θ_{13} IN CNGS WITH A TELESCOPE ARRAY

Hypotheses

oscillations $\nu_\mu \rightarrow \nu_\tau$

$\delta m^2_{23} = 3.\,10^{-3}\ eV^2$

$\theta_{23} = 45°$

$\Rightarrow$ **"indirect" oscillations**

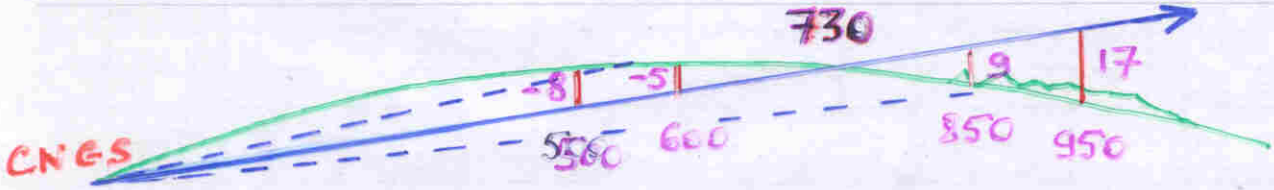
$\nu_\mu \rightarrow \nu_e$

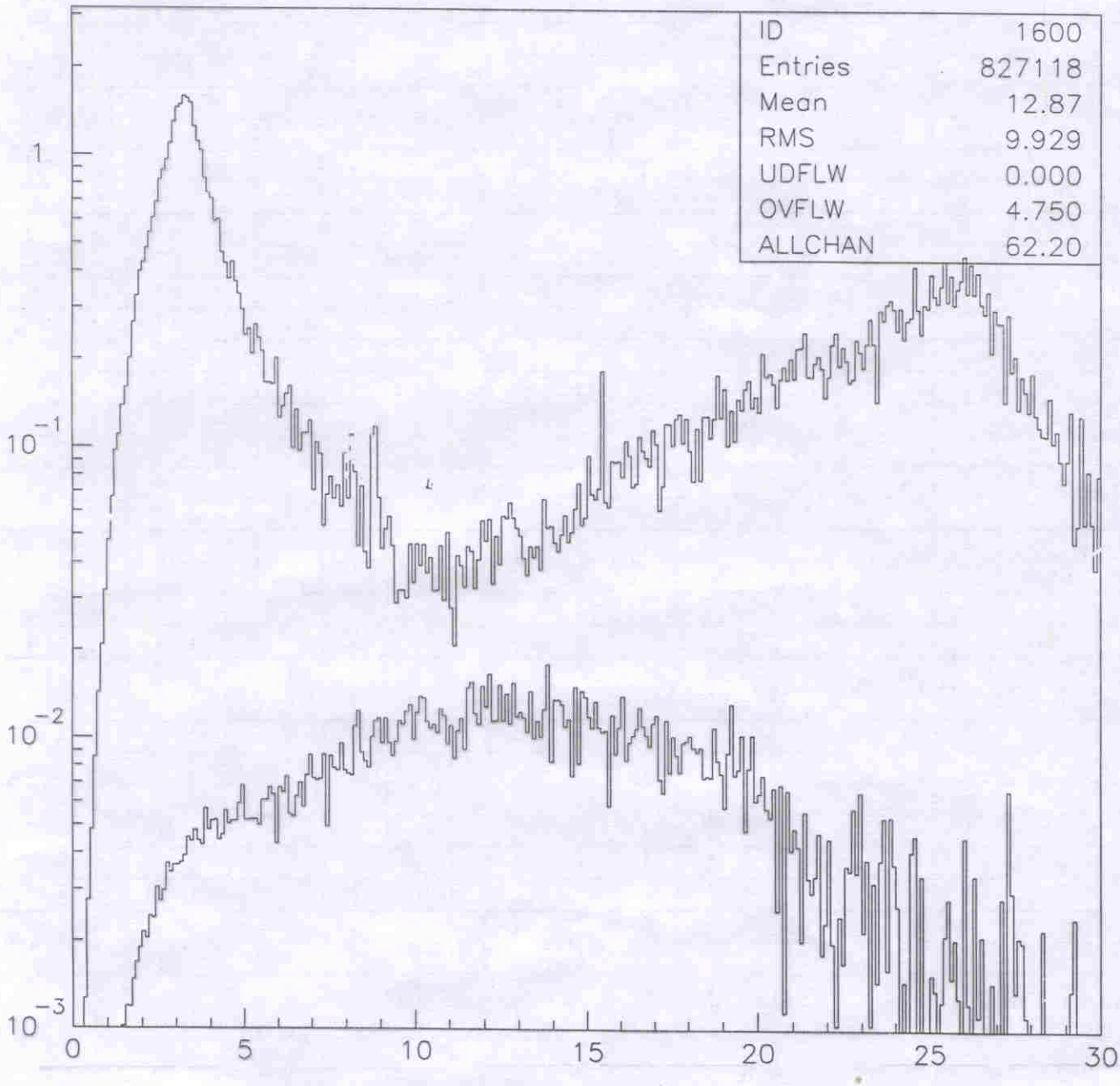
$$P = 2 \sin^2\theta_{13} \sin^2 \pi \frac{R}{\lambda_{23}}$$

present limit

$2 \sin^2\theta_{13} \lesssim 5\%$

OFF-AXIS BEAM





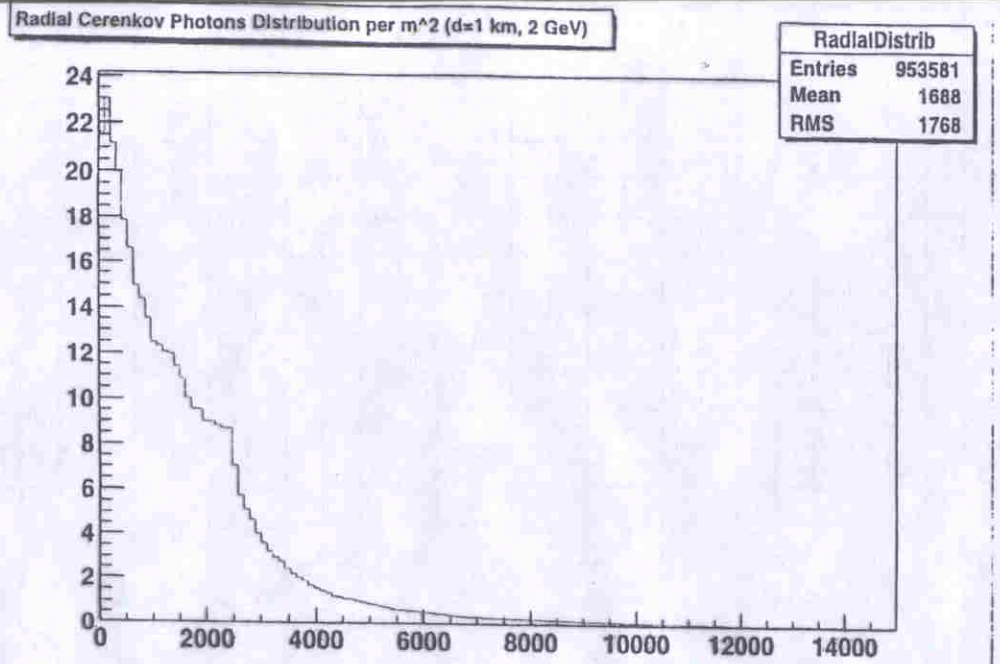
ν_e DETECTION

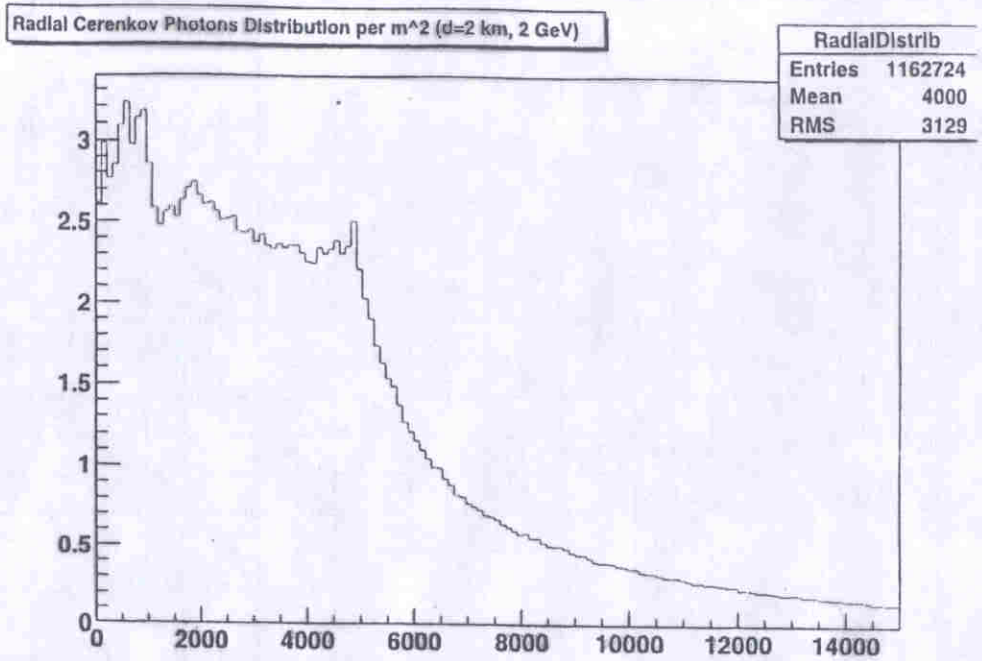
ν_e CC $\rightarrow$ e

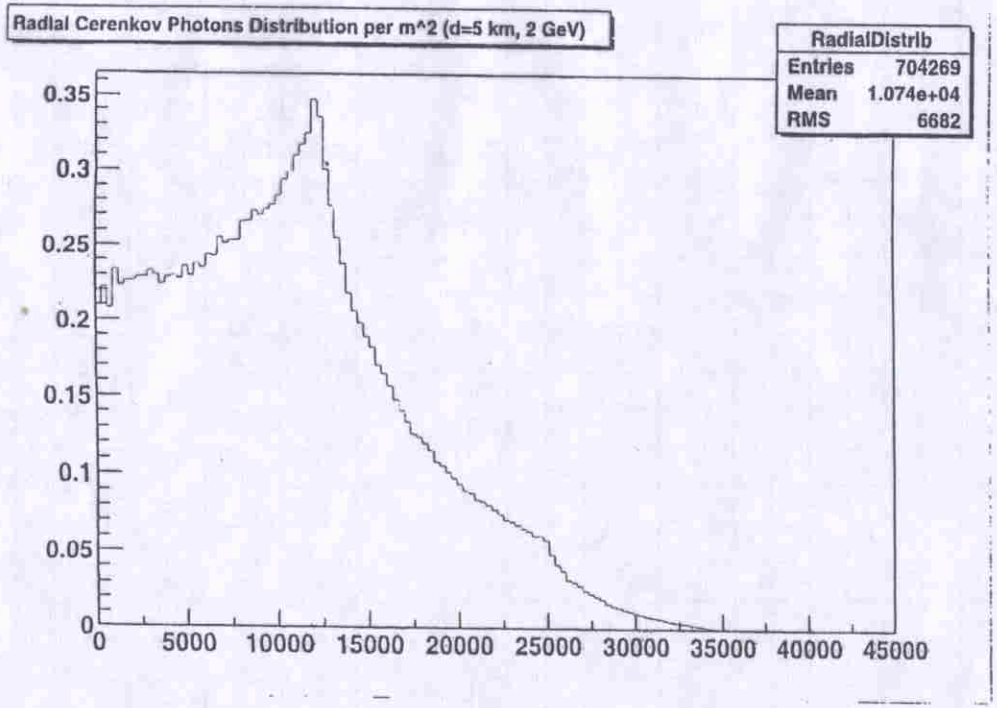
EM shower ... in air

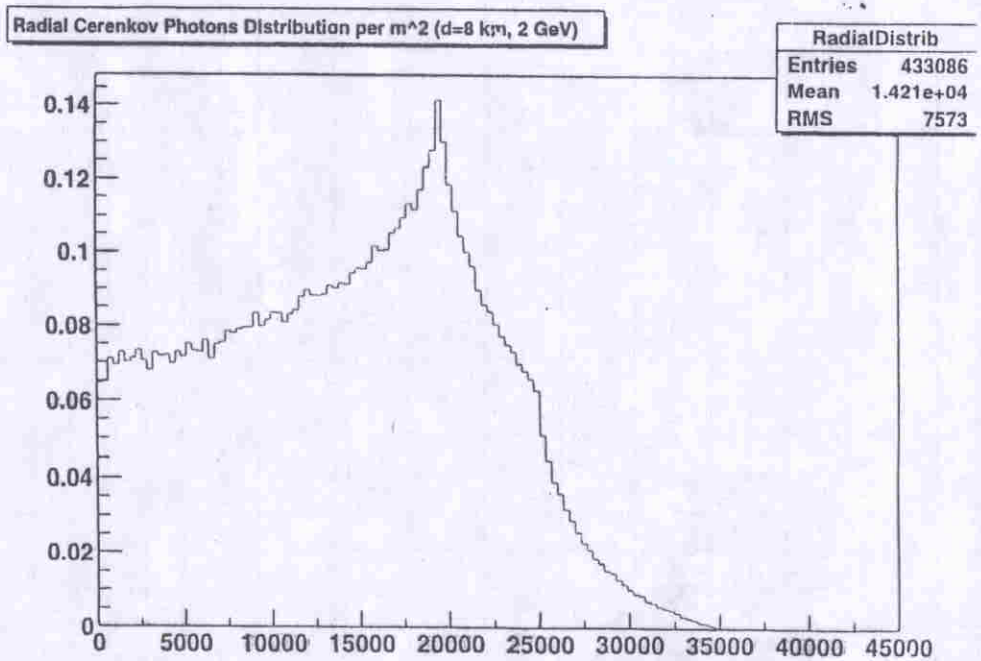
(1 km atm = 1,3 m water

1 X° atm = 300 m)

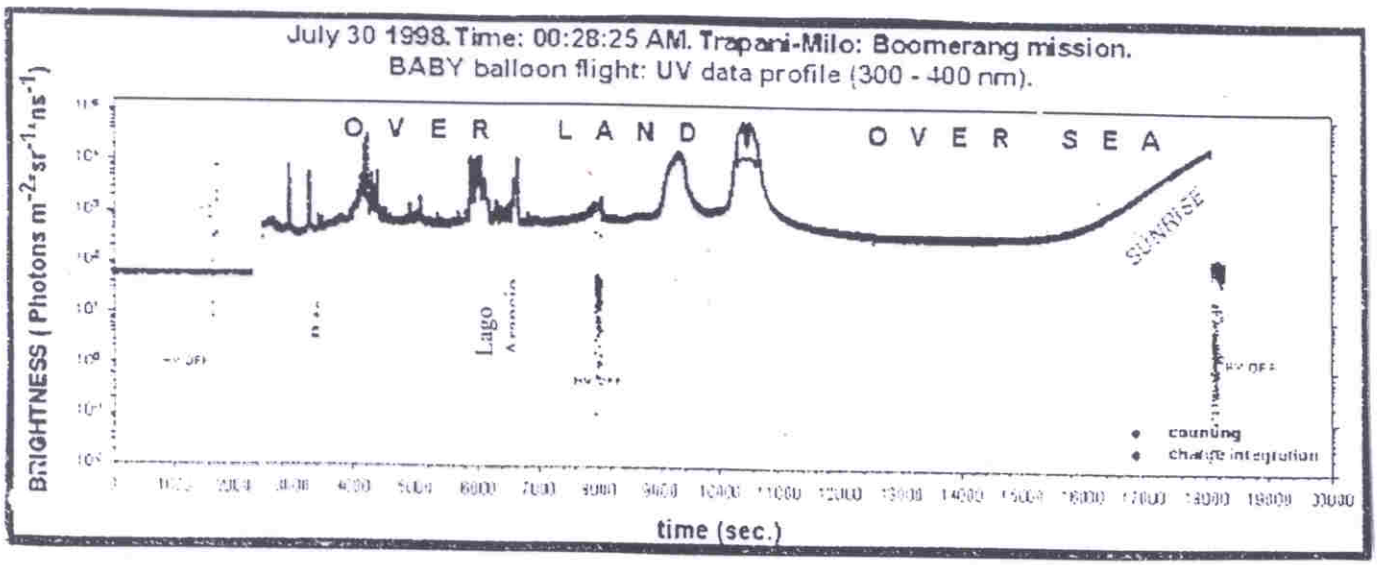

Radial Cerenkov Photons Distribution per m^2 (d=1 km, 2 GeV)
RadialDistrib
Entries 953581
Mean 1688
RMS 1768
0 2 4 6 8 10 12 14 16 18 20 22 24
0 2000 4000 6000 8000 10000 12000 14000


Radial Cerenkov Photons Distribution per m^2 (d=2 km, 2 GeV)
RadialDistrib
Entries 1162724
Mean 4000
RMS 3129
0 0.5 1 1.5 2 2.5 3
0 2000 4000 6000 8000 10000 12000 14000


Radial Cerenkov Photons Distribution per m^2 (d=5 km, 2 GeV)
RadialDistrib
Entries 704269
Mean 1.074e+04
RMS 6682
0 0.05 0.1 0.15 0.2 0.25 0.3 0.35
0 5000 10000 15000 20000 25000 30000 35000 40000 45000


Radial Cerenkov Photons Distribution per m^2 (d=8 km, 2 GeV)
RadialDistrib
Entries 433086
Mean 1.421e+04
RMS 7573
0 0.02 0.04 0.06 0.08 0.1 0.12 0.14
0 5000 10000 15000 20000 25000 30000 35000 40000 45000

NIGHT SKY BACKG.



⇒ 200 photons / m² / srd / ns

Toward mountain ?

depends on wavelength

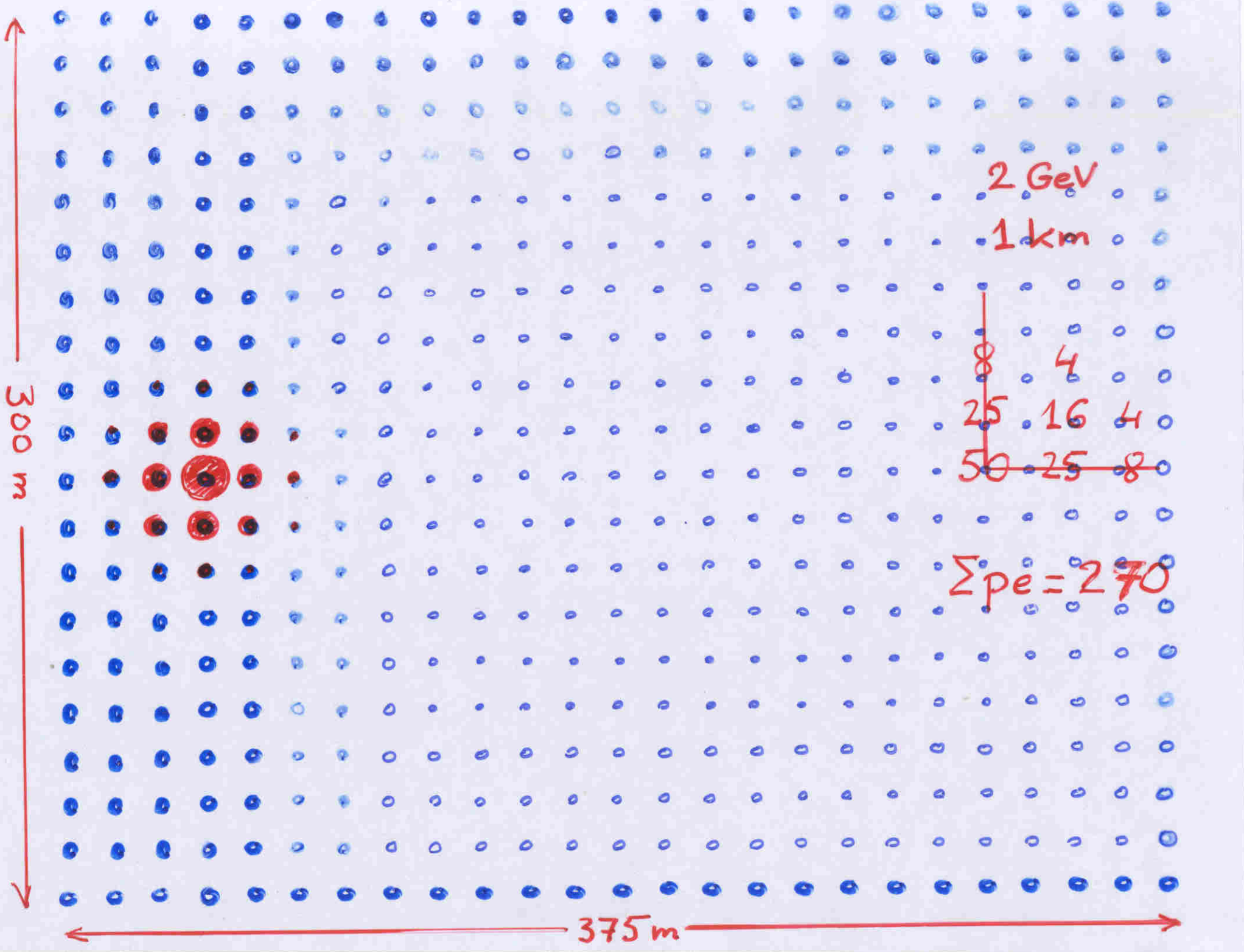
337 nm 0.28

391 nm 0.53

on green vegetation surface

⇒ First priority

Clouds , filters ...


2 GeV
1 km
8
4
25
16
4
50
25
8
Σpe = 270
300 m
375 m

STATISTICS

Target

405 x 330 x 6

800 kT

"Duty cycle" 25%

200 kT

At 900 km 15 CC evts /kT/year

. Oscillation prob 0.9

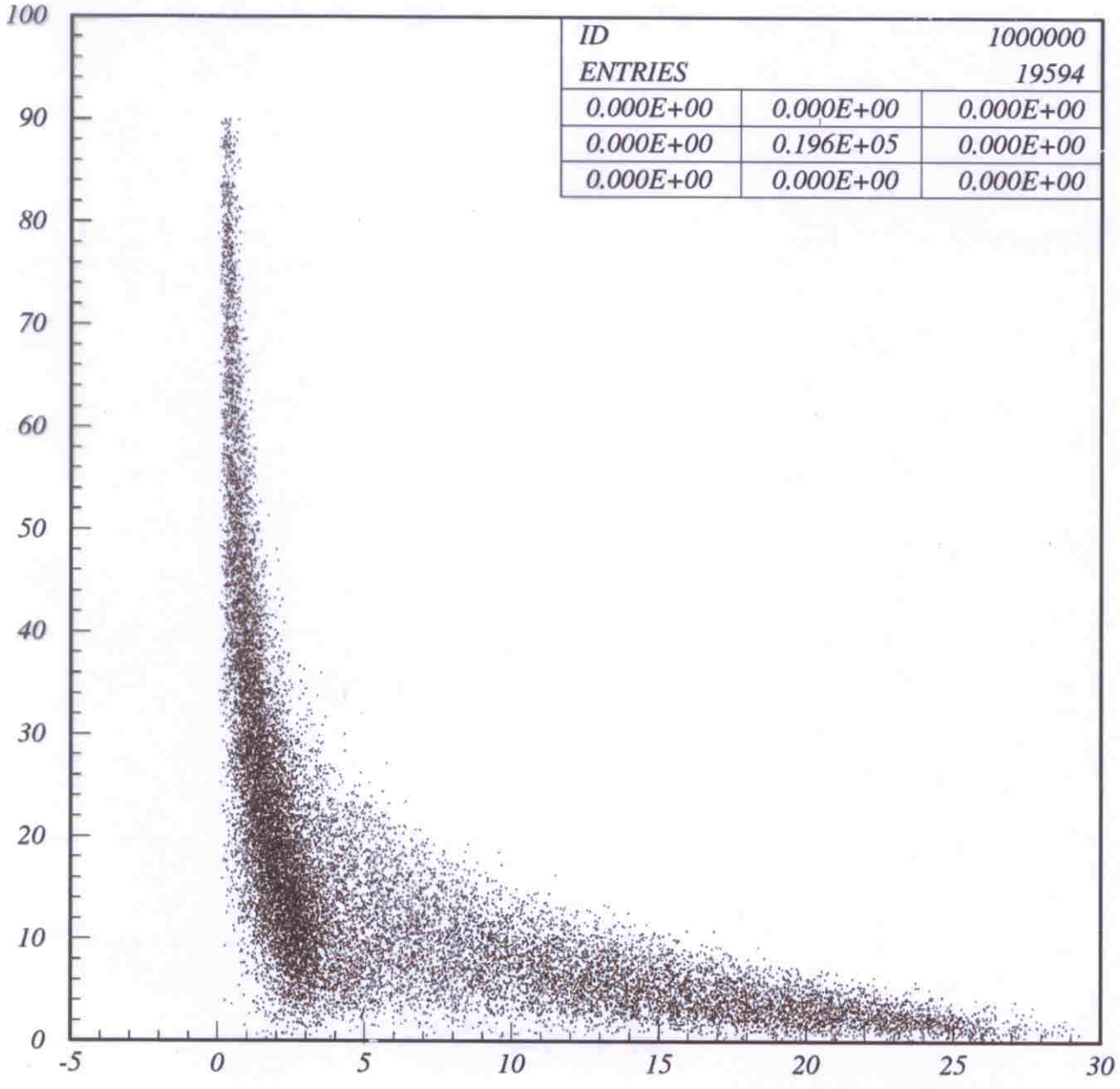
. Efficiency 0.42

cuts $E_e > 1.5$ GeV

$\theta_e < 20°$

For $2 \sin^2 \theta_{13} = 5\%$

283 ν_e evts / 5 years



*atan(1./plepout(3)*sqrt(plepout(1)*plepout(1)+plepout(2)*plepout(2)))*180/3.1415926 VS. plepout(4)*

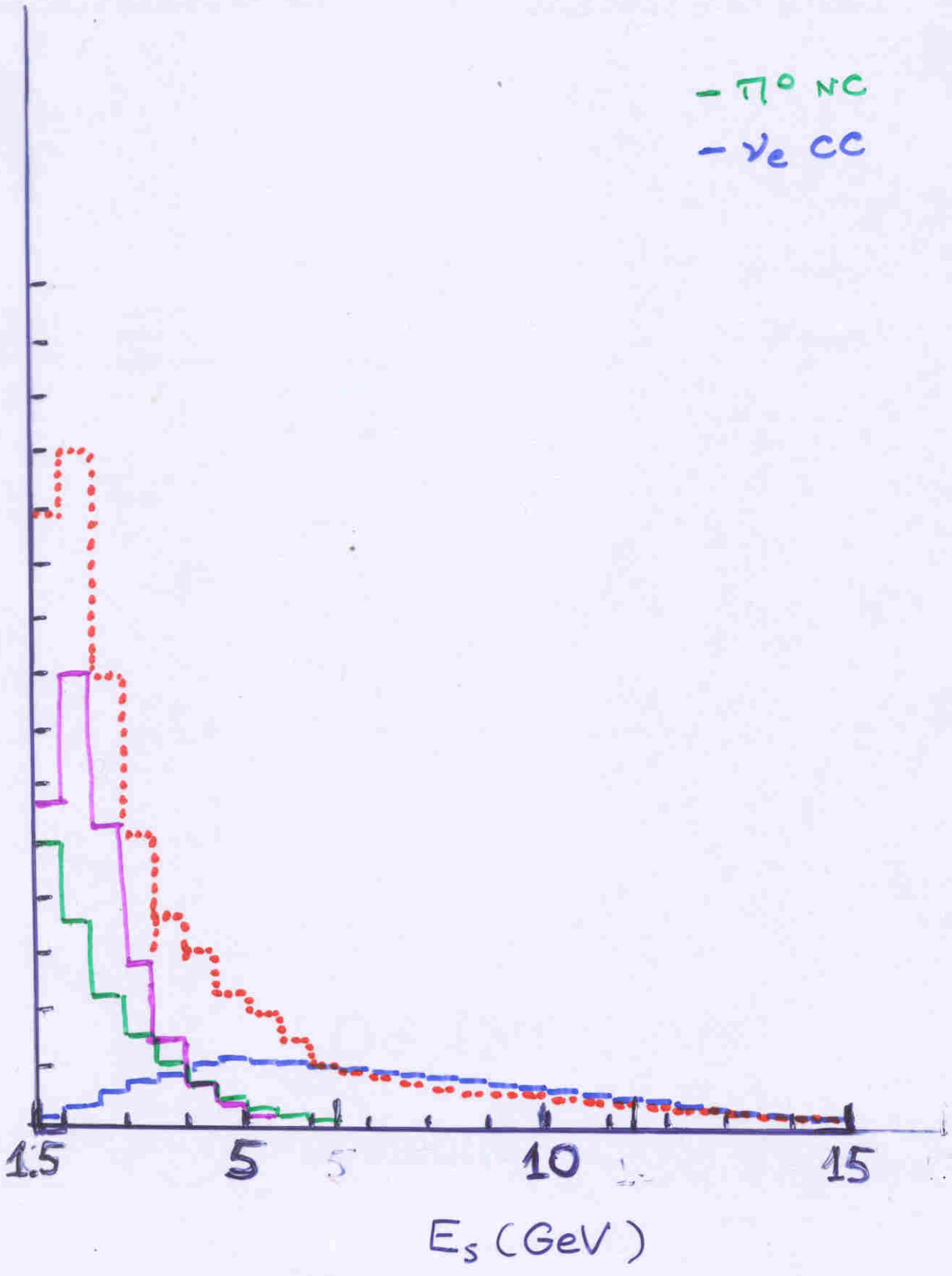
PHYSICS BACKG.

- ν_e of contamination
  - ~ same number of events $\varepsilon = 75\%$
  - but very different energy distribution
- π^0 from NC
  - $\varepsilon = 14\%$

$\Rightarrow$ Direct measurement of physics background

Same beam at ~ 500 km

- × same ν_e
- × same NC for ν_μ and ν_τ


- π° NC
- νe CC
1.5
5
10
15
Es (GeV)

CONCLUSION

- Worth continuing
- Steps :
  - find a valley 11-12 mrad
  - measure night sky backg
  - optimize . cuts
    . detector

⇒ sensitivity on θ_{13}

Opera ?

Tosca ?

NORMA

- Astroparticle physics
  - charged cosmic rays
  - H.E. ν_e from point-sources