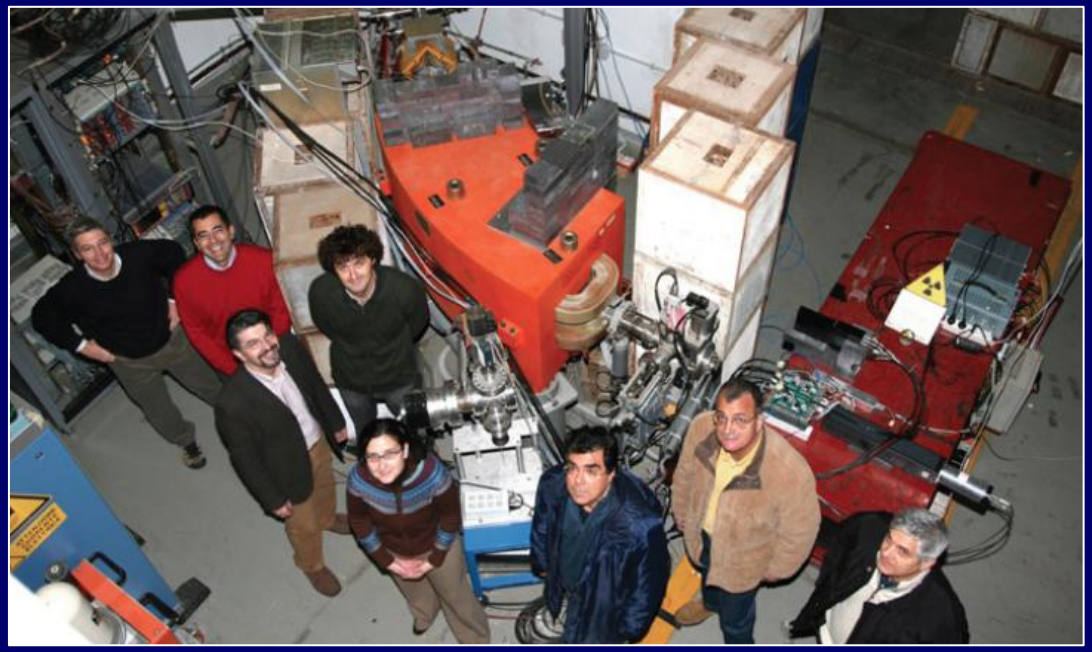
Frascati beam-test facility (BTF)

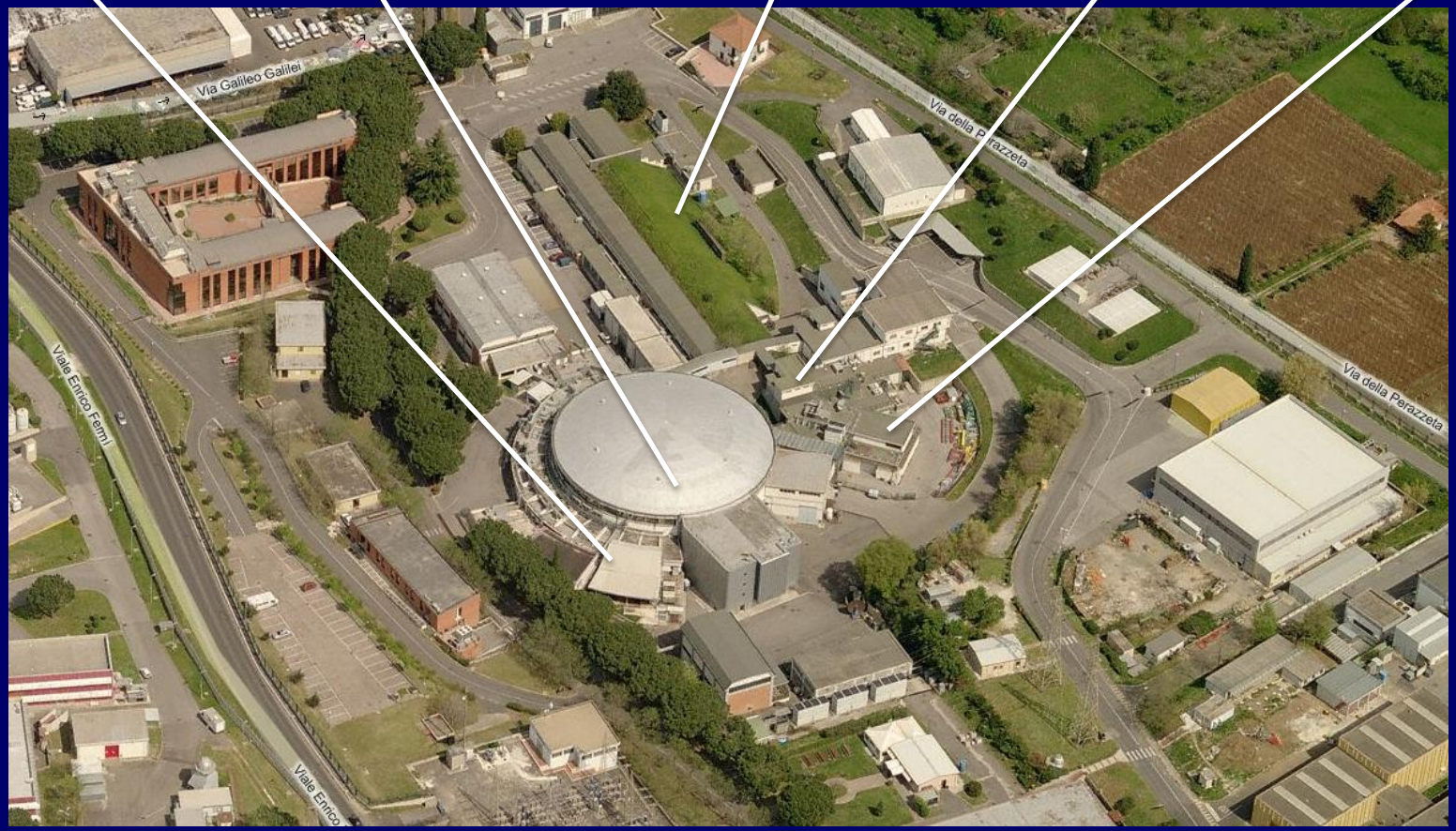


BTF team: G. Mazzitelli (responsible), B. Buonomo, L. Foggetta, L. Quintieri, P. Valente

UA9 Frascati: F. Murtas, B. Buonomo, S. Dabagov

UA9 Roma: G. Cavoto, L. Ludovici, R. Santacesaria, W. Scandale, P. Valente

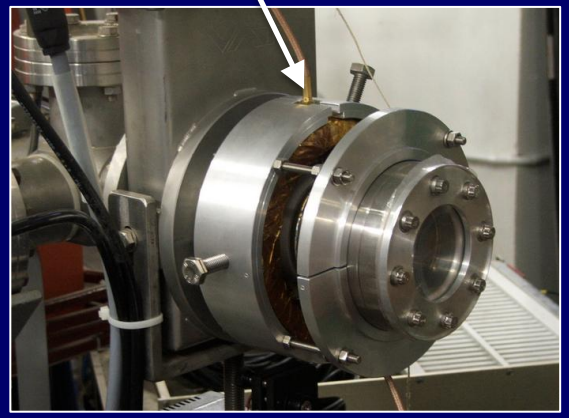
Frascati e^+ e^- collider DAFNE



Final dipole
ICT
Slits
Slits
to BTF hall
E measurement dipole
DC dipole 3
to accumulator
from Linac
Pulsed dipole 3
Slits
Slits
Target
E selection dipole

BTF experimental hall

Air gap for detectors



Beam exit ICT

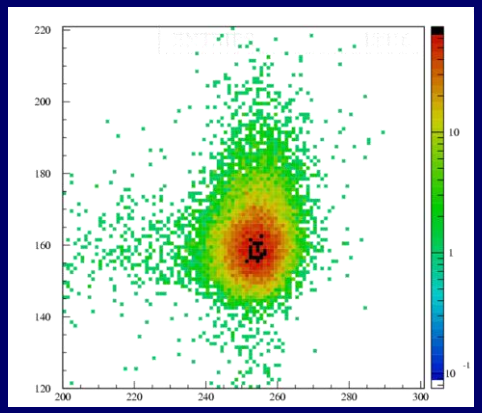
Beam intensity

- Medium-high intensity:
  - **electron or positron beam**
  - 10 ns shots (can be operated also at 1 ns), **50 Hz** repetition rate
  - **Beam charge: few fC – 1.5/5 nC (e^+/e^-)**, measured by **ICT**
  - Linac standard energy (for collider operations): **510 MeV**, possible to operate in the range **250-650 MeV**

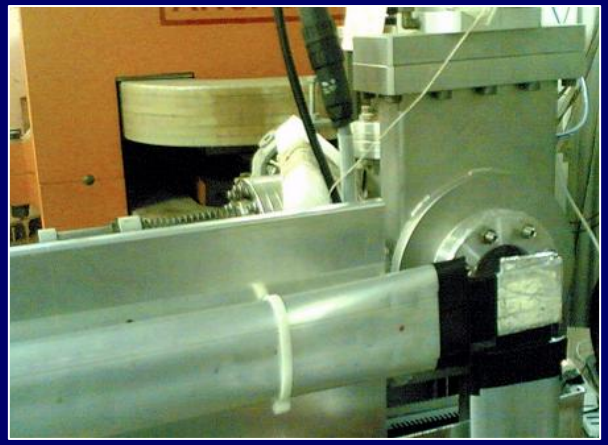
- Low intensity:
  - Beam showering on **copper target**, selectable depth: 1.7 to 2.3 X_0,
  - secondaries collimated and momentum-selected by **dipole magnet+slits**, down to few tens of MeV
  - From single particle to few thousands per shot

Beam size and divergence

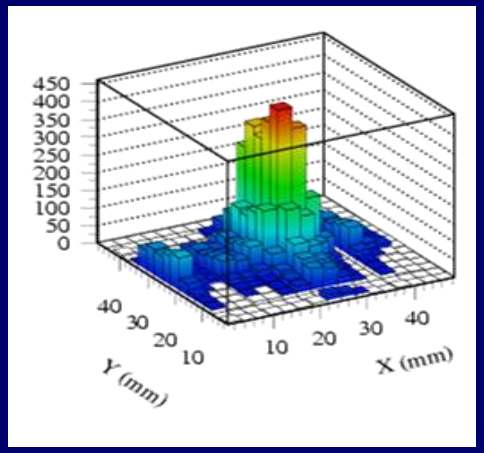
Silicon micro-strips detector



Fluorescence flag



Scintillating fibers detector



At E=508 MeV, (100 mm air gap):

$\langle x^2 \rangle = 16\ mm^2$

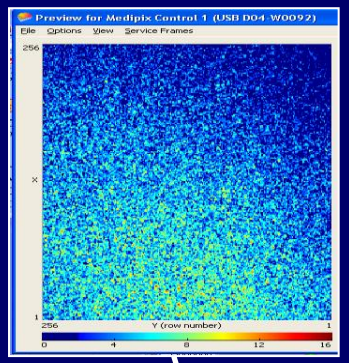
$\langle x'^2 \rangle = 2.8\ mrad^2$

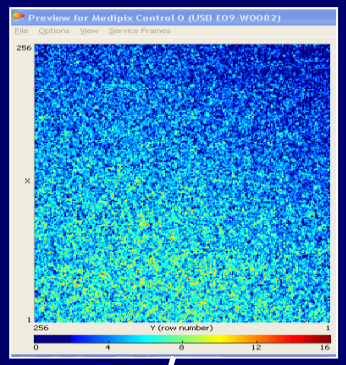
$\varepsilon_{RMS} = 4\ mm\ mrad$

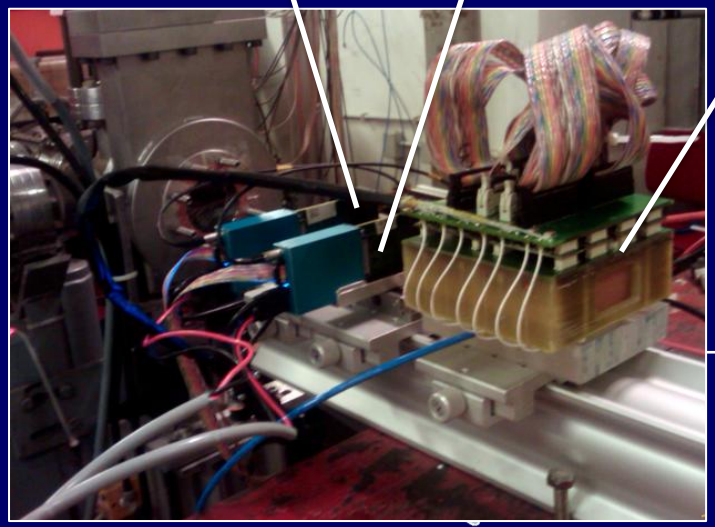
(N. Delerue *et al.*)

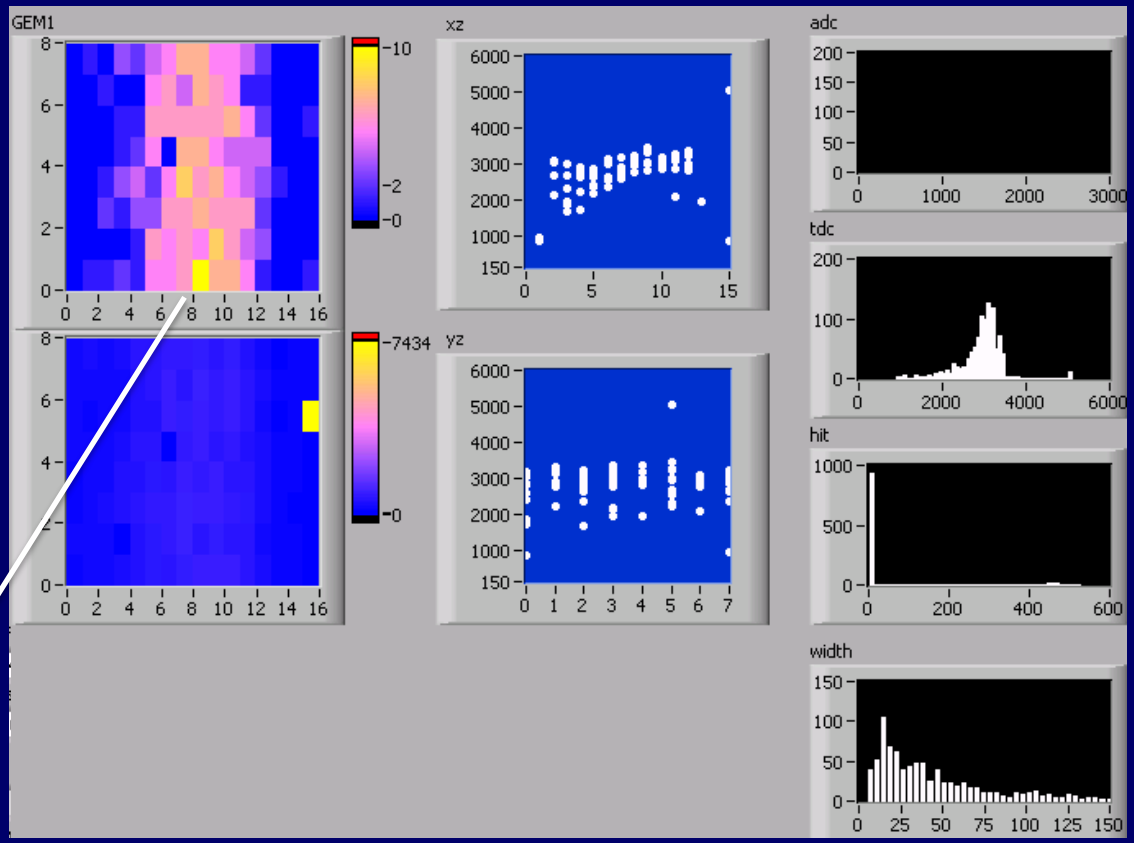
Example: Medipix & TPCGem test

≈10000 electrons/bunch

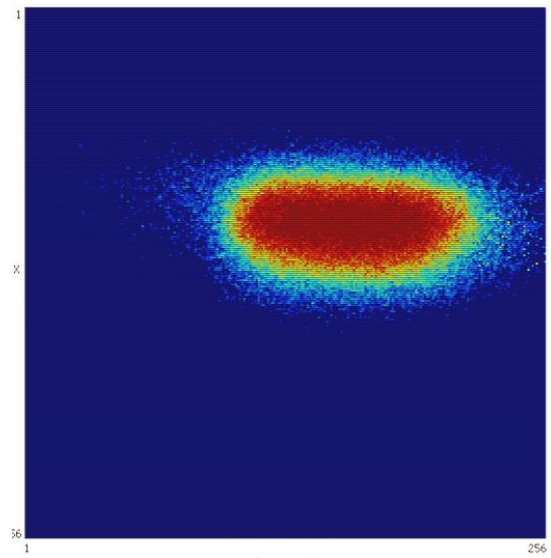


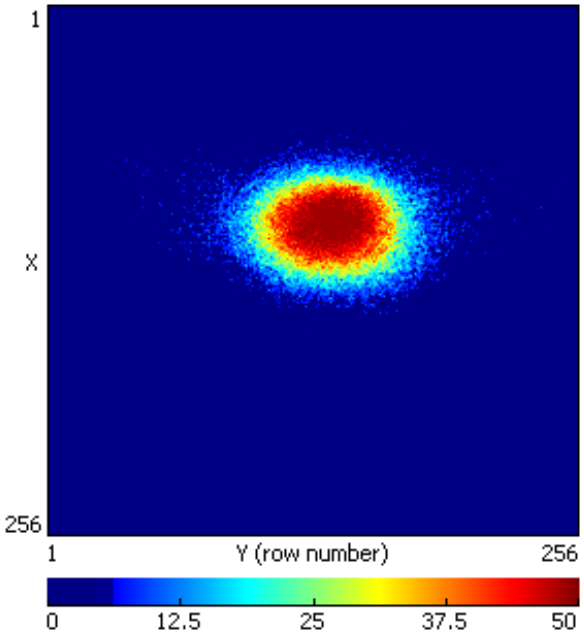


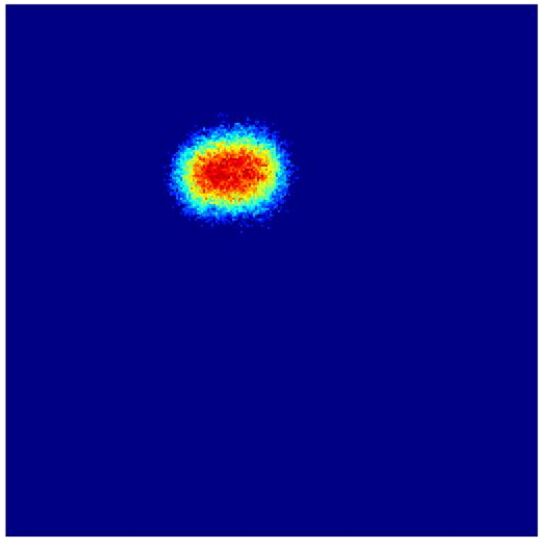




Beam size optimization with Medipix





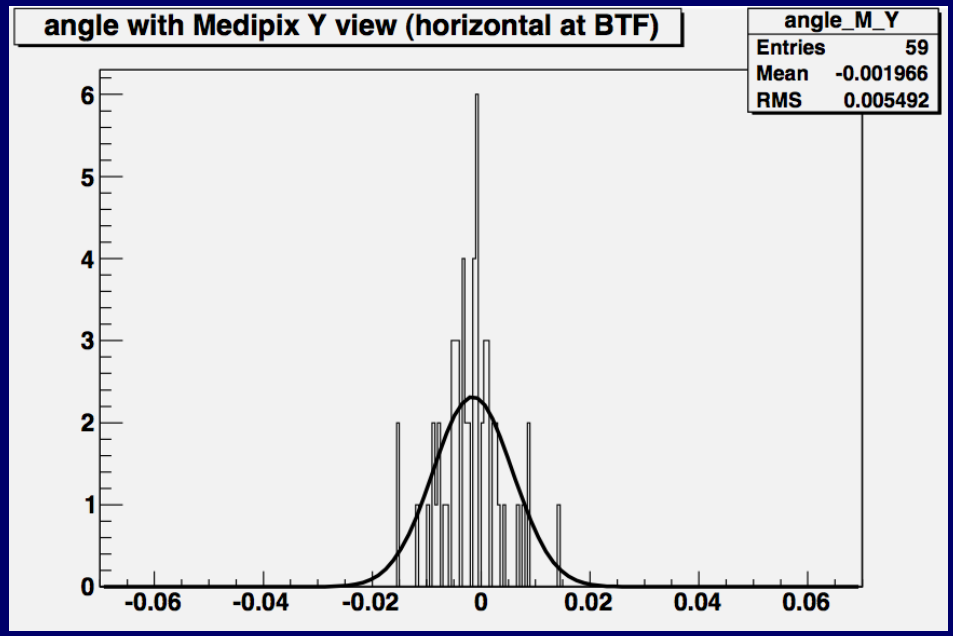


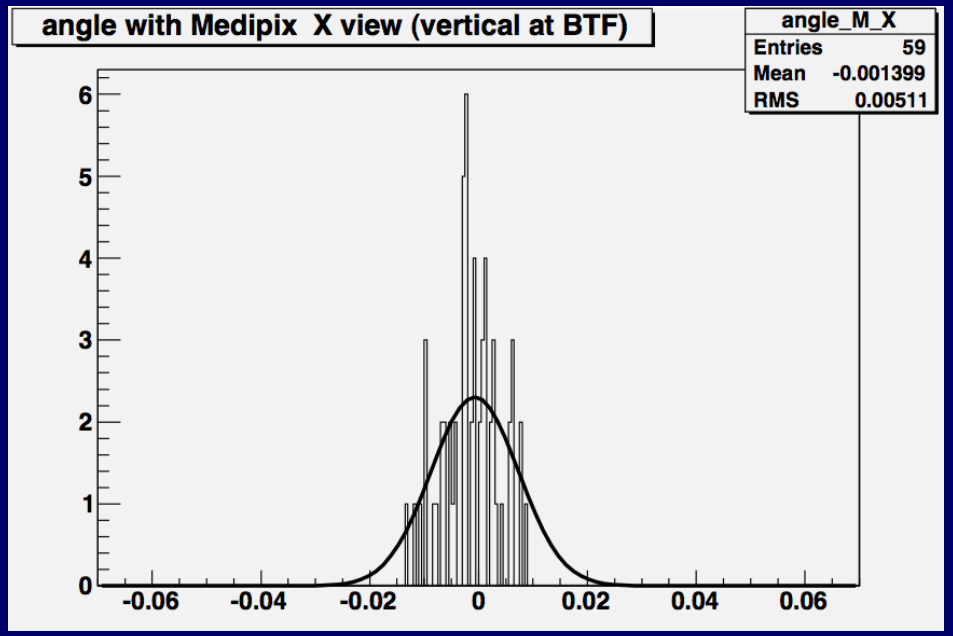
FWHM 6.8 3.0 mm

FWHM 4.0 2.8 mm

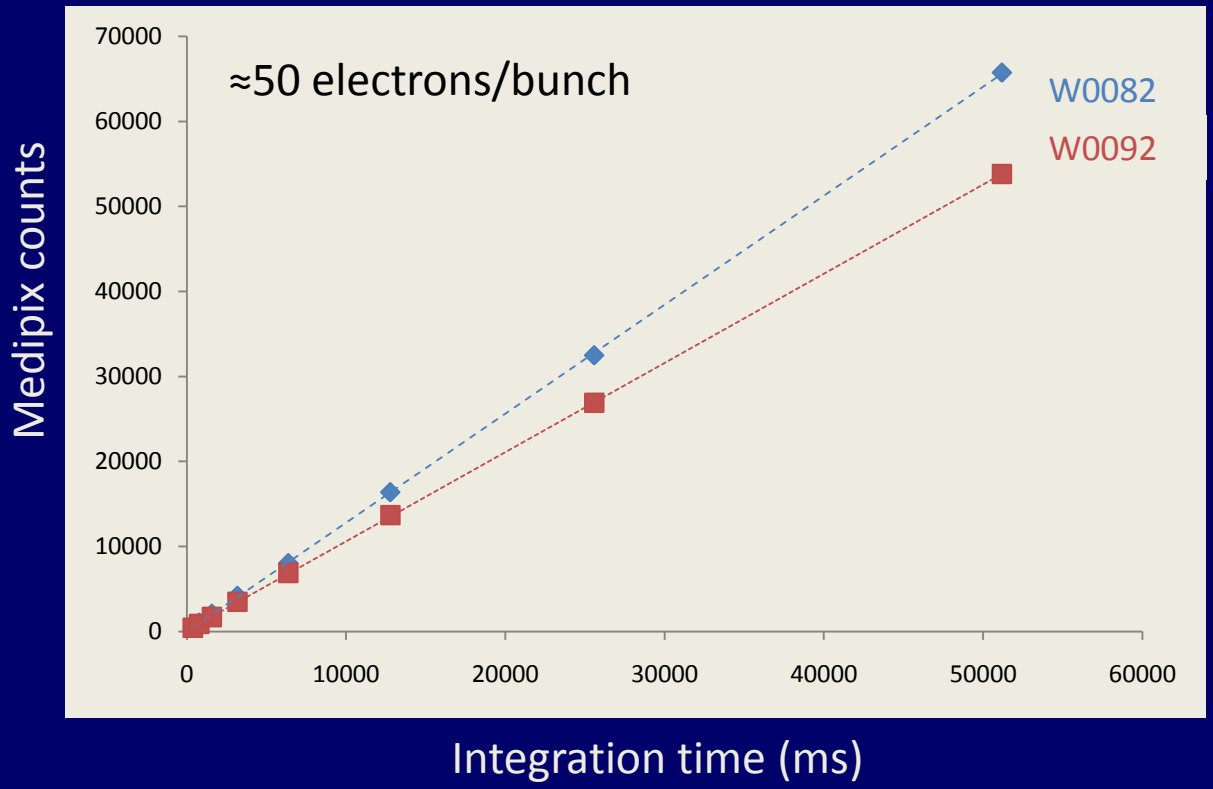
FWHM 2.4 1.8 mm

Beam divergence with Medipix



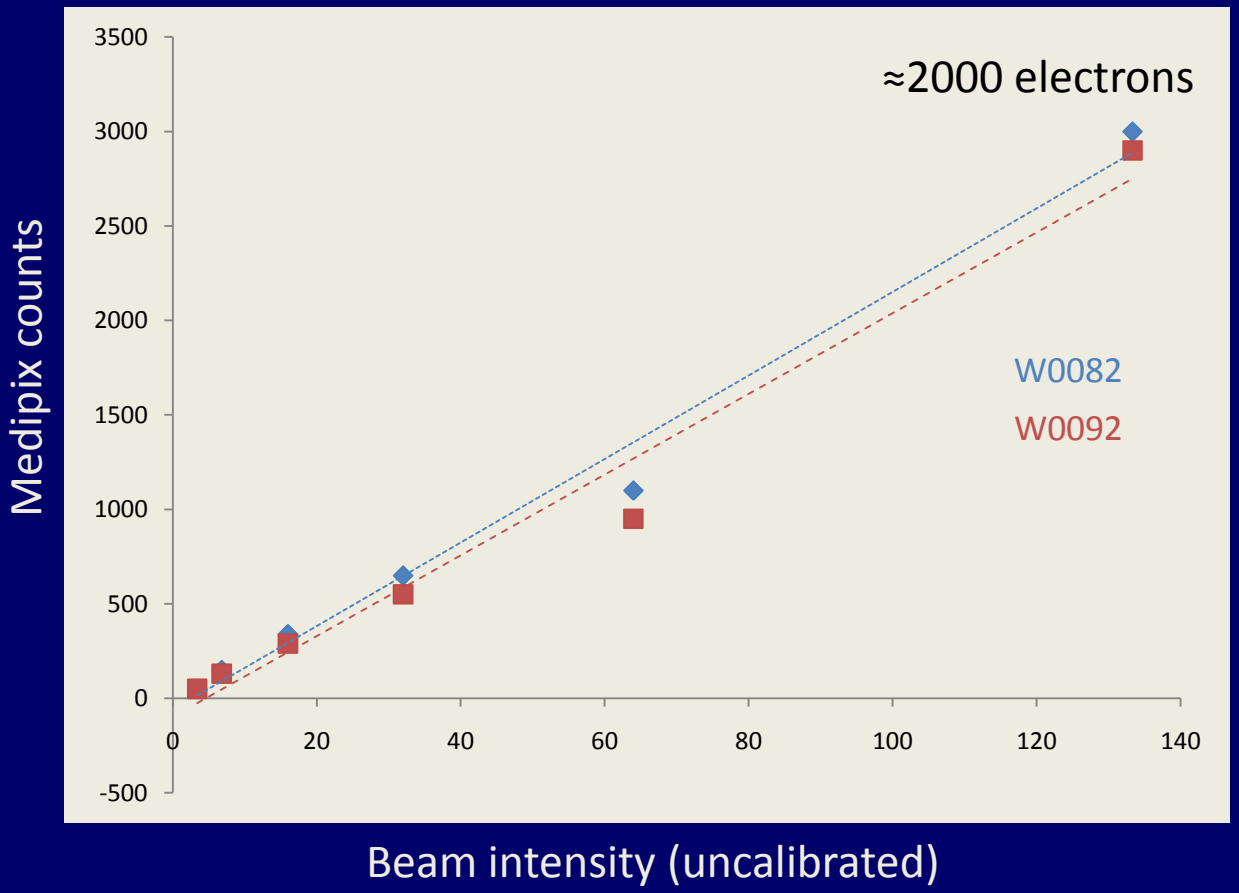


Example: Medipix with beam trigger



25 Hz repetition rate
(40 ms bunch spacing)

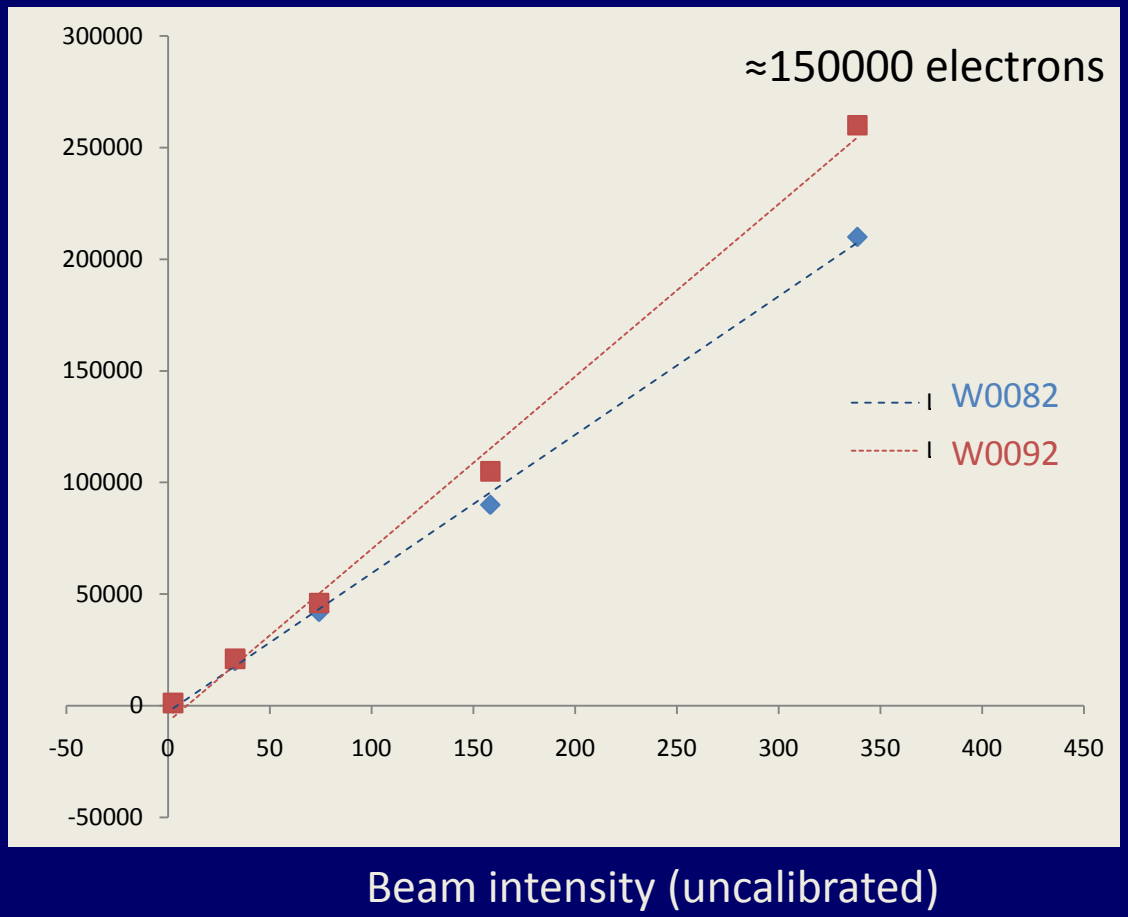
Example: Medipix multiplicity



1 Hz repetition rate

1 s integration time

Example: Medipix multiplicity

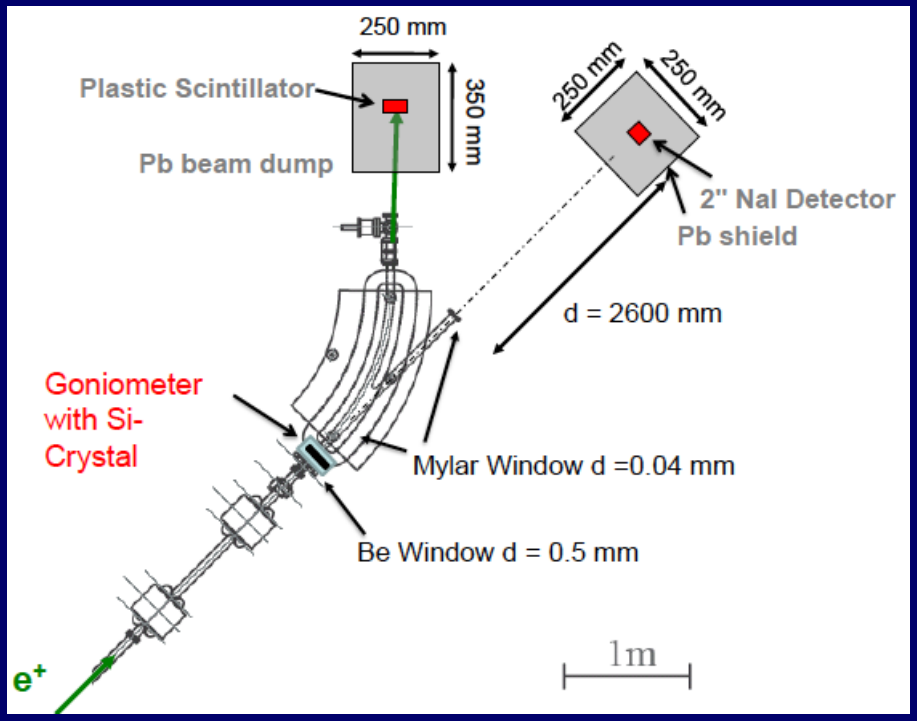


25 Hz repetition rate

1 s integration time

Example of channeling setup

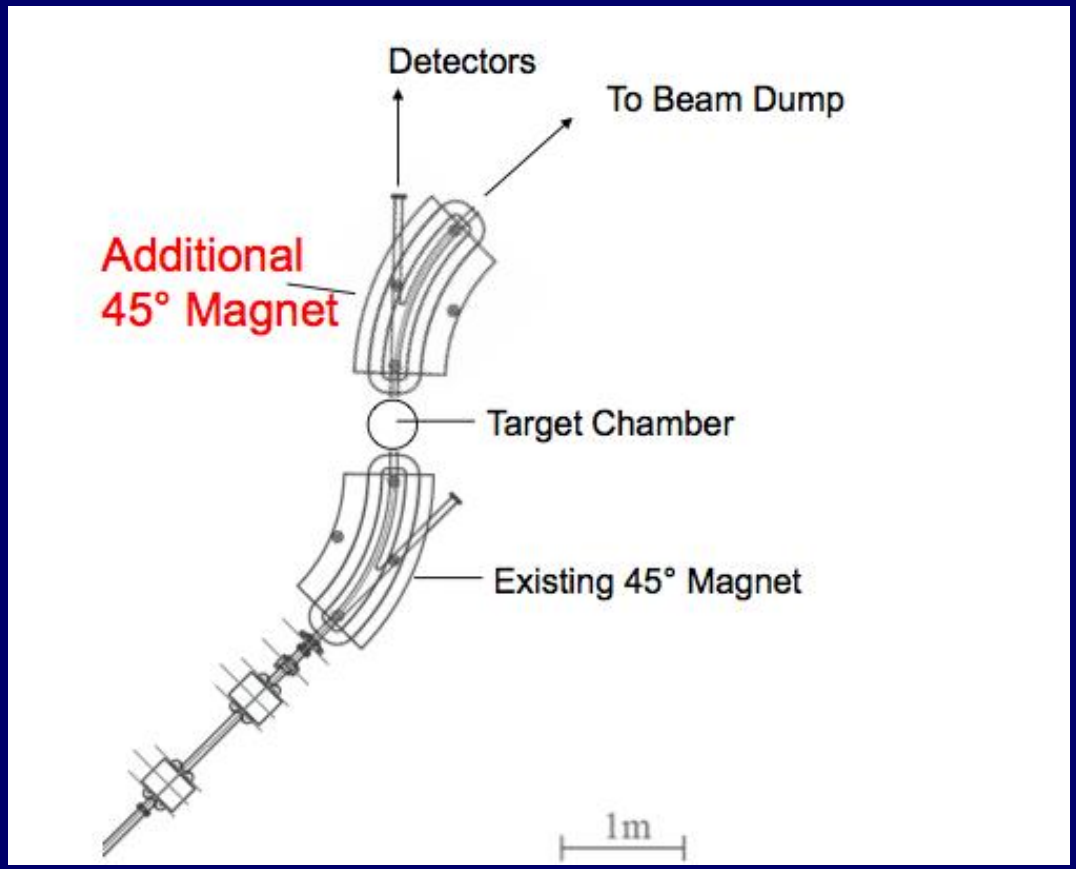
Undulator radiation in positron channeling in Si-crystal



(S. Dabagov *et al.*)

Improved setup at BTF

Undulator radiation in positron channeling in Si-crystal



(S. Dabagov *et al.*)

BTF for channeling: pro's and con's

Pro's

- Can provide relatively high-intensity beam (up to 2.5 10^{10} electrons)
- Easily tunable in **intensity** and **energy**
- Can provide **positrons** as well

Con's

- Low repetition rate (max 50 Hz)
- Emittance limited to 1 mm mrad for electrons, 5 mm mrad for positrons
- Relatively low-energy (max 550 MeV positrons, 650 MeV electrons)
- Need vacuum installation to limit multiple scattering in air
- Background from very low-energy secondaries, Bremsstrahlung

Vacuum

N. Delerue, University of Oxford

More info

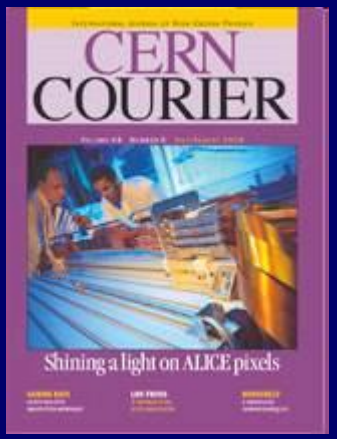
Web site:
http://www.lnf.infn.it/acceleratori/btf/

Beam request form:
http://www.lnf.infn.it/acceleratori/btf/request.html

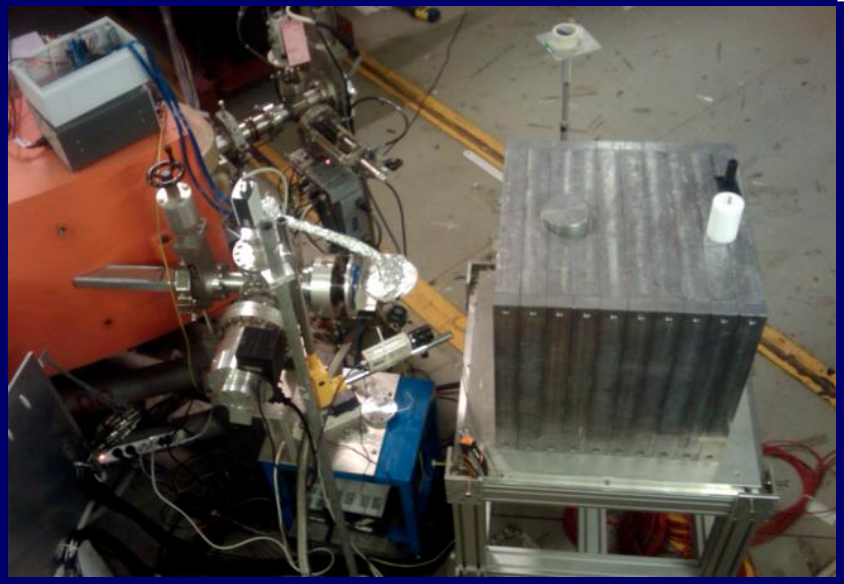
Schedule:
http://www.lnf.infn.it/acceleratori/btf/php/schedule.php?acc=1

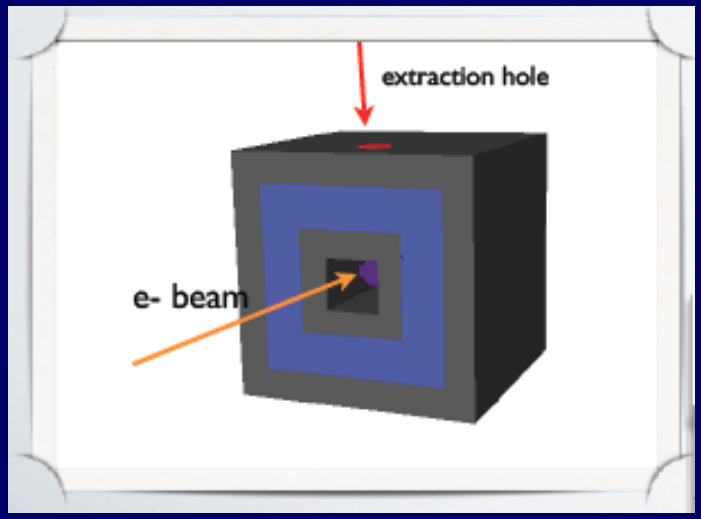
Main references:
- IEEE Trans.Nucl.Sci.52:824-829,2005.
- Nucl.Instrum.Meth.A515:524-542,2003.

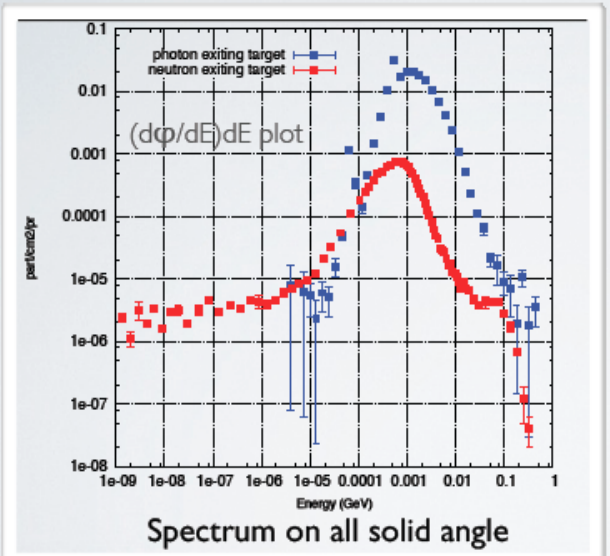
See also:
http://cerncourier.com/cws/article/cern/34935



Neutron electro-production at BTF







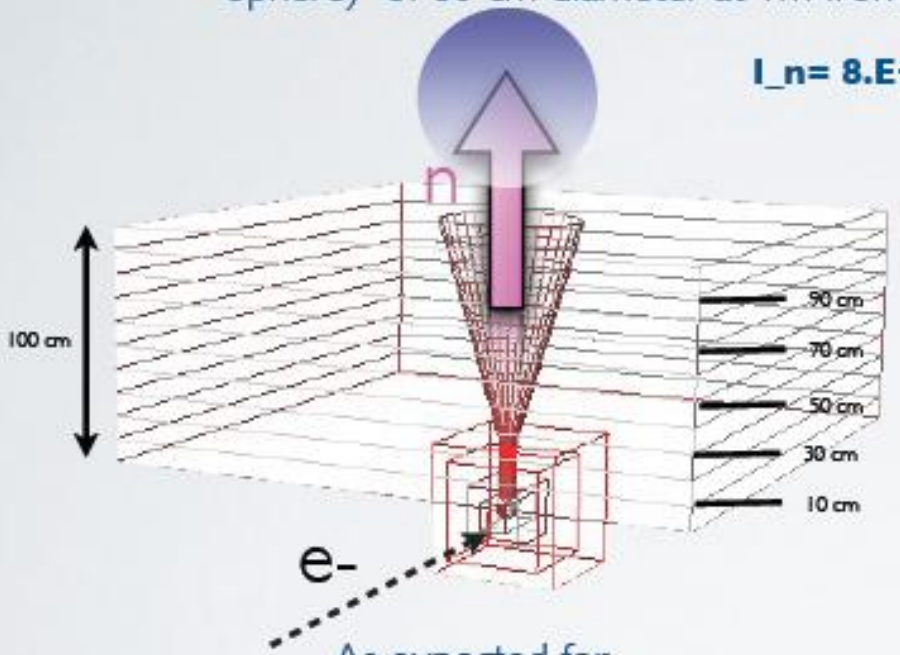
Optimized target	n@BTF
n_yield in the target	1.1E+11 n/s
n_out exiting from tgt	8.8E+8 n/cm2/s
ph_out exiting from tgt	1.87+10 n/cm2/s

Fluxes are integrated on all solid angle and energy spectrum

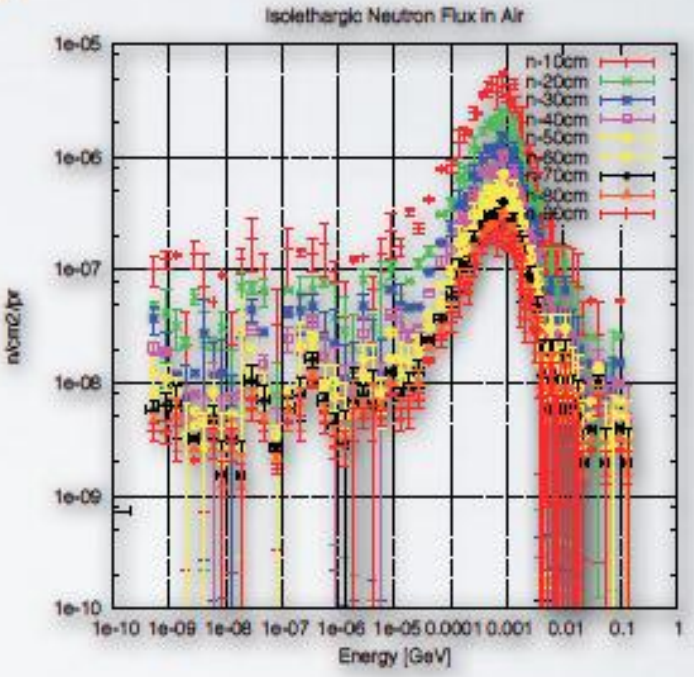
Neutron Spectra along extraction line in air

With the BTF Maximum Electron Beam= 5E+11 e/s,
the neutron current (integrated on all spectrum) entering on a spherical detector (Bonner Sphere) of 60 cm diameter at 1m from the shield has been estimated to be

I_n= 8.E+8n/s

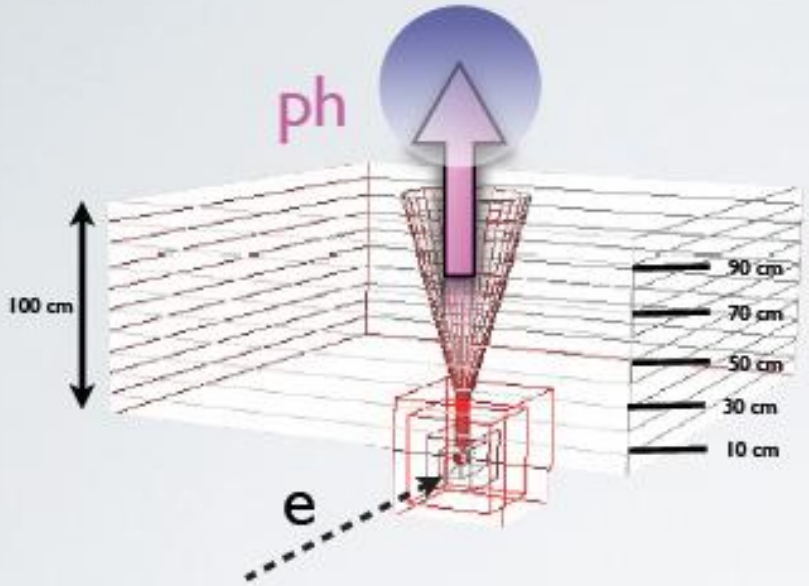


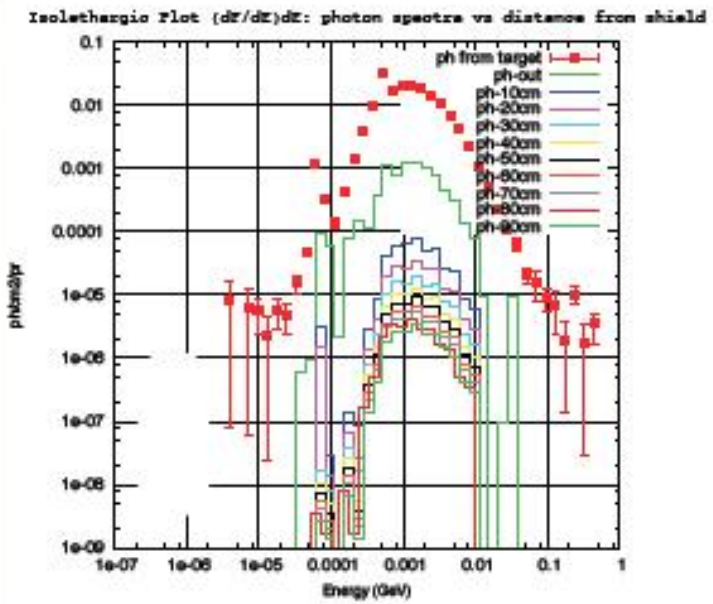
As expected for,
the neutron spectrum shape along the extraction line in air remains essentially unmodified whereas, the intensity of fluxes decreases according the inverse of square distance from the neutron source



Neutron Energy spectra at different distances along the extraction line

Photon Spectra along extraction line in air





Photon at 1m from shield entering the Bonner sphere:

Rate of photons (integrated on all the spectrum and solid angle) expected to enter the spherical detector of 60 cm Diameter with center 1m apart from the upper face of the shield in case of Maximum electrcon beam

Photon rate = 7.8E+9 ph/s

(an order of magnitude more than neutron)