UK

19.3.99

Scattered synchrotron radiation into inner detector

(E_0 = 250 GeV)

Sources

incoming beam

last bending magnet ρ = 22600 m E_{krit} = 1.2 MeV

$2 \cdot 10^9$ γ/m · crossing $E_\gamma > 100$ keV

→ leads to edge + backscattering from coll 1

~ 10^8/crossing hit coll 1

final quadrupoles ρ_{eff} ≈ 8000 m E_{krit} ≈ 4 MeV

~ 10^{10} γ/m · crossing $E_\gamma > 100$ keV

→ leads to backscattering from coll 1

~ 10^8/crossing hit coll 1

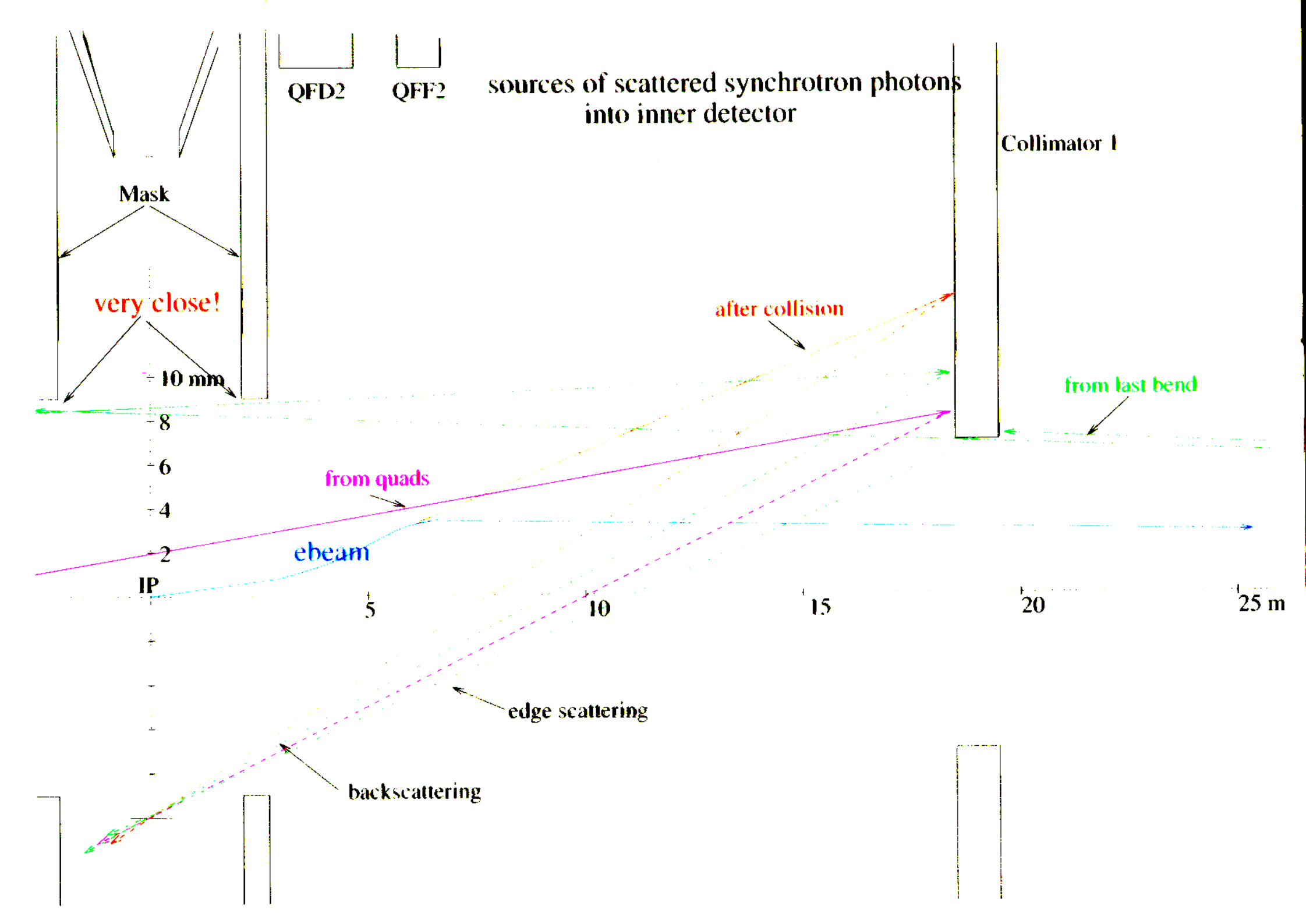
outgoing beam

offset in quads due to wide angular distribution

$\rho_{eff} \geq 1000$ m $E_{krit} \leq 35$ MeV

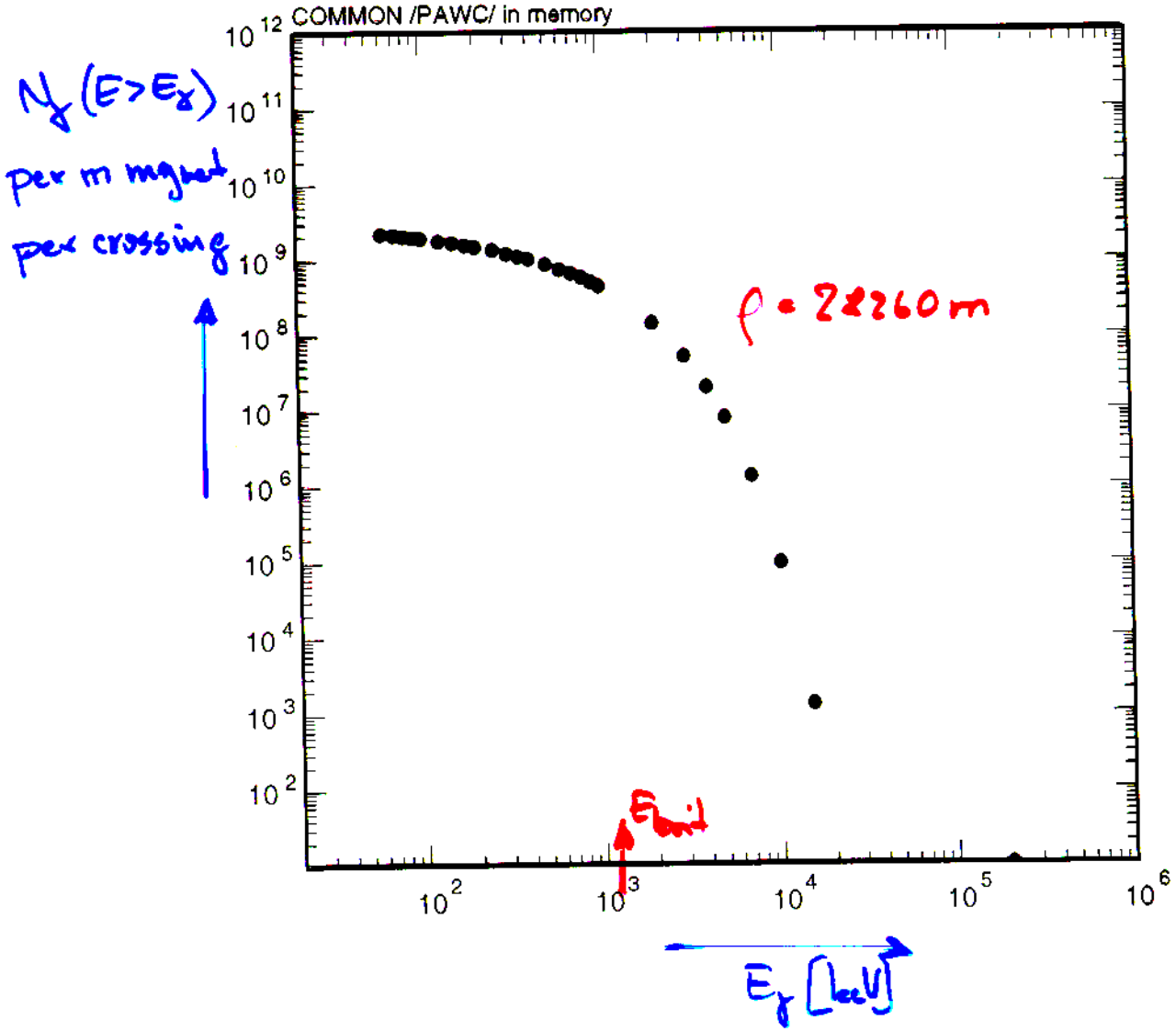
leads to backscattering from coll 1

→ ~ $1.6 \cdot 10^4$/crossing hit coll 1


QFD2
QFF2
sources of scattered synchrotron photons
into inner detector
Collimator 1
Mask
very close!
after collision
10 mm
8
6
4
2
from last bend
from quads
ebeam
IP
5
10
15
20
25 m
edge scattering
backscattering

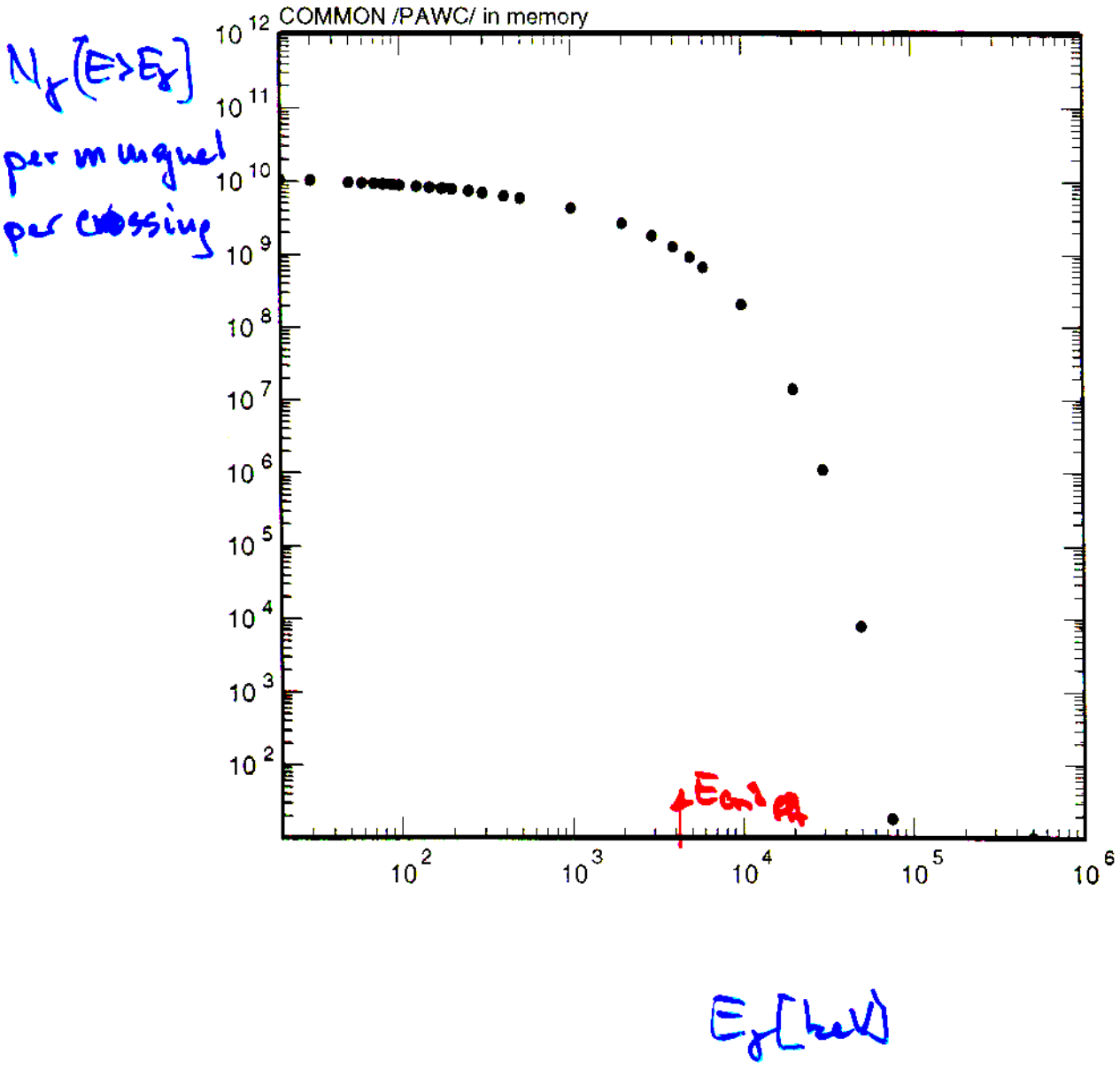
$E_0 = 250$ GeV, 10 mA

Legal standard bend

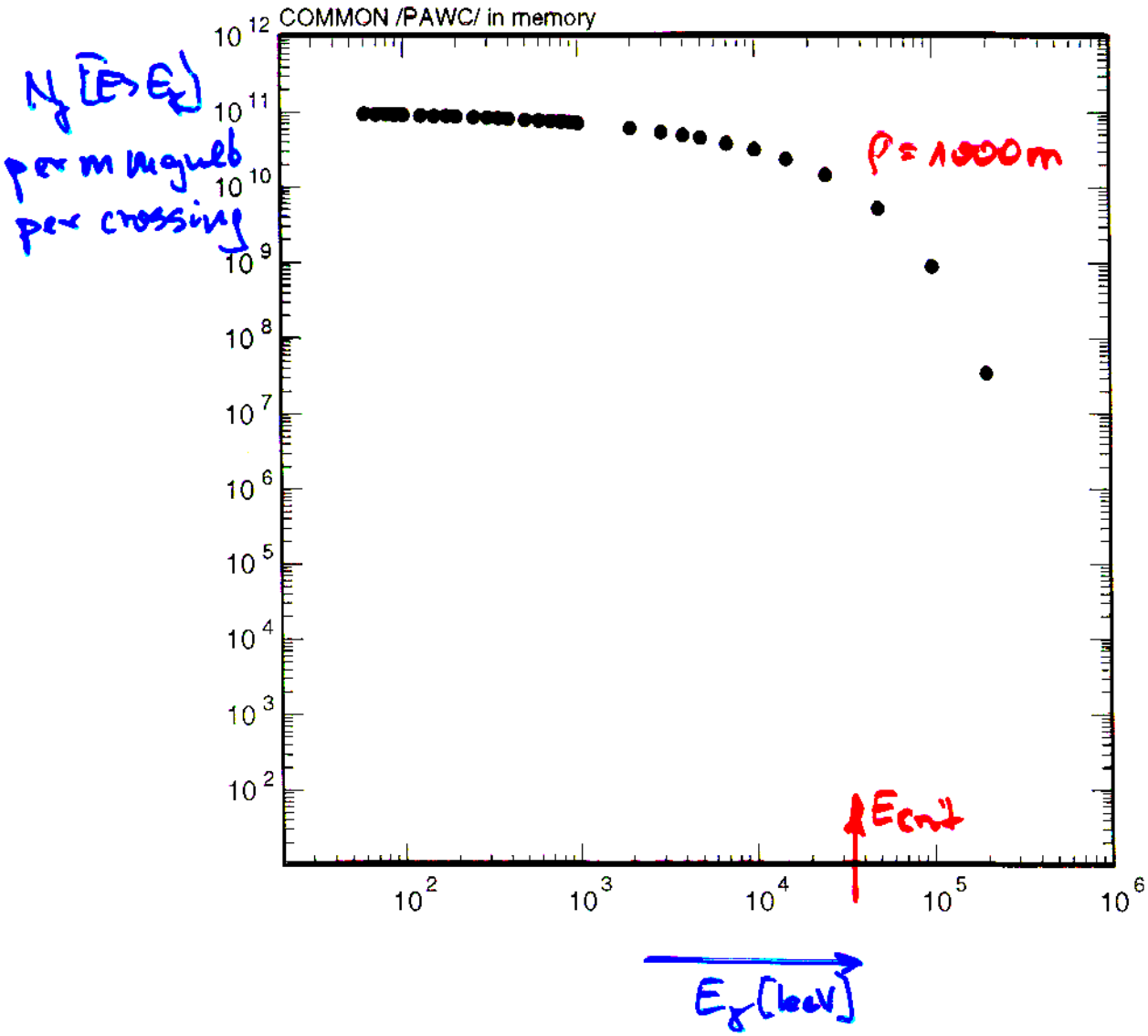


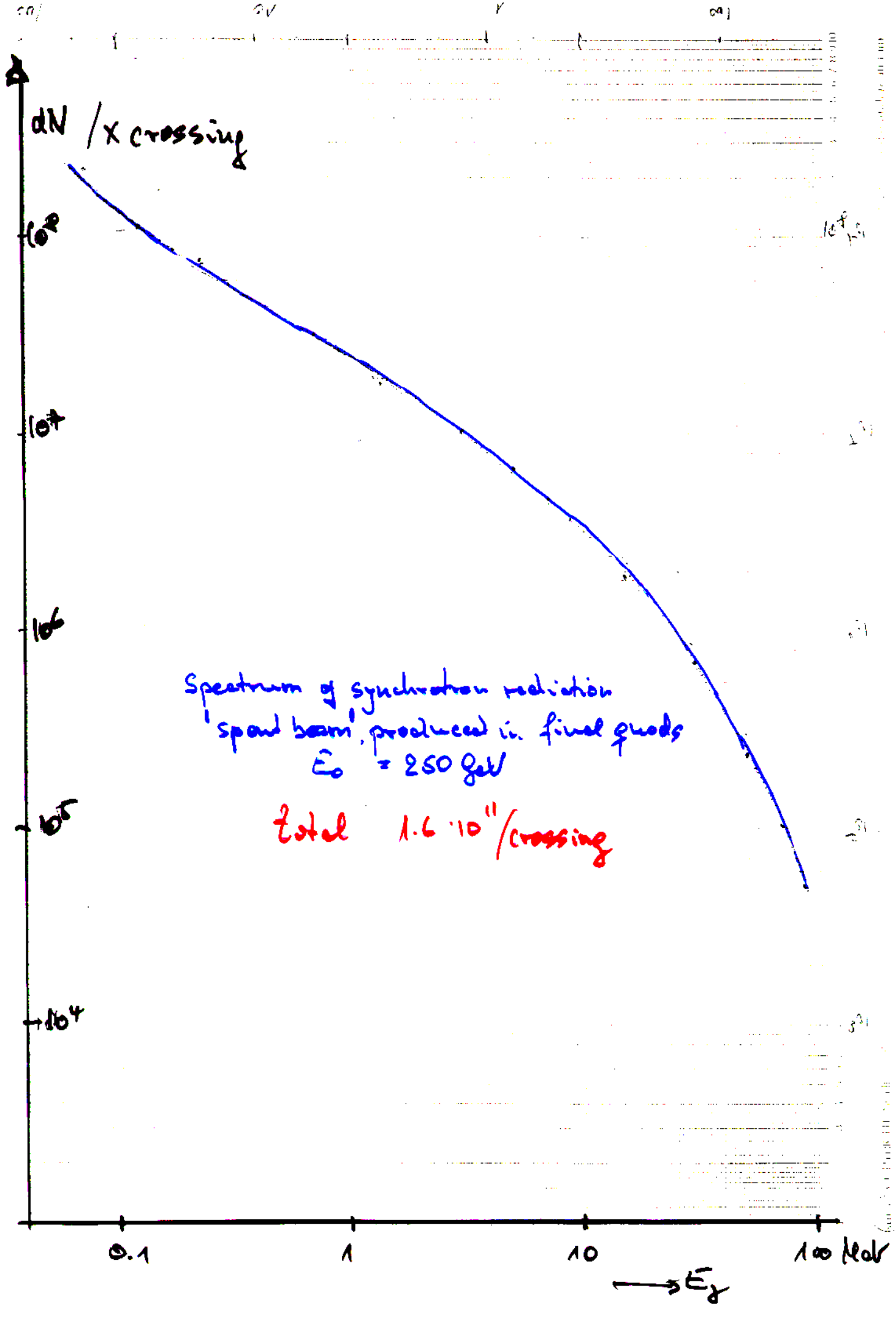
$E_0 = 250$ keV , 10 mA

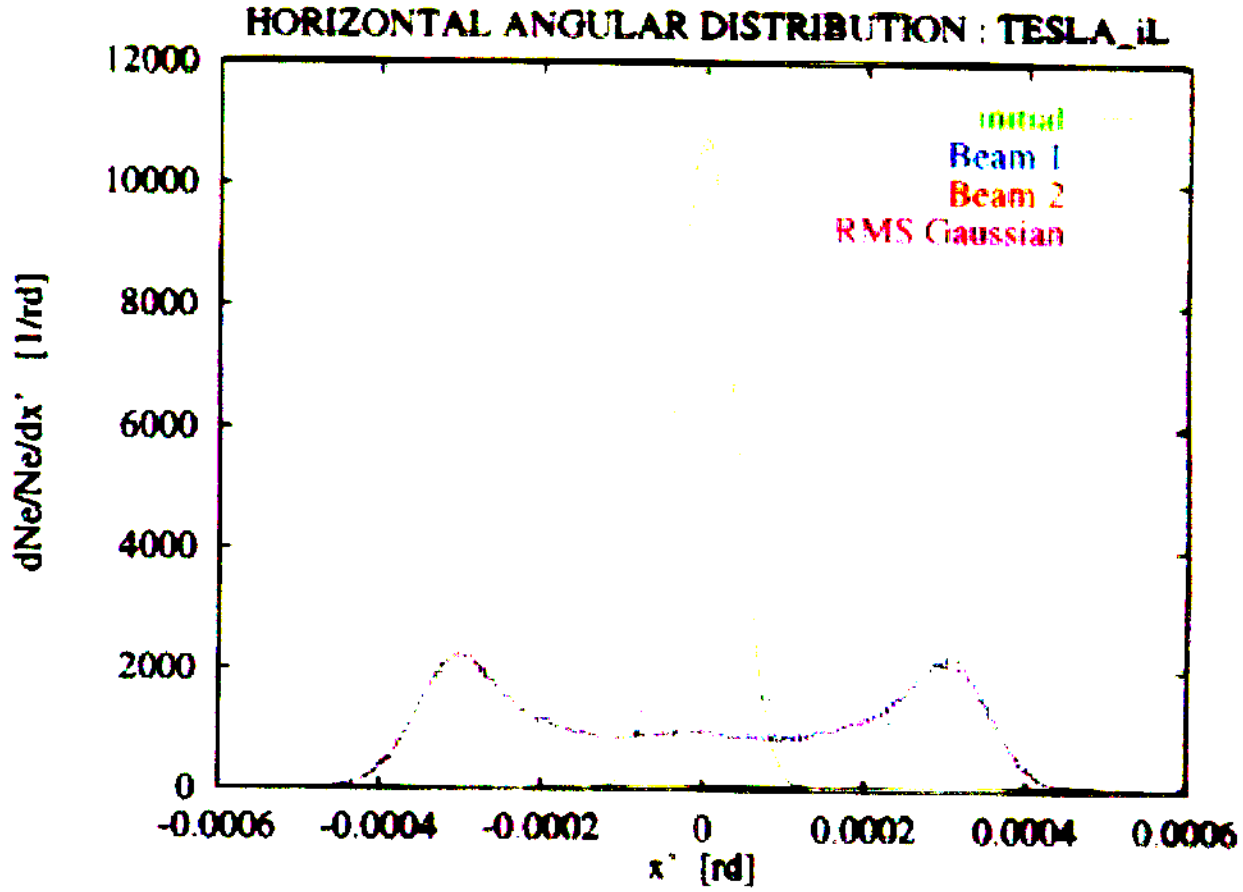
QFF2 $\sigma = 0.4$ mm

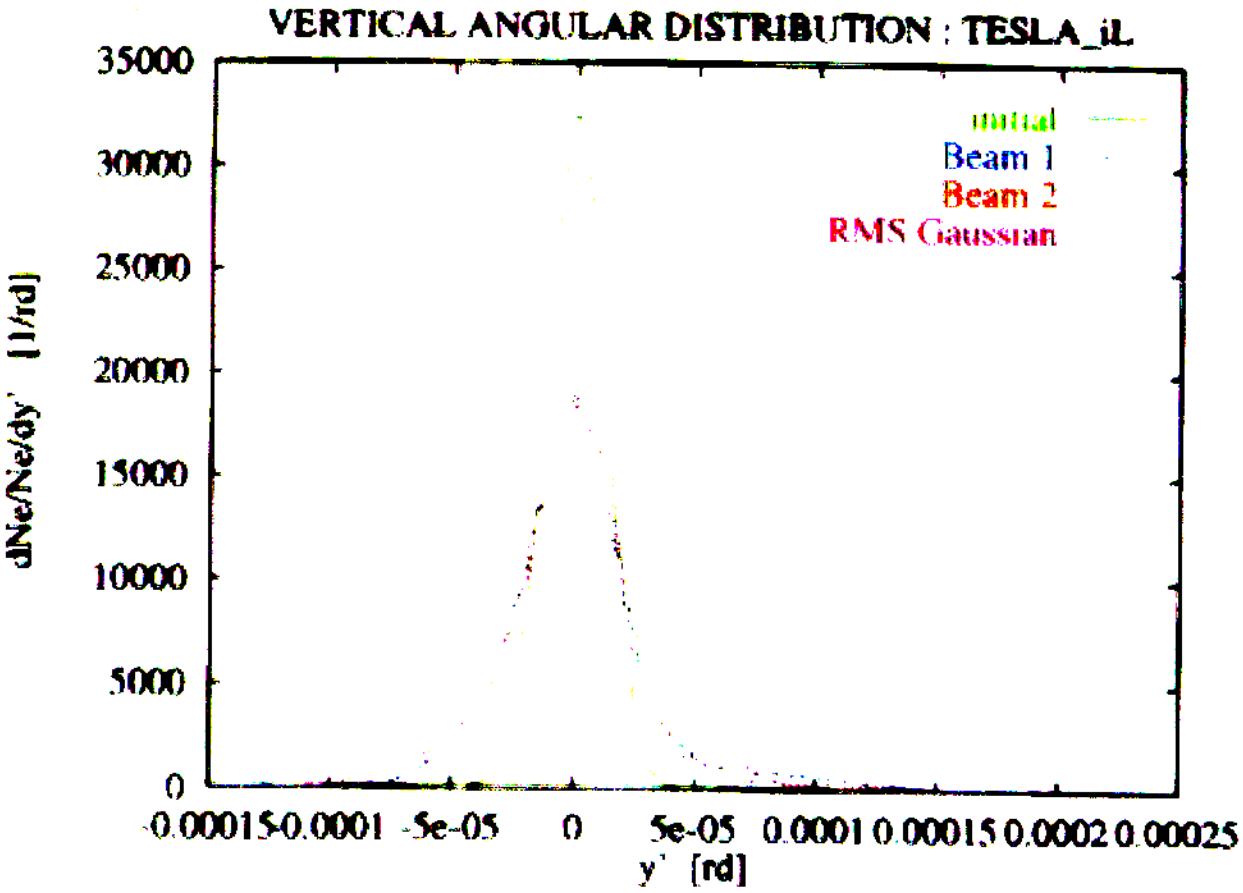


$E_0 = 250$ GeV , 10 mA




dN / x crossing
10^8
10^7
10^6
10^5
10^4
Spectrum of synchrotron radiation
'spent beam', produced in final quads
E_0 = 250 GeV
total 1.6 · 10^{11}/crossing
0.1
1
10
100 keV
E_γ

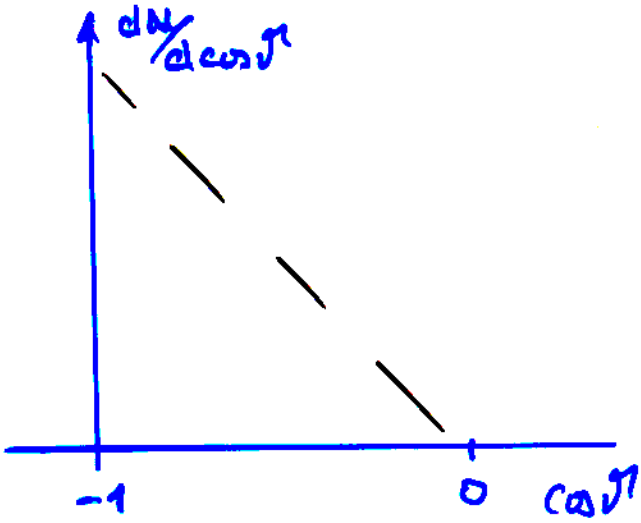

HORIZONTAL ANGULAR DISTRIBUTION : TESLA_iL
initial
Beam 1
Beam 2
RMS Gaussian
dNe/Ne/dx' [1/rd]
12000
10000
8000
6000
4000
2000
0
-0.0006
-0.0004
-0.0002
0
0.0002
0.0004
0.0006
x' [rd]


VERTICAL ANGULAR DISTRIBUTION : TESLA_iL
initial
Beam 1
Beam 2
RMS Gaussian
dNe/Ne/dy' [1/rd]
35000
30000
25000
20000
15000
10000
5000
0
-0.00015
-0.0001
-5e-05
0
5e-05
0.0001
0.00015
0.0002
0.00025
y' [rd]

EGS4 calculation (from C. Hensel)

normal incidence on W collimator

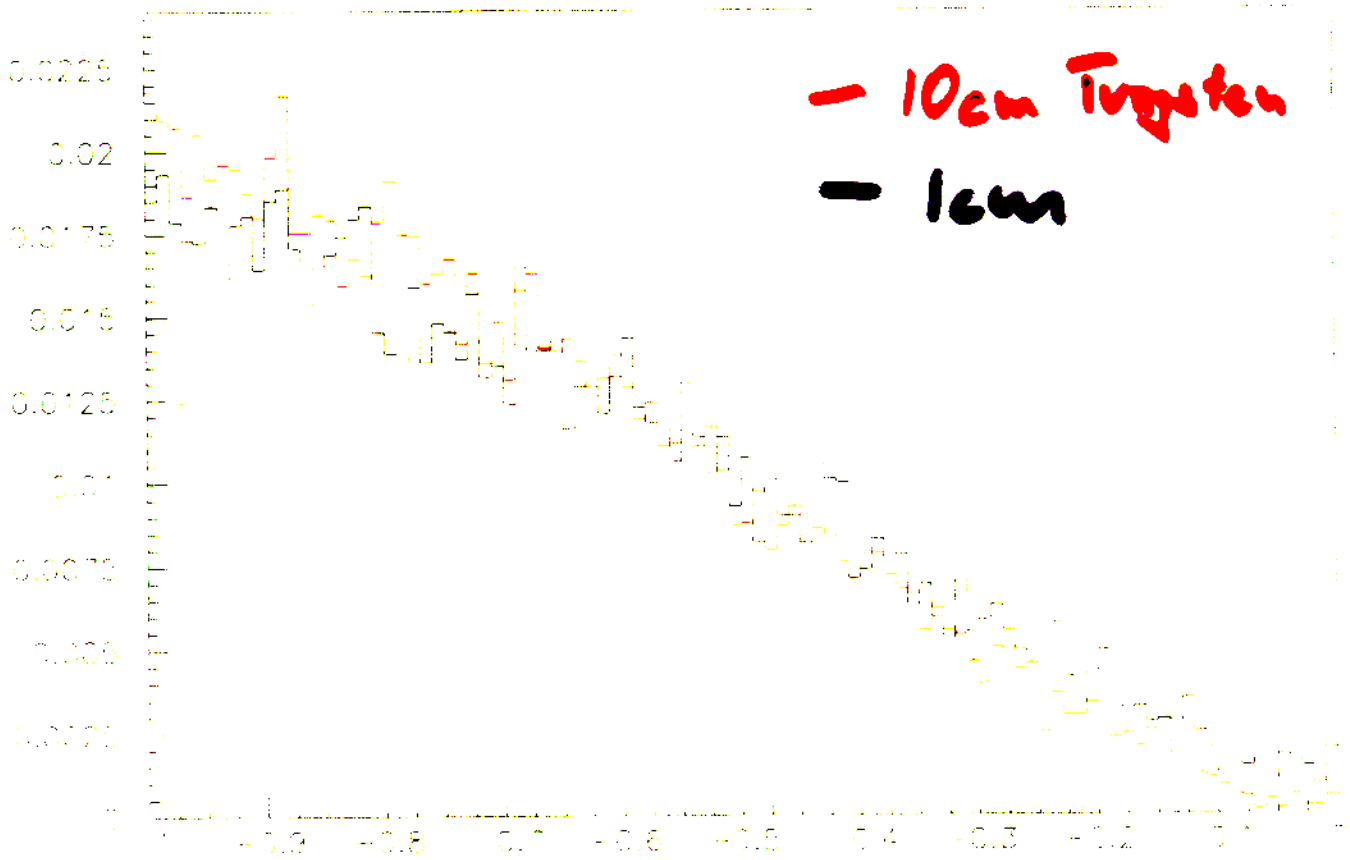
* angular distribution of scattered photons peaks in backward direction



* mean backscattered energy saturates at a few MeV

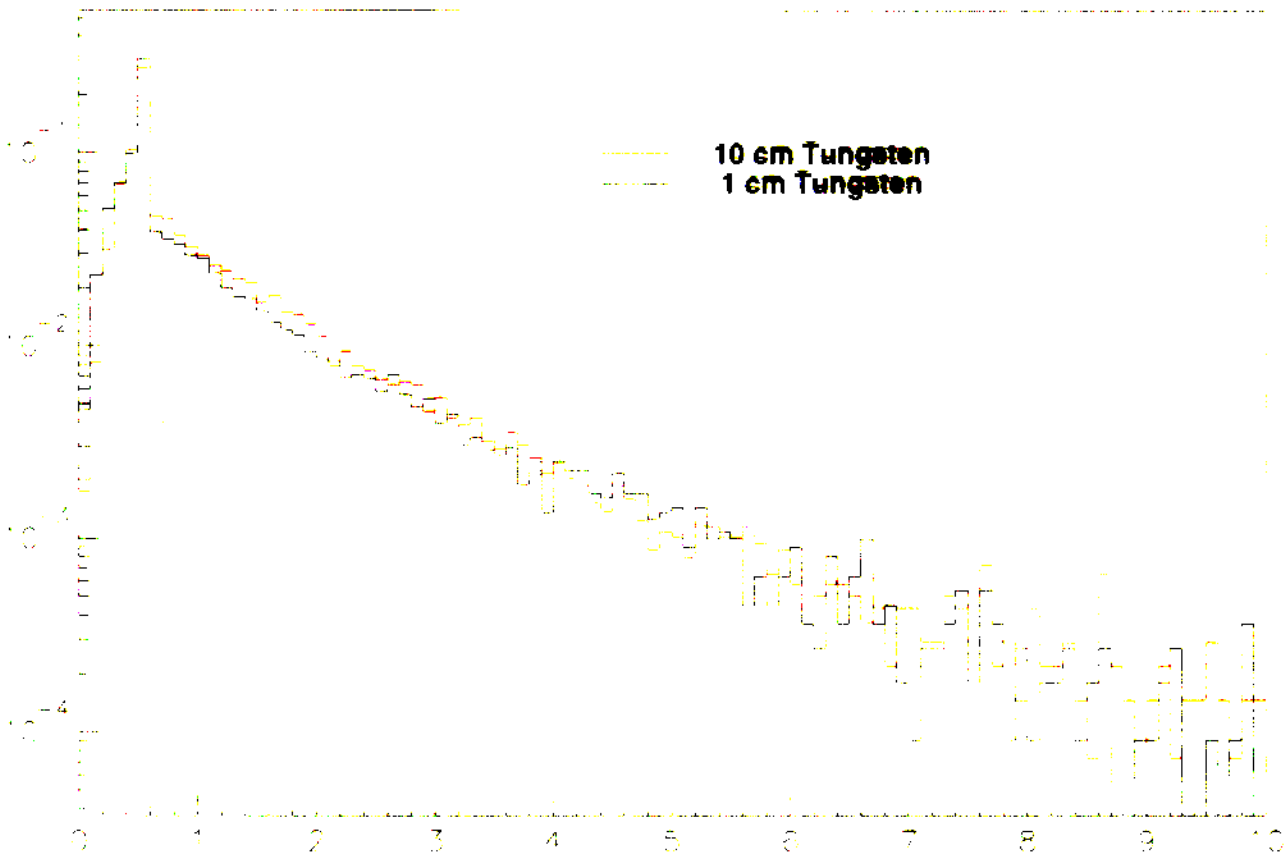
* number of backscattered photons rises ~ E_{in} beyond pair production threshold

energy of primary photons: 100MeV



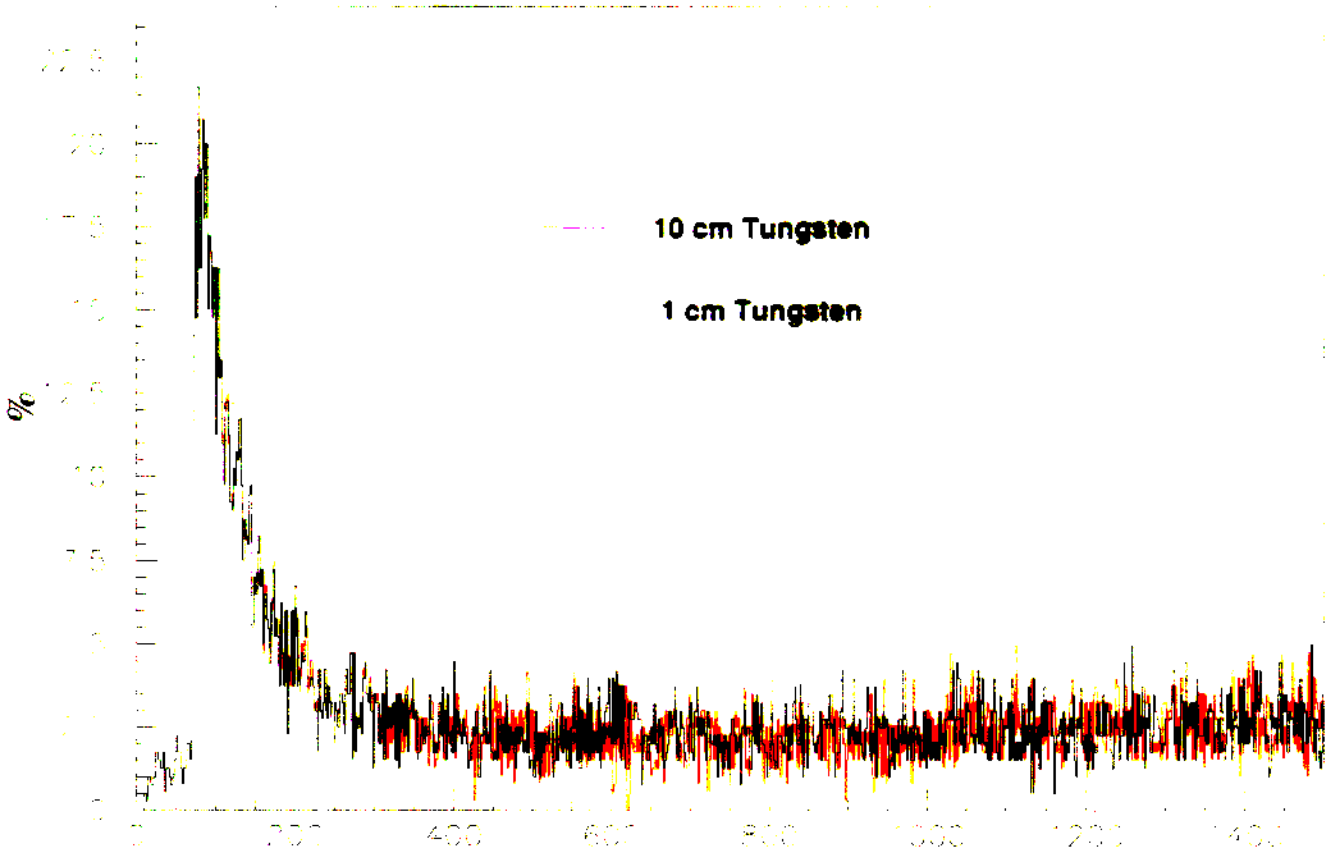
angular distribution sencondaries cosΘ

energy of primary photons: 100MeV

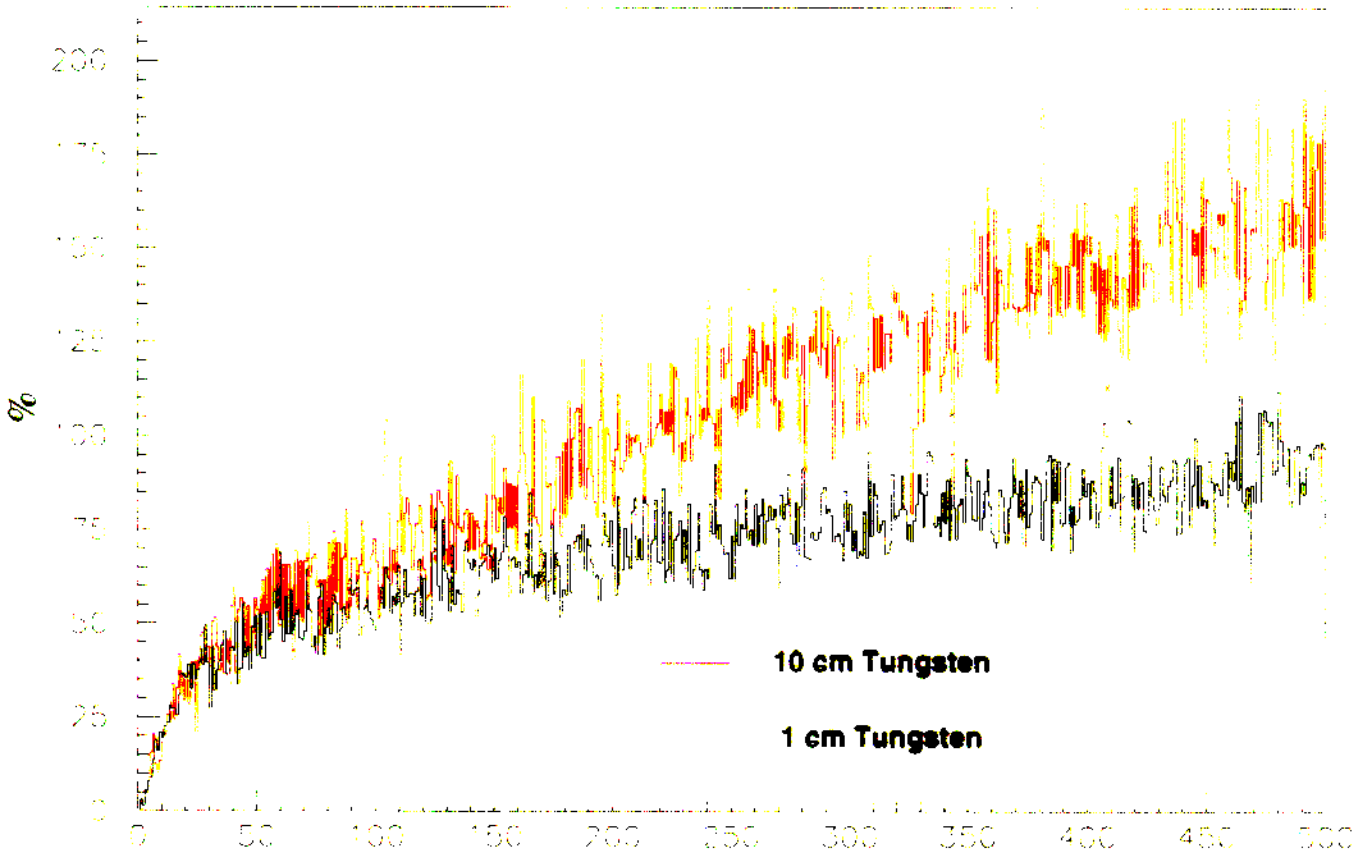


energy spectrum secondary photons E/MeV

Albedo: Tungsten



Albedo: Tungsten



Rates into inner detector

only outgoing beam

* **10 cm long "CCD" at r = 1 cm**

solid angle + albedo + ang. distribution

⟶ 2 × 1500 γ / crossing

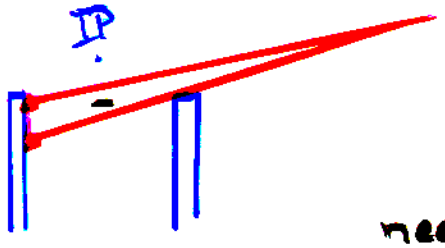
distributed over ~ 50 cm² cylinder surface

⇒ 60 γ / cm².crossing

⇒ dose ~ 10 Gray/y

} no problem

* **photons into solid angle between masks**



~ 2 · 4 · 10⁴ γ / crossing

needs extra beamscattering before it hit active elements

Conclusion

* far from last bend very close to mask

* direct back scattered photons into vertex

  no problem

  double scattered no problem

* there are other sources of backscattered photons

  point into mask
  beam stretcher into coll1, shadow
  has to be checked