor, etc), radioactive BTF control room background detector (manufactured by Berthold), synchronous CCD dedicated to the YAG flag placed on the straight BTF beam line.

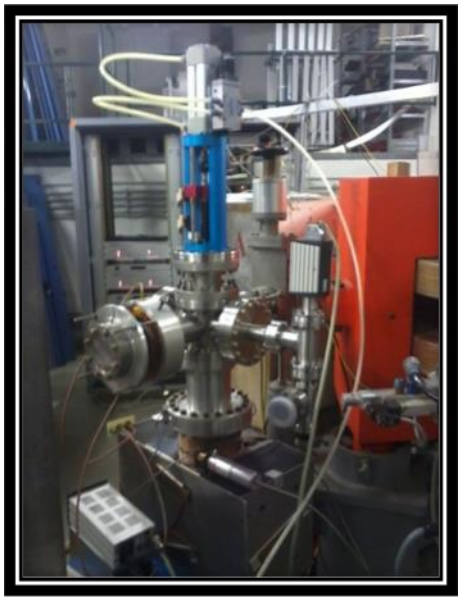
➡ A workaround start on **virtual machines** (both of Linux and Windows OS's) aimed to **centralize the DAQ/Diagnostic** software based on Ethernet bus. The target will be to separately include BTF standalone diagnostics (and the multipurpose DAQ) in !CHAOS framework.

New diagnostics for N@BTF

Vacuum Services
Hot Cathode Gauge and pre-vacuum for service cycle speed improvement

High Vacuum
$8*10^{-9}$ [mb]

500µm Be flange



N@BTF target

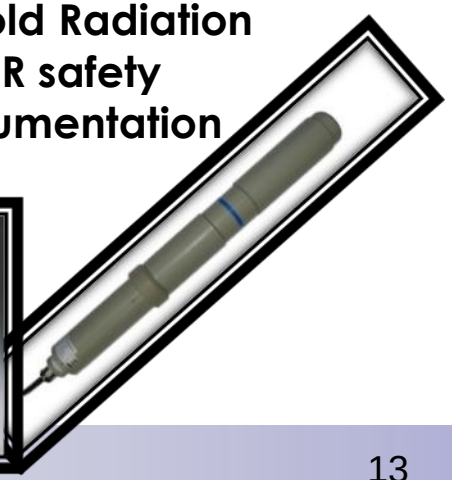
Remote Flag insertion
WCM
BERGOZ
ICT

YAG:Ce Flag

GigE Beam Camera

Polyethylene moderated BF_3 Detector
BTFDAQ integration

Berthold Radiation CR safety instrumentation



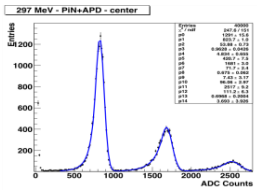
AIDA Task 8.2.2 Status Report

- **remote trolley**

✓ **done**

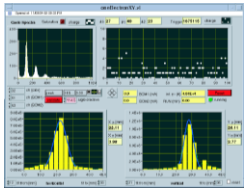
- equip the BTF with a **GEM** chambers for monitoring with a resolution of about 100 µm

➡ **in progress: two tests performed in 2012 showing good agreement whit the expected performance; integration in the BTF DAQ in progress**



- equip the BTF with **LYSO** calorimeter as monitor the beam energy

➡ **in progress: LYSO resolution data normalized by energy beam spread are now fitting optimally the montecarlo data; SiPM UV optimized are under test to reduce SNR.**



- multi purpose **DAQ** system

➡ **in progress: neutron detectors, environmental detectors, and beam diagnostic detectors has been implemented**

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