V. Palladino
NU-VE 26/7/0

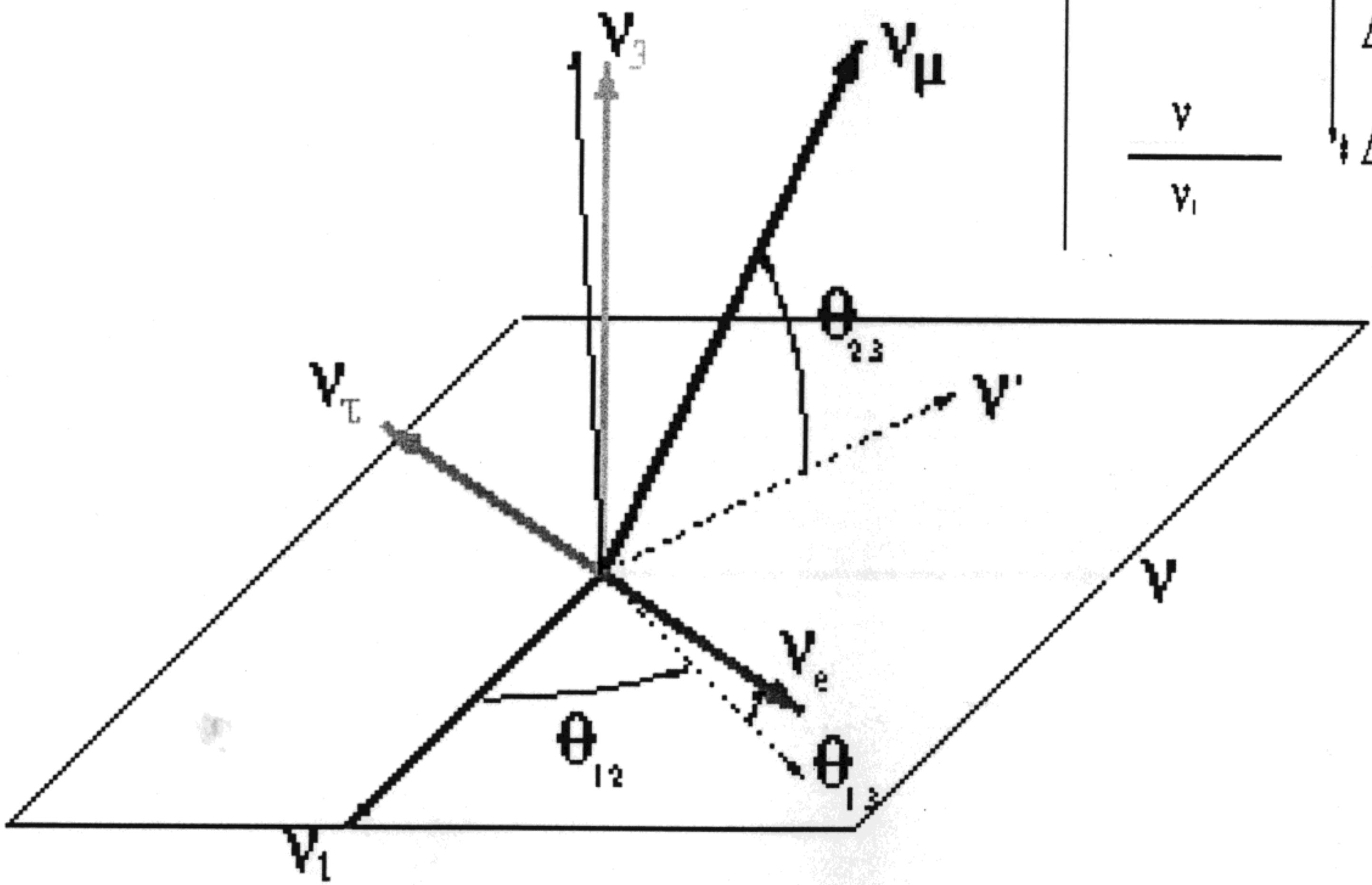
WHAT CHOICES for the ν-FUTURE

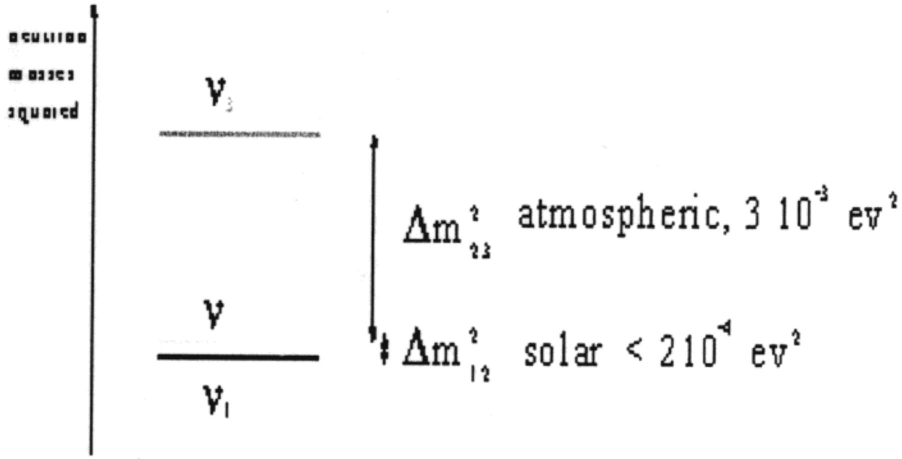
... ν sources ...
..... ν detectors ..

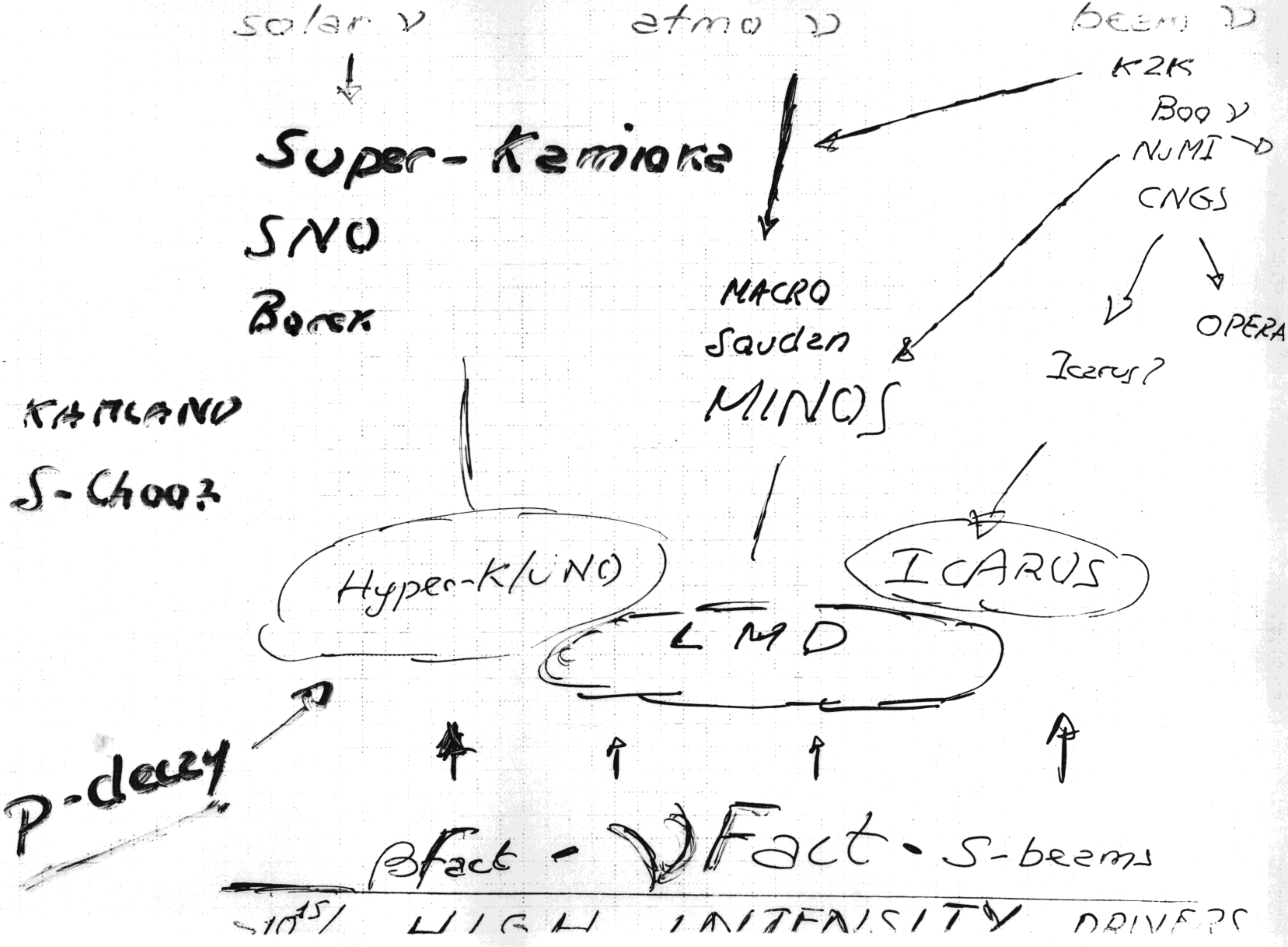
where to put

- energies
- money
- students
- ......

The neutrino mixing matrix







solar ν
atmo ν
beam ν
K2K
Boo ν
NuMI
CNGS
Super-Kamioka
SNO
Borex
MACRO
Soudan
MINOS
Icarus?
OPERA
KAMLAND
S-Chooz
Hyper-K/UNO
ICARUS
LMD
p-decay
βFact - νFact - S-beams
HIGH INTENSITY DRIVERS

A Neutrino Factory Complex

- Overview: what is a neutrino factory
- Neutrino oscillation experiments
- R&D status and plans
- Other Physics opportunities
  - Low energy muon physics
  - Radioactive beams
  - Kaon physics
  - Short baseline neutrino experiments
- Higgs colliders

- Conclusions

next Plenary 15-18/10, CERN

EU NuFact

EU-NO networks

ECFA μ Study Group

CERN, CH (A. Blondel), England, Italy, Spain, Greece...

WG's + R&D's projects

LBL ν
SBL ν
Slow μ
Kaons
Rad. Ions
- - - -
μ Colliders

Target R&D
HARP
Cooling Dem. Expt

νFact
S-beams
β-beam

high intensity ≈ 4 MW

NuFact
Lyon 99
Monterey 00
Tsukuba 01

- - - - - - - - - - -

Lab Coordination ... MOU's etc

NuFact 01

Tsukuba 24-30 May

- international collaboration (Sugawara, Sessler)

  target (BNL + CERN) → Cooling Exp. (EU + US + Japan)

- staging .... of successive hi intensity facilities

  $p \to \pi \to \nu$ ($\vec{B}$) } p driver + target + collect

  $\to \mu$. slow

  cool + accelerate → baby νFact (few GeV), SBL, g-2, LBL?

  ....

  mature νFact, VLBL (+ $\vec{B}$!)

- S-beam potential

  ... mid way between present & νFact

- JHF approved! → S-beam (≲1 MW, ≳4 MW)

  → PRISM I, PRISM II, νFact I, νFact II

  ..... Comm. II 14 giugno!!

νFact 02, London 1-6 July 2002

Physics Reach

$$V_{CKM} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & C_{23} & S_{23} \\ 0 & -S_{23} & C_{23} \end{pmatrix} \begin{pmatrix} C_{13} & 0 & S_{13} \\ 0 & 1 & 0 \\ -S_{13} & 0 & C_{13} \end{pmatrix} \begin{pmatrix} C_{12} & S_{12}e^{i\delta} & 0 \\ -S_{12}e^{-i\delta} & C_{12} & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Atmo,CNGS (→ C_{23}, S_{23}) **νFactory** (→ S_{23}, 0, $e^{-i\delta}$) **solar** (→ C_{12})

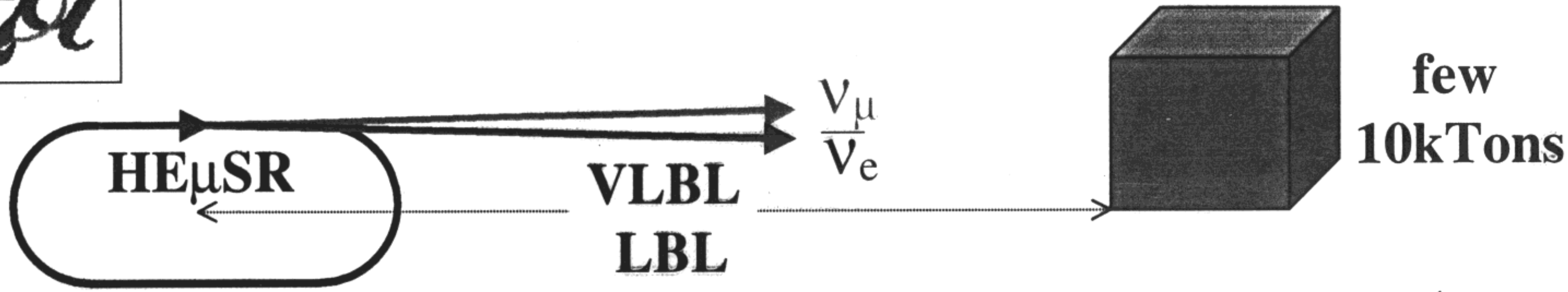
1. $sin^2\theta_{13}$ via $P(\nu_e \rightarrow \nu_\mu) = sin^2 2\theta_{13}\, sin^2\theta_{23}\, sin^2\left(\frac{\Delta m^2_{23} L}{4E_\nu}\right)$ wrong sign μ ! down to ~10^{-4}

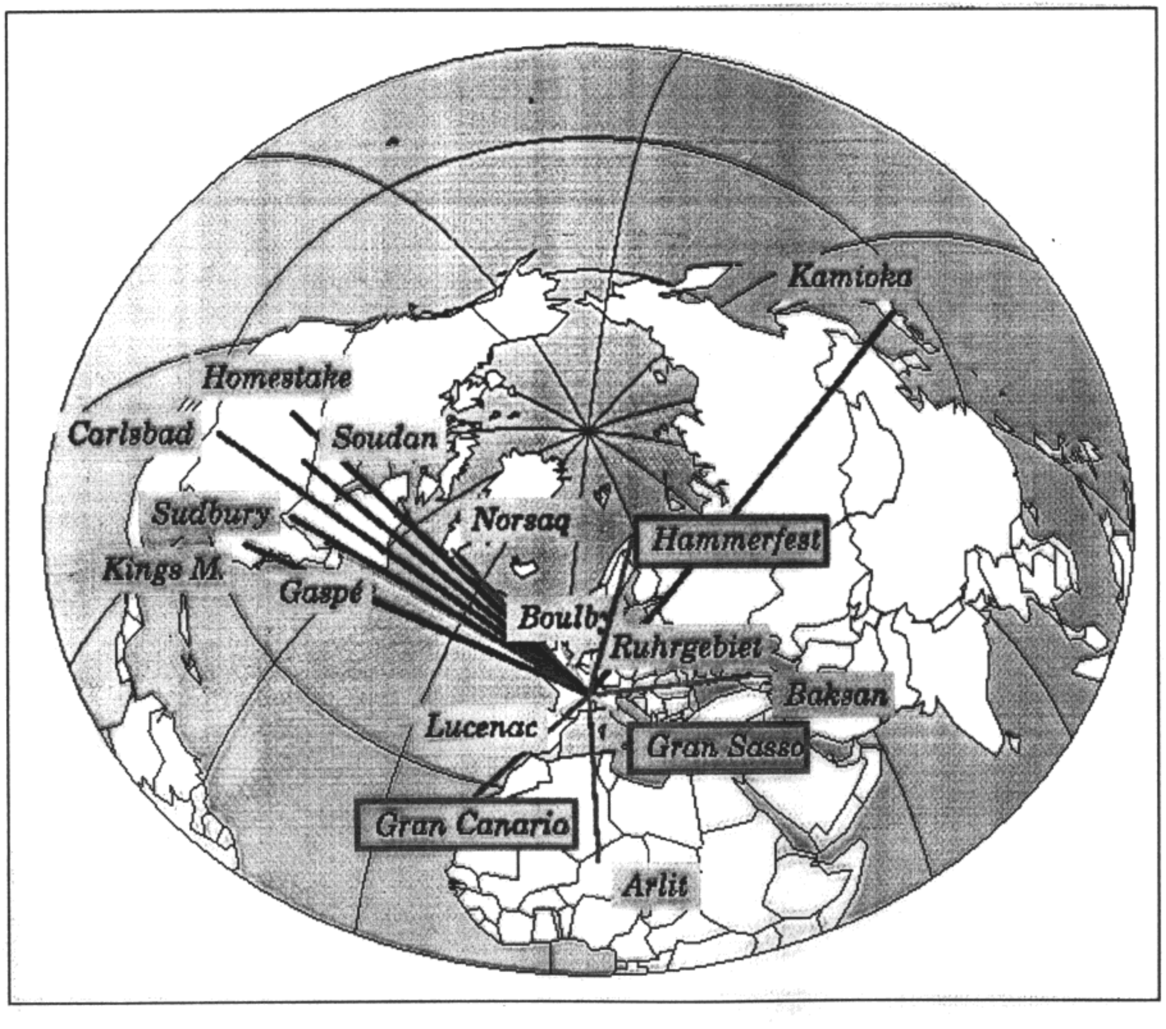
2. **matter effects :** $\left\{\begin{matrix}\text{enhanced } \nu \text{ oscillation} \\ \text{depressed } \bar{\nu} \text{ oscillation} \\ \text{or viceversa}\end{matrix}\right\}$ at large distance (few MKm)

3. **sign** $\left\{\Delta m^2_{23}\right\}$ through $tg^2 2\theta_{13}^{\text{matter}} = \frac{sin\,\theta_{13}}{cos\,2\theta_{13} - \frac{A^{\text{matter}}}{\Delta m_{23}}}$

4. $A_{CP} = \frac{P(\nu_i \rightarrow \nu_j) - P(\bar{\nu}_i \rightarrow \bar{\nu}_j)}{P(\nu_i \rightarrow \nu_j) + P(\bar{\nu}_i \rightarrow \bar{\nu}_j)} = sin\,2\theta_{12}\, \frac{\Delta m^2_{21} L}{2E_\nu}\, sin\delta$ NB. need solar LMA !

...experimentation with intense beams of ν_μ and ν_e's





CERN to Gran Sasso
(LBL)
+
far site
(VLBL: ~3000 Km)

Physics Reach

$$V_{CKM} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & C_{23} & S_{23} \\ 0 & -S_{23} & C_{23} \end{pmatrix} \begin{pmatrix} C_{13} & 0 & S_{13} \\ 0 & 1 & 0 \\ -S_{13} & 0 & C_{13} \end{pmatrix} \begin{pmatrix} C_{12} & S_{12}e^{i\delta} & 0 \\ -S_{12}e^{-i\delta} & C_{12} & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Atmo,CNGS   νFactory   solar

1 $sin^2\theta_{13}$ via $P(\nu_e \to \nu_\mu) = sin^2 2\theta_{13}\, sin^2\theta_{23}\, sin^2\left(\frac{\Delta m^2_{23} L}{4E_\nu}\right)$ wrong sign μ ! down to $\sim 10^{-4}$

2 **matter effects :** { enhanced ν oscillation / depressed $\bar{\nu}$ oscillation / or viceversa } at large distance (few MKm)

3 **sign** $\{\Delta m^2_{23}\}$ through $tg^2 2\theta_{13}^{matter} = \dfrac{sin\,\theta_{13}}{cos\,2\theta_{13} - \dfrac{A^{matter}}{\Delta m_{23}}}$

4 $A_{\not{CP}} = \dfrac{P(\nu_i \to \nu_j) - P(\bar{\nu}_i \to \bar{\nu}_j)}{P(\nu_i \to \nu_j) + P(\bar{\nu}_i \to \bar{\nu}_j)} = sin\,2\theta_{12}\,\dfrac{\Delta m^2_{21} L}{2E_\nu}\, sin\delta$ NB. need solar LMA !

Most sensitive transitions:

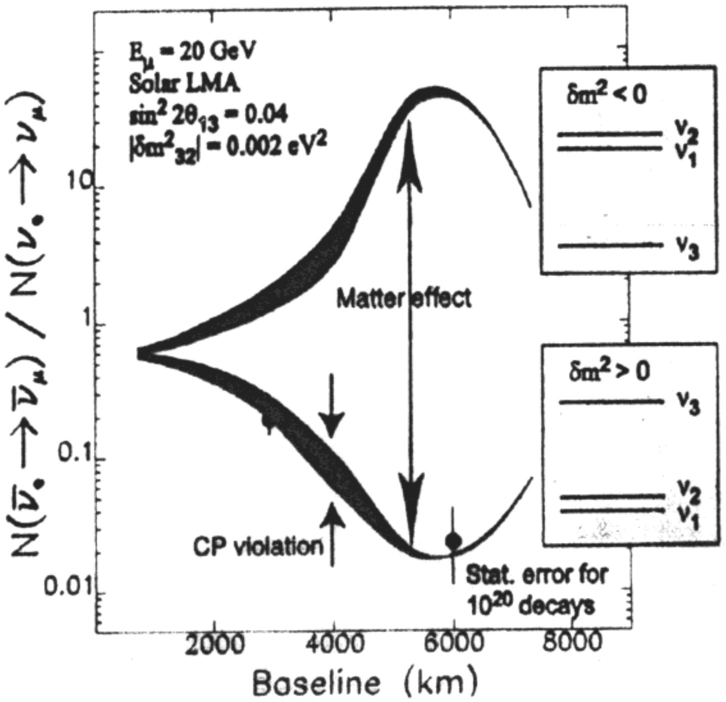
$$\overset{(-)}{\nu}_e \leftrightarrow \overset{(-)}{\nu}_{\mu,\tau}$$

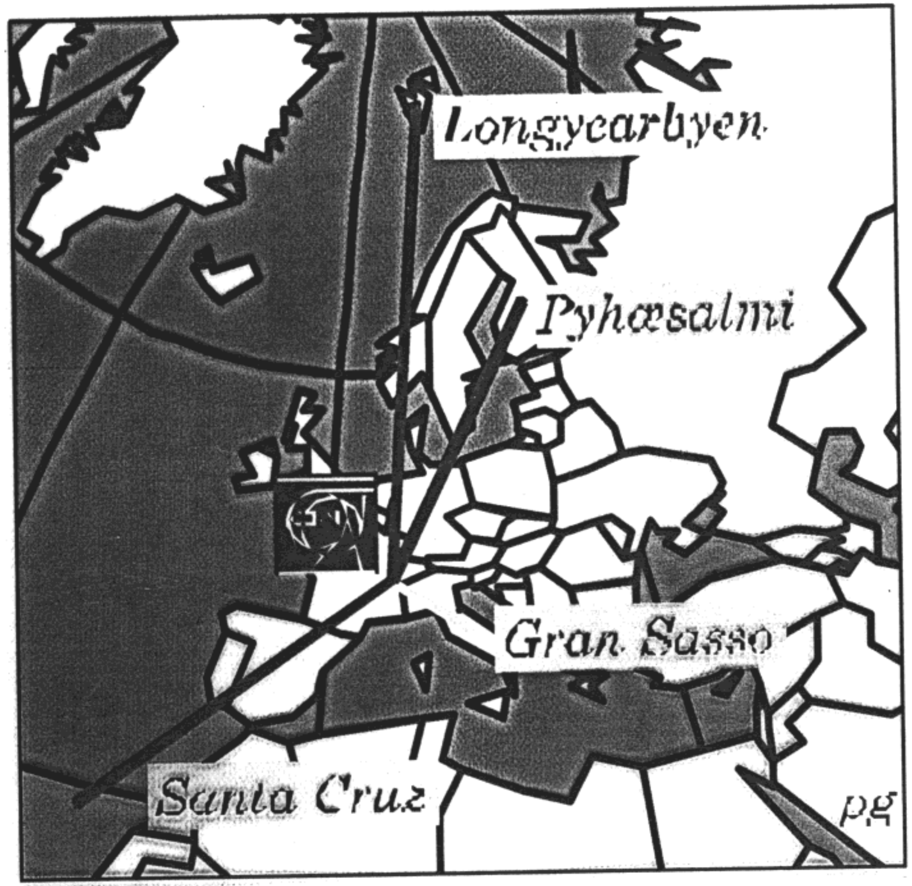
$\overset{(-)}{\nu}_e \rightarrow \overset{(-)}{\nu}_\mu$ is the golden measurement at Nufact: appearance of wrong-sign muons

$$\begin{array}{llll} \mu^- \rightarrow \nu_\mu & \bar{\nu}_e & e^- & \\ & \downarrow & & \\ & \bar{\nu}_\mu & \rightarrow \mu^+ & \\ \mu^+ \rightarrow \bar{\nu}_\mu & \nu_e & e^+ & \\ & \downarrow & & \\ & \nu_\mu & \rightarrow \mu^- & \end{array}$$

Search for long-baseline detector laboratories

Best long baseline is around 3000km for CP violation + matter effects.





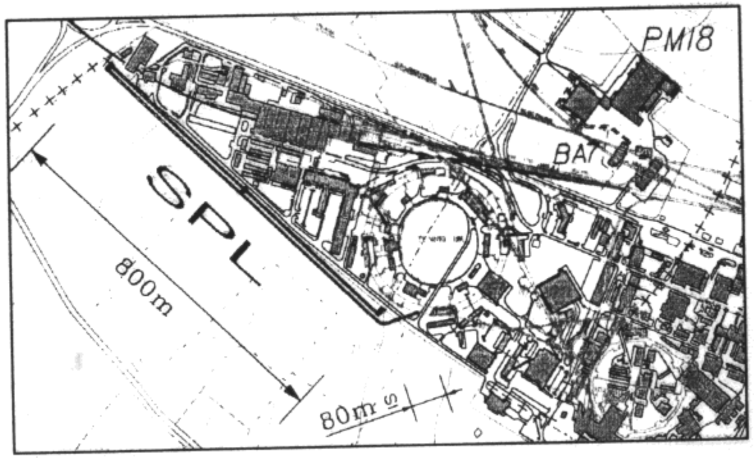
Detector must be underground
=> search for possible sites (H. Wenninger et al)
Gran Canaria (Spain); Spitzbergen (Svalbard,Norway);
Center for underground physics Pihäsalmi(Finland)

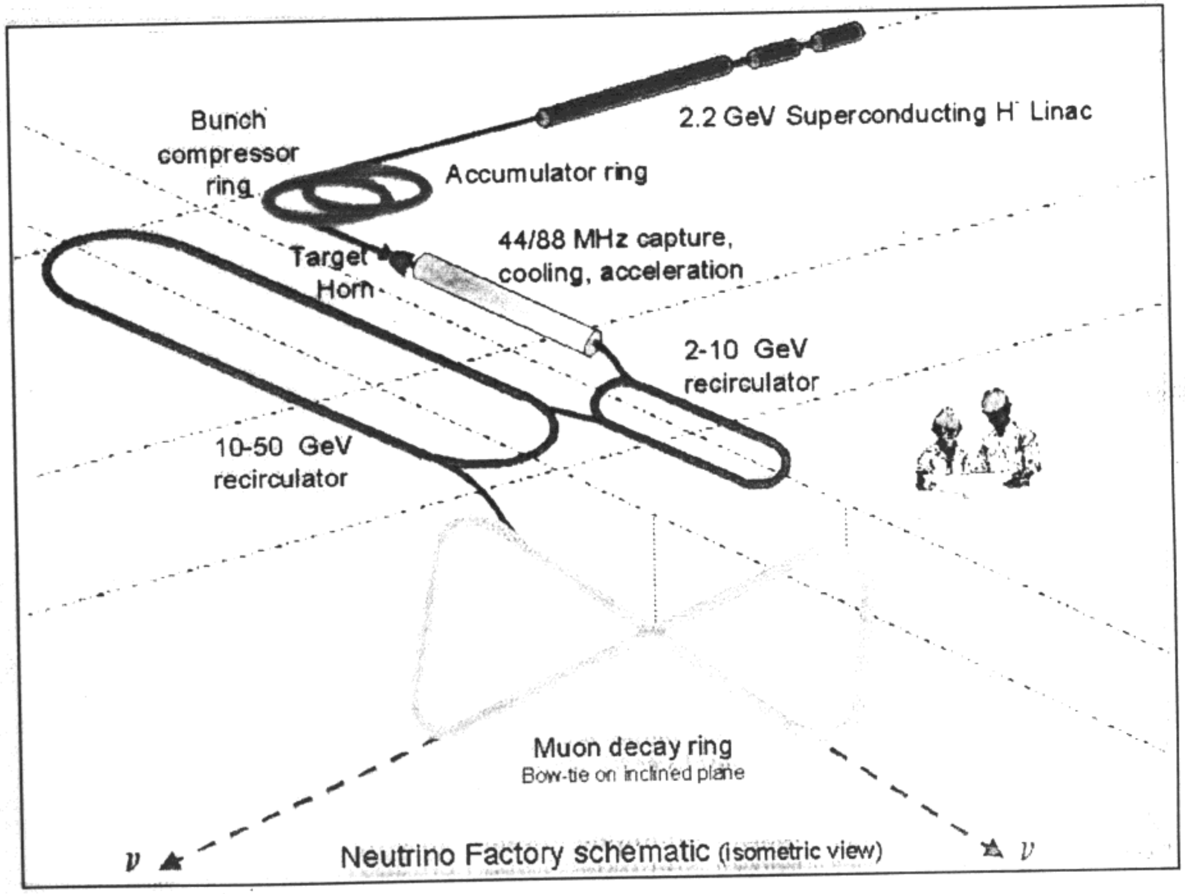
P. Gruber

Superior flux at ν Fact thanks to:

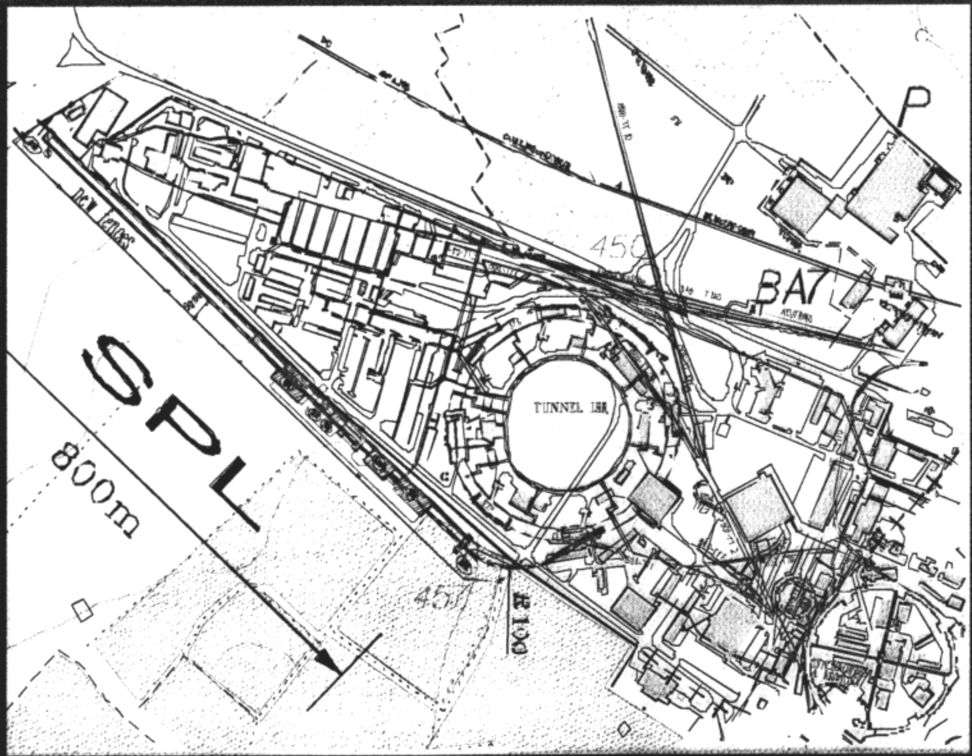
1. unprecedented proton intensities (SPL)
2. selective acceleration of ν parent

$\Phi_\nu \sim \gamma^2_{parent}$ $\qquad$ $N_\nu^{inter} \sim \gamma^3_{parent}$





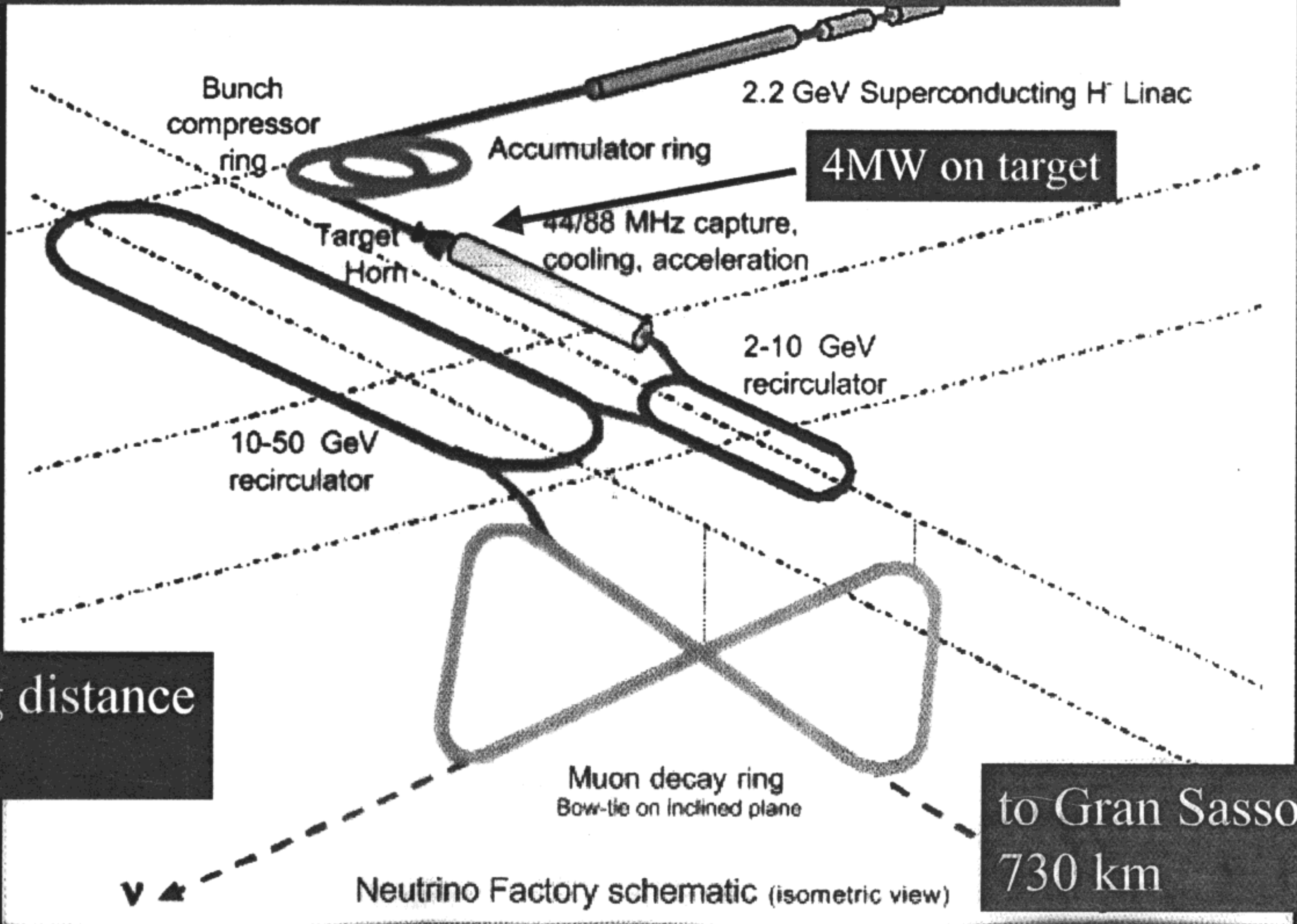
Layout on the CERN site



Linac + klystron gallery parallel to the fence of Meyrin site (Route Gregory)

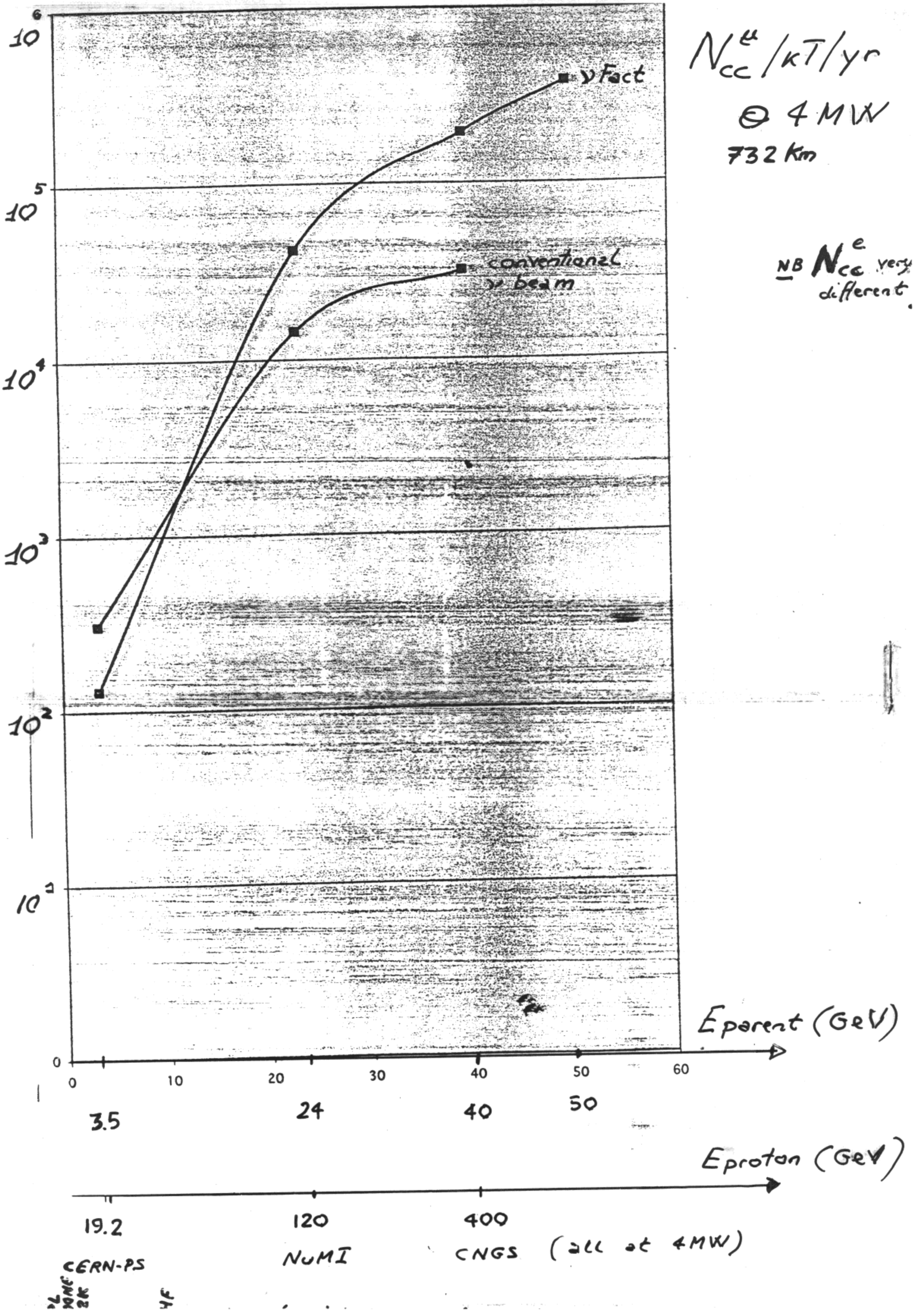
- Economic trench excavation
- Geological advantages (tunnel on"molasse", no underground water)
- Minimum impact on the environment (empty field)
- Simple connection to PS & ISR via existing tunnels
- Use some of the old ISR infrastructure (electricity, cooling)

Isometric schematic of the CERN reference scenario for a Neutrino Factory(CERN, NF Note 28, 16th August 2000)



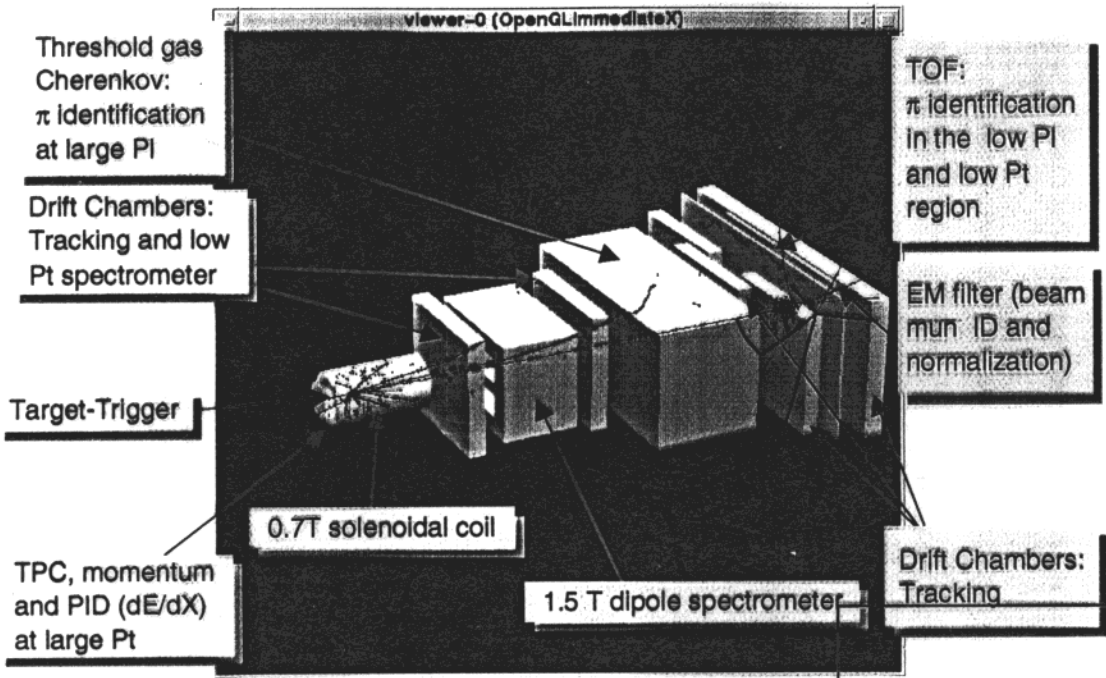
to very long distance Laboratory

to Gran Sasso, 730 km



N_{cc}^{μ} /kT/yr
@ 4 MW
732 Km
NB N_{cc}^{e} very different
ν Fact
conventional ν beam
10^6
10^5
10^4
10^3
10^2
Eparent (GeV)
0 10 20 30 40 50 60
3.5 24 40 50
Eproton (GeV)
19.2 120 400
CERN-PS NuMI CNGS (all at 4MW)

The Harp detector: Large *Acceptance*, *PID Capabilities*, *Redundancy*



νFact R&D

COOTEF

μ cooling test facility

Proposal in 2001 (?)

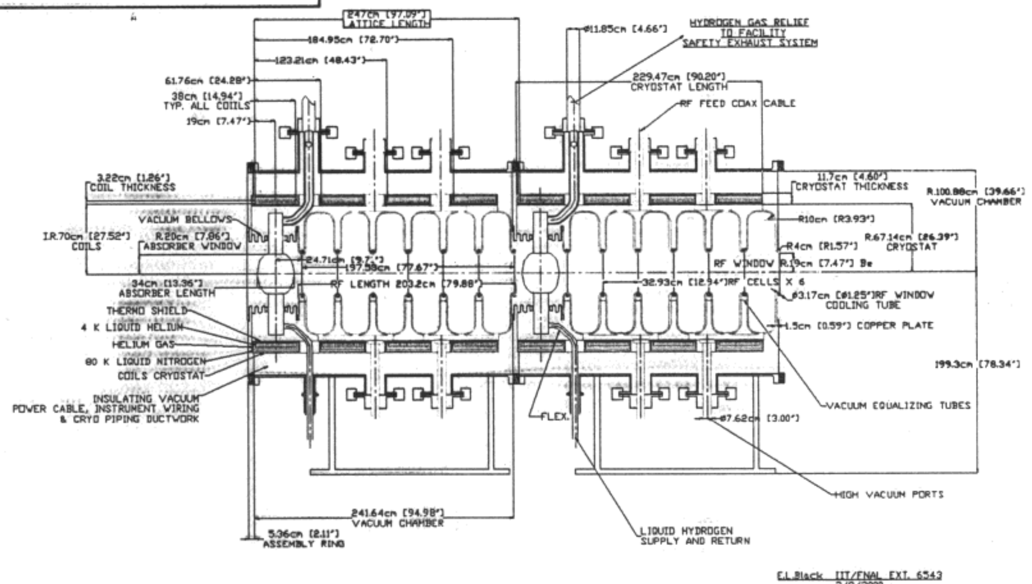
HARP

π production measurements

Running

νFact (also HARP II)

Atmo (also HARP II and III)



V.B. CHANNEL LATTICE LAYOUT

Many studies have become more concrete

- **Proton driver: SPL, high power Superconducting H- Linac**
  Conceptual Design Report ready + Cost estimate 350.- MCHF

- **HARP and MUSCAT: both had engineering runs and getting ready to take data in 2001. Future projects delineated.**

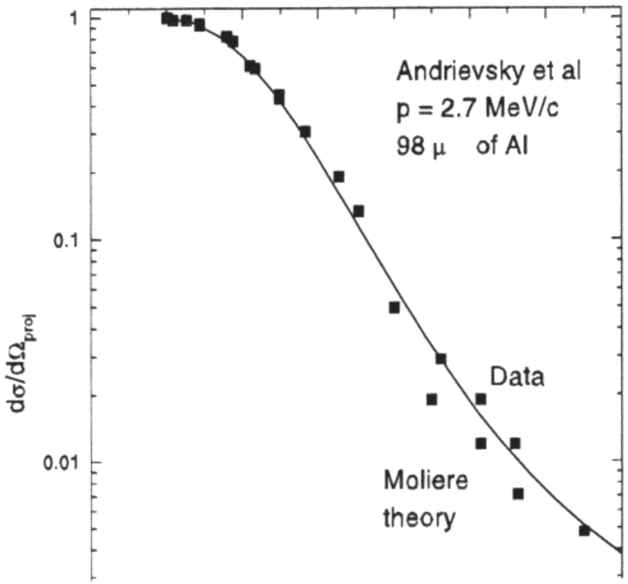
- **RF tests in high radiation** http://www.lbl.gov/Conferences/nufact00/docs/WG5_0525_Lombardi_sl.pdf
  200 MHz cavity, up to 47 MV/m, near target $1.5 10^{13}$ 26 GeV p.o.t.
  no breakdowns, some frequency shifts with ~10s time constant

- **Target tests:**
  liquid target tests at CERN (being designed for ISOLDE beams -- or BNL)
  solid target material tests with 100kW electron beams at RAL; proposal

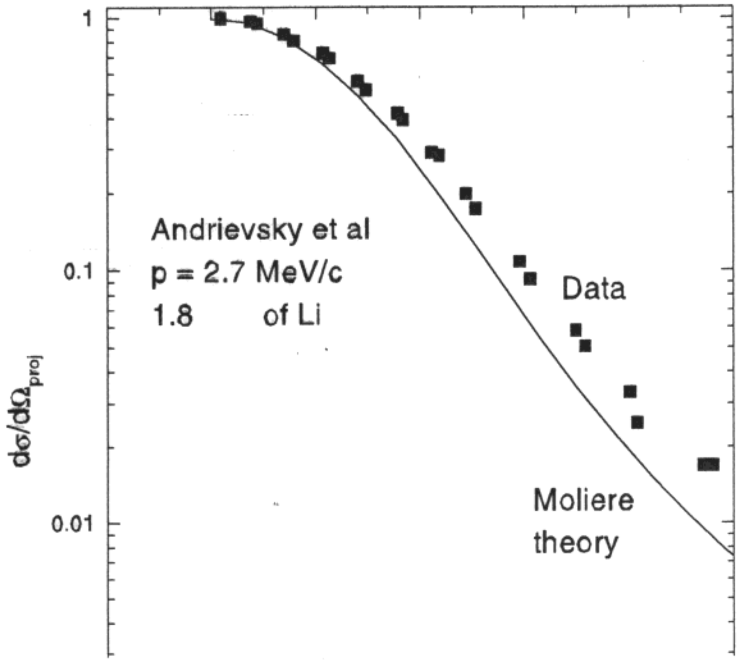
- **Search teams for muon test beams and long baseline sites set-up**

- **R&D on High intensity proton source and Neutrino Factory**
  included in 4-year plan of CERN;
  N.F. supported at RAL and Frascati;
  HI machine in many European labs (M.A.F.@CEA+ ESS)

MUSCAT a muon scattering experiment



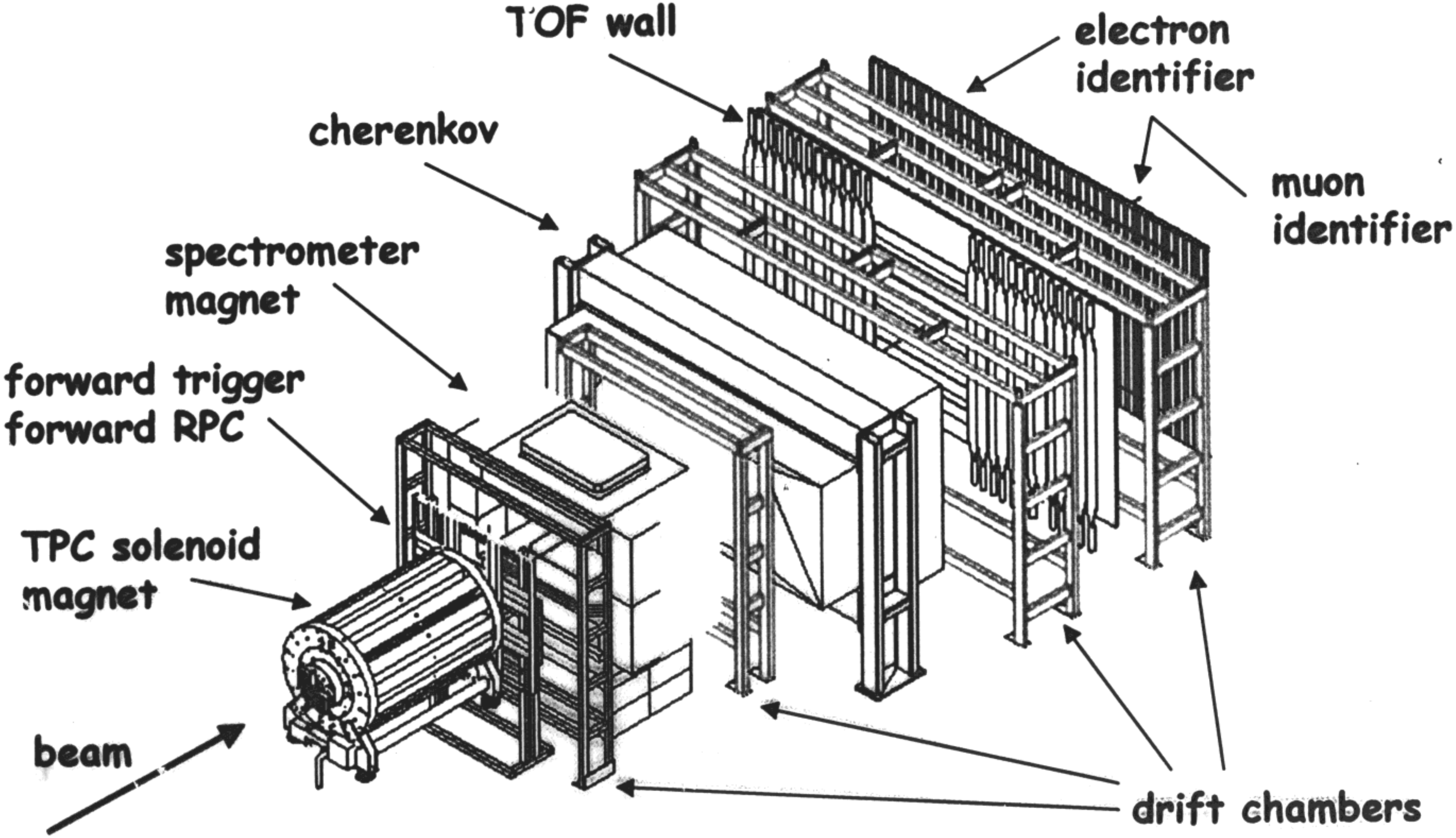
aluminum



lithium

Agreement gets worse for light Z, no data for Hydrogen => measure!

Experimental setup



HARP will measure......

Hadronic production cross sections ($d\sigma/dP_t.dP_l$)
at various energies and with various targets

Z = 1 → 70 !

Goal: **2% accuracy over all phase space**
O(10^6) events/setting, low systematic error

!!

CERN PS, T9 beam, 2 GeV/c - 15 GeV/c

"Stage 0"
Technical run with partial set-up, 25 September - 25 October 2000

Stage 1
Measurements with solid and crygenic targets, 2001

Future plans:
- **Measurements with incoming Deuterium and Helium, 2002**
- **~100 GeV incoming beam, using NA49 set-up**

Deliverables

Input data

for the design of the Neutrino factory/Muon collider

Input data

for the Atmospheric neutrino flux calculations

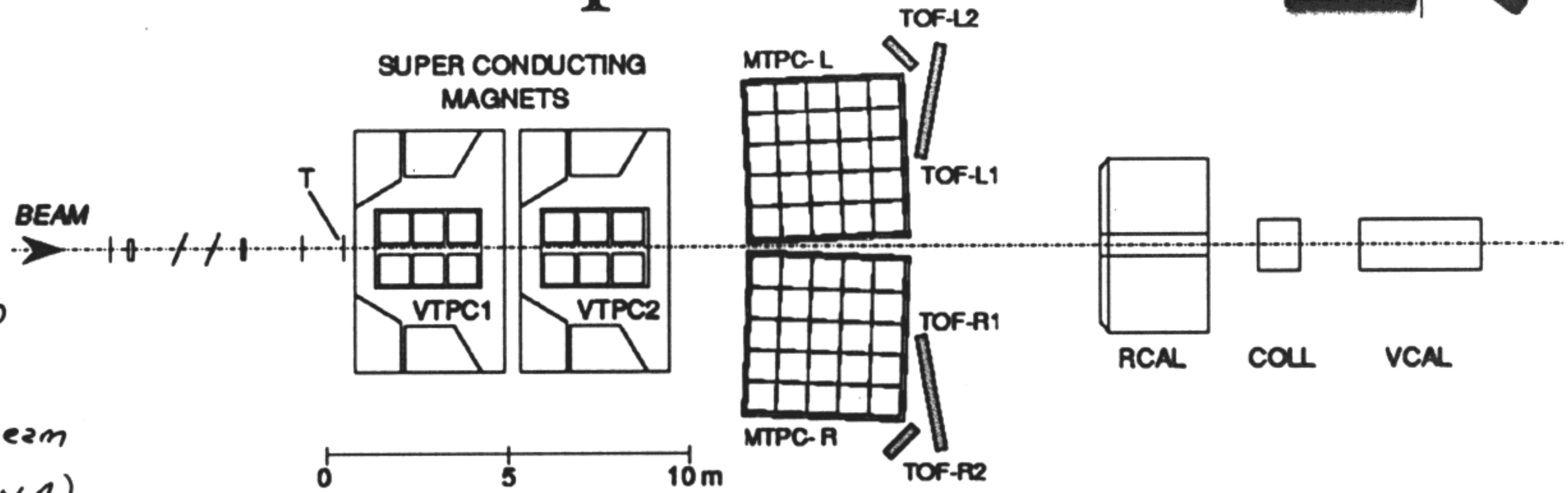
Precise predictions

of the neutrino fluxes for the K2K and MiniBooNE experiments

Input data

for the hadron generators in Monte Carlo simulation packages working since years, fully debugged .... associated software

The NA49 experiment



40 - 350 GeV/c

p/n/k beam (H2 SPS NA)

- Four large TPCs.
  - Drift vertically up.
  - Pad readout follows trajectories.
  - Very large acceptance.
  - Superconducting magnets 1.5T field.
- TOF (4-12 GeV).
- Beam.
  - H2 beam line (secondaries).
  - CEDAR particle ID - in trigger.
- DAQ — 1 million triggers/week.
- Trigger — We will use min bias 'bulls-eye' trigger.

Ionisation COOLING

COOLING: baseline scenario defined; simulations in progress

[Fermilab study lost factor 4 from paper study to engineered realistic set-up (this was due to mismatches => iterations needed!)]

ionisation cooling of muons has never been done before

=> Cooling test experiment needed

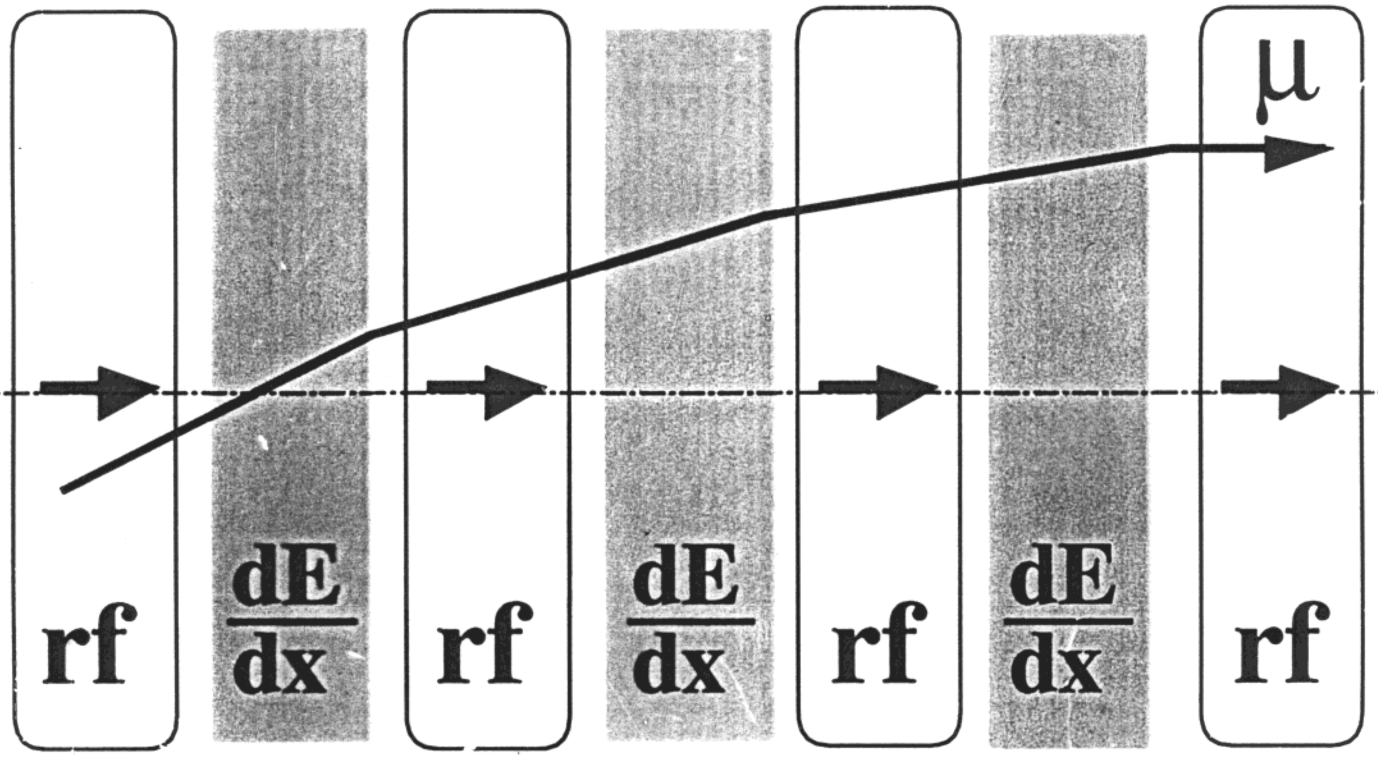
build- assemble- put into beam- operate a section of foreseen cooling channel
show that it performs (cools) as expected.

Need: **beam**
- **RF**
- **H2 absorbers**
- **Solenoids**
- **instrumentation**

Large project; will require collaboration
- **accelerators/experimenters**
- **across Europe**
- **international**

Discussions started to define project (next: CERN 23 January)
Intl workshops on instrumentation (next: London 23-24 February)
aim: written proposal in spring 2001; in beam in 2004/2005.

Ionization Cooling



$$\frac{d\varepsilon_n}{dx} = -\frac{1}{\beta^2}\frac{dE_\mu}{dx}\frac{\varepsilon_n}{E_\mu} + \frac{\beta_\perp \cdot C}{2\beta^3 E_\mu m_\mu X_0}$$

ε = emmittance

$\beta_\perp$ = focalisation au points de $\frac{dE}{dx}$

$1/f$

$\Rightarrow$ Luminosity $\propto B^2$ at last cooling stage!

June 01

DRAFT 2.1

Towards an International Muon Cooling Experimental Demonstration

Alain Blondel, Rob Edgecock, Steve Geer, Helmut Haseroth, Yoshi Kuno, Dan Kaplan, Michael Zisman

June 15th 2001

Motivation

Ionisation cooling of minimum ionising muons is an important ingredient in the performance of a neutrino factory. However, it has not been demonstrated experimentally. We seek to achieve an experimental demonstration of cooling in a muon beam. In order to achieve this goal, we propose to continue to explore, for the next six months or so, at least two versions of an experiment based on existing cooling channel designs. If such an experiment is feasible, we shall then select, on the basis of effectiveness, simplicity, availability of components and overall cost, a design for the proposed experiment.

On the basis of this conceptual design, we will then develop detailed engineering drawings, schedule and a cost estimate. The costs and responsibilities will be broken out by function (e.g. magnets, RF, absorbers, diagnostics etc) and also by laboratory and region. A technical proposal will be developed by Spring 2002, and will be used as the basis for detailed discussions with laboratory directors and funding agencies.

The aim of the proposed cooling experimental demonstration is

a) to show that we can design, engineer and build a section of cooling channel capable of giving the desired performance for a neutrino factory;
b) to place it in a beam and measure its performance, i.e. experimentally validate our ability to simulate precisely the passage of muons confined within a periodic lattice as they pass through liquid hydrogen absorbers and RF cavities.

The experience gained from this experimental demonstration will provide input to the final design of a real cooling channel.

The signatories to this document volunteer to organise this international effort. It is expected that the membership of this group, referred to in this document as the Muon Cooling Demonstration Experiment Steering Committee (MCDESC) will evolve with time. It is proposed that the Chair of this group should be Alain Blondel for the first year.

Organisation

1. The overall responsibility for the organisation and coordination of the activity shall be the responsibility of the MCDESC.

July 01

Draft 0.0
July 2001
A.B.

An International Muon Ionization Cooling Experiment

Goals and preliminary design

A neutrino factory based on a muon storage ring is the ultimate tool for studies of neutrino oscillations, including possibly leptonic CP violation. It is also the first step towards $\mu^+\mu^-$ colliders. The performance of this new and promising line of accelerators relies heavily on the concept of ionisation cooling of minimum ionising muons, for which much R&D is required. The concept of a muon ionisation cooling experiment has been extensively studied [1] and first steps are now being taken towards its realisation at an international level. This note summarises the present status of this process, presents a preliminary scenario, and aims to serve as a basis for the discussions leading to a real proposal.

1. Aims of a cooling experiment

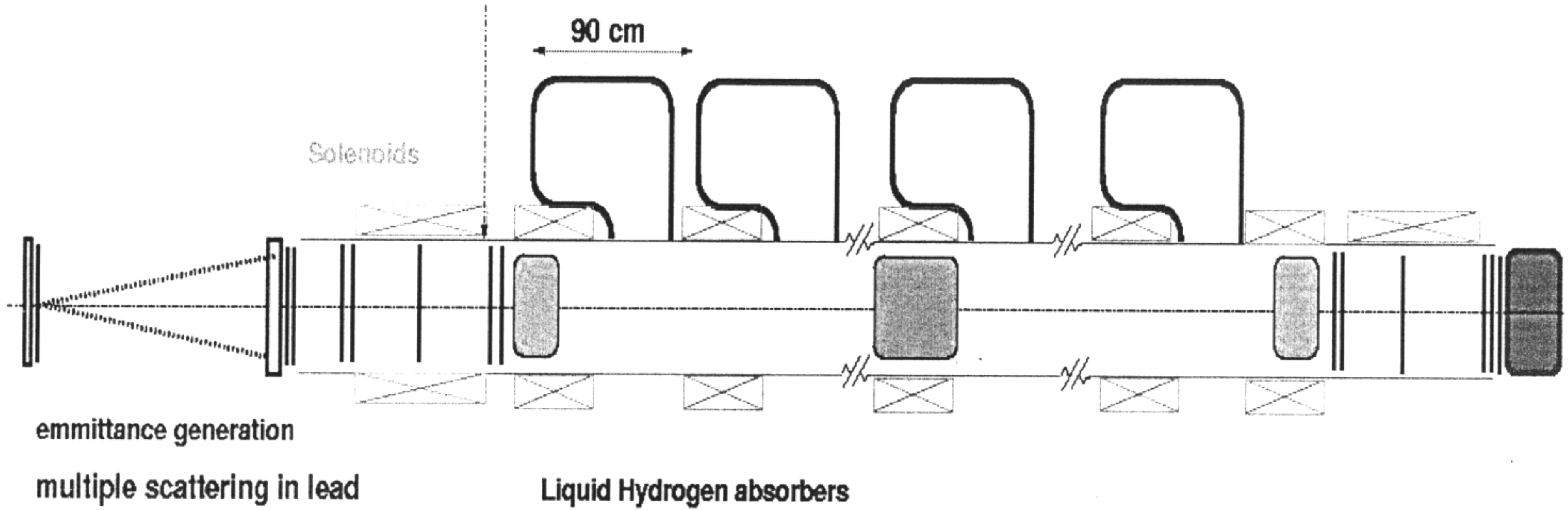
The neutrino factory [2] is a completely new type of accelerator and offers many new challenges. Probably the largest novelty from the point of view of accelerator physics is ionisation cooling. Altholugh the concept was proposed thirty years ago and is generally considered very sound, ionisation cooling of muons at minimum ionising energy has never been realized in practice. In its present concept, it constitutes an important ingredient of the performance and cost of a neutrino factory. This motivates the proposal of a muon cooling experiment. The demonstration that one is capable of designing, building and instrumenting a section of the cooling channel of a neutrino factory, and to verify its performance in a muon beam, is an important milestone before the accelerator can be proposed.

The aim of the proposed cooling experimental demonstration is

a) to show that one can design, engineer and build a section of cooling channel capable of giving the desired performance for a neutrino factory;
b) to place it in a beam and measure its performance, i.e. experimentally validate our ability to simulate precisely the passage of muons confined within a periodic lattice as they pass through liquid hydrogen absorbers and RF cavities.

The experience gained from this experimental demonstration will provide input to the final design of a real cooling channel. This approach comes in addition to the basic R&D one the individual components, which is already underway within the MUCOOL collaboration and at CERN. A section of a cooling channel assembles liquid hydrogen absorbers providing energy loss, combined with high gradient RF cavities to re-accelerate the particles, the ensemble being tightly contained in a magnetic bottle. Many new practical or perhaps fundamental problems are bound to present themselves in such a combined system, which would not necessarily show up in a component-by-component approach, but could be lethal. The process of accumulating this irreplaceable experience will be long and should begin without delay. The point is not to demonstrate that the principle of cooling works, which is expected if all components work, but that one can learn how to build and operate a device that performs as desired as proven by measuring its performance in a real beam. The beam never lies.

Generic layout of a cooling test expt.



INSTRUMENTATION SECTION I

time of flight measurements

position measurements

INSTRUMENTATION SECTION II

Electron identification

Est. order of magnitude: 30m, 64MV, 30 MChF

International

Workshop on a

Muon Cooling Demonstration

Experiment

CERN 25-27 October

EU + US + Japan

LOI **Dec 15**

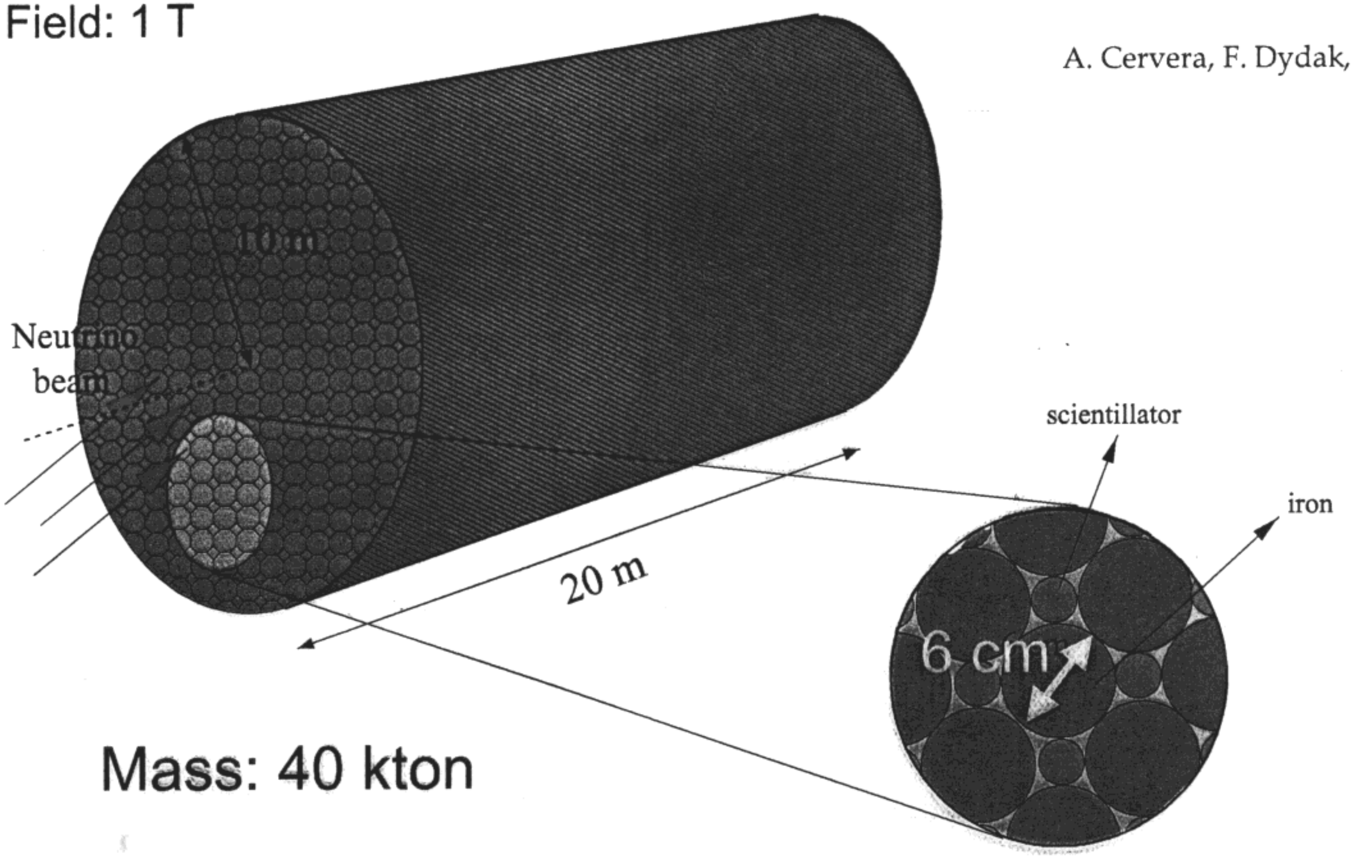
Proposal June 15, 02

(to PSI Committee)

1b. Large Magnetized Detector

Cylindrical symmetry, R=10m,=20m
6 cm thick iron rods interspersed with 2cm thick scintillators "longitudinally segmented"
Field: 1 T

A. Cervera, F. Dydak, J.J. Gomez. , NIM.A451 (2000) 123



Mass: 40 kton

⇒ Muon performance studied with GEANT and assume MINOS-like performance for E_{had}, θ_{had}...

$\sigma_{E_h}/E_h \sim 76\%/\sqrt{E_h} \oplus 3\%$
$\sigma_{\theta_h}/\theta_h \sim 17/\sqrt{E_h} \oplus 12/E_h$

Workshop

on

Large Magnetic Detectors

Barcelona 8-10 NOV

LMD, Megalith, Super Minos

(..... NOE, NICE, I216 ......

LMD

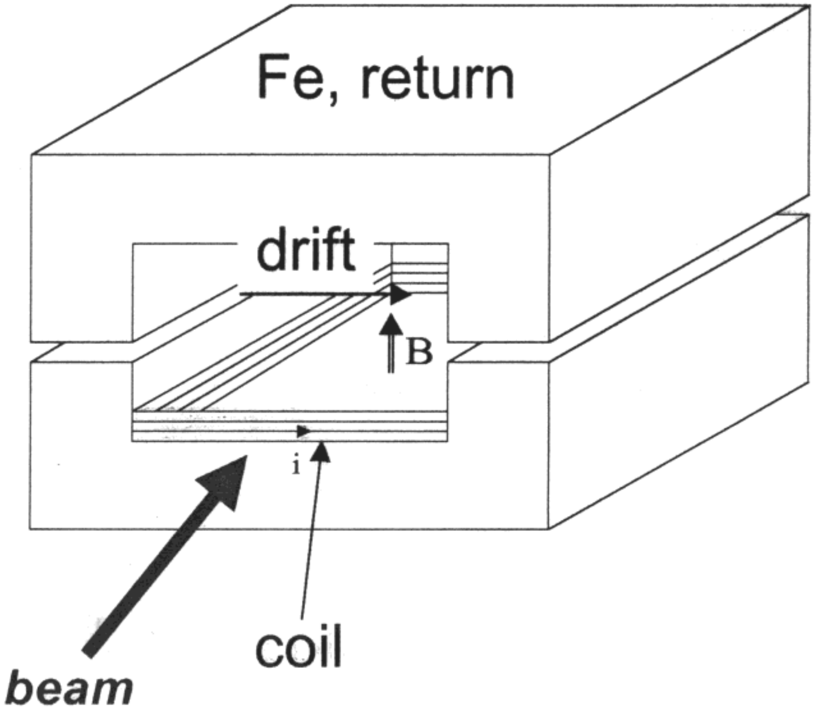
R&D Project

in 2002?

A large magnet ?

*An interesting possibility, **to be further understood**, is the creation of the B-field over the large volume encompassing the LAr with the help of a very large solenoid*

$\vec{B} \perp \vec{v}_{drift} \perp \vec{p}$



Joule Power (non-superconducting):

$$P = \rho \frac{2(a+b)hB^2}{md\mu_0^{\ 2}}$$

d=coil thickness, m=#windings, h=height, a=width, b=length

Parameter	
Argon volume	$8 \times 8 \times 16 m^3$
Argon mass	1.4 kton
Magnetic field	1.0 T
Current	2000 A
Conductor length	150 km
Resistance	1 Ω
Dissipated power	4 MW
Iron mass	5 kton

Much to do!

-- R&D for long baseline detectors

-- target stations & beam designs for stopped muon physics

-- beam design for near-by neutrino physics

-- nufact target tests (collection system must be integrated)

-- cooling test facility

-- etc etc

project has many facets; ideal to European competence

world wide:
communication takes place already (NUFACT series)
formal collaboration under discussion

A possible road map

2000

Continue work on detector, machine parameters, sites.

Explore conventional ν beams $2 \rightarrow 50$ GeV.

Oct Proton Driver Report, 23 Oct (CERN) ECFA μ week, 10 Nov (Chicago) II μ-instrumentation Workshop, 30 Nov Report from IWG on μ test beams, 1 Dec (Desy) ECFA Oral Report

2001

1 Mar ECFA Written Report, 1 Apr (BNL) νFact feasibility II, late May (Japan) νFact 2001 (propose COOTEF?, launch detector studies?), Summer MUSCAT results, 1 June ECFA Report on "Beyond LHC", 30 June Snowmass01, late 2001 first HARP results

2002

Prototyping COOTEF

2005

νFact Conceptual Study Design Report. Run COOTEF

2006

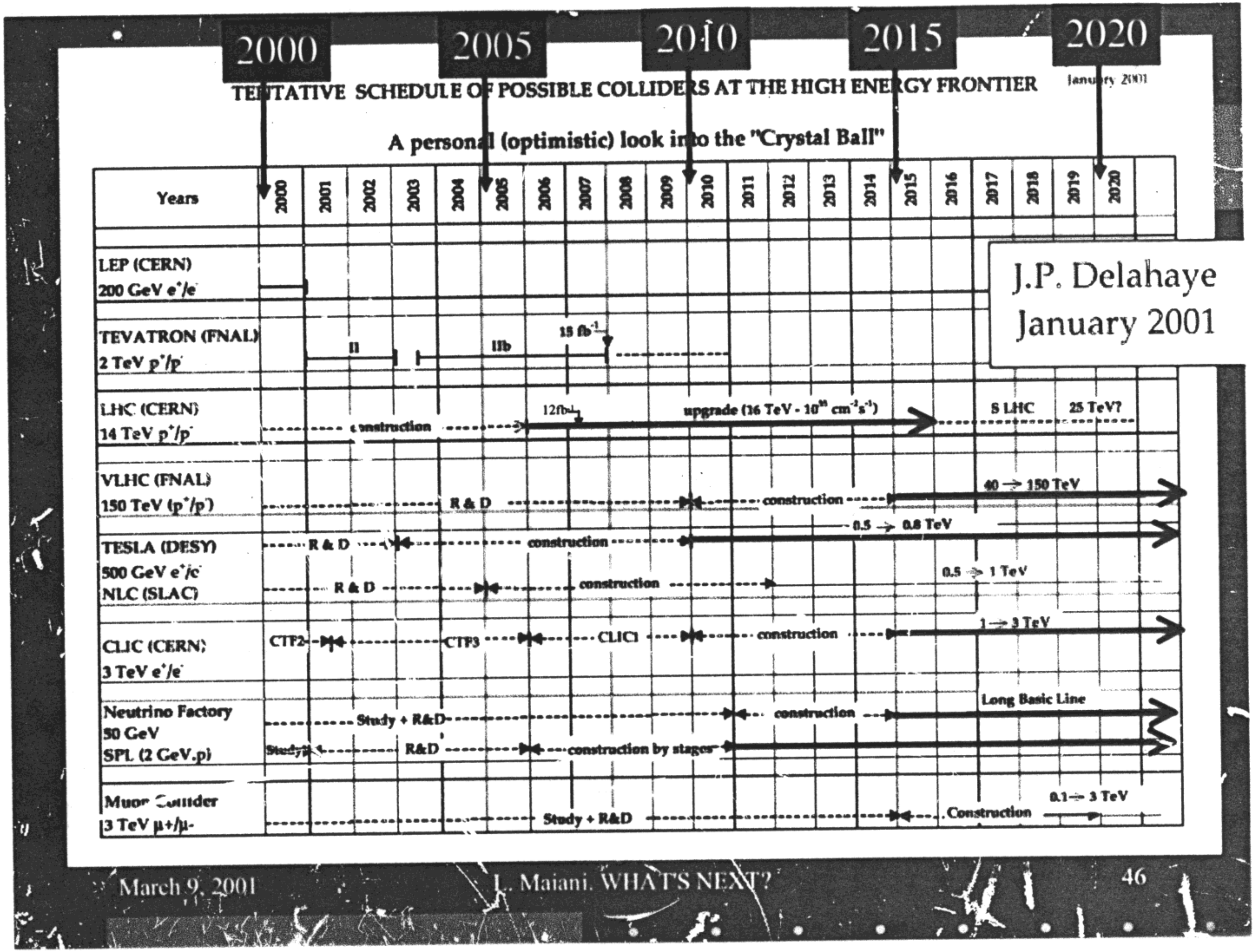
Prepare SPL

2010

First SPL beams ($p \Rightarrow \pi \Rightarrow \nu$, stopped μ , rare K decays)

2012

Accelerated and stored muons. First ν_e, ν_μ beam.


2000
2005
2010
2015
2020
TENTATIVE SCHEDULE OF POSSIBLE COLLIDERS AT THE HIGH ENERGY FRONTIER
January 2001
A personal (optimistic) look into the "Crystal Ball"
Years
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
J.P. Delahaye
January 2001
LEP (CERN)
200 GeV e+/e-
TEVATRON (FNAL)
2 TeV p+/p-
II
IIb
15 fb-1
LHC (CERN)
14 TeV p+/p-
construction
12fb-1
upgrade (16 TeV - 10^35 cm^-2s^-1)
S LHC
25 TeV?
VLHC (FNAL)
150 TeV (p+/p-)
R & D
construction
40 → 150 TeV
TESLA (DESY)
500 GeV e+/e-
NLC (SLAC)
R & D
construction
0.5 → 0.8 TeV
R & D
construction
0.5 → 1 TeV
CLIC (CERN)
3 TeV e+/e-
CTF2
CTF3
CLIC1
construction
1 → 3 TeV
Neutrino Factory
50 GeV
SPL (2 GeV.p)
Study + R&D
construction
Long Basic Line
Study
R&D
construction by stages
Muon Collider
3 TeV μ+/μ-
Study + R&D
Construction
0.1 → 3 TeV
March 9, 2001
L. Maiani. WHAT'S NEXT?
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SLAC-PUB-8587
August 2000

Conventional Beams or Neutrino Factories: The Next Generation of Accelerator-Based Neutrino Experiments *

Burton Richter
Stanford Linear Accelerator Center
Stanford, California 94309-0450

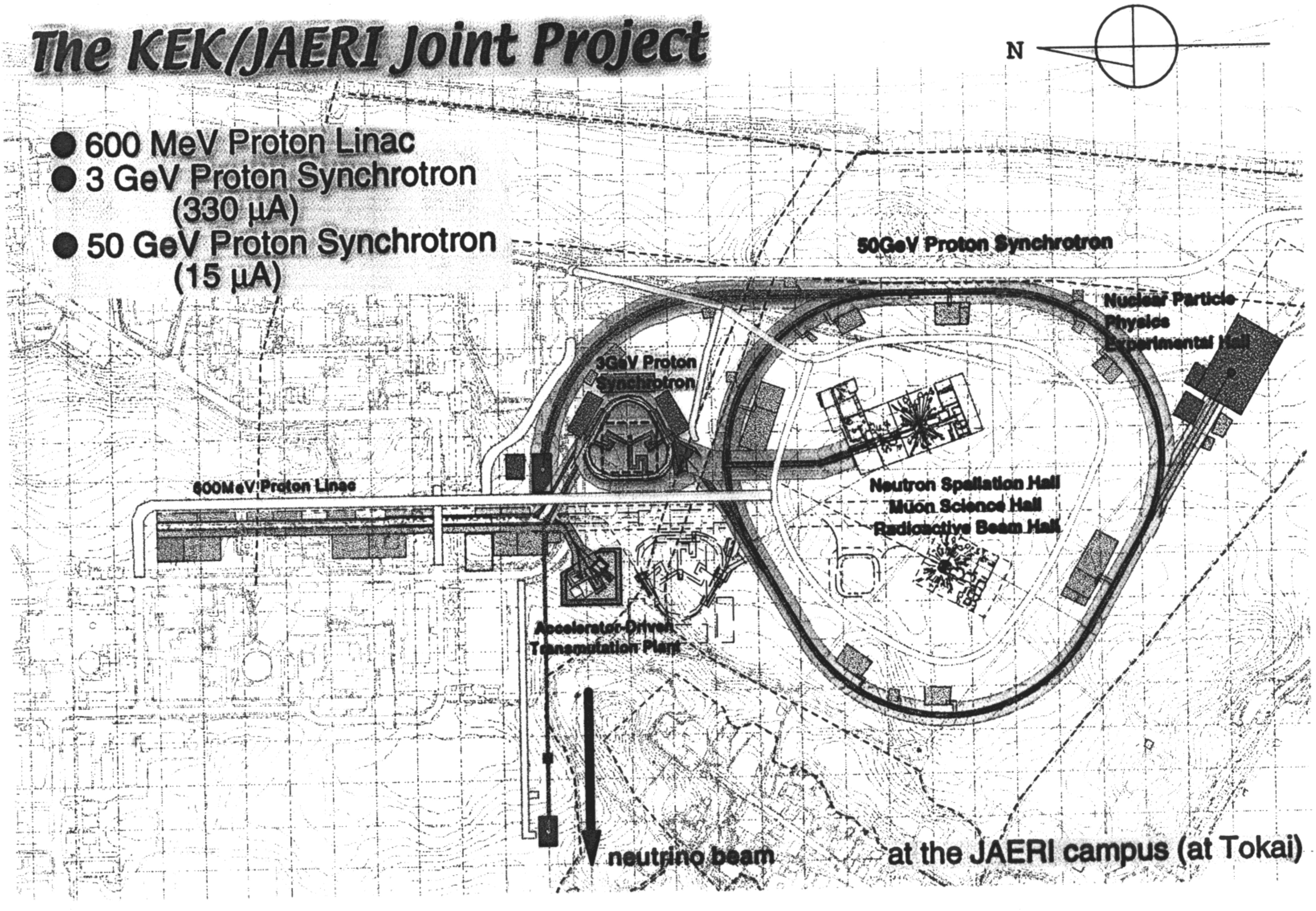
Abstract

The purpose of this paper is to provoke a discussion about the right next step in accelerator-based neutrino physics. In the next five years many experiments will be done to determine the neutrino mixing parameters. However, the small parameters θ_{13}, Δm^2_{21}, and the CP violating phase are unlikely to be well determined. Here, I look at the potential of high-intensity, low-energy, narrow-band conventional neutrino beams to determine these parameters. I find, after roughly estimating the possible intensity and purity of conventional neutrino and anti-neutrino beam, that $\sin^2\theta_{13}$ can be measured if greater than a few parts in ten thousand, Δm^2_{21} can be measured if it is greater than 4×10^{-5} $(\mathrm{eV})^2$, and the CP violating phase can be measured if it is greater than 20° and the other parameters are not at their lower bounds. If these conclusions stand up to more detailed analysis, these experiments can be done long before a muon storage ring source could be built, and at much less cost.

*Work supported by Department of Energy contract DE-AC03-76SF00515.

The KEK/JAERI Joint Project

- 600 MeV Proton Linac
- 3 GeV Proton Synchrotron (330 μA)
- 50 GeV Proton Synchrotron (15 μA)



at the JAERI campus (at Tokai)

UNO/HyperK

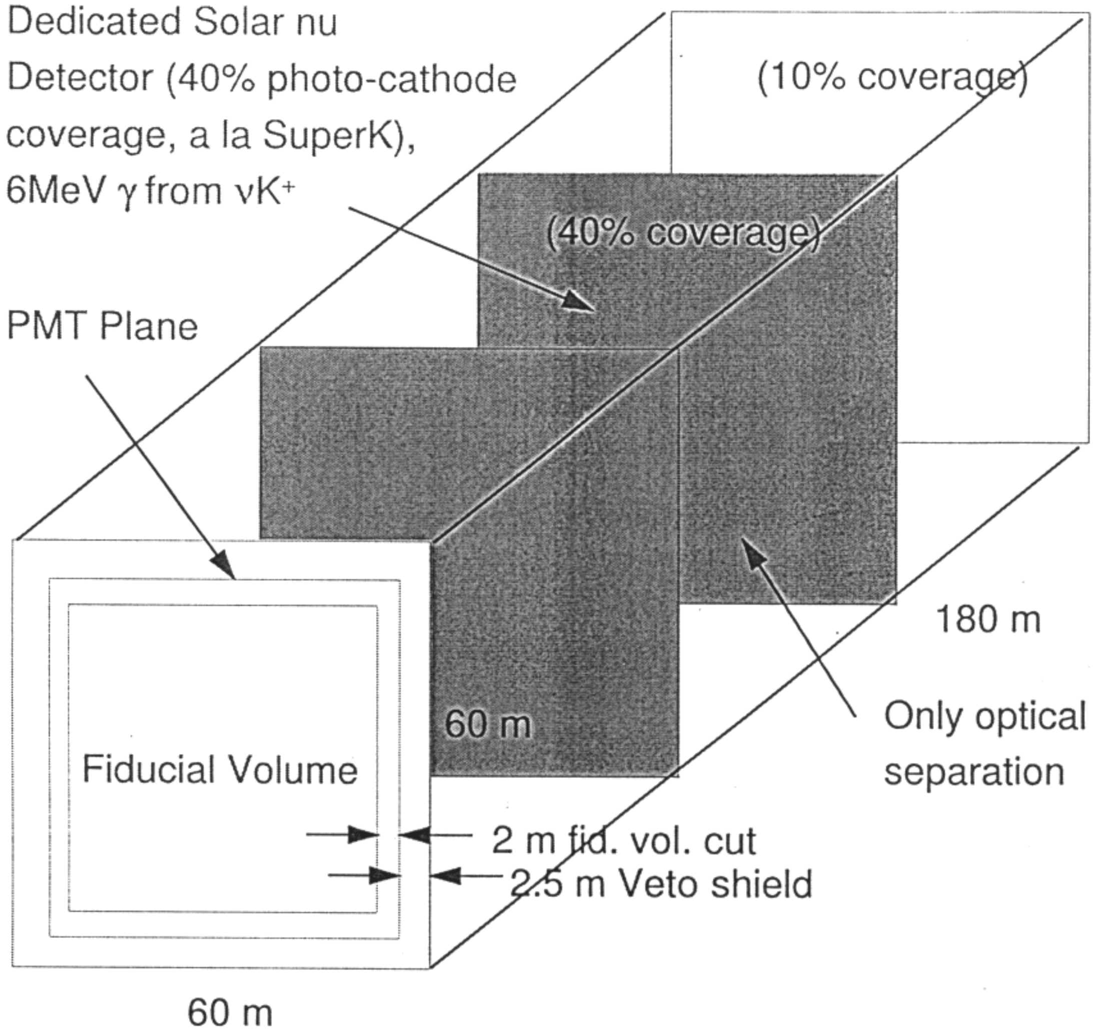


Figure 2.1: Baseline configuration of the UNO detector

The detector has three compartments, each measuring $60 \times 60 \times 60\,\mathrm{m}^3$, for a total length of 180 m and a total mass of 648 kton. The outer detector region serves as a veto shield of 2.5 m depth, and is instrumented with 14,901 outward-facing 8″ PMTs at a density of 0.33 PMTs/m^2. The inner detector regions contain the software-defined fiducial volume, beginning 2 m within the PMT planes; the total fiducial mass the three subdetectors is 445 kton. The inner detector regions are viewed by 56,650 20″ PMTs, with an average PMT

NNNO2

A workshop on

"LARGE DETECTORS FOR PROTON DECAY, SUPERNOVAE AND ATMOSPHERIC NEUTRINOS AND LOW ENERGY NEUTRINOS FROM HIGH INTENSITY BEAMS"

CERN, 16-18 January 2002, "Council Chamber", bldg. 503-1-001

Tentative Agenda

Tuesday 15 January 2002

18:00 • Registration

Wednesday 16 January 2002

08:30 • Registration
09:30 • Welcome
time • Proton Decay

12:00 • Lunch

time • Supernovae Neutrinos

Thursday 17 January 2002

08:30 • Atmospheric Neutrinos
time • Solar Neutrinos

12:00 • Lunch

Time • Low Energy Neutrinos from High Intensity Beams
• Engineering of Large Excavations

20:00 • Dinner

Friday 18 January 2002

08:30 • Detector Options
time

• Lunch
12:00

• Detector R&D
time • Conclusions
time

Last updated by tk on Thursday, July 5, 2001

Water Cerenkov
EU R&D Project
in 2002?

Coming Events

Snowmass 1 - 20 July
- grand review of US plans
- few EU (Blondel, cooling paper)

15-18 Oct **EU μ-Week** (CERN)
- Mo HARP, ... (R&D)
- Tu NOWG, ... (physics)
- We NFWG (accelerator)
- Th Plenary

25-28 Oct (CERN)

Meeting of **Int. Cooling Exp. Collab.** (PSI?)

goal: Conceptual Design Dec 15
Technical Proposal Jun 02

8 - 10 Nov (Barcelona)

Large Magnetic Detector W-shop

(10 → 100 kT) ν Atmo, ν Fact, p-decay?, S-Novae??

goal: launch R&D program

16 - 18 Jan (CERN) NNN02 (UNO)

Large H_2O Cerenkov W-Shop

(500 kT) p-decay, ν Atmo, S-beam, S-Novae?
θ_{13}

ICARUS

goal: launch R&D program