

$\nu_\mu$  (SPL) --> FREJUS TUNNEL

## MOTIVATIONS

- Gain > a factor 10 on proton lifetime
- A step towards neutrino factory
- Gain > a factor 10 on  $\nu_\mu \rightarrow \nu_e$  appearance
- Sensitivity to maximal CP violation

## CONSEQUENCES

SPL plus UNO type of detector (400 kT water Cerenkov)

# Acknowledgements D. CASPER

• In collaboration with:

- A. Blondel, J. Burguet, M. Donega, S. Gilardoni,  
J-J. Gomez-Cadenas, P. Hernandez, M. Mezzetto

• Detector simulation, reconstruction software:

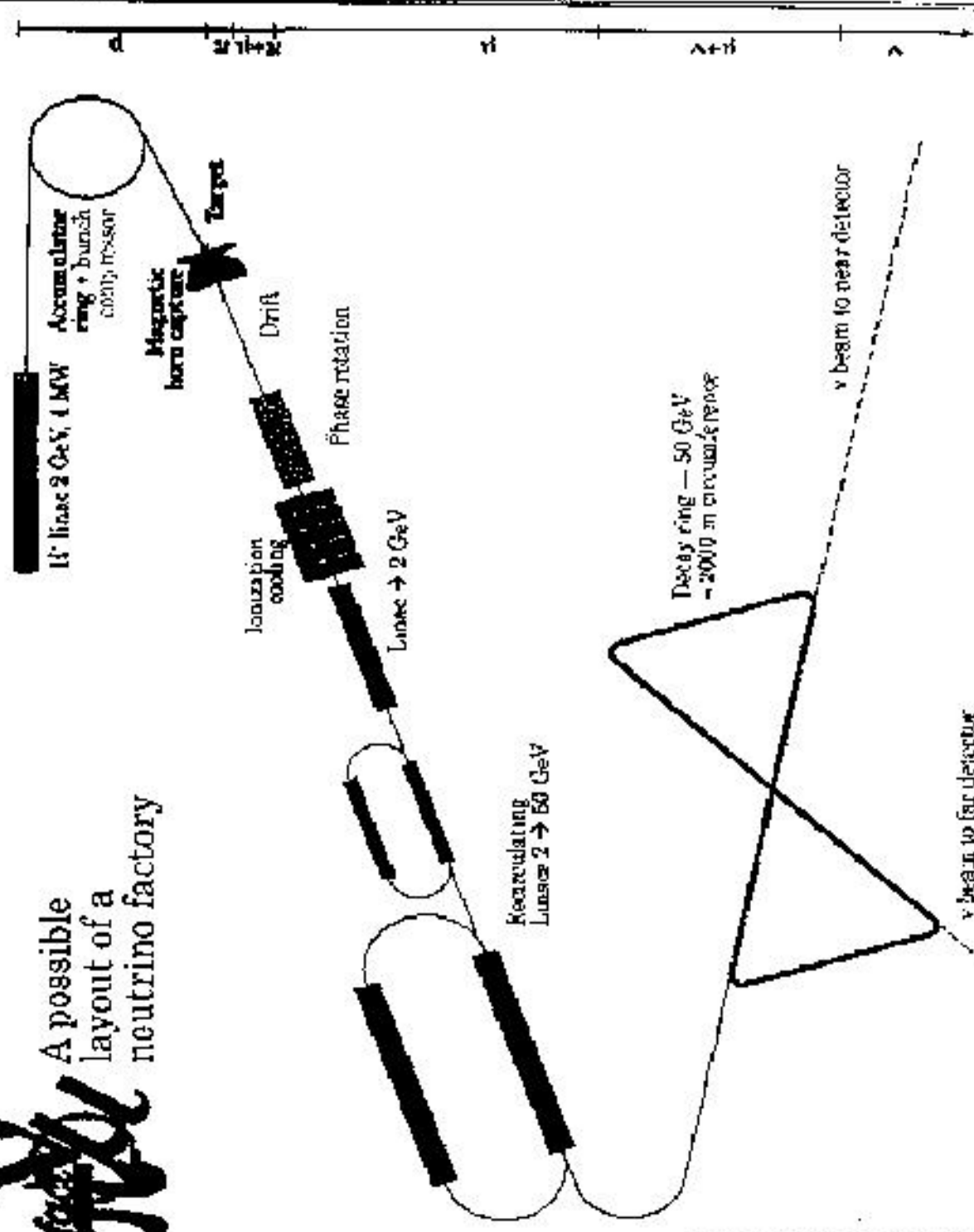
- Super-Kamiokande collaboration

+ J. BOULCHEZ, L. MOSCA, F. PIERRE

+ F. DYDAK

**FNAL**

# A possible layout of a neutrino factory



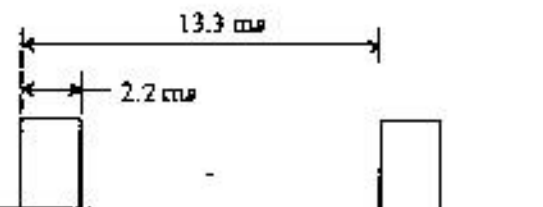
# Why the accumulator?

Atmospheric events: 100/kton/y

Detector (40kton \* 5 y): Atmospheric 20000 events  
Super Beam ~10 events

~2000

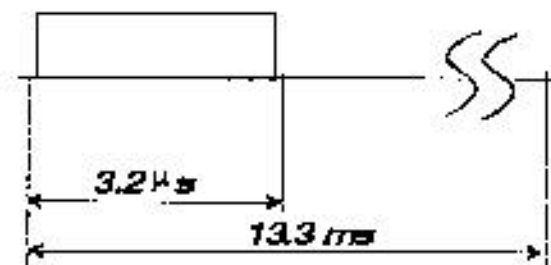
Form SPL



$$13.3 \text{ ms} / 2.2 \text{ ms} = 6$$

NOT enough!

After NuFact accumulator:

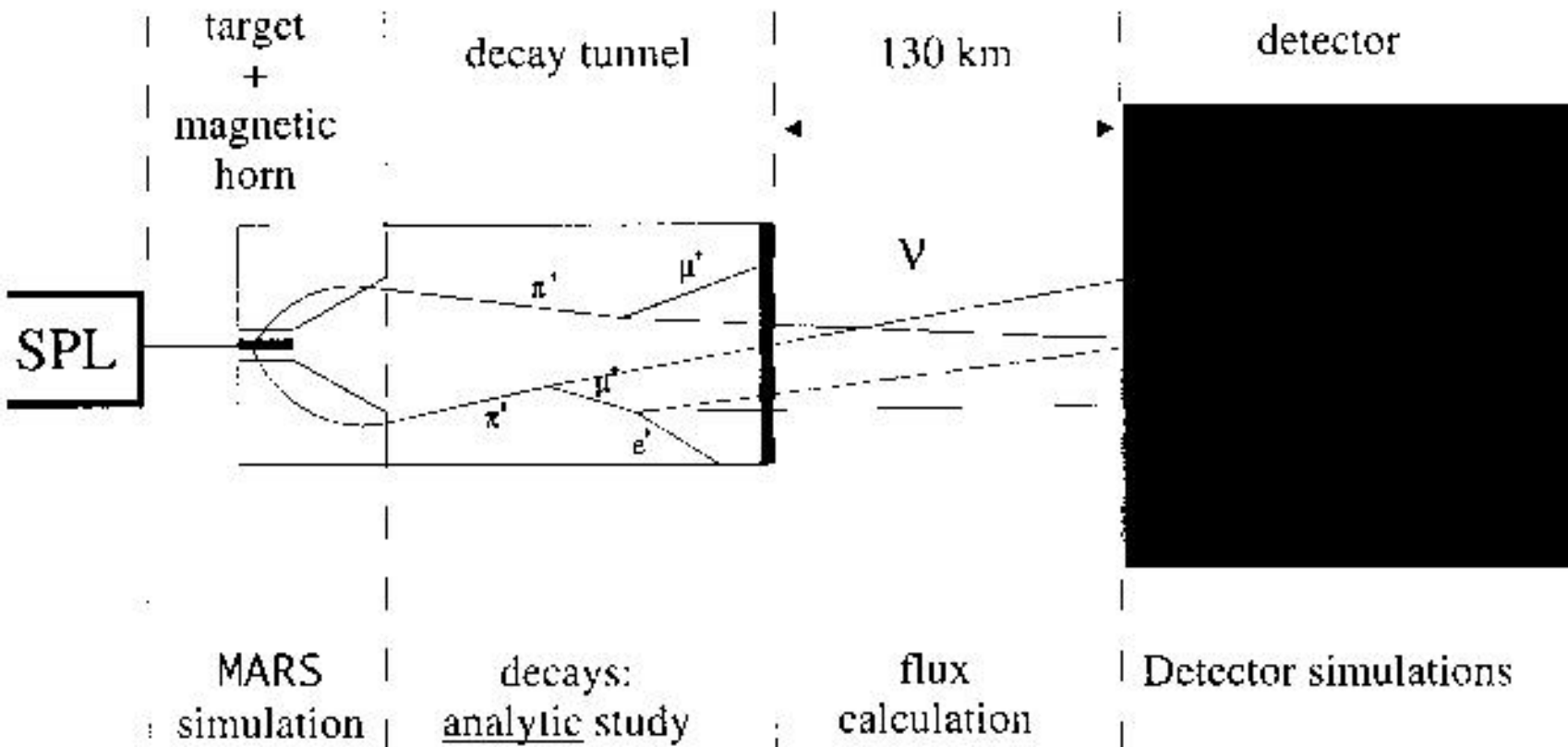


$$13.3 \text{ ms} / 3.2 \cdot 10^{-3} \text{ ms} = \sim 4000$$

x

BUNCH COMPRESSOR  $\rightarrow 1 \text{ ns} / 23 \text{ ns} = 23$

# Super beam analysis:

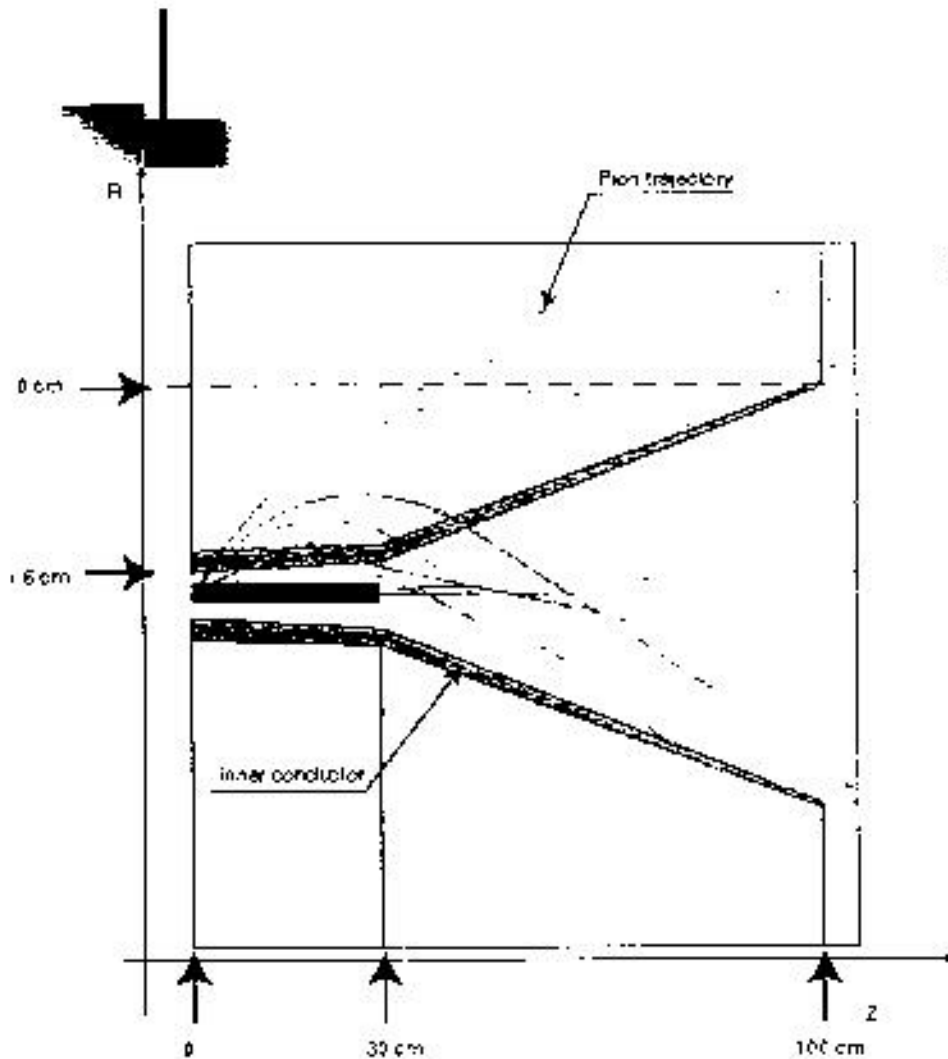


$\pi^+ \rightarrow \mu^+ \nu_\mu$  signal

$\rightarrow e^+ \nu_e \bar{\nu}_\mu$  background

H<sup>-</sup> linac 2 GeV, 4 MW

Accumulator  
ring + bunch  
compressor



Magnetic  
horn capture

Target

- 4 MW proton beam at 2.2 GeV  
 $\approx 10^{16}$  p.o.t./sec  
Rep. Rate = 75 Hz
- Hg liquid target
- Focusing system: Horn

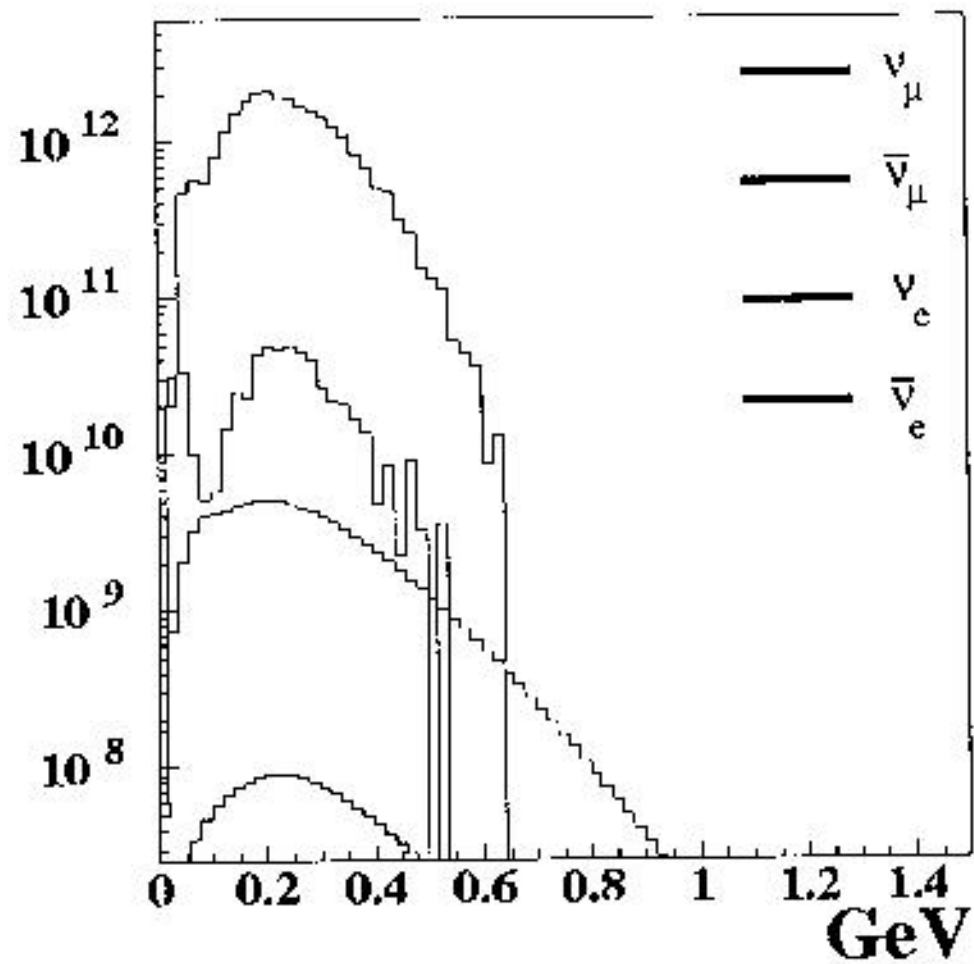
$^4\text{He}$  ?

Juan José Gómez Cadenas  
Neutrino Telescopes, Venice,  
March, 2001

3/5/2001

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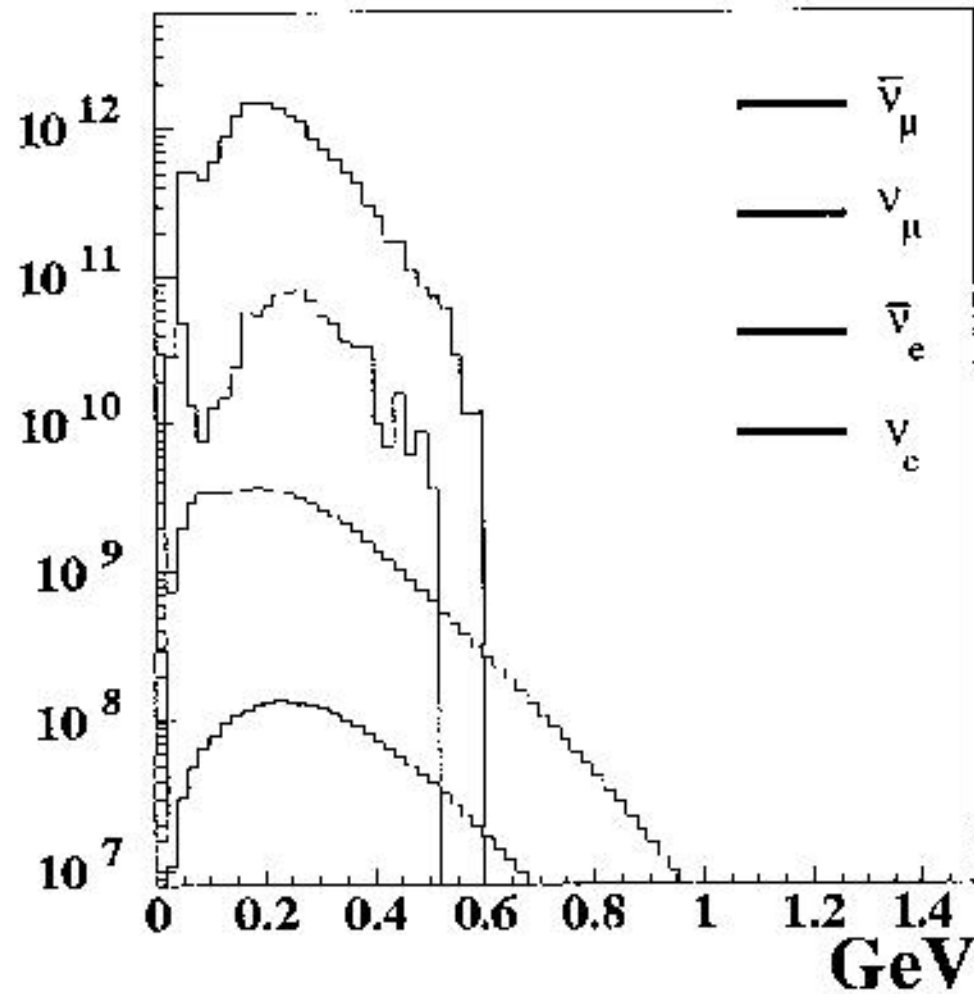
"Best" decay tunnel configuration:



Focusing  $\pi^+$

Length 20 m  
Radius 1 m

"Best" decay tunnel configuration:



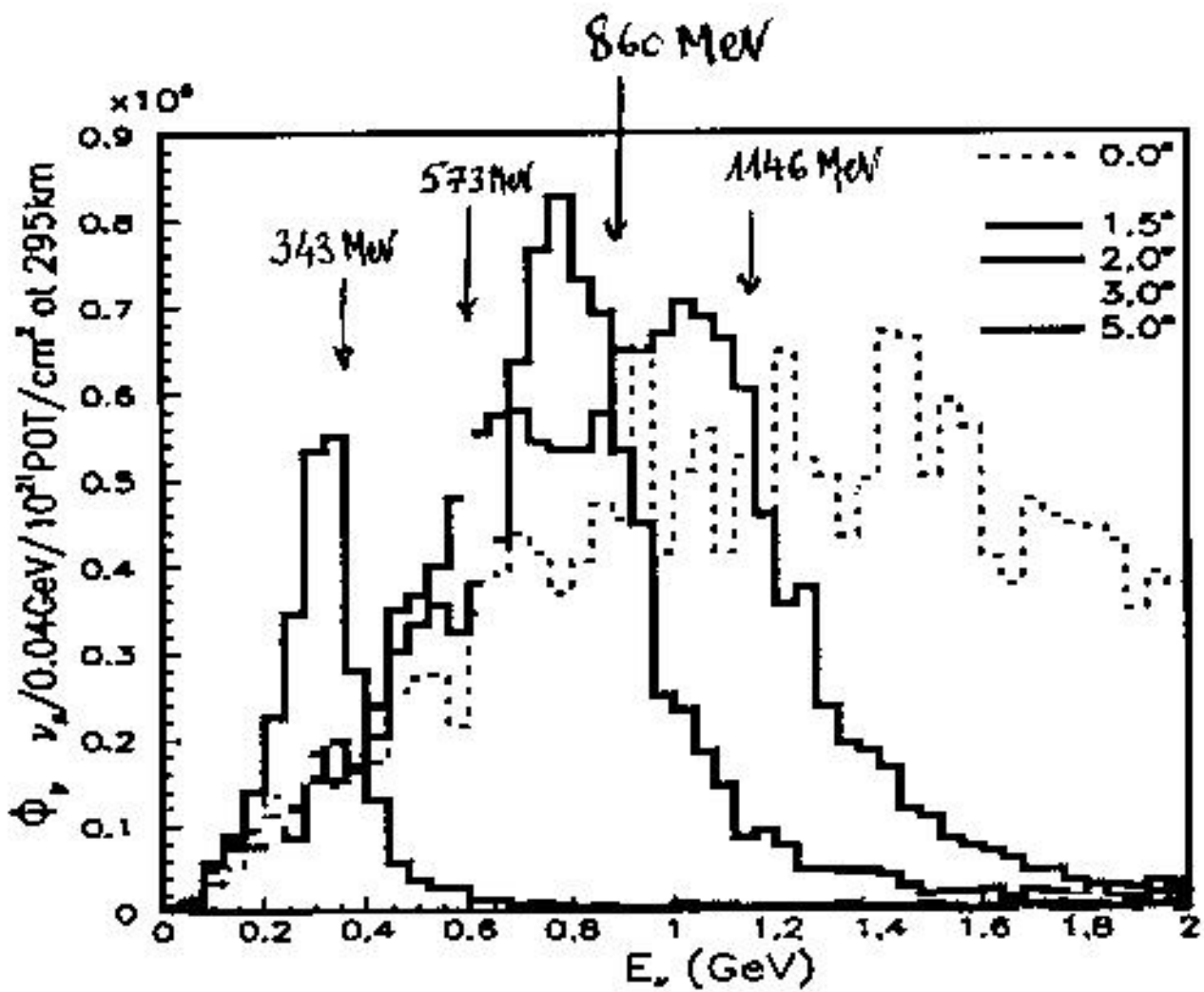
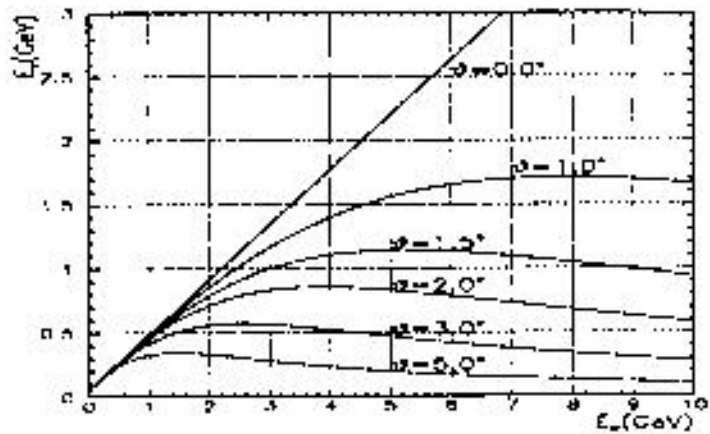
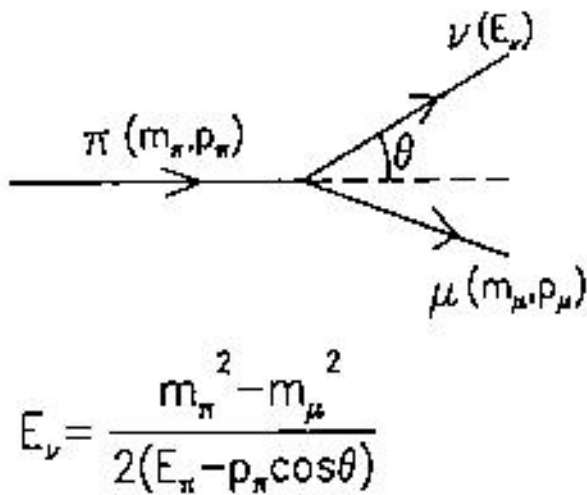
Focusing  $\pi^-$

Length 20 m  
Radius 1 m

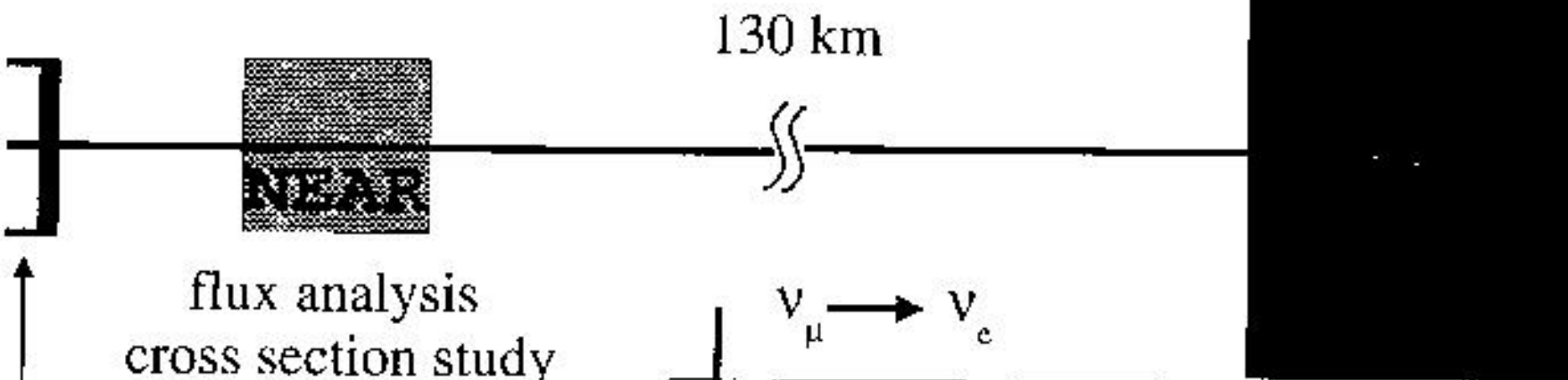


# Off axis neutrino beam

BNL-E889 proposal, April 1995



# Detectors



flux analysis  
cross section study

decay tunnel

LMA:

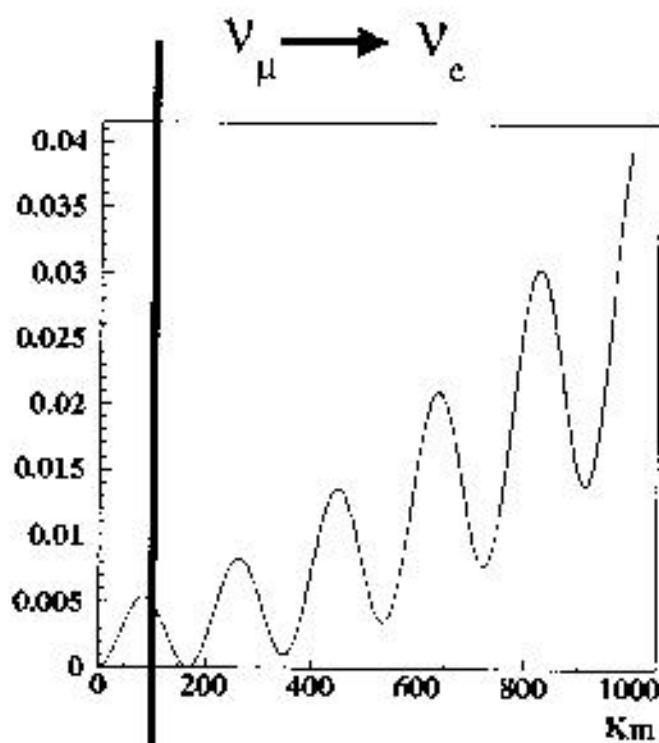
$$\sin^2(2\theta_{12}) = 0.8$$

$$\sin^2(2\theta_{23}) = 1$$

$$\sin^2(2\theta_{13}) = 0.01$$

$$\delta m_{12}^2 = 5 \cdot 10^{-5} eV^2$$

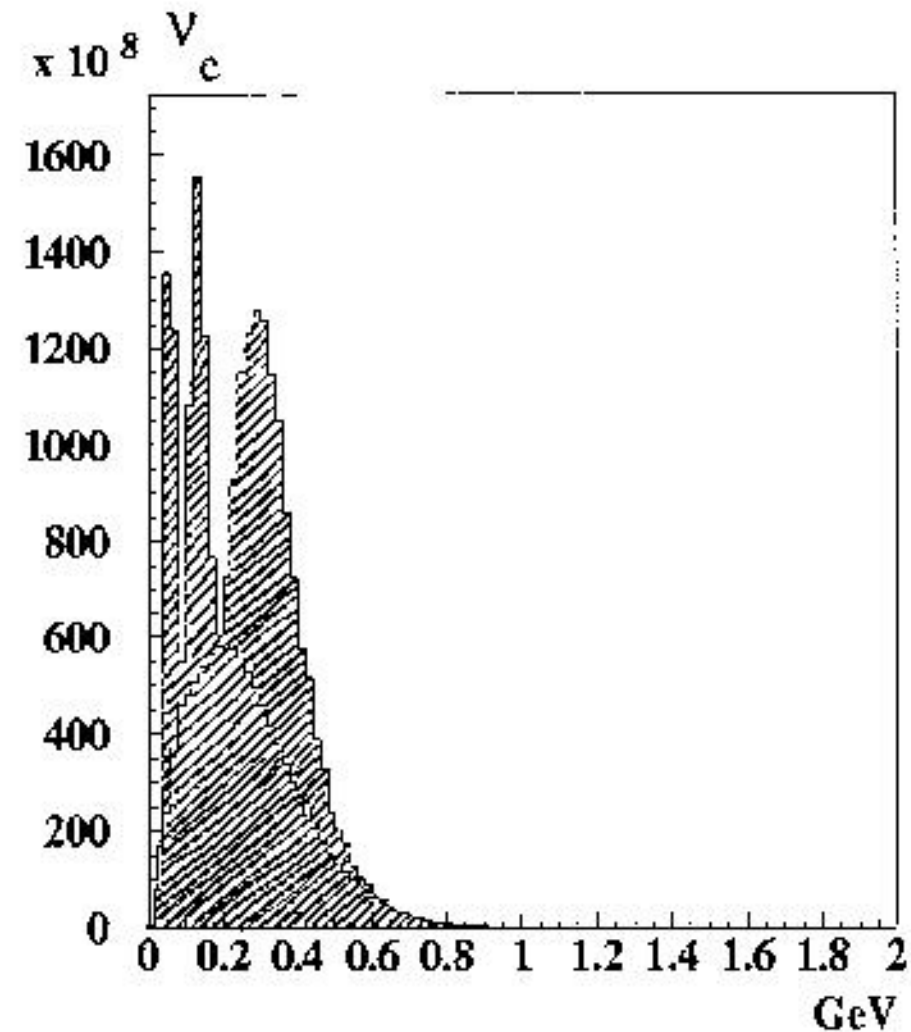
$$\delta m_{23}^2 = 3.2 \cdot 10^3 eV^2$$



oscillations  
study

(250 MeV)

# Signal / background



—  $\nu_e$  total

—  $\nu_e$  contamination

LMA:

$$\sin^2(2\theta_{12}) = 0.8$$

$$\sin^2(2\theta_{23}) = 1$$

$$\sin^2(2\theta_{13}) = 0.01$$

$$\delta m_{12}^2 = 5 \cdot 10^{-5} eV^2$$

$$\delta m_{23}^2 = 3.2 \cdot 10^{-3} eV^2$$

(  $L = 130$  km)

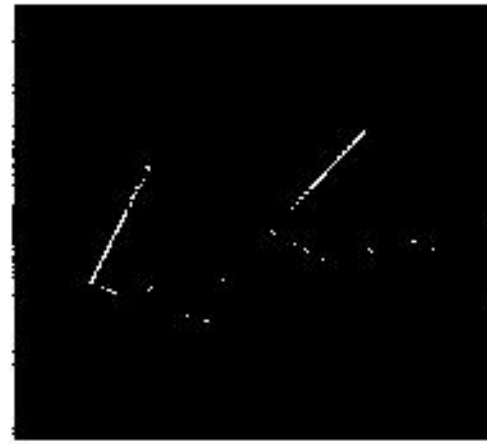
face  
100

IP linac 2 GeV, 4 MW Accumulator ring

Magnetic horn capture  
Target

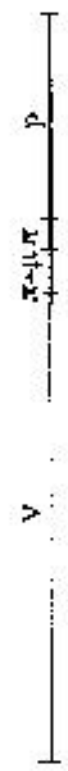
20 m  
Decay Tunnel

Near Detector

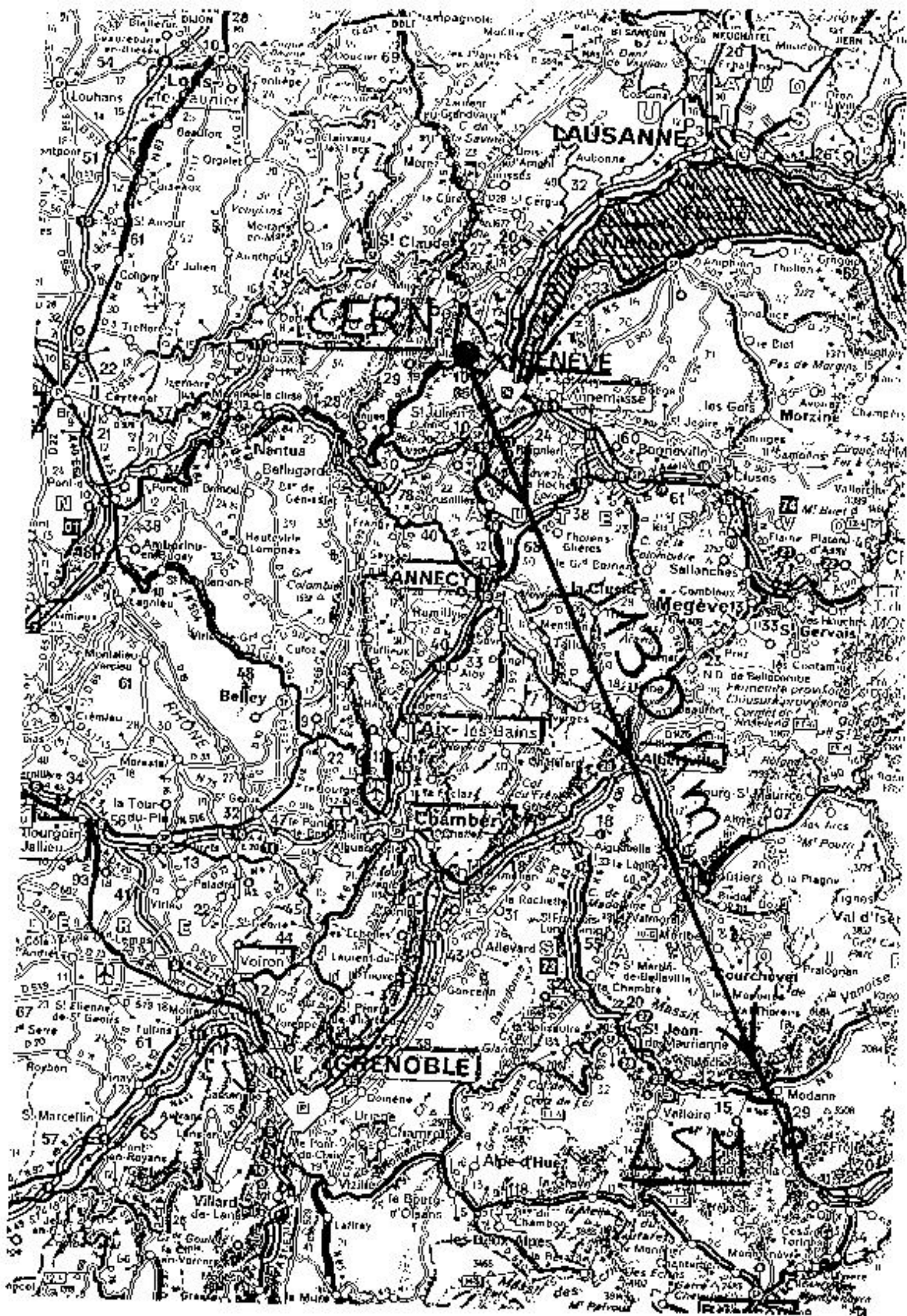


Far Detector

130 km



Possible Low Energy Super Beam Layout



Intensité des Muons ( $m^{-2} \cdot year^{-1}$ )

