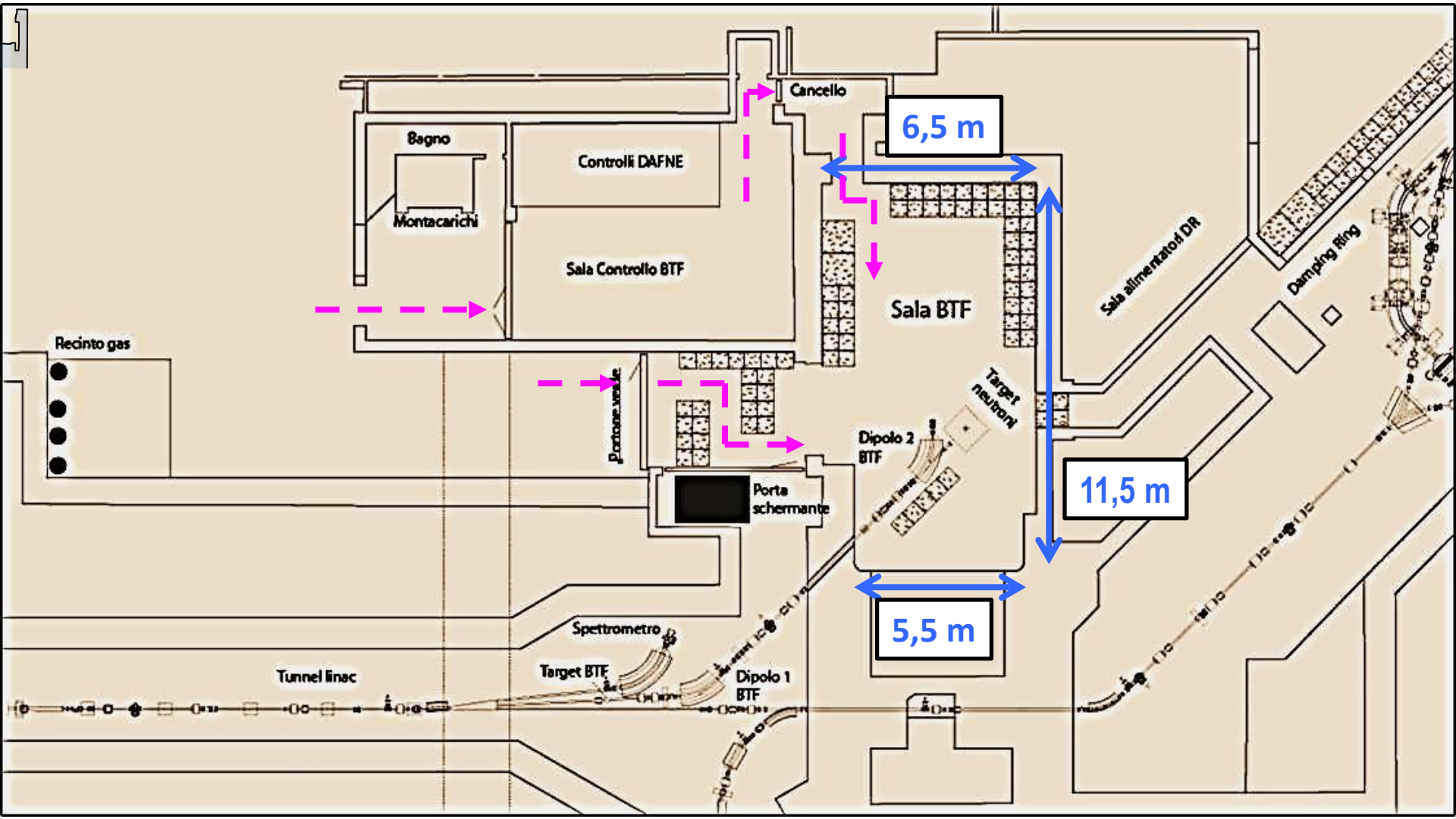
BTF TC 2015

Luca Foggetta on behalf of BTF group

07/01/2015

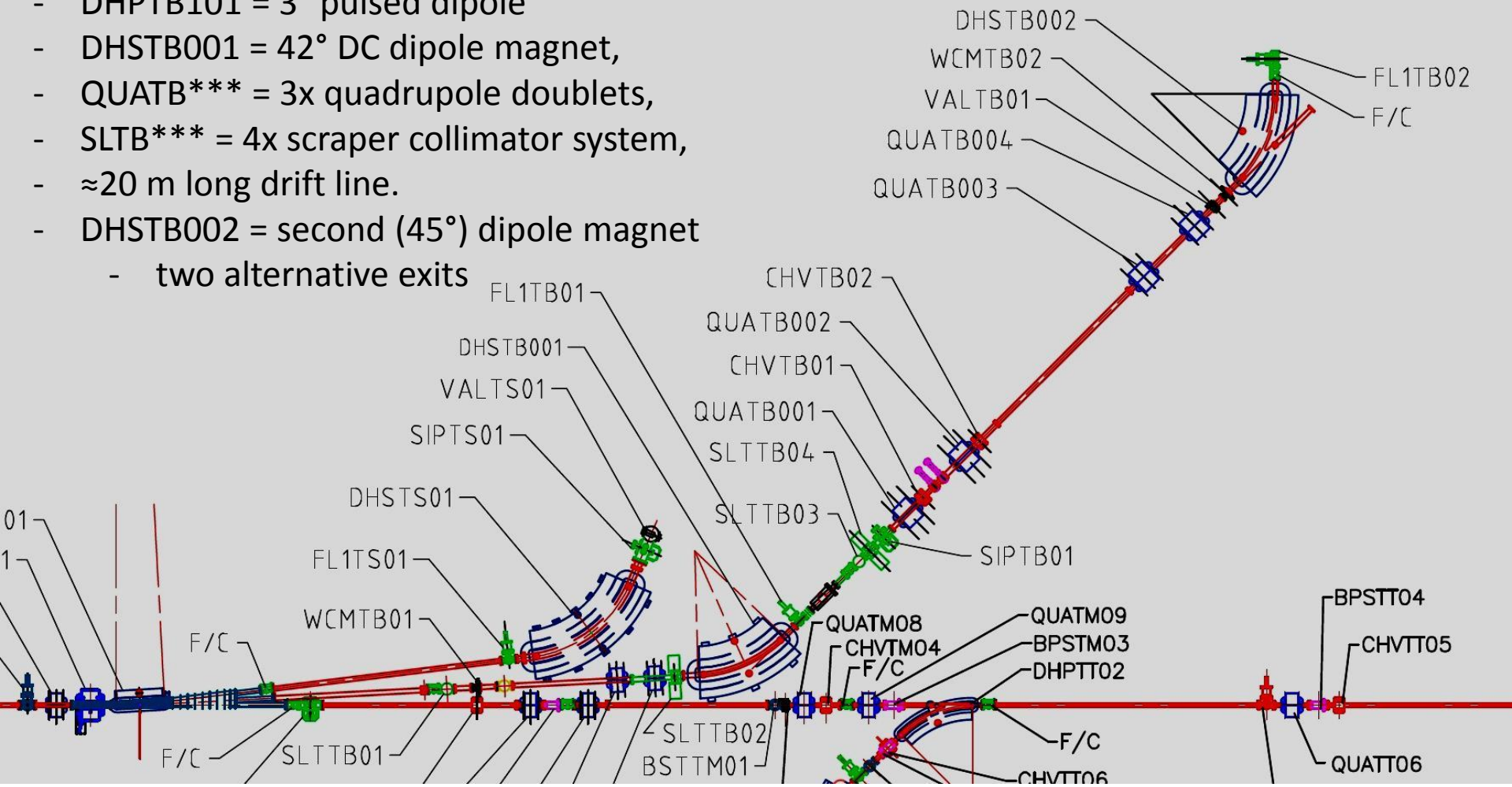
LNF - Frascati

BTF Layout - Logistic

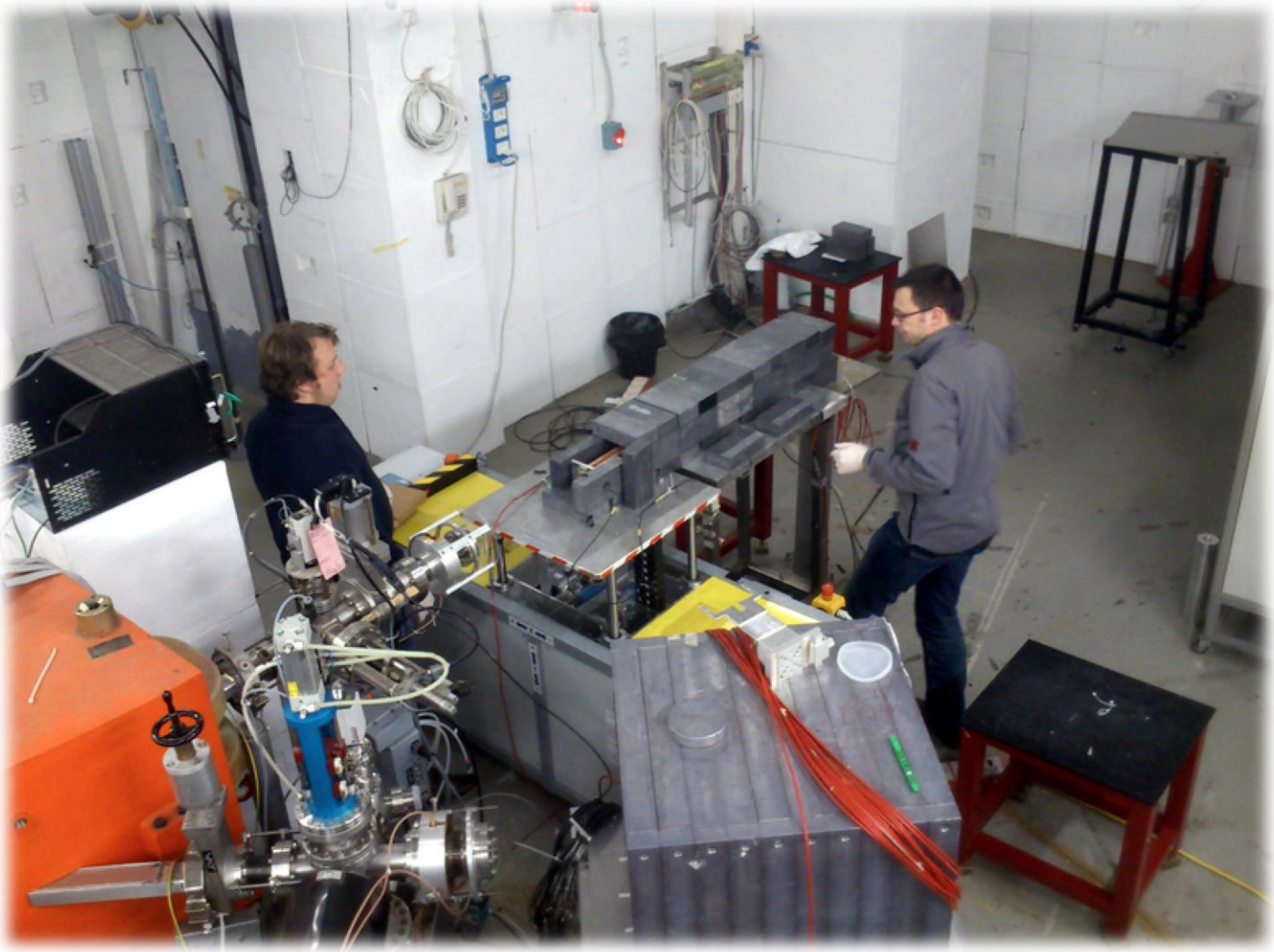


BTF Layout - Transport

- DHPTB101 = 3° pulsed dipole
- DHSTB001 = 42° DC dipole magnet,
- QUATB*** = 3x quadrupole doublets,
- SLTB*** = 4x scraper collimator system,
- ≈20 m long drift line.
- DHSTB002 = second (45°) dipole magnet
  - two alternative exits



BTF Layout - IMAGES



BTF Layout – IMAGES 1

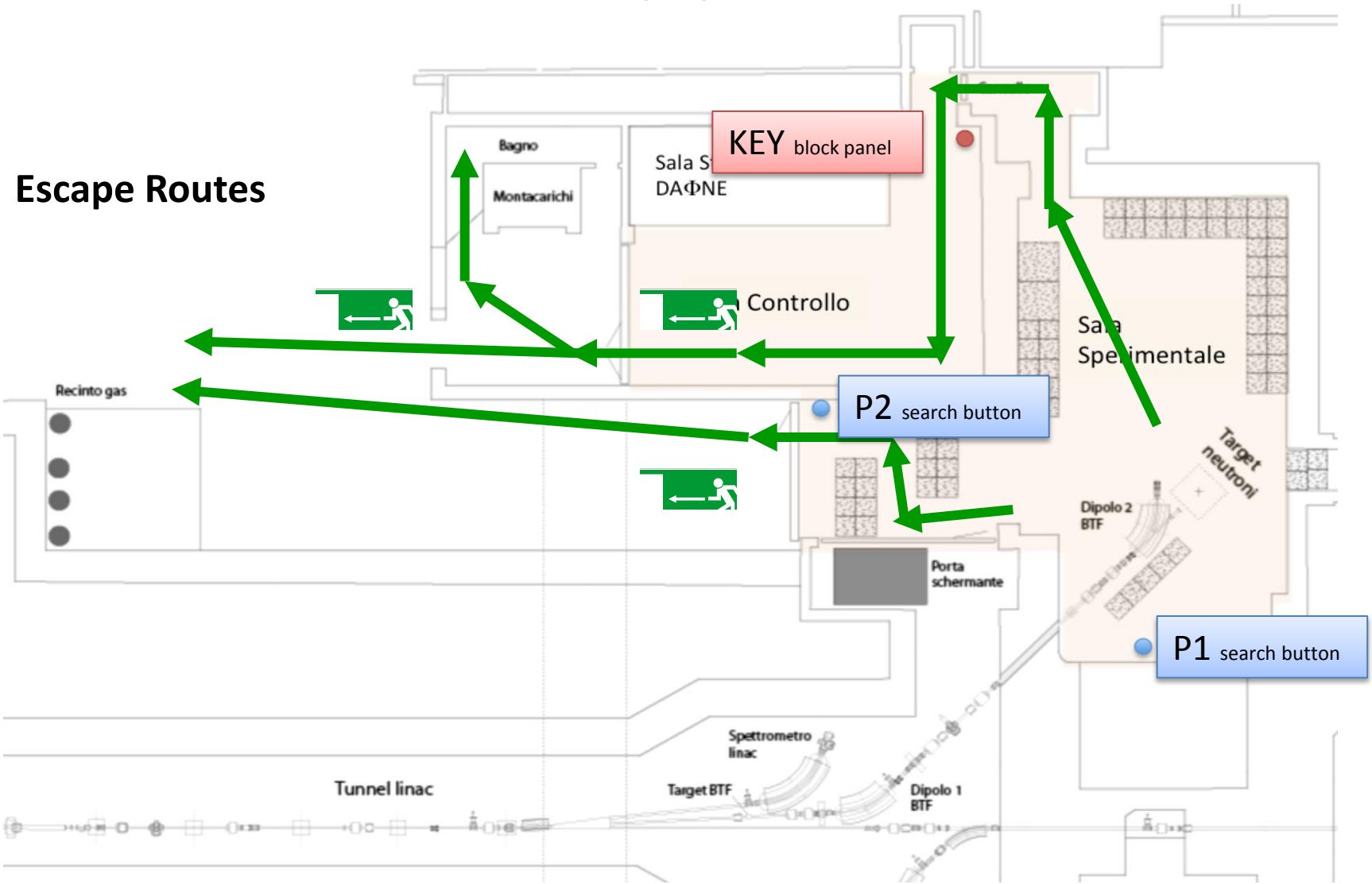
BTF Layout – IMAGES 2

BTF –Safety procedures

- **Responsibilities**
  - **B. Buonomo** is the safety officer for BTF installations and operation in BTF area
  - The **BTF staff** member(s) following your installation and run will:
    - Instruct on safety in the test beam area
    - Check [and **enforce**] safety rules
      - Starting from Rule #1: PEOPLE **not in the list** of authorized personnel, **you cannot enter** the test beam area

BTF –Safety procedures

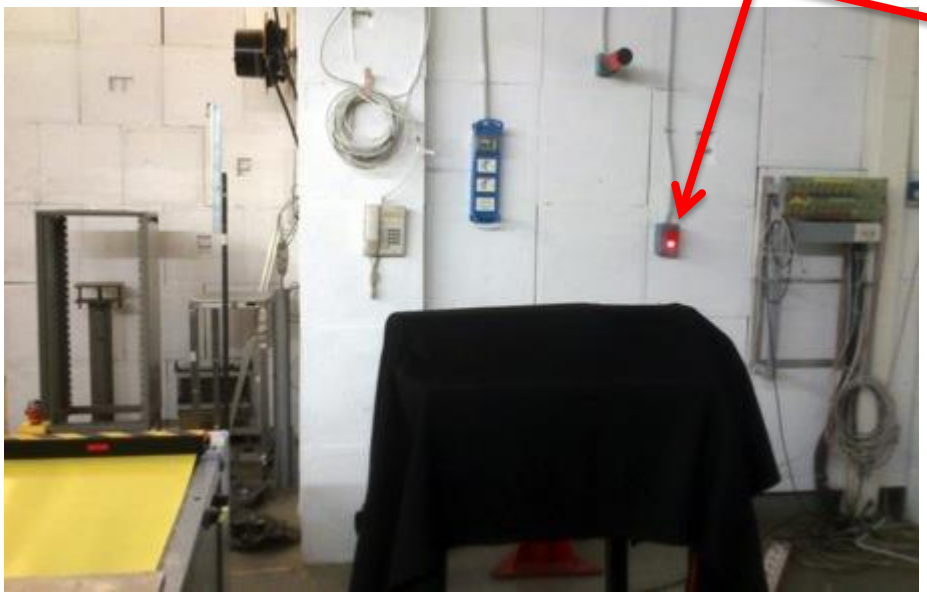
- **Escape Routes**

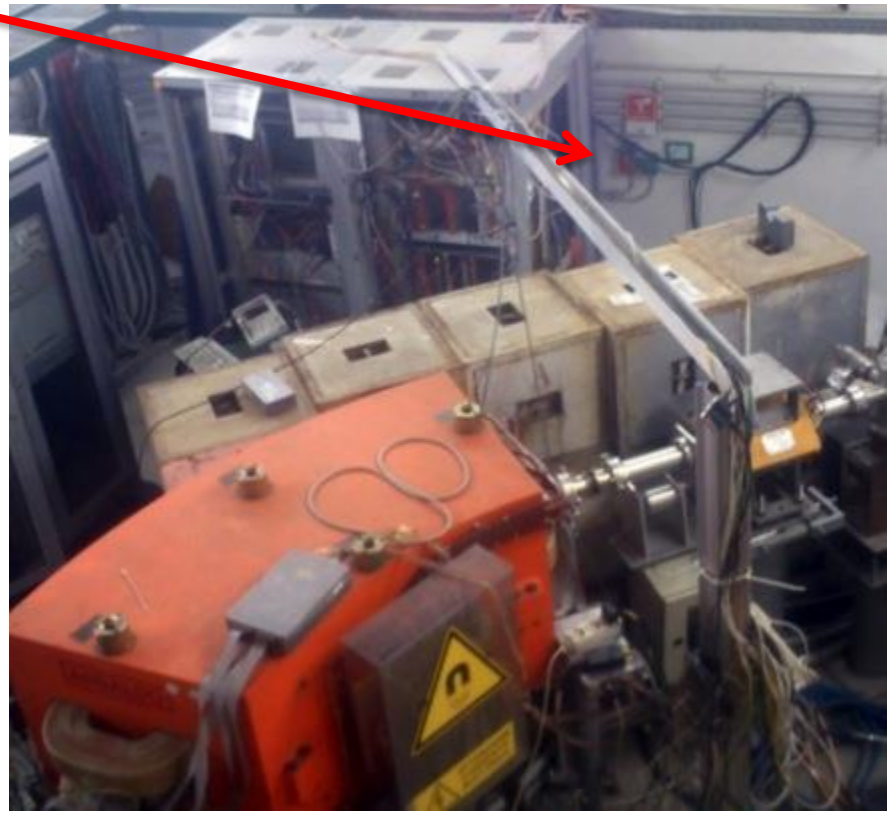


BTF –Safety procedures

◎ Emergency off:

⊙ Emergency off buttons in the experimental hall





BTF –Search procedures

◎ Searching and closing the area

◎ Search procedure (Ronda)

- ◎ **Two persons**:
  - ◎ the first one must stand close to the gate, ensuring that **nobody is entering the area**,
  - ◎ the second one checking that nobody else is in the area and pushing the two search **buttons in sequence**:
    - ◎ **P1** behind the BTF rack (the one with HV mainframe)
    - ◎ Shortly after (<30 seconds) **P2** (close to the large green door)

⊙ As soon as the buttons are pushed, the green light starts **flashing**

BTF –Search procedures

◎**Close** the gate, **turn the key** clock-wise (once), and remove the key (you will need the other, **smaller key**, attached to it, for the next step)

◎Make sure that the "**RONDA OK**" led in the synoptic panel close to the gate is **on**, otherwise you have to **repeat the search** correctly

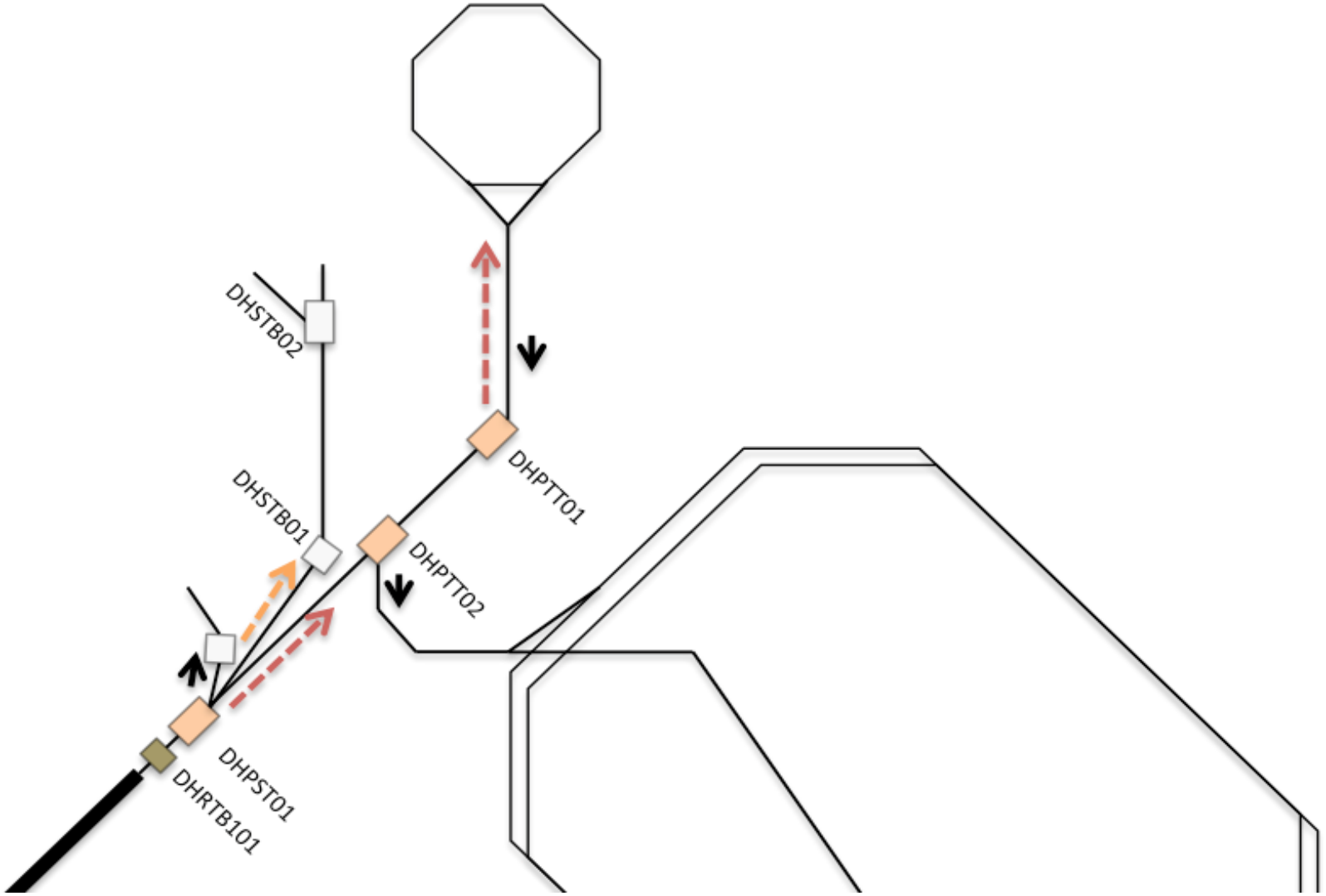
BTF –Search procedures

◎ Searching and closing the area

◎ Closing the area and enabling beam

- ◎ Insert the small key in the **KEY BLOCK PANEL** to the access gate
- ◎ Turn from the free (**libera**) to the blocked position (**bloccata**) turning clock-wise
- ◎ The **green** led (left) on the key panel will stay **on**
- ◎ Ask to **enable beam** to the main control room (**2400**)
- ◎ The green led will go off and the **red led** (right) will go **on**
- ◎ **Only after the red led is lighted, you can switch on the transport dipole magnet (DHSTB01)**

BTF INJECTION SEQUENCE



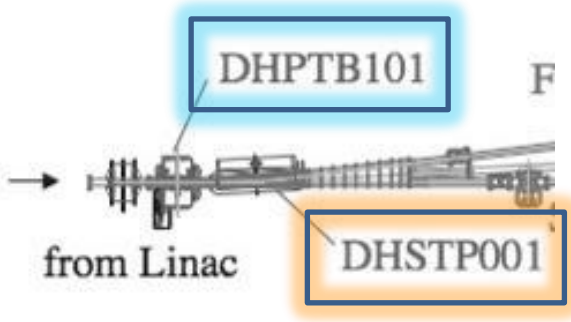
BTF INJECTION SEQUENCE

DAΦNE phases of the complex LINAC, BTF and DAΦNE:

- **LINAC** = LINAC shots are delivered at 25(50) pulse per second and dumped at the end of TL
- **LINAC+BTF** = LINAC shots are delivered with a selectable duty cycle to BTF from 1 to 24(49) pulse per second. The remaining are dumped at the end of the TL
- **GLOBAL** = LINAC shots are delivered with a variable duty cycle to BTF in dependence of the injection parameter in ACCUMULATOR
  - NO INJECTION => SELECTABLE from 1 to 24(49) pulse per second
  - INJECTION => the injection needs are DAΦNE CR controlled. Typically an injection sequence pulses at 2Hz, taking from 1(1) up to 7(19) LINAC bunches per sequence => BTF delivers 22(48) down to 10(10) bunches per second

BTF SEQUENCE - Pulsed Magnet

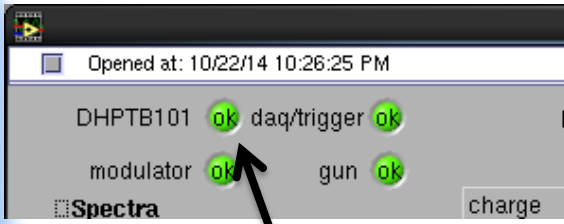
DHPTB101

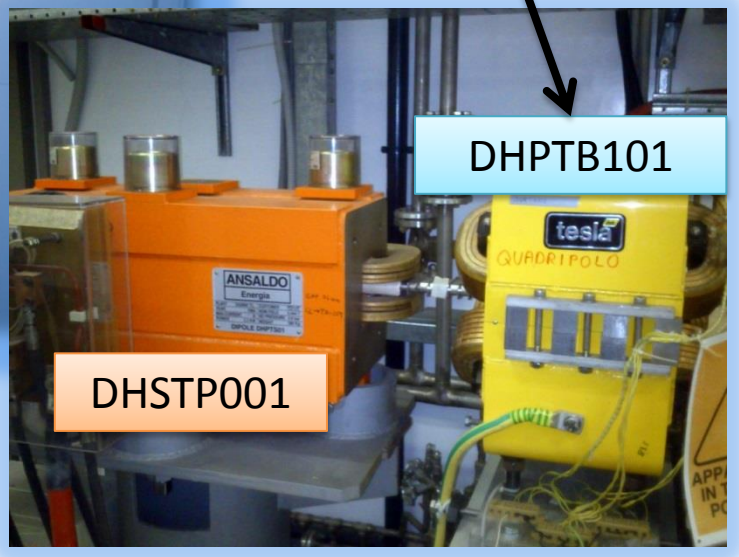


Located in PS modulator hall

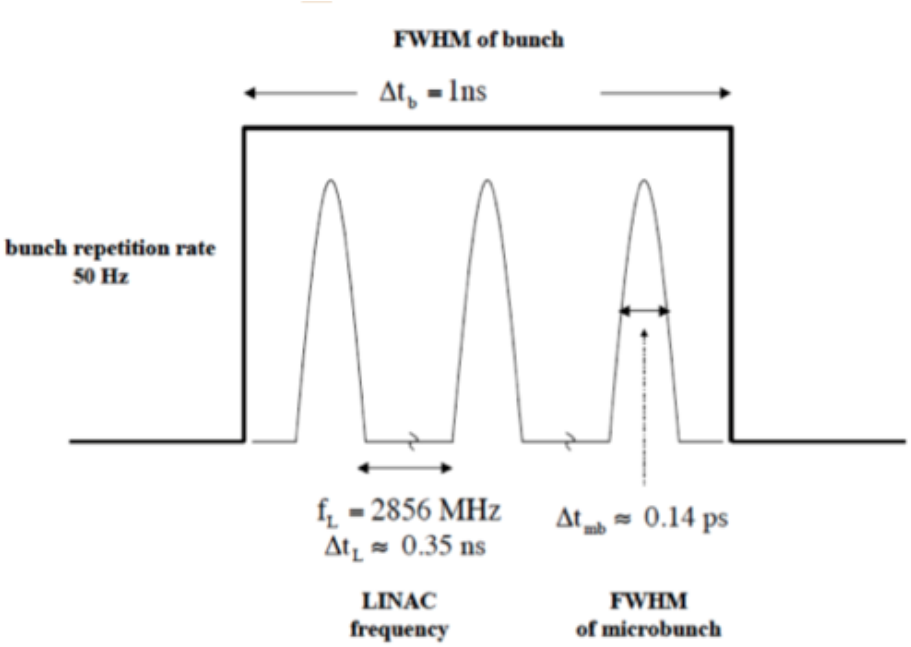
- Sometimes trips!
- Shows no ALERT!!!
- Users can't run without

=> **Look at the oneElectron.vi**





BTF – LINAC Beam



Parameter	Value
Maximum rep. rate	1-25 Hz [50 Hz]
Pulse duration	1.4 ⟶ 40 ns
Linac frequency	2,856 GHz
Microbunching period	~350 ps
Nominal energy	510 MeV

Electron phase par	Value
Tunable Energy	300->750 MeV
Nominal charge	3×10^{10} e^-/bunch
Nominal current	500mA

Positron phase par	Value
Tunable Energy	300->550 MeV
Nominal charge	5.5×10^{9} e^+/bunch
Nominal current	85mA

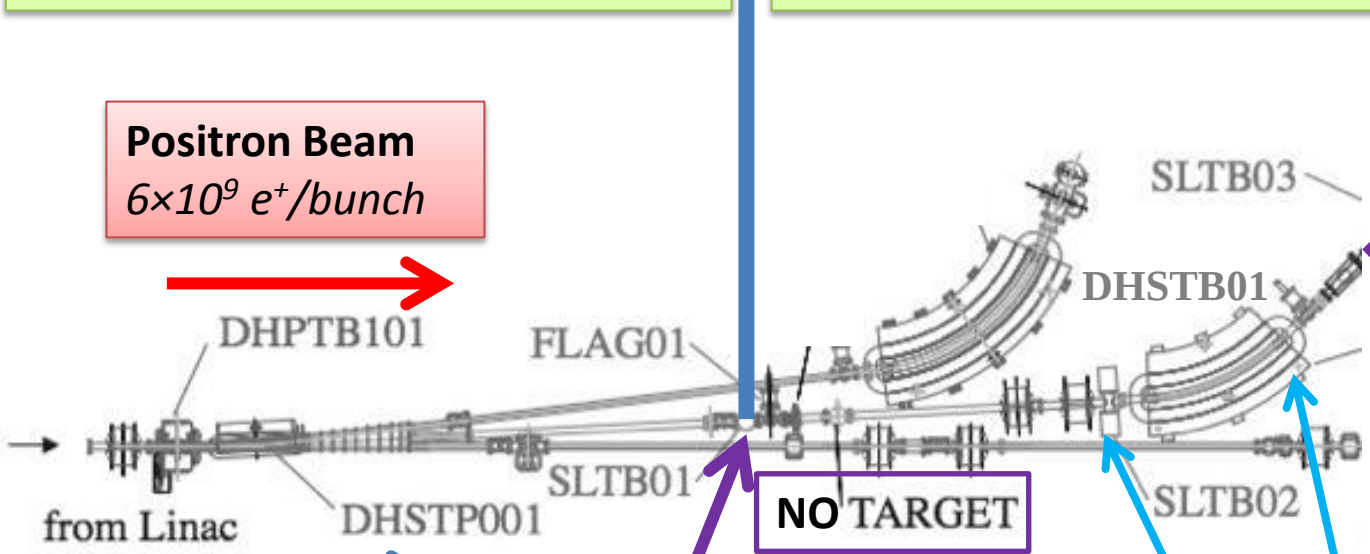
BTF LAYOUT – Primary beam

PRIMARY

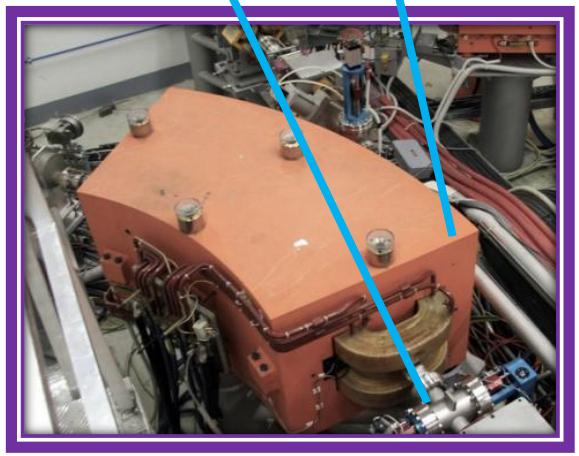
PRIM conditioned

Positron Beam
6×10⁹ e⁺/bunch

Electron Beam
3×10¹⁰ e⁻/bunch



- 4x single-axes SCRAPERS
- LINAC Energy is conserved
- NO TARGET!!!!



DHSTB001 steers and no more

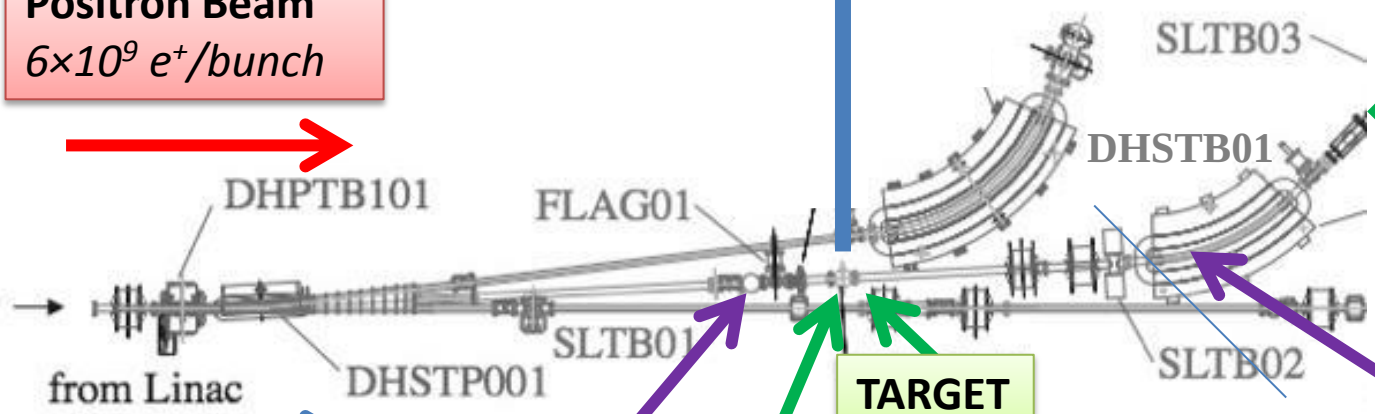
BTF LAYOUT - Secondary Beam

PRIMARY

SECONDARY

Positron Beam
6×10⁹ e⁺/bunch

Electron Beam
3×10¹⁰ e⁻/bunch



TARGET

- 4x single-axes SCRAPERS
- LINAC Energy is different to BTF energy
- YES, TARGET!!!!

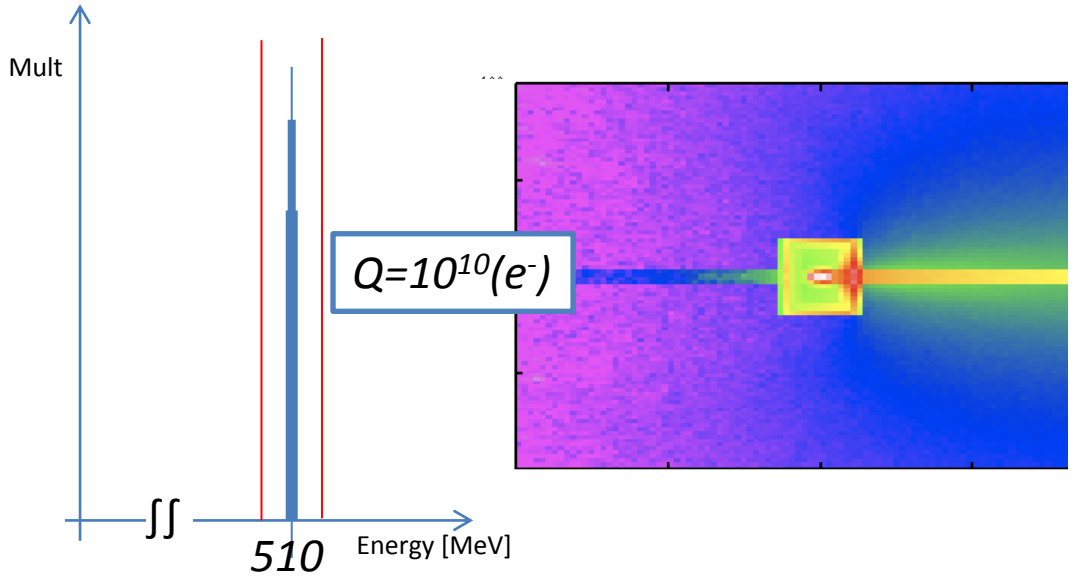
DHSTB001
- Selects energy
- Steers

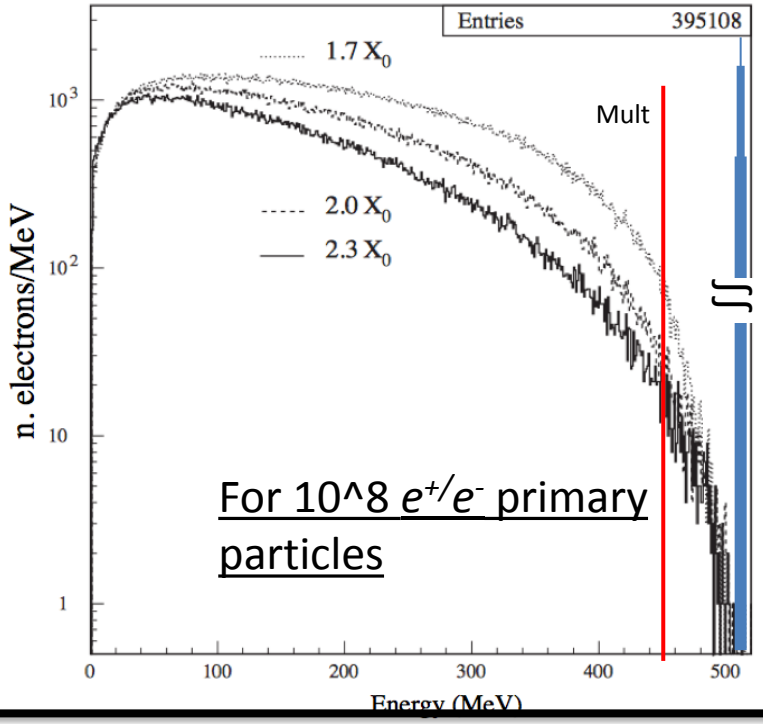
Is a spectrometer!

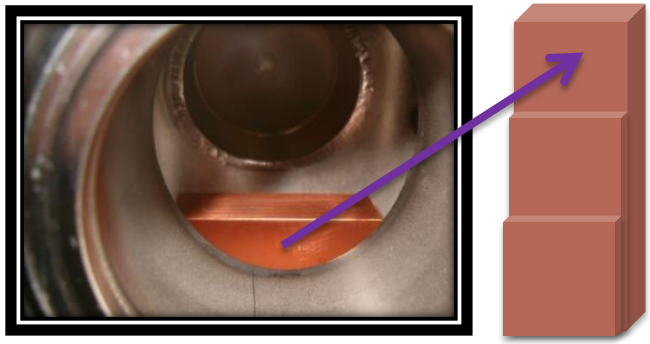
BTF LAYOUT - Secondary Beam

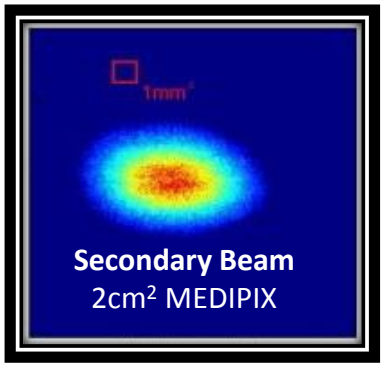
3-selectable thickness Copper Showering TARGET (Targhettone…)

- 1.7, 2.0 or 2.3 radiation lengths





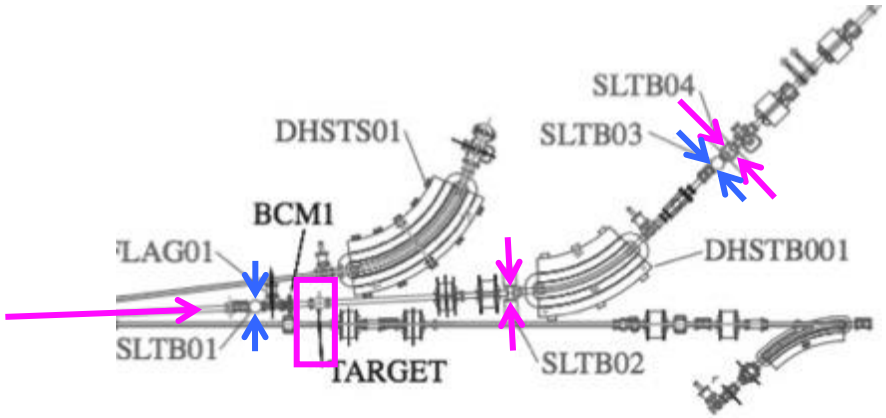


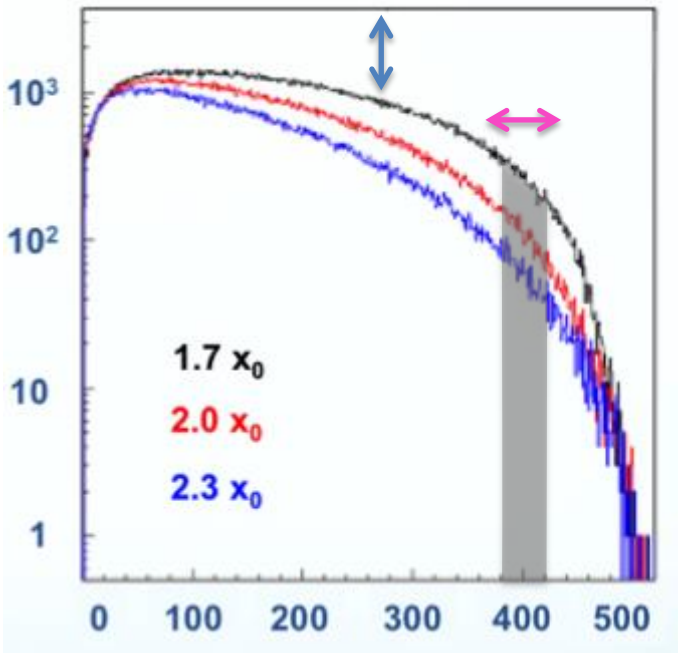


BTF BEAM - Intensity tuning

Adjustment of the number of particles can be achieved:

- Without changing the momentum resolution:
  - **Modulating** the LINAC **current** [not possible in 'parasitic mode', very rough]
    - Act on transport optics or modulators power/phase
  - Choosing another **target depth** [step change but reproducible] –> **Secondary beam**
  - Closing/Opening the **down-stream vertical collimators** [fine but small range]
  - Closing/Opening the **up-stream vertical collimators**
- Also changing the momentum resolution:
  - Closing/Opening the **horizontal collimators**





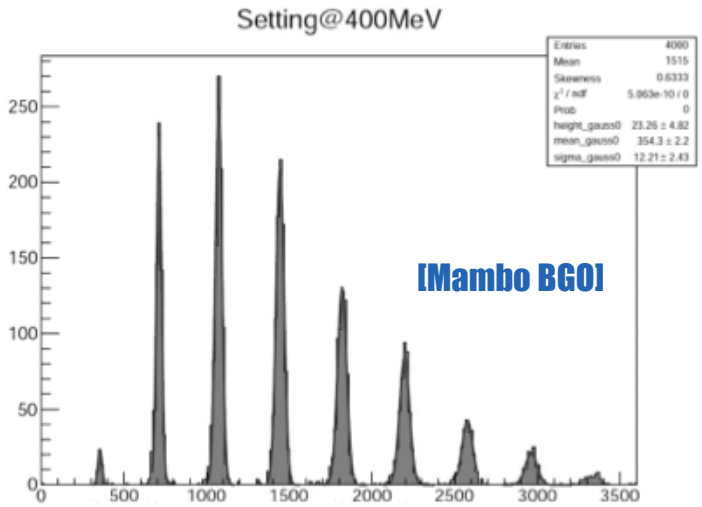
BTF LAYOUT - Secondary Beams

Secondary beam, single particle

- The primary beam is attenuated by the copper target
- Starting from primary beam energy down to 50 MeV
- Multiplicity as Poissonian distribution with a given average multiplicity is selectable
- Selectable positrons or electrons , independently from LINAC phase

Secondary beam, intermediate intensity

- The primary beam is attenuated by the copper target
- ranging from ten to hundred thousand particles per bunch
- selecting at least 10MeV energy lower than the primary one
- Multiplicity is directly related to the secondary energy spectrum accepted by the line
- Selectable positrons or electrons , independently from LINAC phase

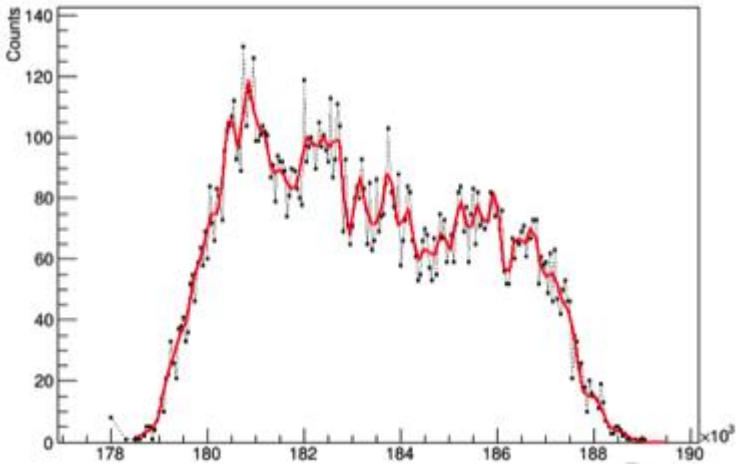


→ thus allowing a very fine tuning of the beam intensity and energy

BTF LAYOUT - Secondary Beams

REMARKS

1. **LINAC phase is independent from BTF phase**
   - Approx. one tenth variation in BTF delivered multiplicity when LINAC switches from electron to positron phase
   - Beam time structure is conserved
   - BTF delivered energy remain the same
   - Sign of the particle remain the SAME!!!!
   - Few tents of ps in delay of the positron phase respect to the electron phase, but under the jitter of the DDG
2. **MULTIPLE SCATTERING**
   - Yes, they are electron and positron
     - 500 0,001
     - 400 0,001
     - 300 0,002
     - 200 0,003
     - 100 0,006



BTF Timing

- DAFNE reference $\emptyset_4$ for the injection systems
- Conditioned $\emptyset_4$ -> DELAYED LINAC SYS SIGNAL moves all the LINAC stuff together to match ACCUMULATOR phase)
  - DELAYED GUN SIGNAL -> LINAC SYS REFERENCE (once optimized, not moved for months)
  - BTF REFERENCE -> USER needs DELAYED LINAC SYS

→ WE ARE WORKING in STATIC LINAC+BTF TRIGGERING SCHEME

Some Jitter contribution (see also AMY and UA9 experiences)

- LINAC SYS reference jitter (rms, 10ps, our best measure)
- LINAC GUN jitter (100ps)
- BTF STANFORD DDG535m single channel jitter (rms, 50ps + 0.01ppm of the channel delay) .

BTF Timing – DAFNE Setup

BTF Setup Menu (BSM)

→ Go Forever = lets the DAFNE injection rejected pulses (minus the Odoscope one per sequence!) to be delivered at set frequency to BTF
→ Single Shot = only one pulse delivered to BTF, after the DAFNE injection pulses

General Timing Status (GTS)

→ Normal = cutoff trigger signal @ BTF and BTF bunches (the DHPTB101 still works!!!)
→ BTF = gives trigger signal @ BTF and implements BTF status setup (BSM)
→ BTF one shot = gives trigger signal @ BTF and implements BTF status setup for one shot per second or manual shot

ODOSCOPE setup (ODO)

→ DAFNE = cutoff the DHPTB101
→ DAFNE+BTF = permits DHPTB101 to pulse

BTF Timing – DAFNE Setup

DAFNE+BTF PHASE

MANUAL SHOT

GTS → BTF 1 shot
BSM → Single shot
ODO → DAFNE + BTF
Press RUN BTF button and it fires one pulse

One shot per second (Two in injection)

GTS → BTF 1 shot
BSM → Go Forever and number of impulses = 1
ODO → DAFNE + BTF
Press RUN BTF button and it fires at 1 Hz (two pulses per second in DAFNE injection)

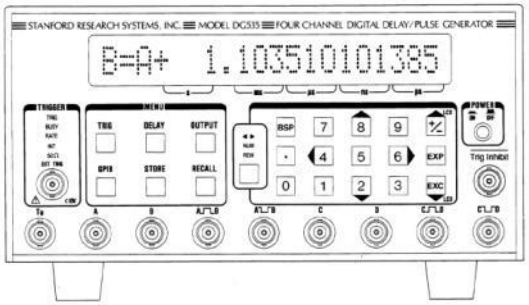
Maximum shot rate (minus the DAFNE injected bunches)

GTS → BTF
BSM → Go forever and number of impluses = 49
ODO → DAFNE + BTF

TIMING – Stanford DDG535m

Stanford DDG535m

- 4 independent timed logic transition
- 2 independent gated pulses
- outputs at TTL, NIM, ECL or continuously adjustable levels.
- drive either 50Ω or high impedance loads.
- The high accuracy (1 ppm), precision (5 ps), wide range (0 to 1000 s), and low jitter (50 ps rms)
- Custom TRG out, Standard and Time (5ps step)
- Run-time user customizable
- Internal and External T0
- Different pulse mode



BTF TIMING – final note

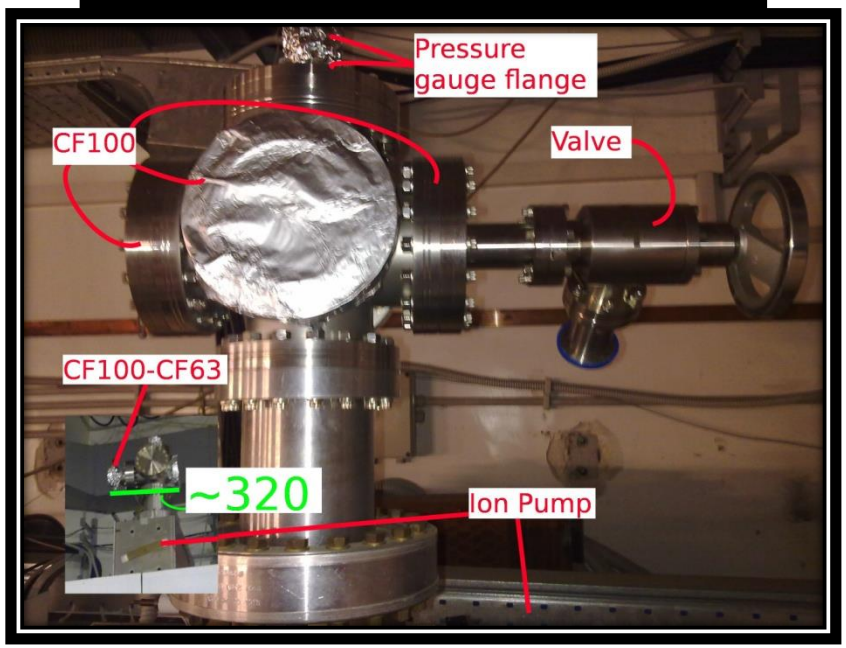
Typical triggering issues:

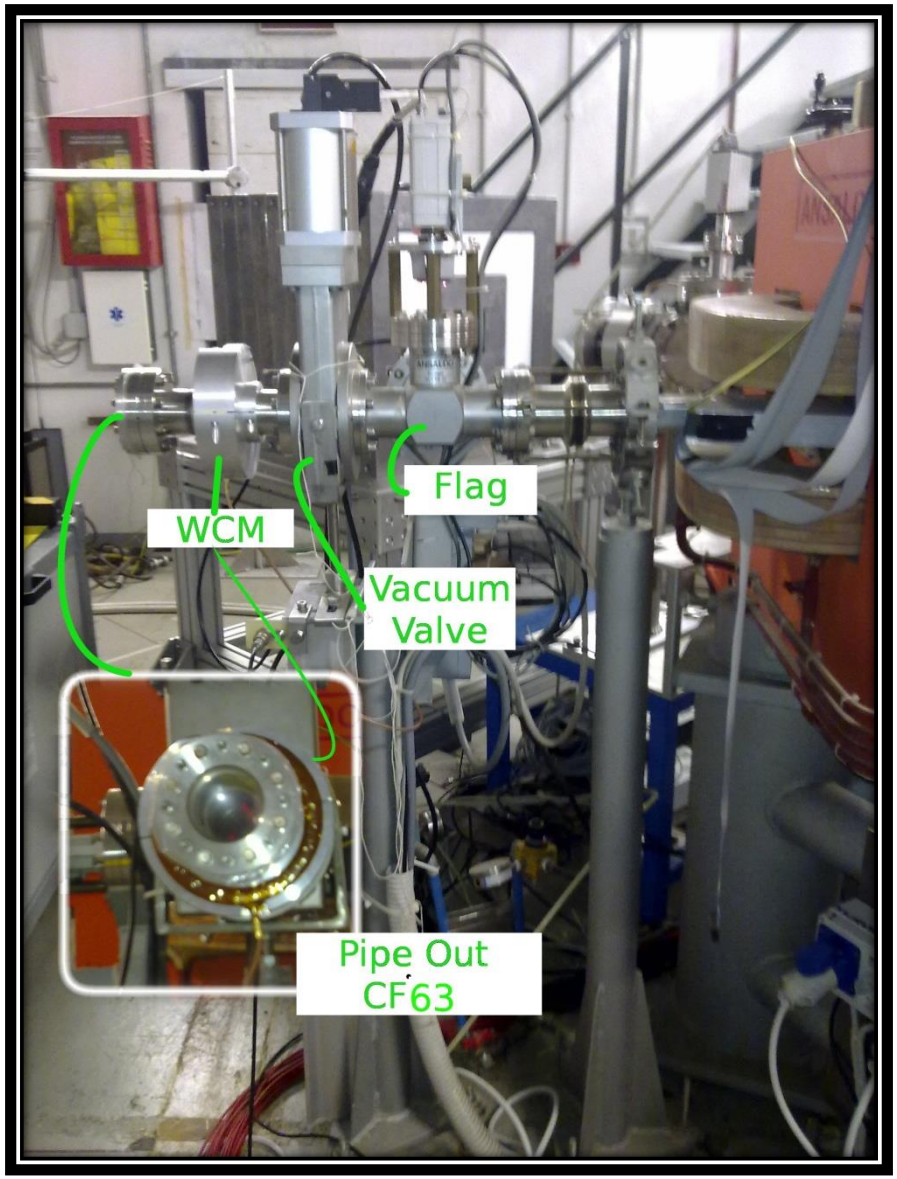
- Wrong external trigger threshold setting -> **USER problem**
- Too much noise (also in burst condition, grounding problem) -> **USER problem**
- Voltage fluctuations on the trigger input (bad power supply condition) -> **USER problem**
- Insufficient or excessive trigger amplitude (wrong selected standard) -> **USER problem**
- Out of temperature operating range -> **USER problem**
- Triggering at too high a rate. -> **USER problem**

BTF VACUUM

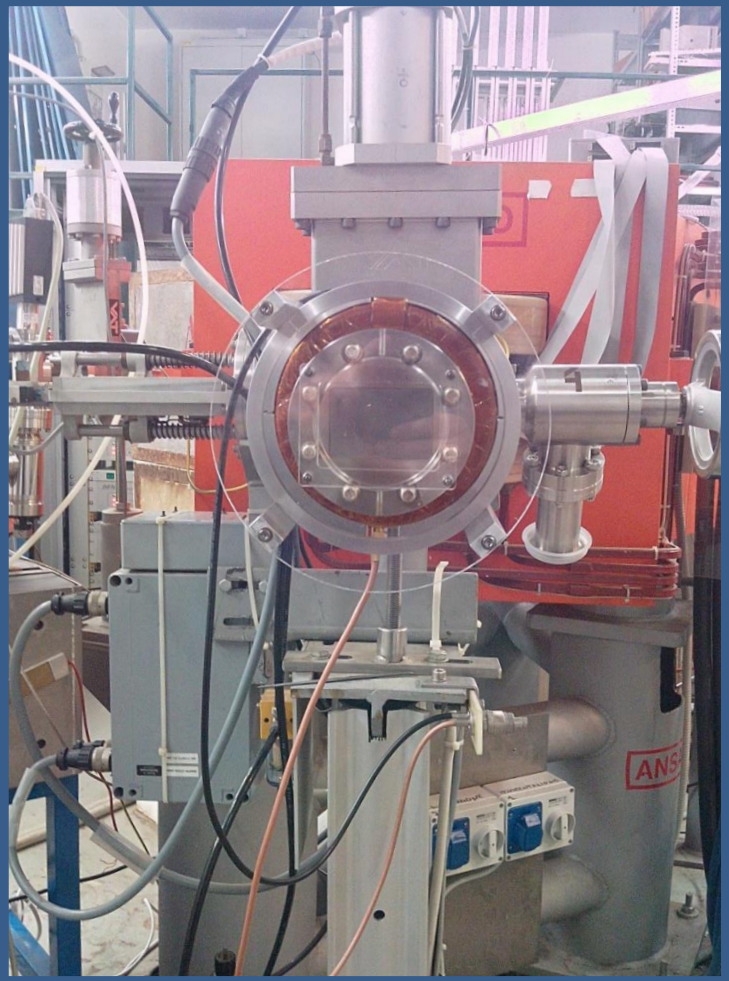
- BTF operate to LINAC-TL Vacuum, meanly down to ~10^-10 mbar
- Vacuum stop at 500µm-thick Be Flange
- Vacuum is operated via Ionic pump, so is not dynamic -> in case of PS mains failure, vacuum is still maintained closed (plus degas…)
- In case of power loss, the vacuum system has a breaker in “SALA ALIMENTATORI ACCUMULATORE”, on the racks at the right of the little entry door before the gate
- Some fragile joints: ceramic gaps on the current transformer and exit windows
- The pipe ends are equipped with prevacuum service for different line extensions

VACUUM - Services

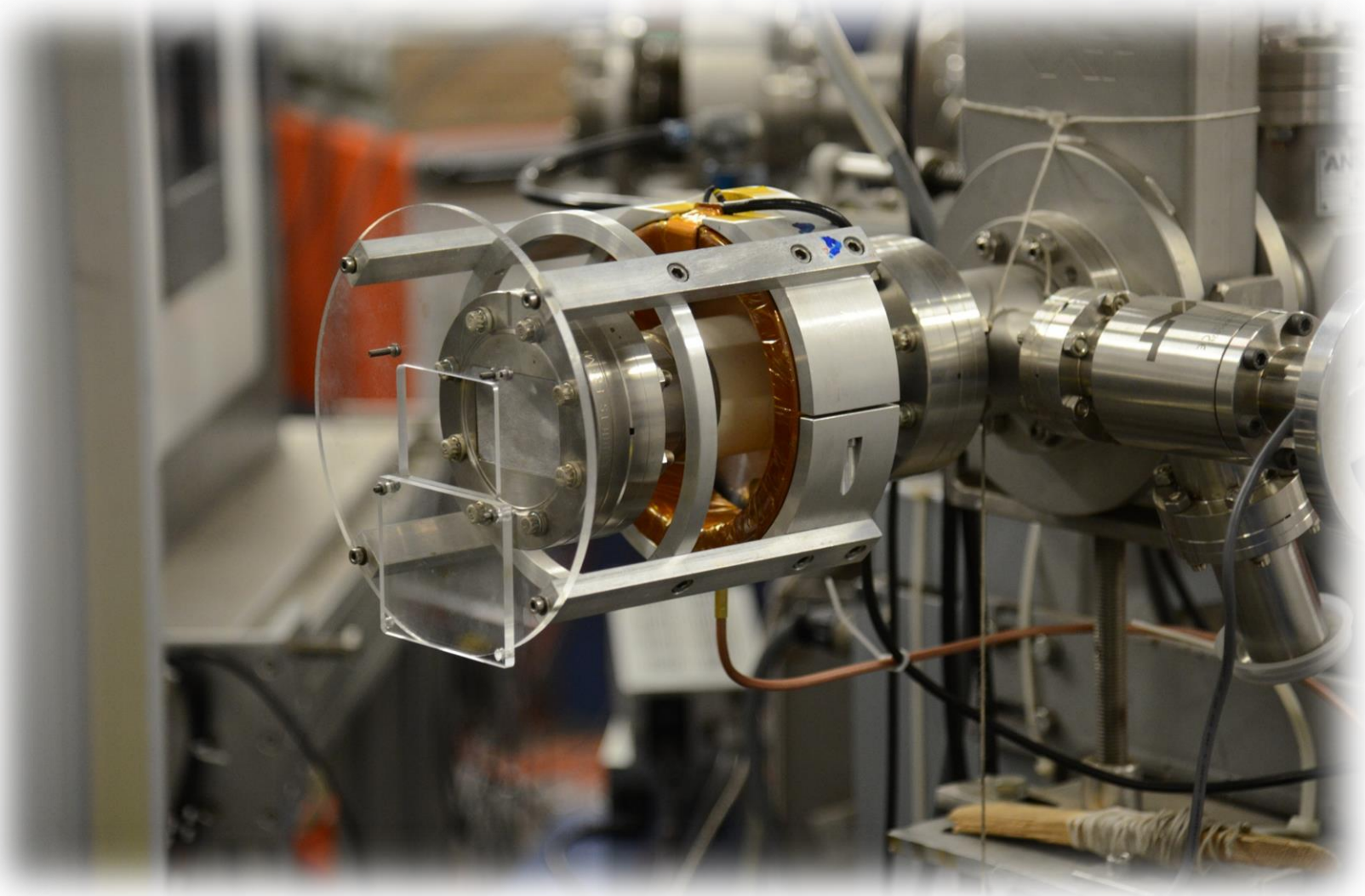




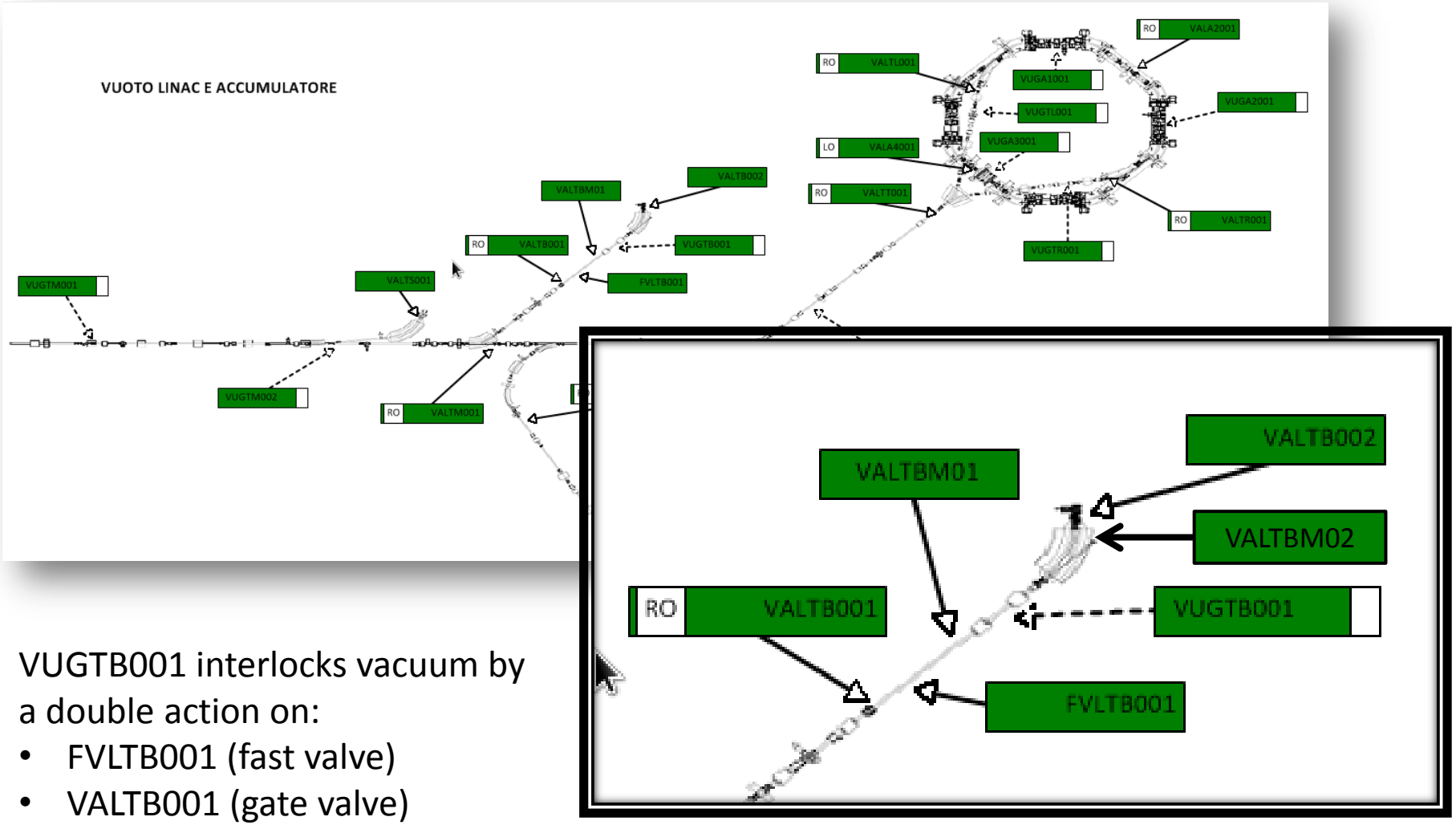
VACUUM – BTF windows



VACUUM – BTF windows



VACUUM – Safety System



VUGTB001 interlocks vacuum by a double action on:

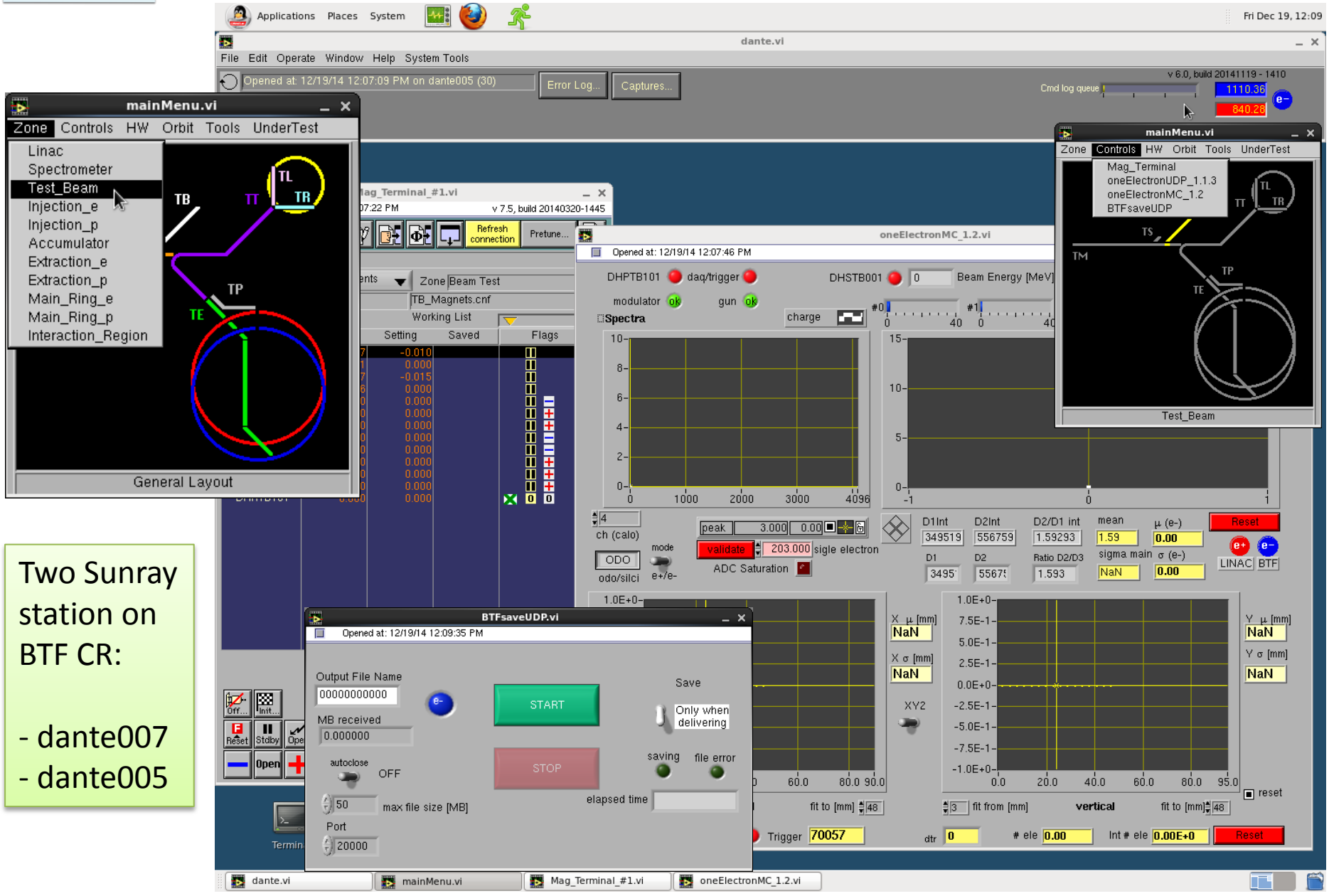
- FVLTB001 (fast valve)
- VALTB001 (gate valve)

Interlock starts > 10^-7mbar

BTF SERVICE - NETWORK

- BTF VLAN -> 250 possible addresses on 192.168.189.xxx
- 100Mbit switches split in three part:
  - First 8 port belong to DAFNE DCS
  - The remaining ones are half for BTF internal network and other half for LNF network
- 3x100Mbit switch(2 @ BTF exp. Hall, 1@ BTF CR)
- DHCP servers as BTF as for LNF
- DHCP lease last one month, please remember for longer experiment
- Are present 4x1Gbit point to point direct cabling from BTF Hall to BTF CR
- 4x static cams and 2X remotely controlled

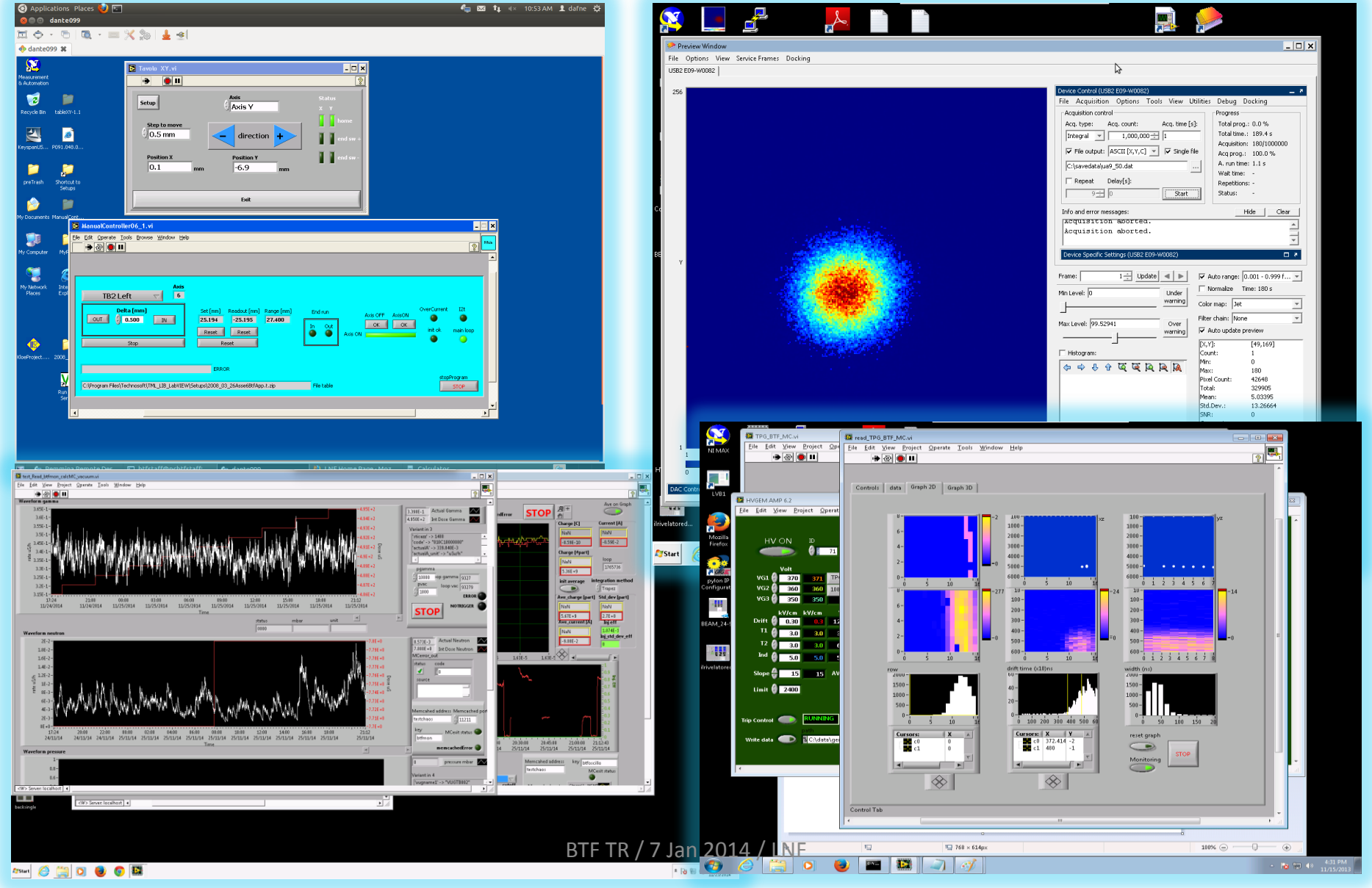
BTF SERVICE - DCS



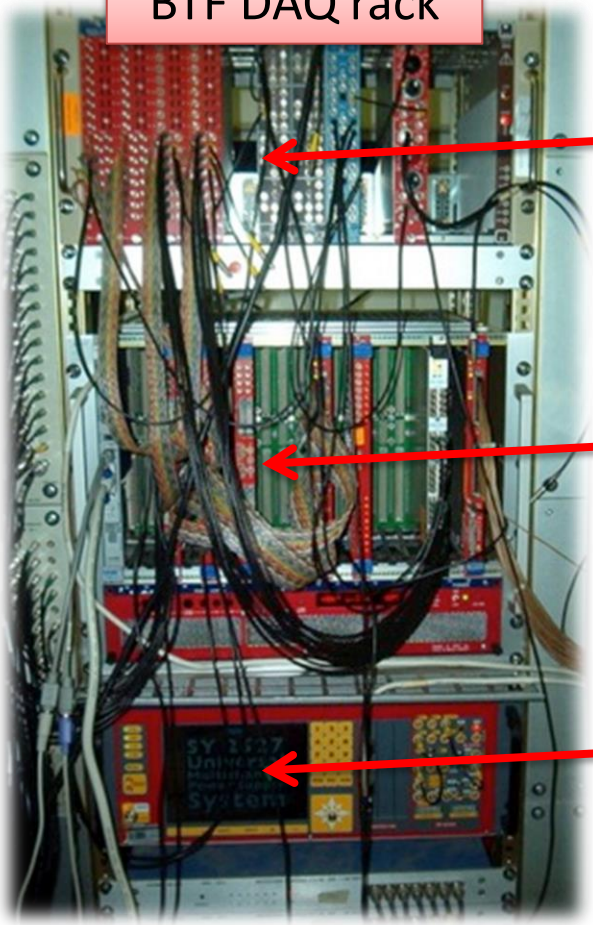
Two Sunray station on BTF CR:

- dante007
- dante005

BTF SERVICE – DCS Standalone



BTF SERVICE – DCS Standalone Rack



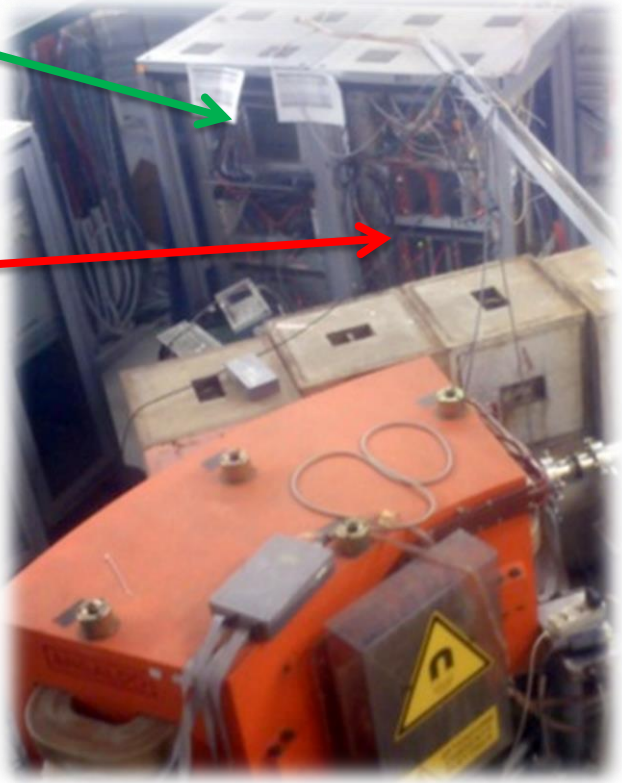
NIM Crate
-BTF

VME Crate
-BTF

HV Crate
-BTF
-DAFNE ODOSCOPIO

ODOSCOPIO rack & VME

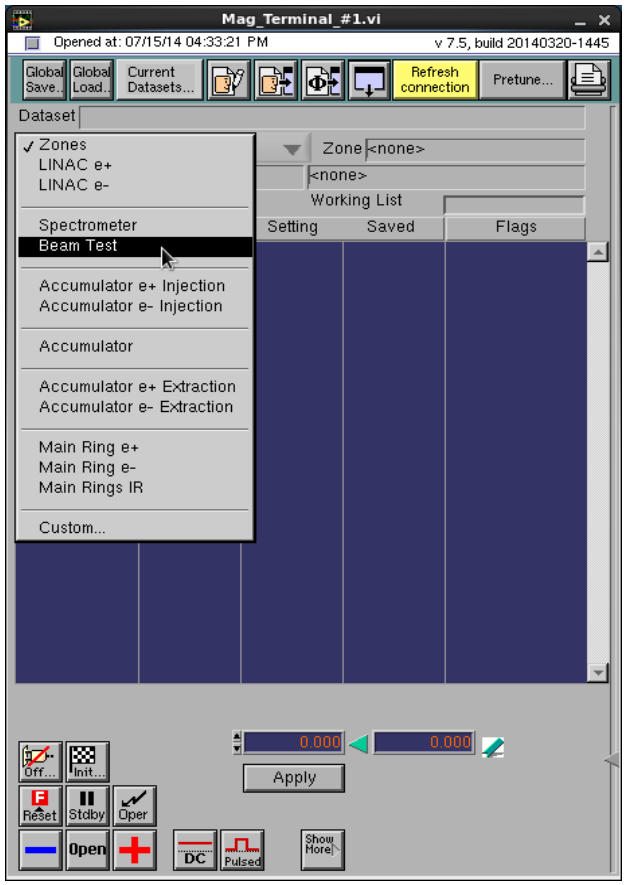
BTF DAQ rack

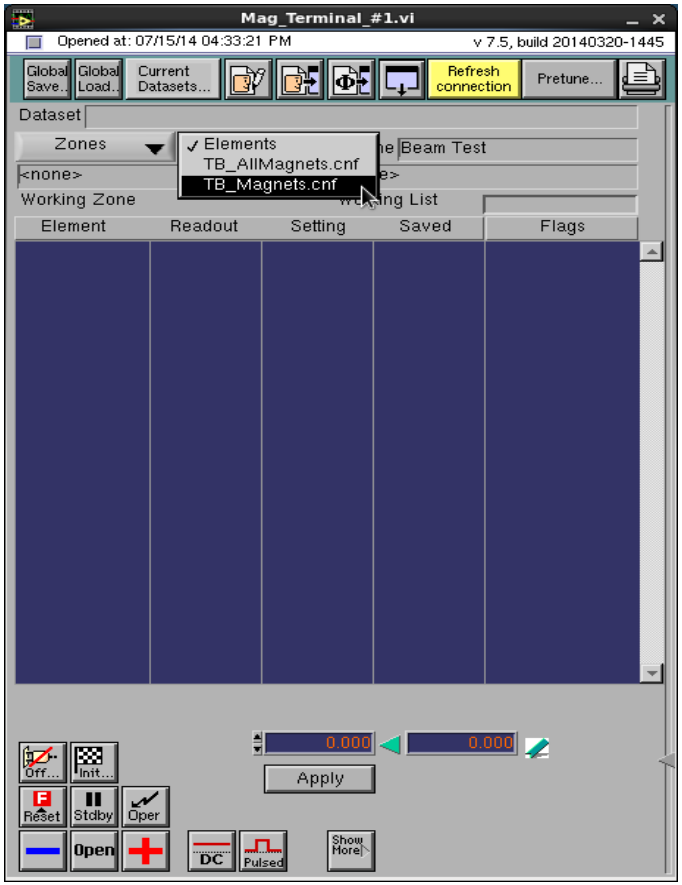


BTF DAQ

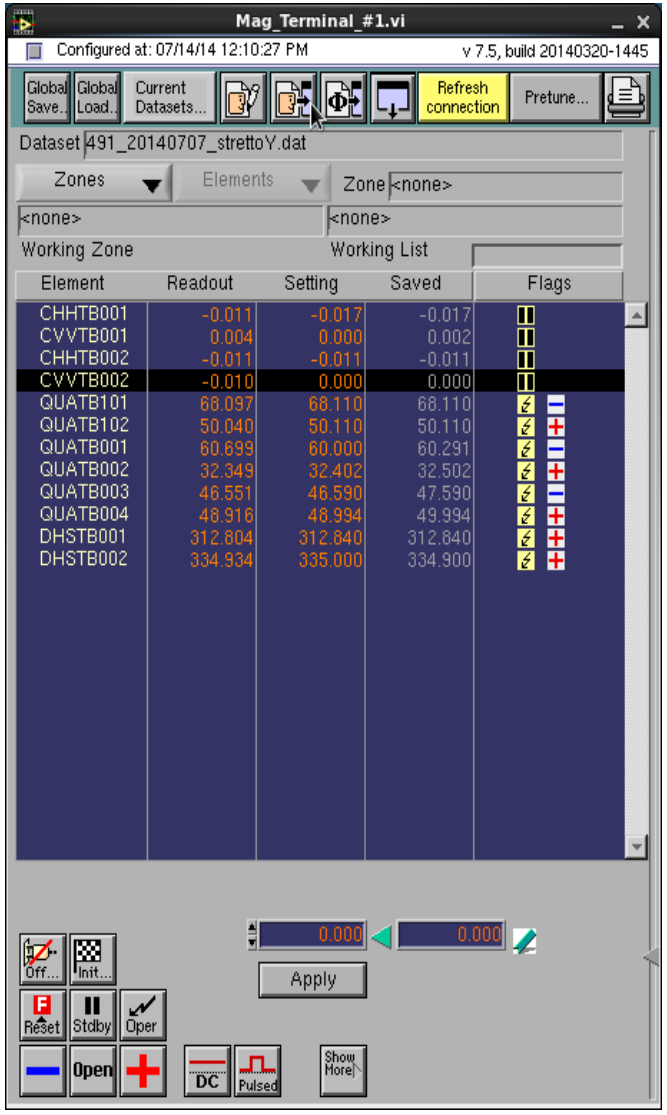
- Typical DAQ configuration
  - VME based DAQ
  - VME arbiter and embedded PC - VMIC
  - Timing unit
  - CAEN V965 (calorimeter, ICT …)
  - CAEN V792 (Hdensity, 32 ch Fiber Hodoscope)
  - DIO for signaling and VETO
  - SYS 3800 32-ch counters (Neutron detector, Trigger diagnostic)
  - TDC and custom boards
- DAQ is managed via DAFNE DCS and is triggered via BTF triggering scheme
- DAQ is projected on Producer-Consumer layout via UDP messaging
- UI is also belonging to DAFNE DCS
- Service programs delivers data to users

BTF DCS – mag terminal





BTF DCS – mag terminal



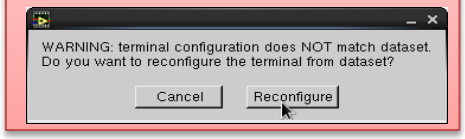
User has just been Trained on the procedure

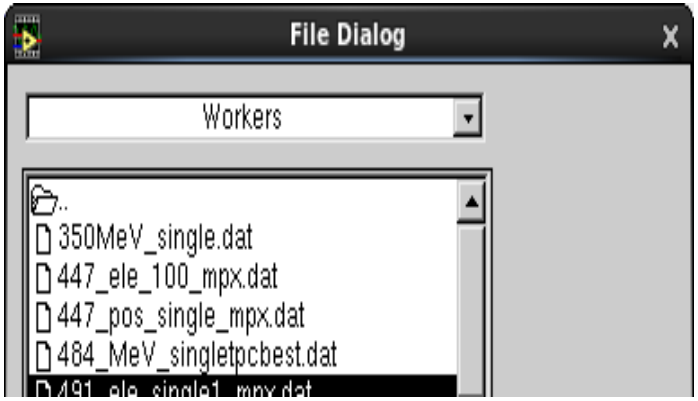
User has to **KNOW** the used filename

\+  =

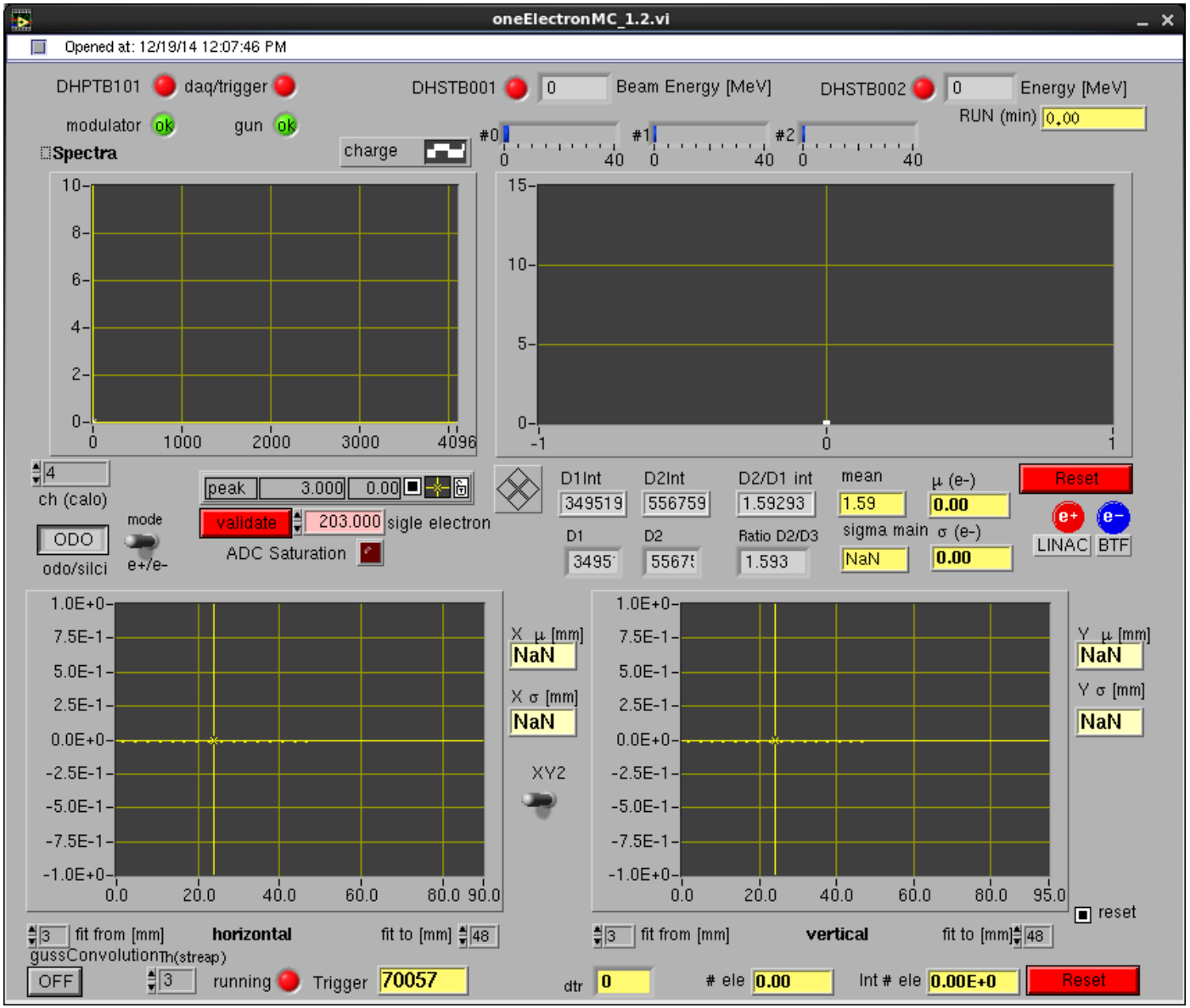
Don't forget the

Sometimes

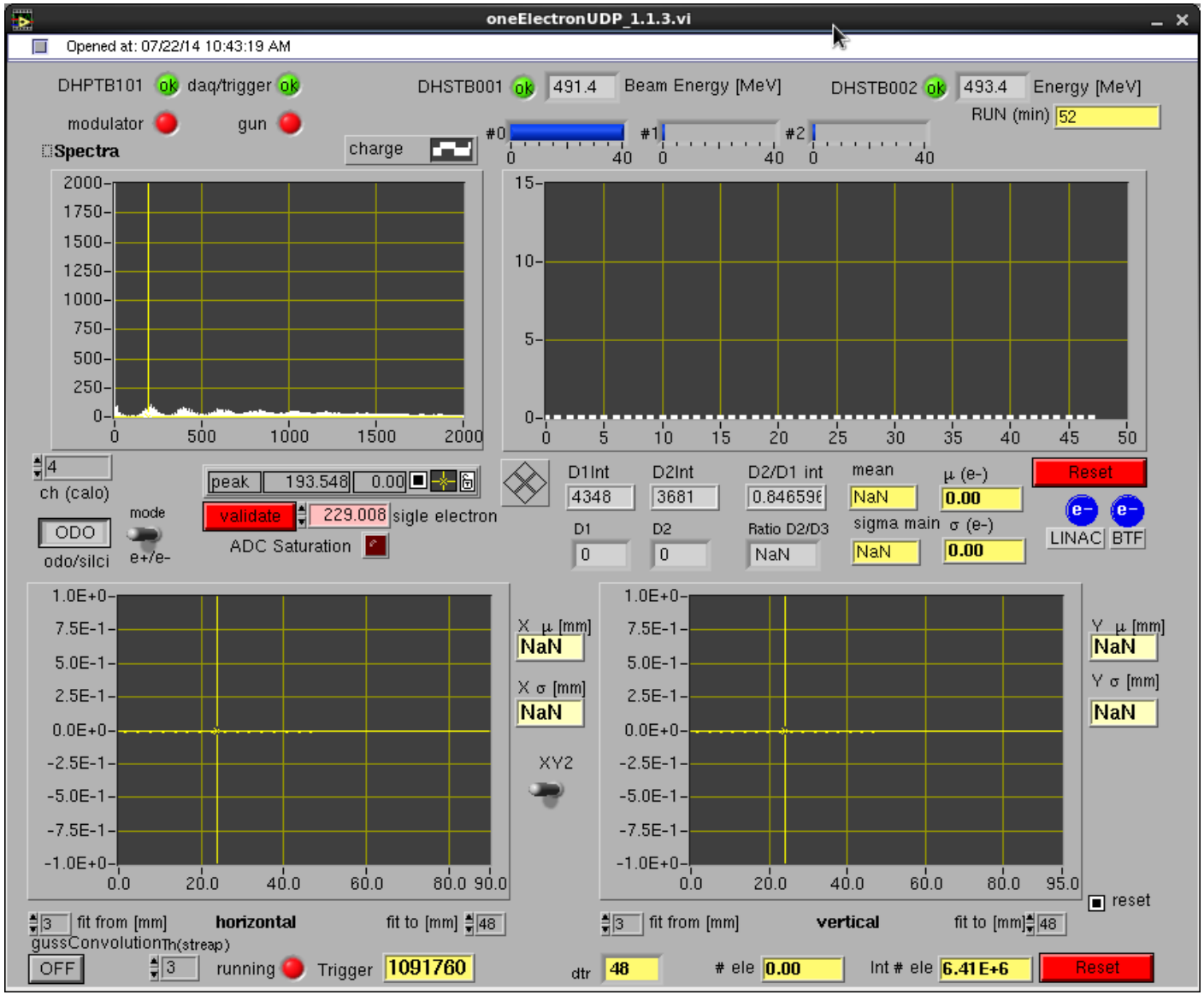




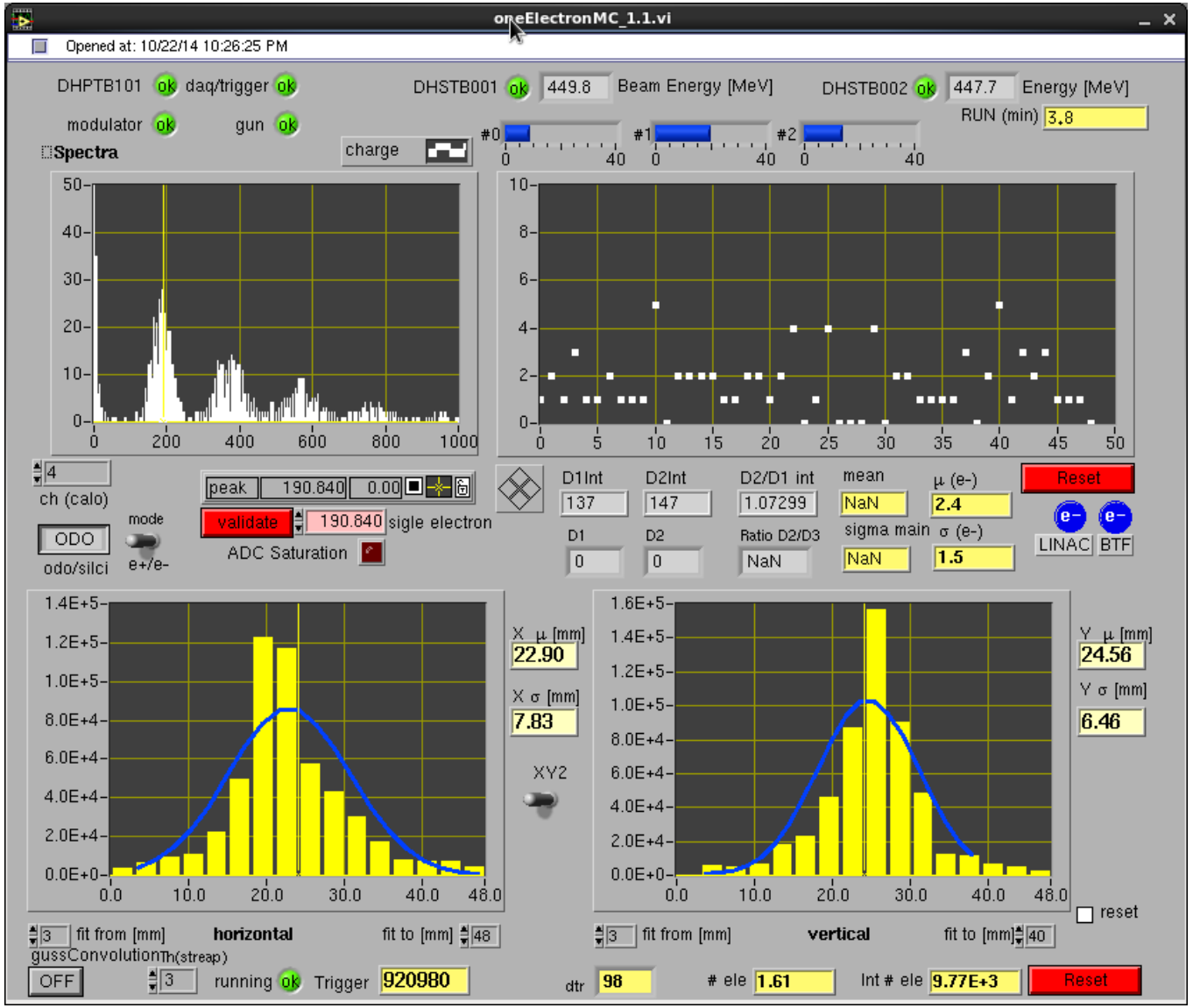
BTF DCS – oneElectron.vi



BTF DCS – oneElectron.vi 2

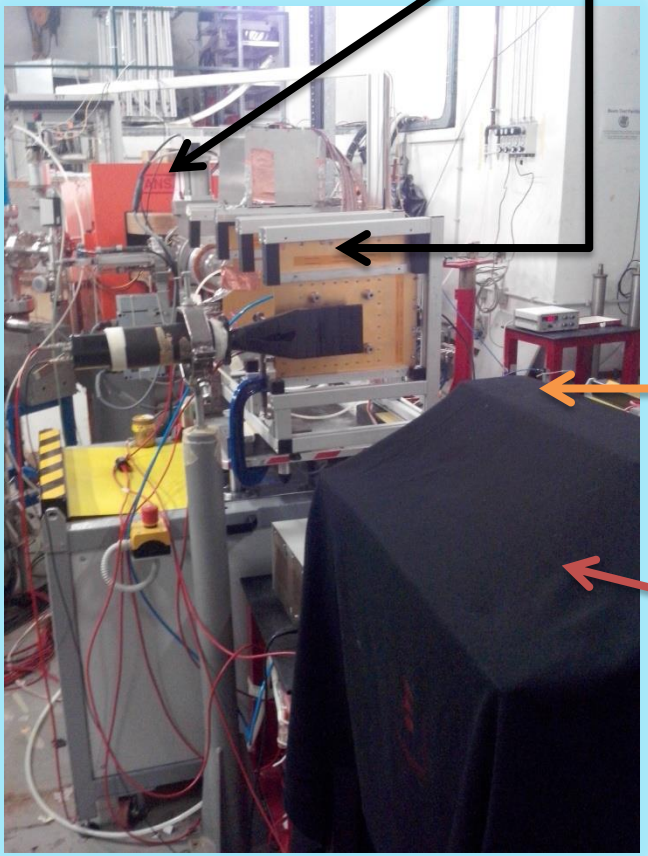


BTF DCS – oneElectron.vi 3



BTF DCS – oneElectron.vi 4

BTF typical setup = Particles + some user stuff + calorimeter



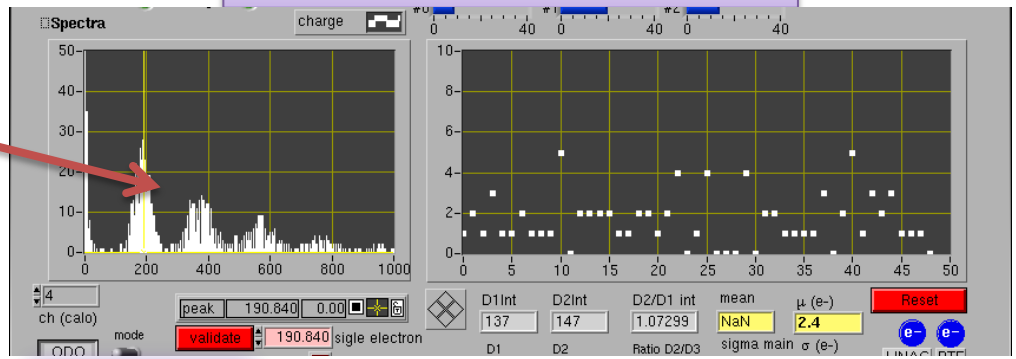
For the most of the users:

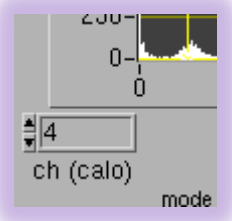
- Controlled multiplicity
- Controlled beam position

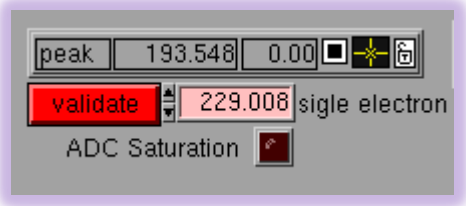
⇒ Using btf measure with calo or some other charge measurement

⇒ **Has to be setupped each time!!**

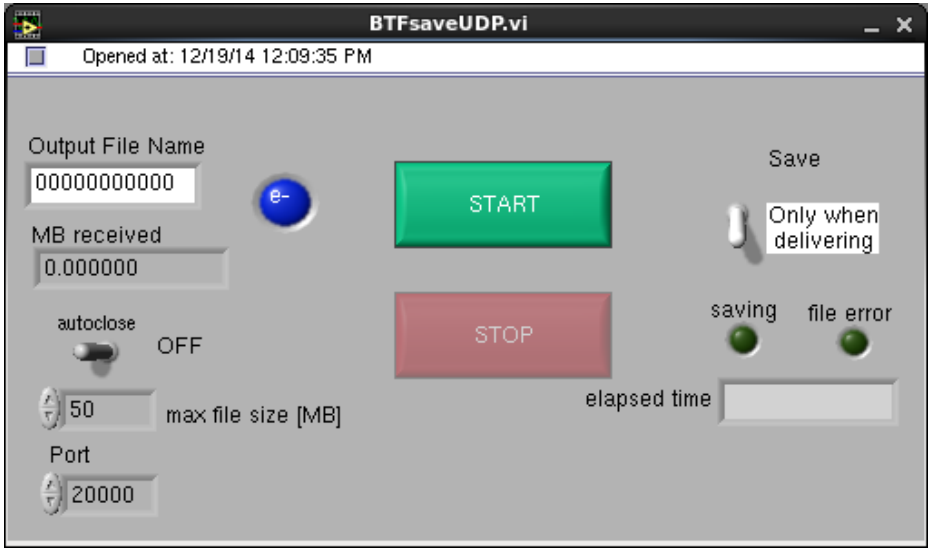
oneElectron stripchart







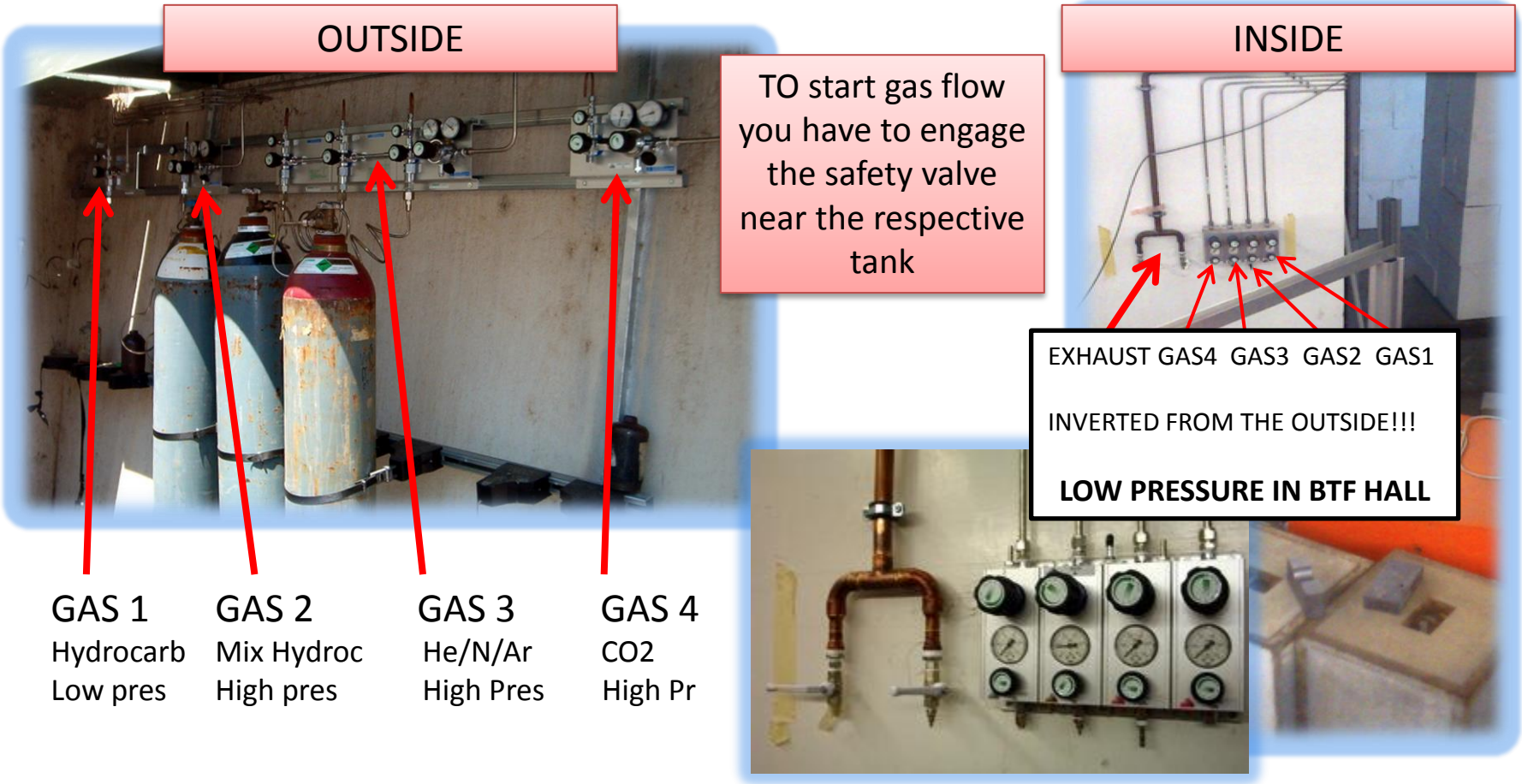
BTF SERVICE – BTFsave.vi



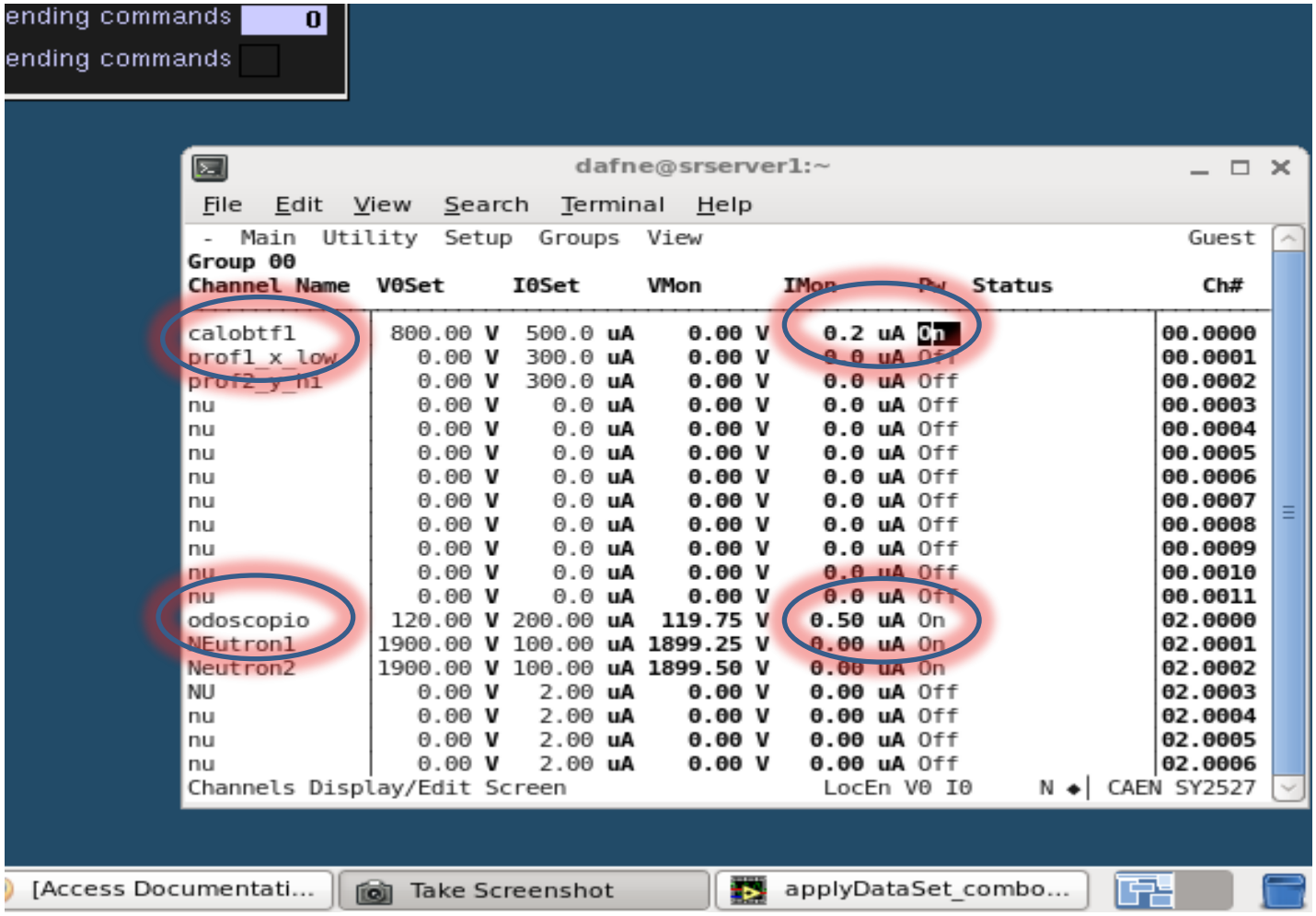
- Stores BTFDAQ file in /u2/data/btf/data in yyyymmddhhmm.dat
- Selectable renewing filename (closing the previous one) at some Mbyte threshold
- Two kind of selectable saving rules (only when delivering when DHPTB001 is on)
- It has to be restarted when the control system or console is rebooted

BTF SERVICE - GAS

- 4-lines gas delivery system – safety system
- Water, dried compressed air, electrical power



BTF SERVICE – HIGH VOLTAGE



Caen SY2527Located at BTF DAQ racks – near the P1 Search button

ODOSCOPIO HV!!!

Remote control with sunray terminal

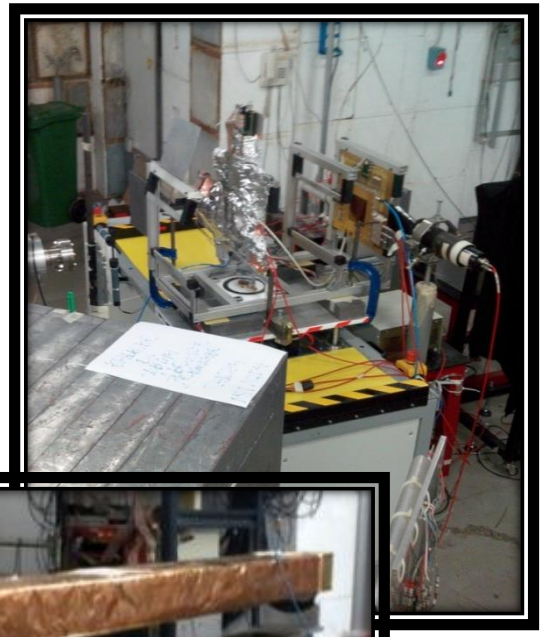
- Term -> btfps
- User dafne
- Main -> channels ->

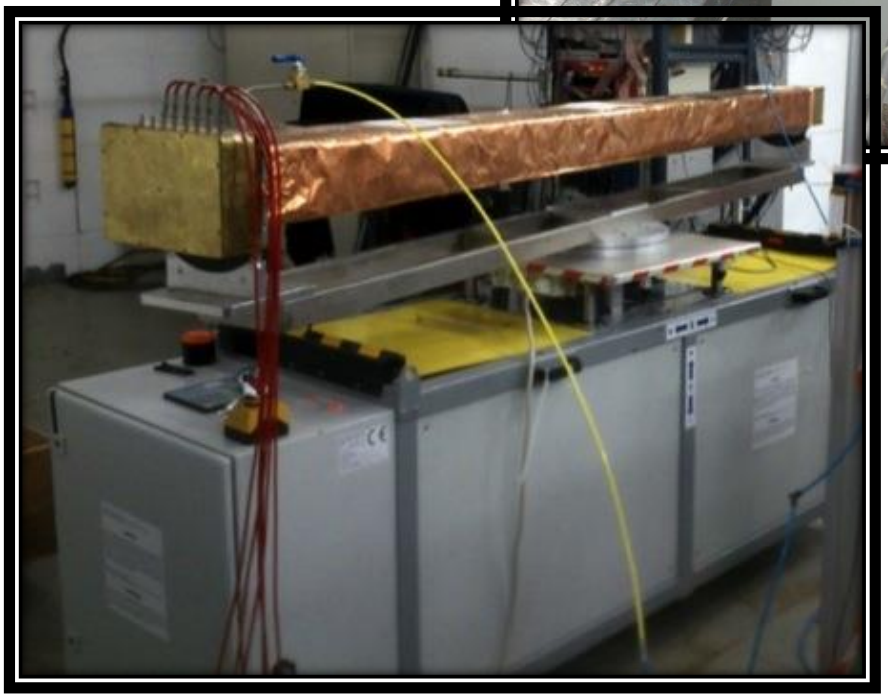
Typing use

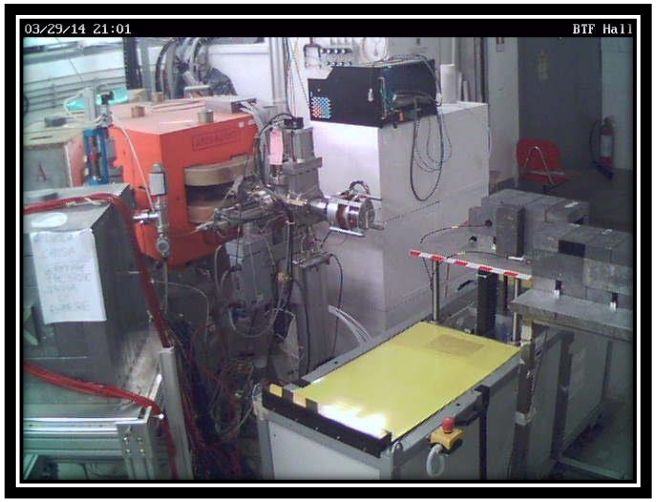
- Use cursors
- Control+H to cancel
- Press space on on-off to swich state

BTF SERVICE – REMOTE TROLLEY

- Remote trolley table
  - Remotely controlled from BTFCR
  - 500µm and 100 µm step
  - 1.0m x 0.3m XY range
  - Up to 200Kg lift

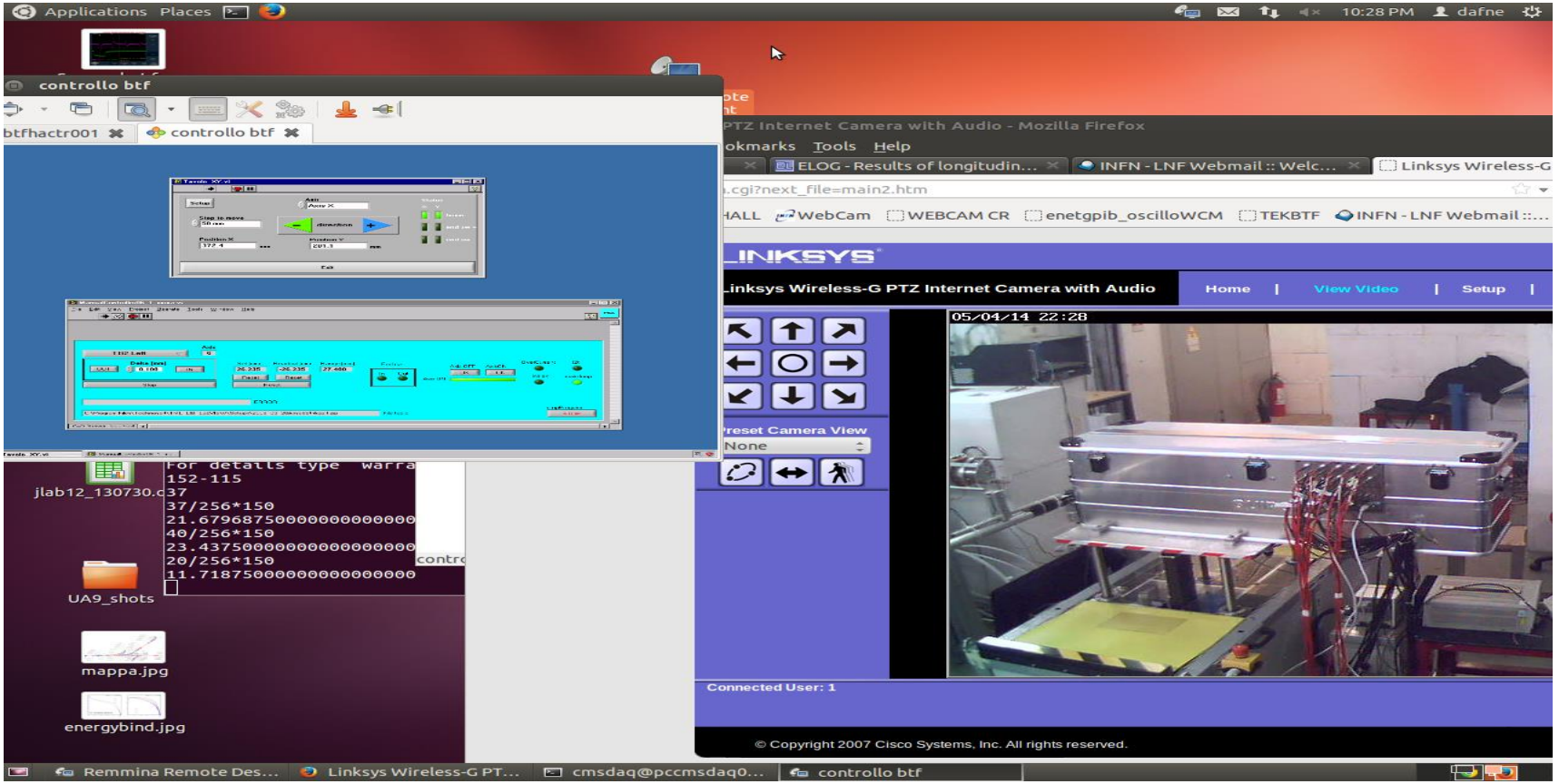




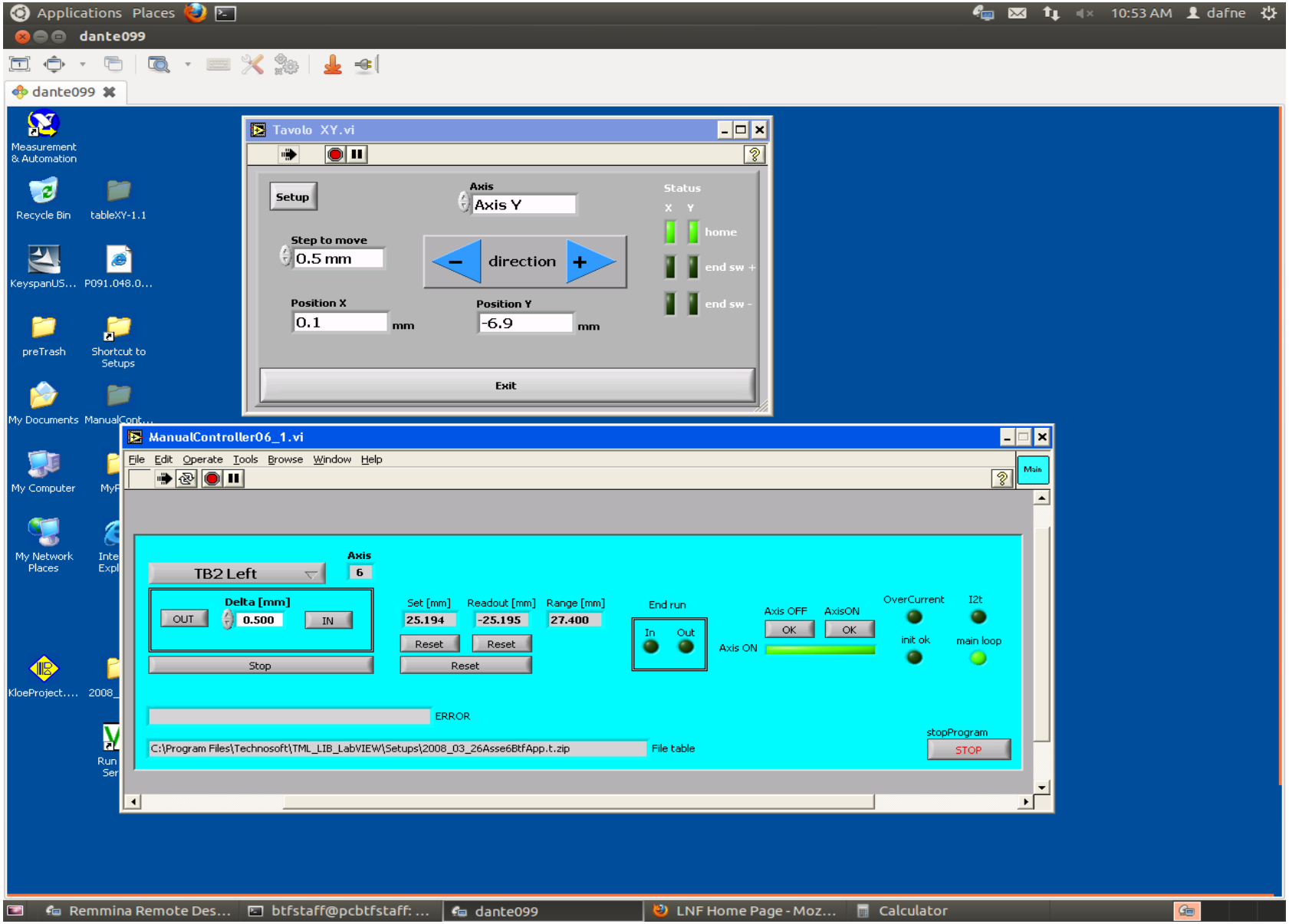


BTF SERVICE – REMOTE TROLLEY

- Remote trolley table is controlled via standalone on lxdatest4 (user=dafne)

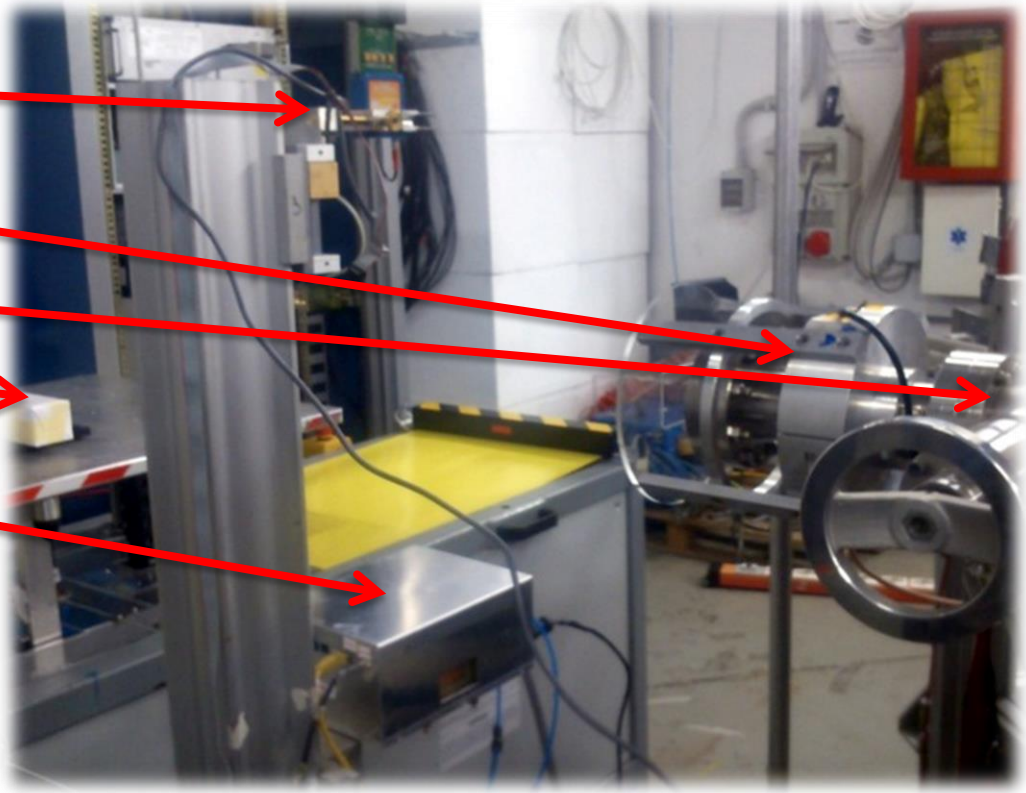


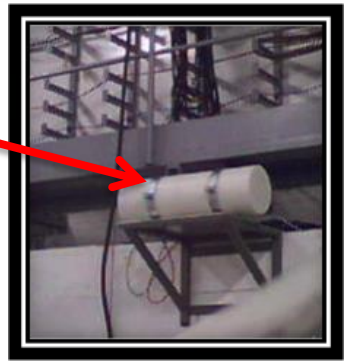
BTF SERVICE – RT & SCRAPERS



BTF DIAGNOSTICS

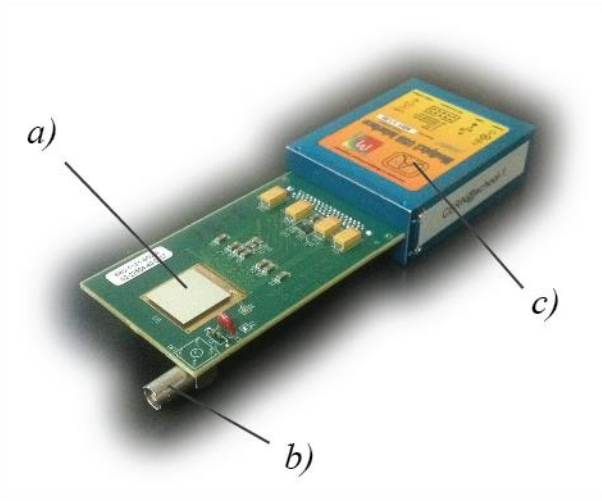
- Timepix
- ICT
- Flags
- Calorimeters
- GEM
- Hodoscope
- Silicon Tracker
- Photon tag
- Neutron detectors
- Cams
- Scintillators
- ……..

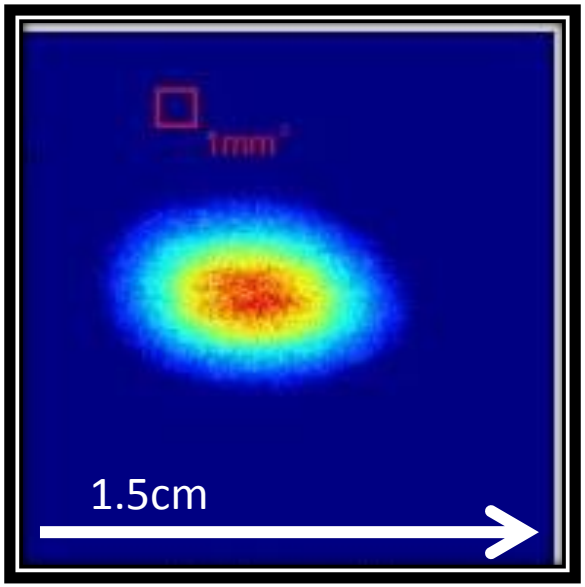


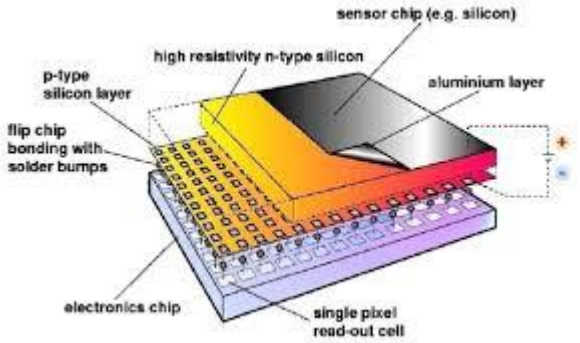


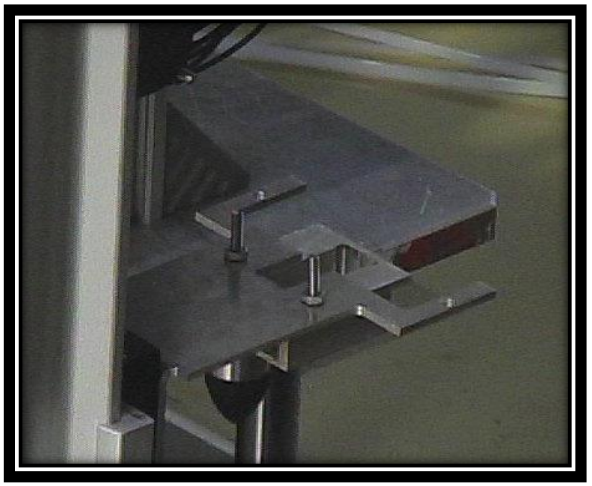
BTF Diagnostic - TIMEPIX

- Timepix and Blue Box
- BTF timing
- Windows VM USB 2.0



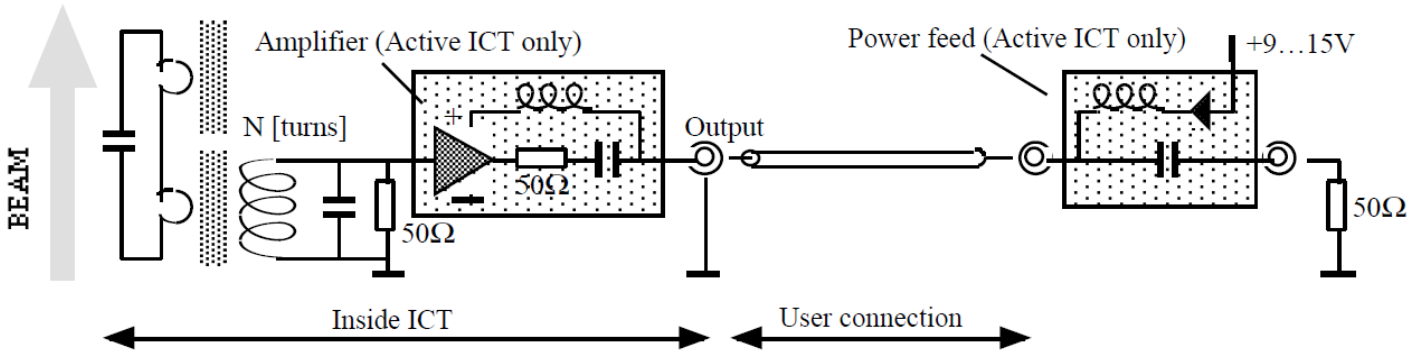


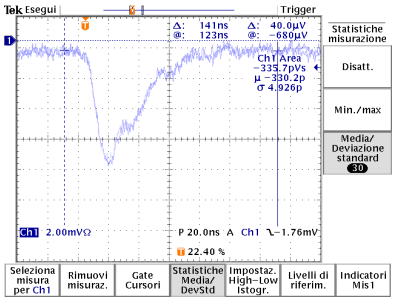


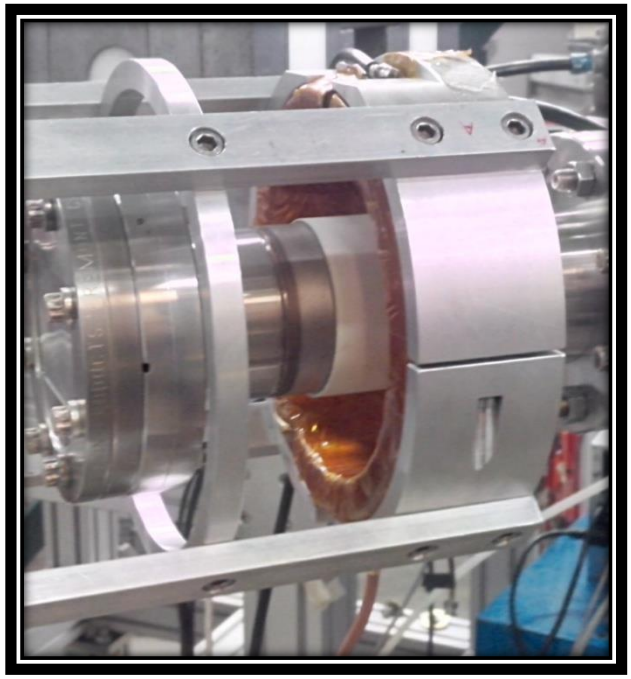


- 256x256 pixel detector
- 55µm pixel - σ=15 µm
- 50 Hz gated OK
- 1.5 cm square -> ~2cm^2 area
- Wide range multiplicity
- Easy to use

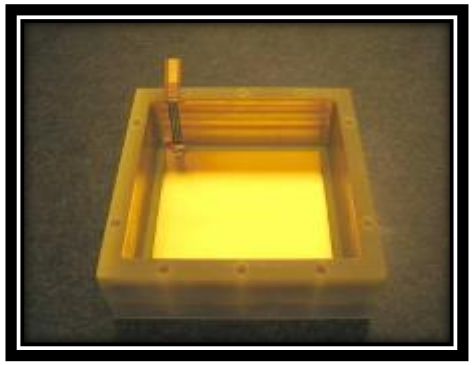
BTF Diagnostics - ICT

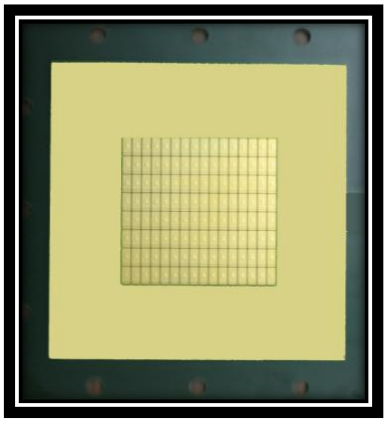






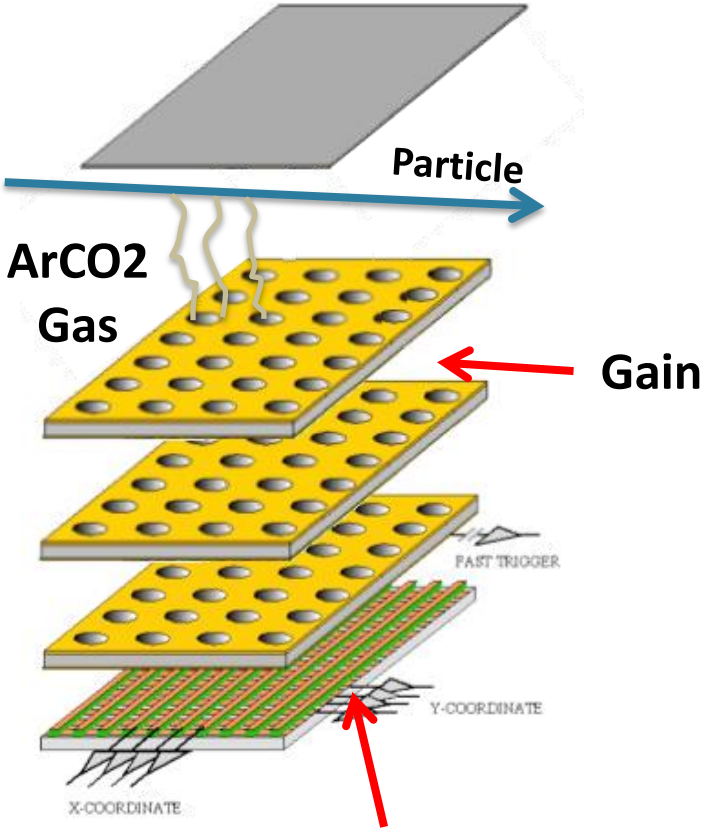
BTF Diagnostics – TPC GEM

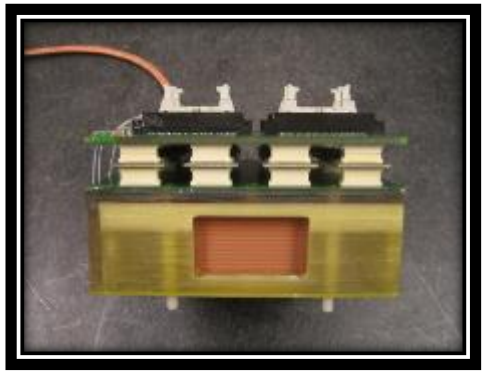




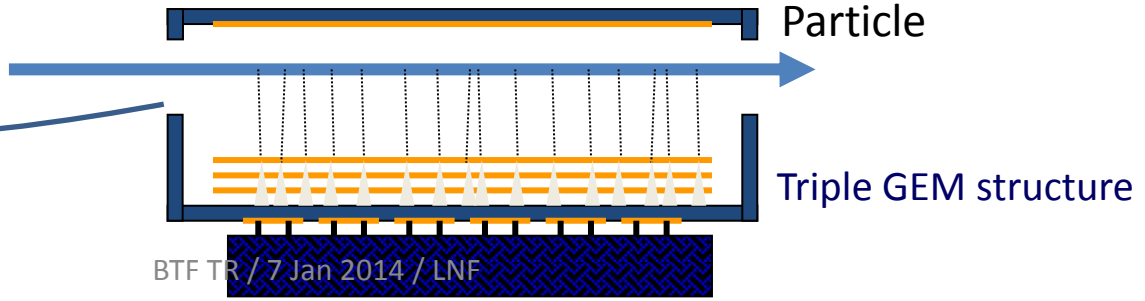
3x6mm² pads
8x16 pads grid

- GAS = Ar/CO2
- Low pressure (few mb diff)



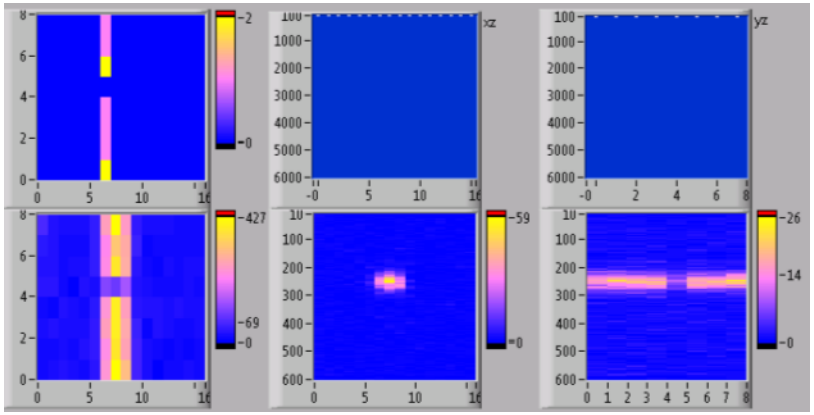


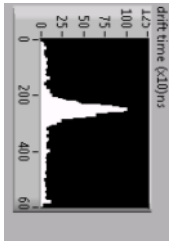
two kapton foils (<0.2%X_0)



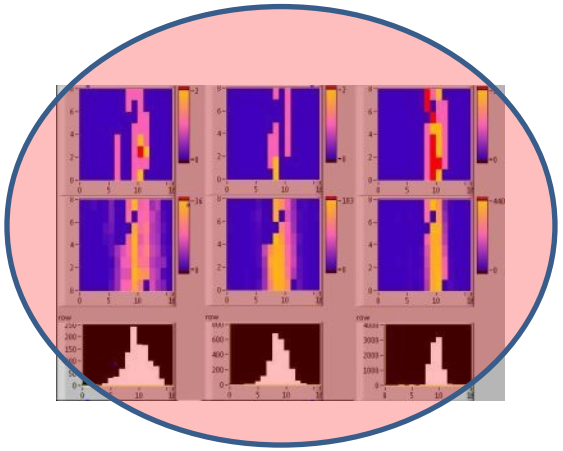
BTF Diagnostics – TPC GEM

Top Front Side

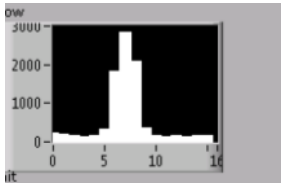




Vertical
4 cm



!CHAOS



5 cm
Horizontal

XY configuration (hit)

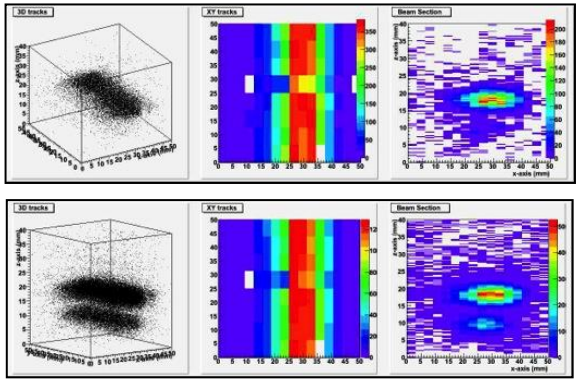
- 16x8 (XY) pads configuration
- 3x6 mm^2 - submm resolution

Z configuration (time)

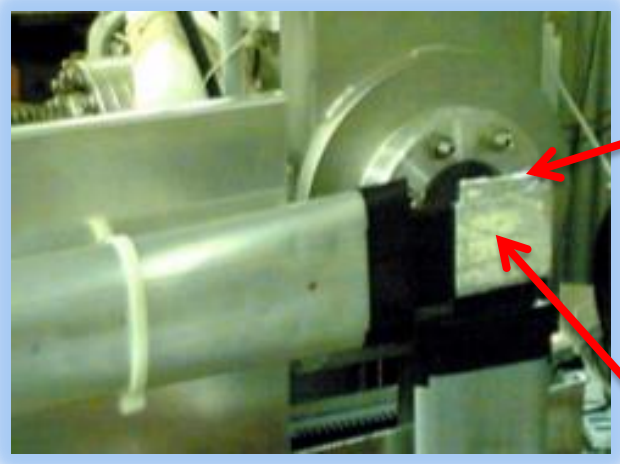
- 6µs max drift -> 80 µm resolution

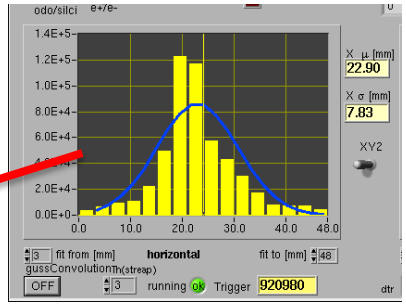
Clocking

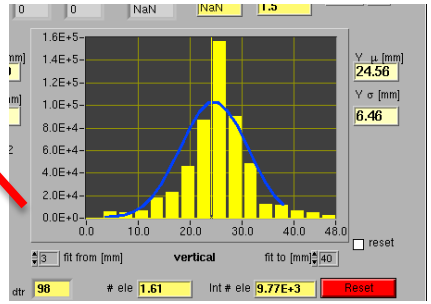
- 15 Hz gated OK

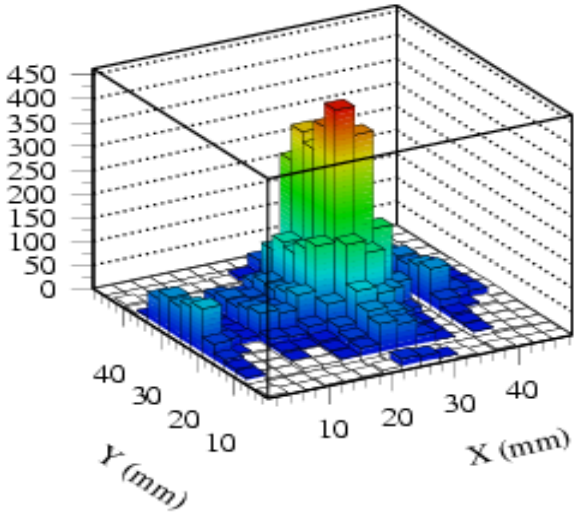


BTF Diagnostics - Hodoscope

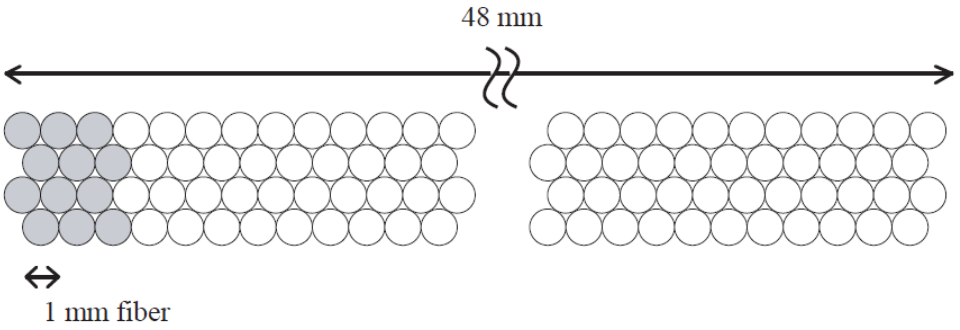




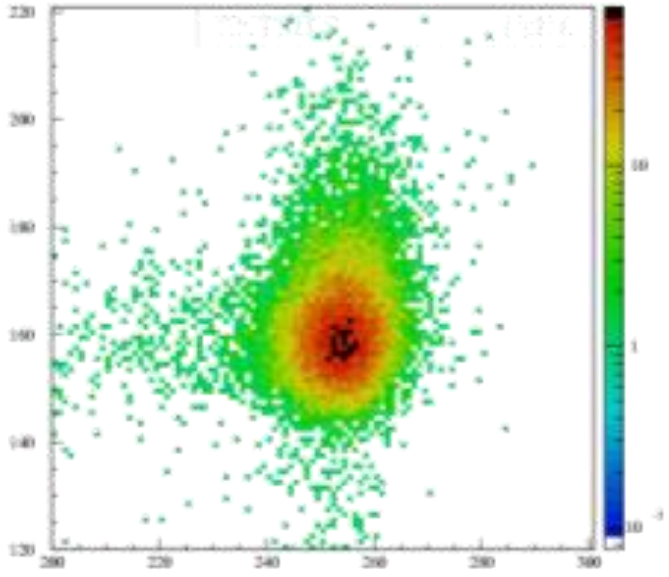




- 16X16 scintillating fibers
- Φ=1mm/12 staggered
- 3 mm pitch readout
- 50 Hz gated OK – DAQ BTF
- 48x48 mm^2-> ~23cm^2 area
- Medium-Low intensity



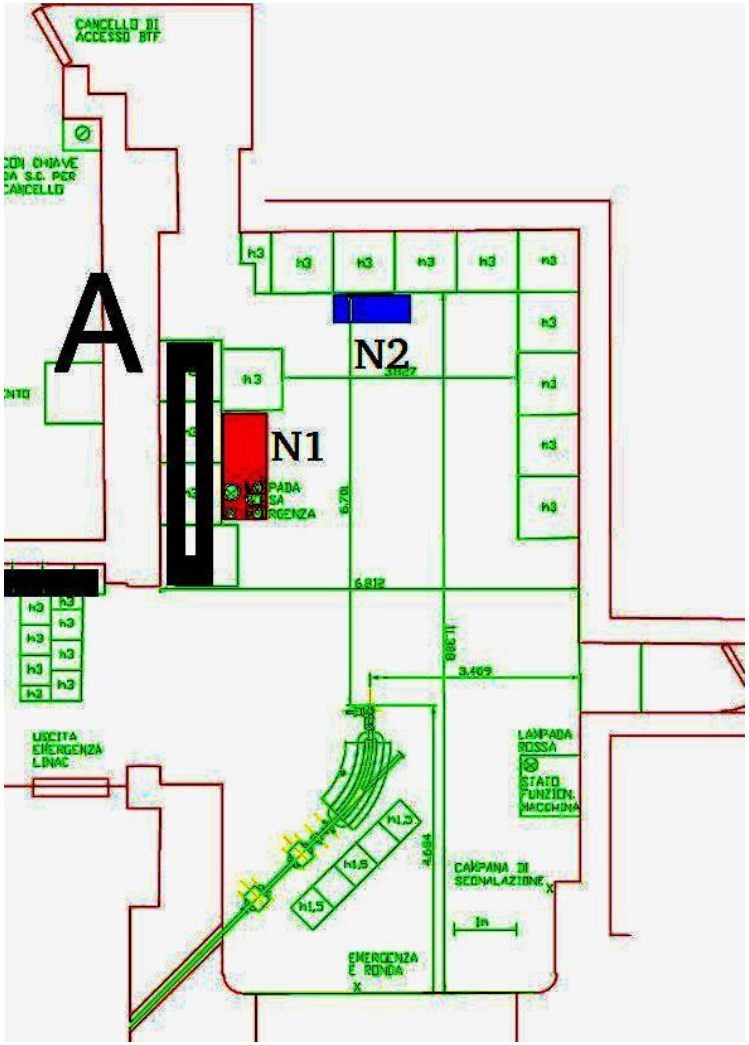
BTF Diagnostics - ST

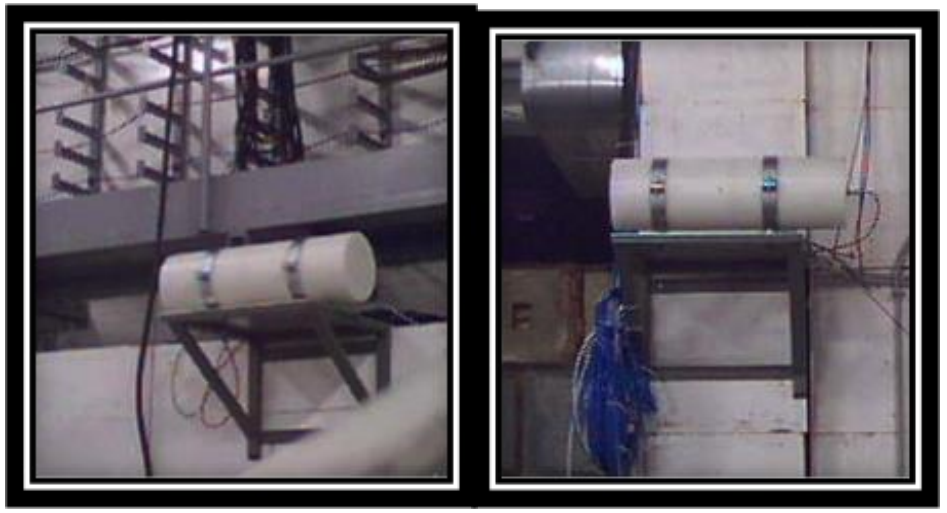


- 400µm Silicon micro-strip detectors
  - 2 couple 10X10 cm^2 XY plane
  - 368 (one read-one float) strips per plane
  - 100 µm resolution
  - TAA1 readout
  - Developed AGILE Satellite
  - 25 Hz gated OK
  - BTF-DAQ
  - Hi and Low multiplicity

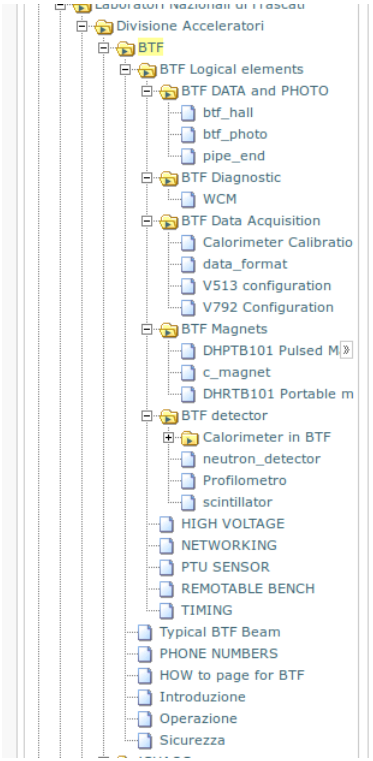
(currently under maintenance)

BTF Diagnostics - OTHER

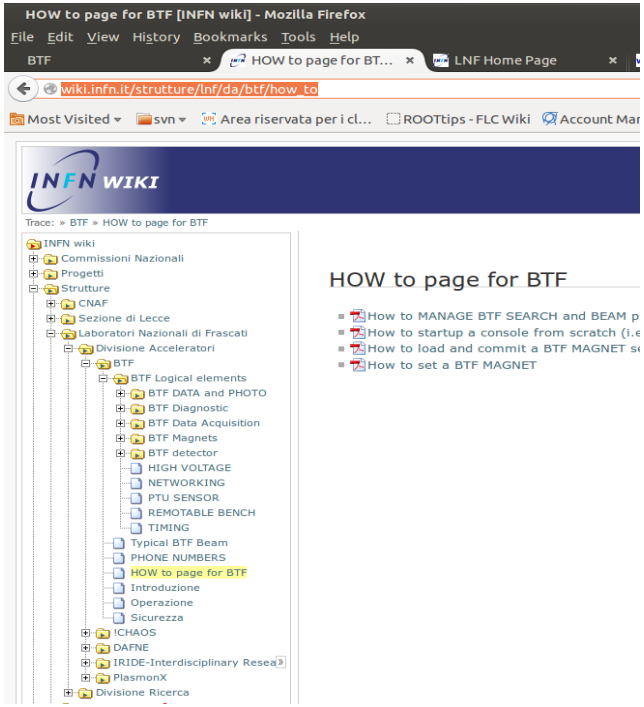




BTF INFO



- http://www.lnf.infn.it/acceleratori/btf/
  - Schedule, papers, booking procedures, access, contacts…
- http://wiki.infn.it/strutture/lnf/da/btf/
  - Operative rewievs, detectors, photo, btf elements data
  - http://wiki.infn.it/strutture/lnf/da/btf/how_to
  - http://www.lnf.infn.it/acceleratori/btf/workshop2014/



Staff

- B. Buonomo (Technical Coordinator)
- L. Foggetta
- P. Valente (Scientific Coordinator)

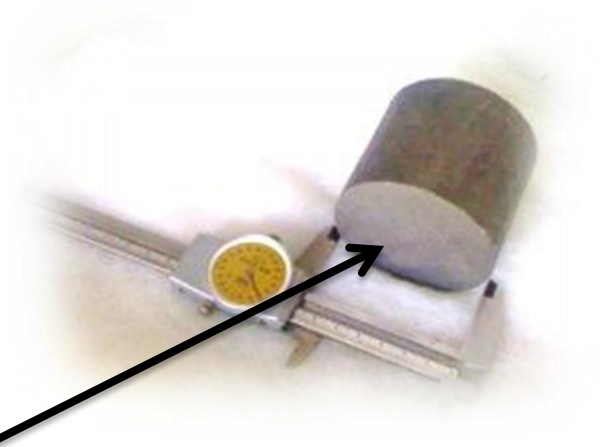
Secretariat

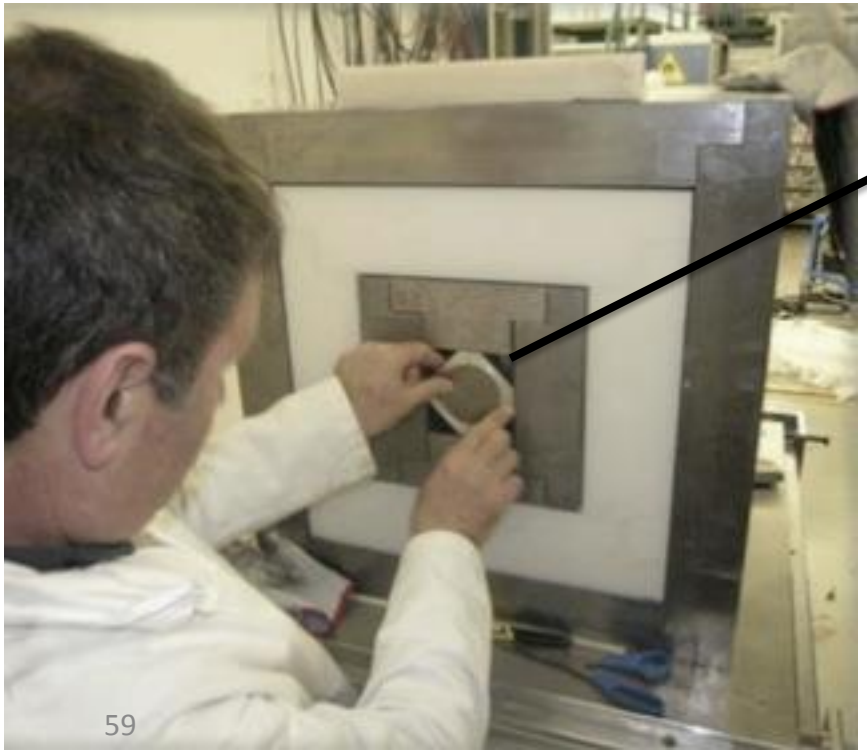
- F. Casarin
- M. R. Ferrazza
- M. Giabbai

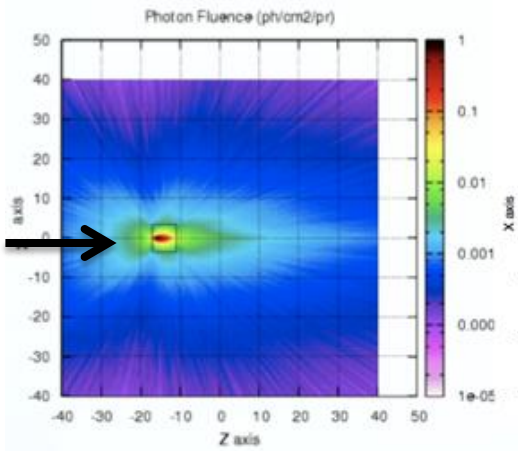
More papers on GOOGLE Scholar

BTF Neutron source - N@BTF 2

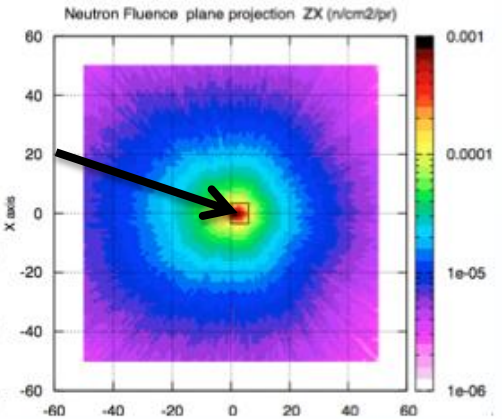
- **n@BTF** project
  - Simulated and designed an **optimized target** (W cylinder d=70 mm, l=60 mm) and **shielding** system (lead and polyethylene)
  - Preliminary measurements of the neutron field and photon background





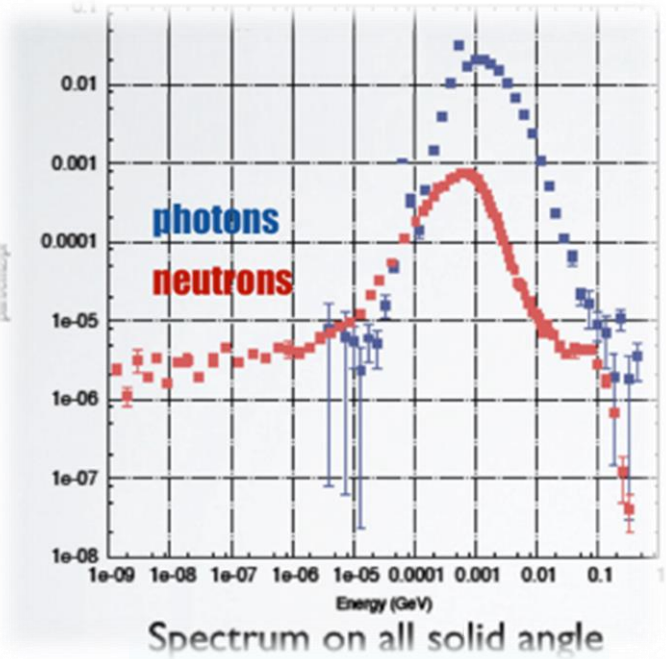


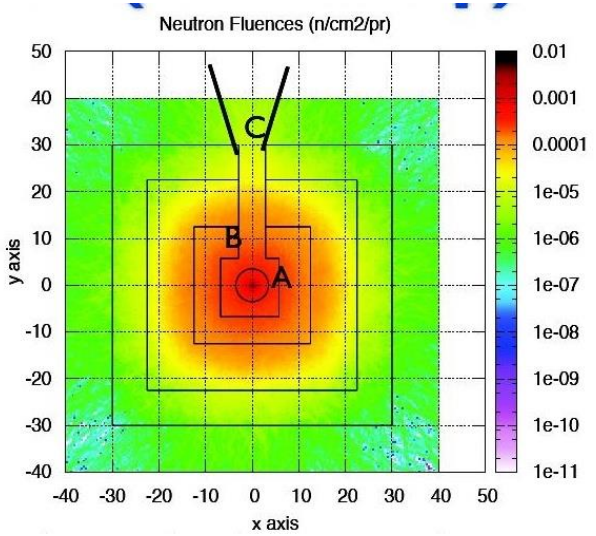
Long

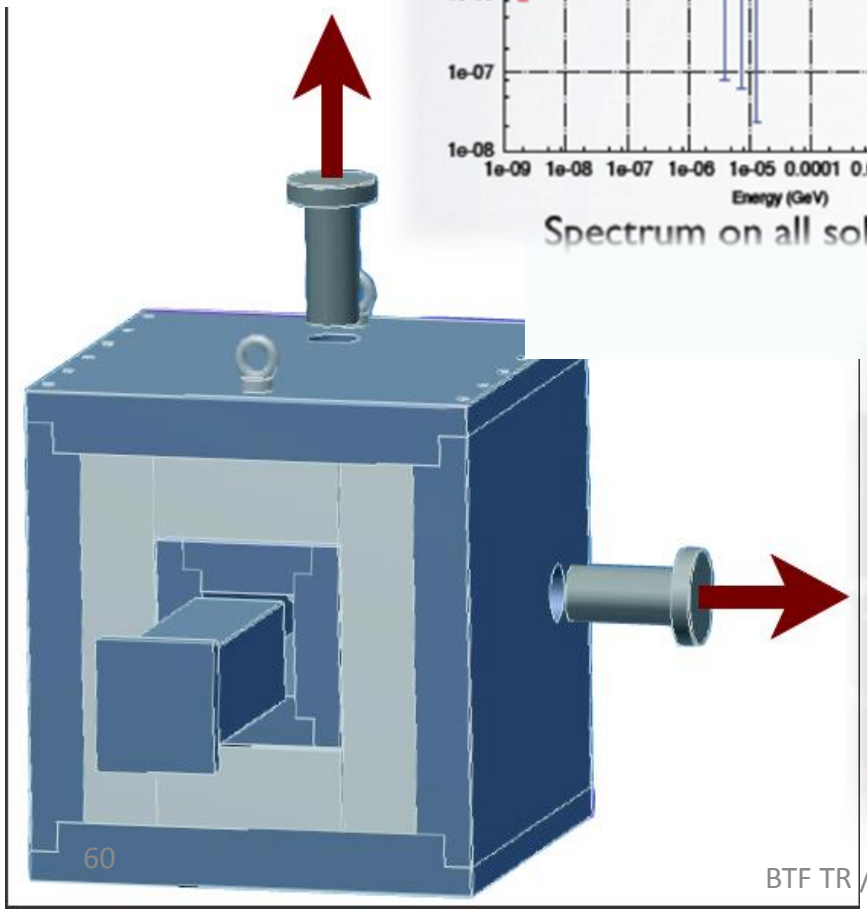


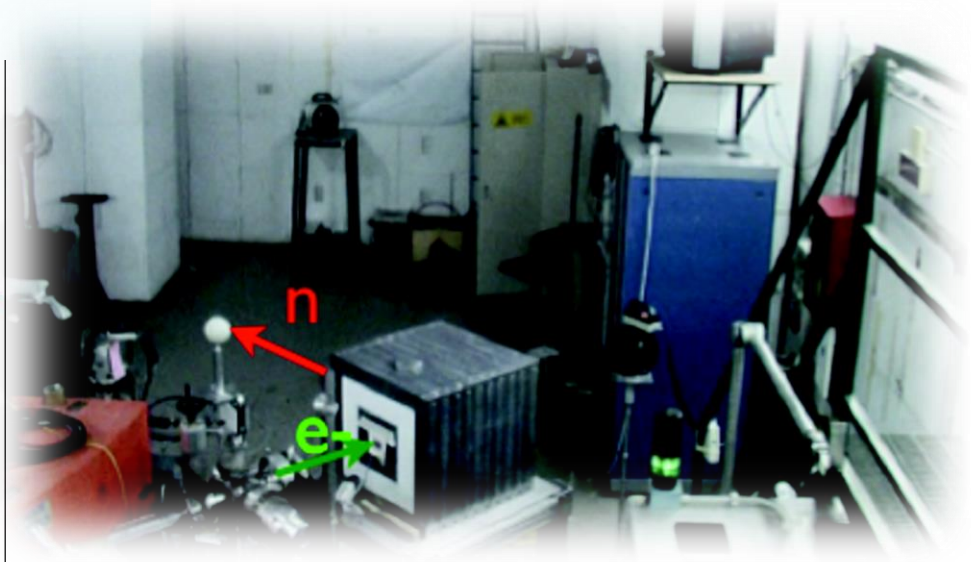
Transv

BTF Neutron source - N@BTF 2









Darwinian Selection rules

New Users Species in BTF – Pay attention to USERS!!!!