EUCARD WP3 -- NEU2012
Introduction and goals of the meeting

1. **CERN Workshop**
2. **recommandations from SPC panel**
3. **Changes at CERN and options**
4. **Preparing the next workshop and the EU neutrino roadmap**

1-3 October 2009, 254 participants, 48 posters.

*** Accelerator based ***

EUROPEAN STRATEGY FOR FUTURE NEUTRINO PHYSICS

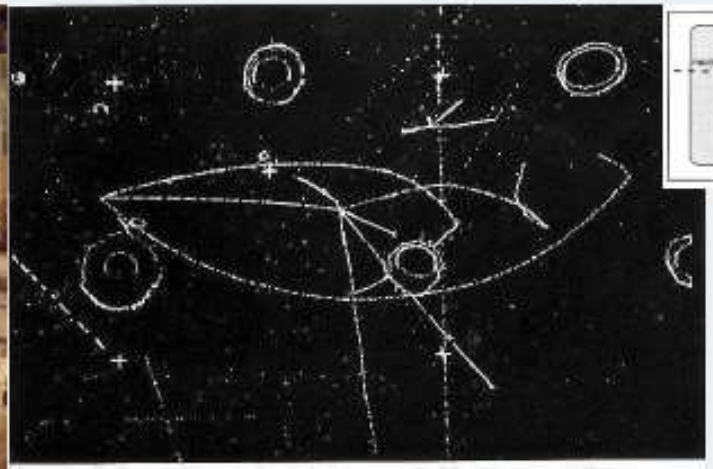
http://indico.cern.ch/conferenceDisplay.py?confId=59378

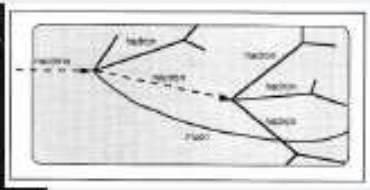
CERN WORKSHOP 1-3 October 2009, 254 participants, 48 posters.

1. The questions
2. Neutrino Physics
3. Accelerator options
4. Detector options
5. Conclusions

Neutrino Physics in Europe - past

- In the past, CERN maintained an important Neutrino Physics program producing important discoveries and contributions to the field
  - EPS 2009 High Energy and Particle Physics Prize to **Gargamelle Collaboration** *"For the Observation of the Weak Neutral Current Interaction"*





$(NC/CC)_{\nu} = 0.21 \pm 0.03$

$(NC/CC)_{\bar{\nu}} = 0.45 \pm 0.09$

- Results published in Physics Letters 46B, 3 September 1973

J.P. Vialle / LAPP, EPS 2009

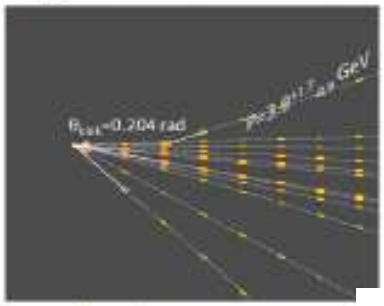
- Beyond Gargamelle: BEBC, CHARM/CHARM-II, CHORUS, NOMAD
  - V-A structure of the weak charged current, ν-N deep inelastic scattering and determination of structure functions, ν-oscillations,...

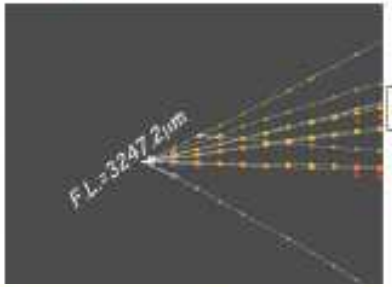
Ilias Efthymiopoulos

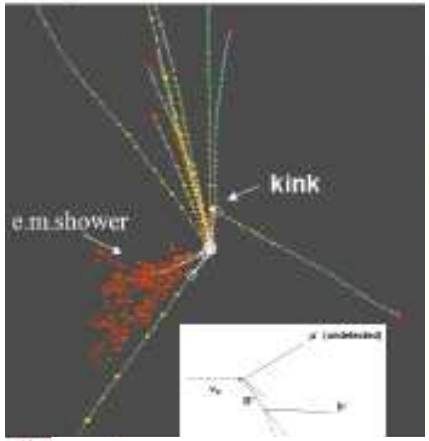
Neutrino Physics in Europe - present

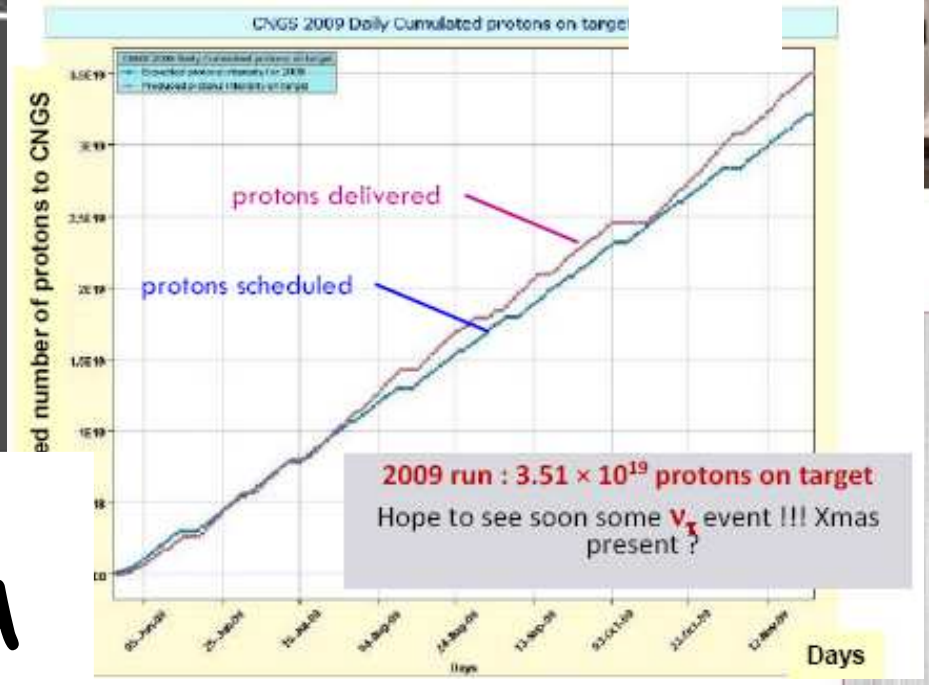
- CERN operates one of the three long baseline neutrino beams: **C**ERN **N**eutrinos to **G**rand **S**asso – **CNGS**

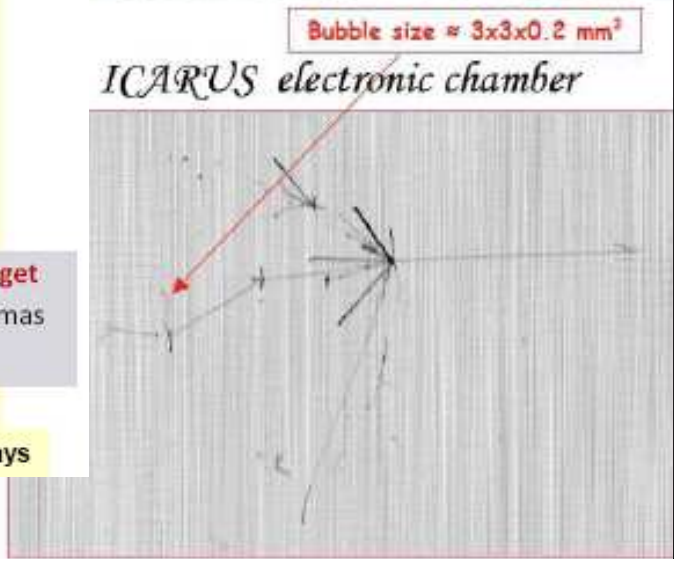
Topological and kinematical analysis - first charm-like event









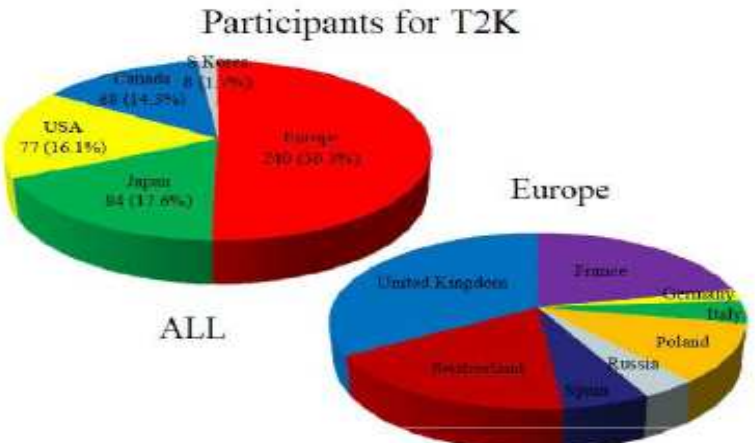


OPERA

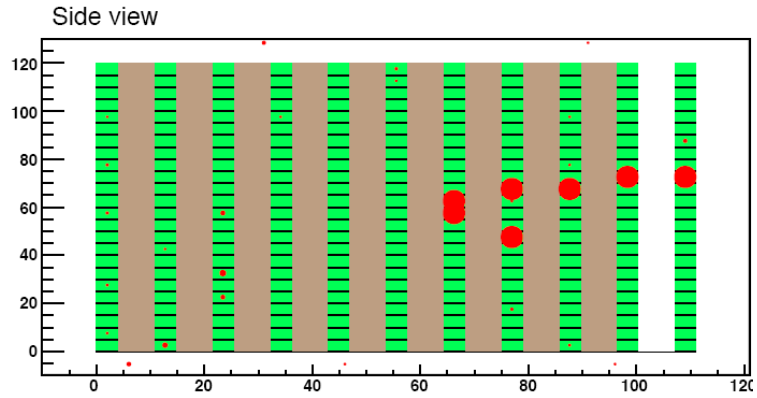
Ilias Efthymiopoulos

Neutrino Physics in Europe - present

- Significant European participation in the T2K long baseline neutrino beam experiments
  - Facility just started operation with first beams in 2009



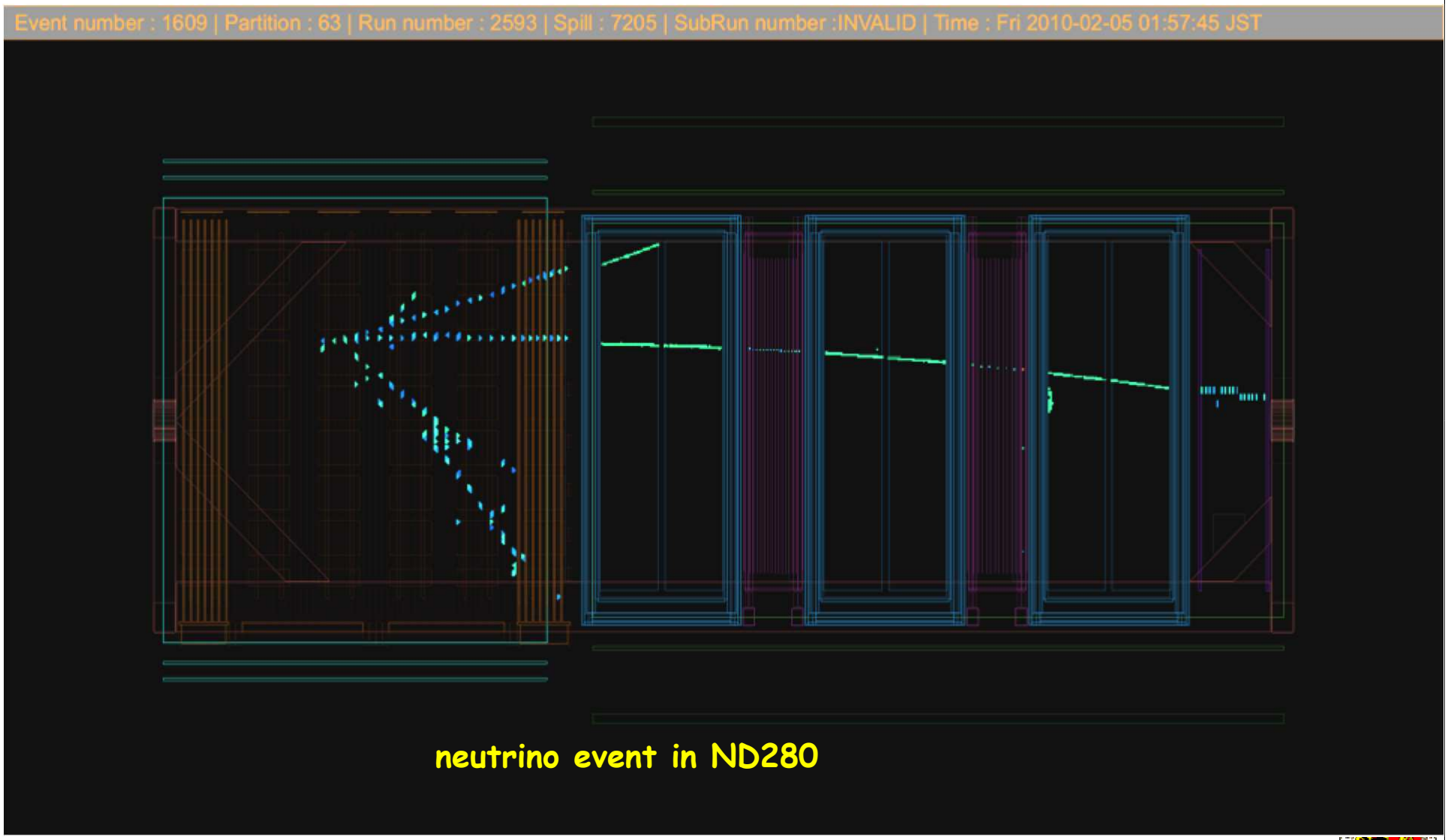
INGRID first neutrino event candidate



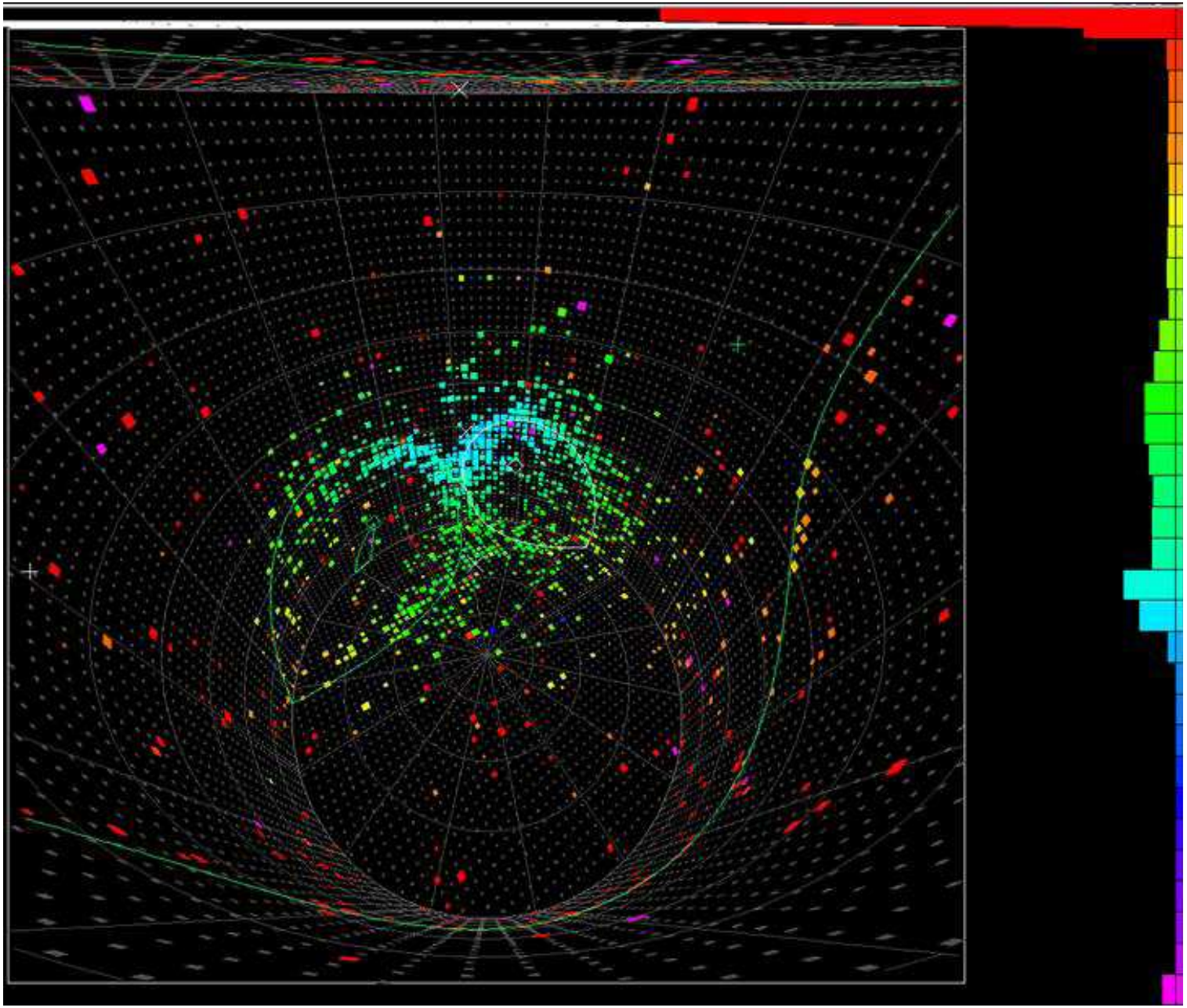
First neutrino event candidate in INGRID at 11:25 UT on Nov. 22nd 2009

ν beam

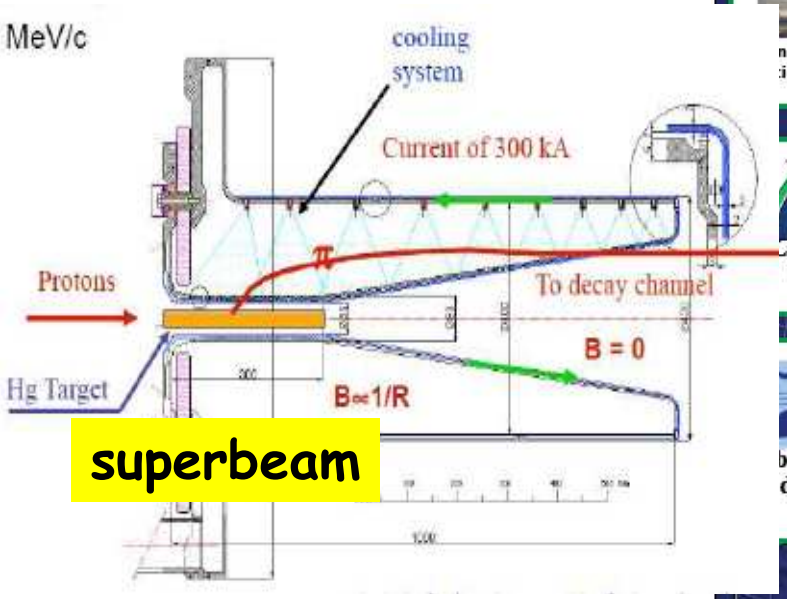
Also: DCHOOZ, MINOS, KATRIN, ββ0ν expts, and more


Event number : 1609 | Partition : 63 | Run number : 2593 | Spill : 7205 | SubRun number :INVALID | Time : Fri 2010-02-05 01:57:45 JST
neutrino event in ND280

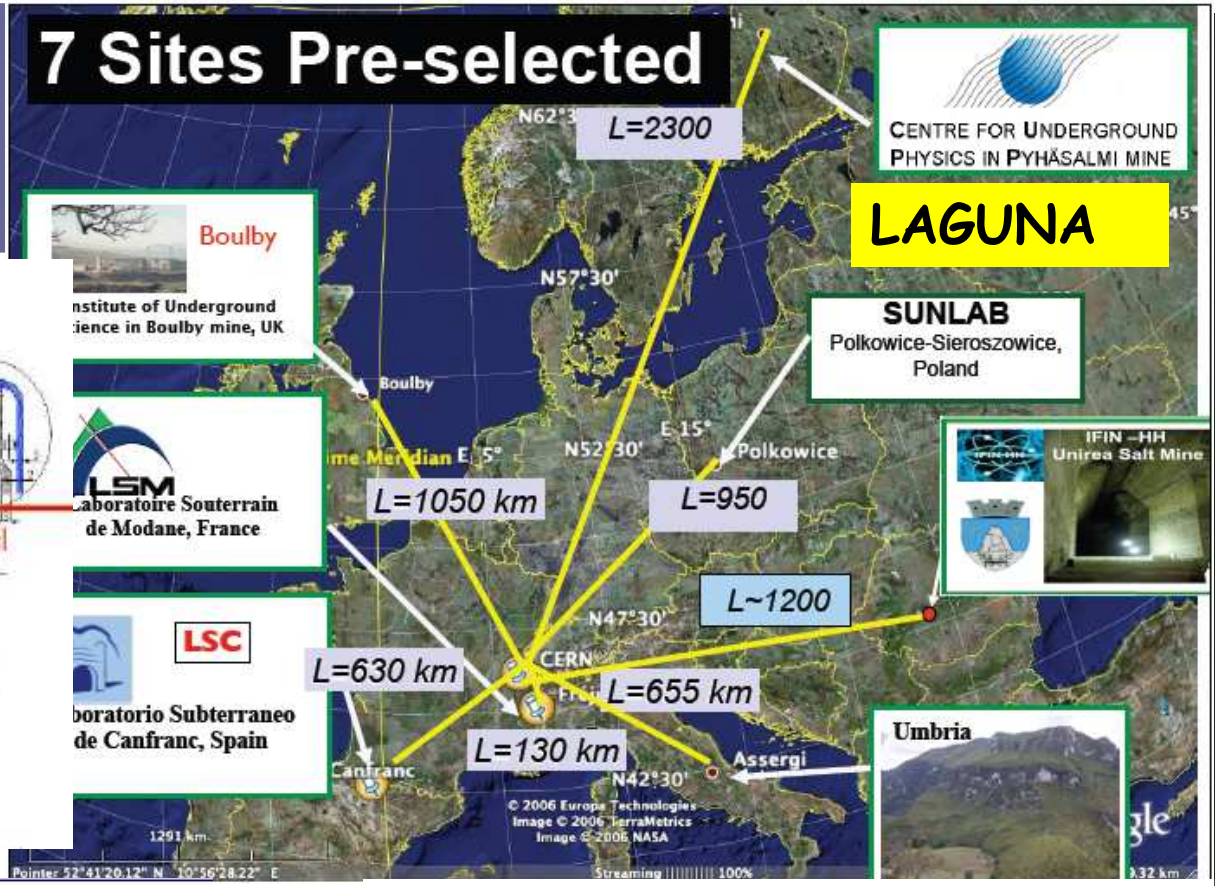
T2K first far detector neutrino event

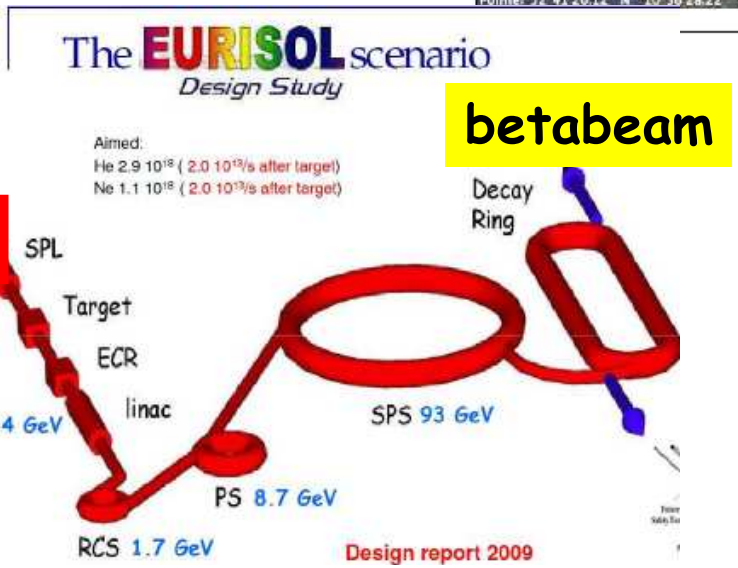


Neutrino Physics in Europe – Future?



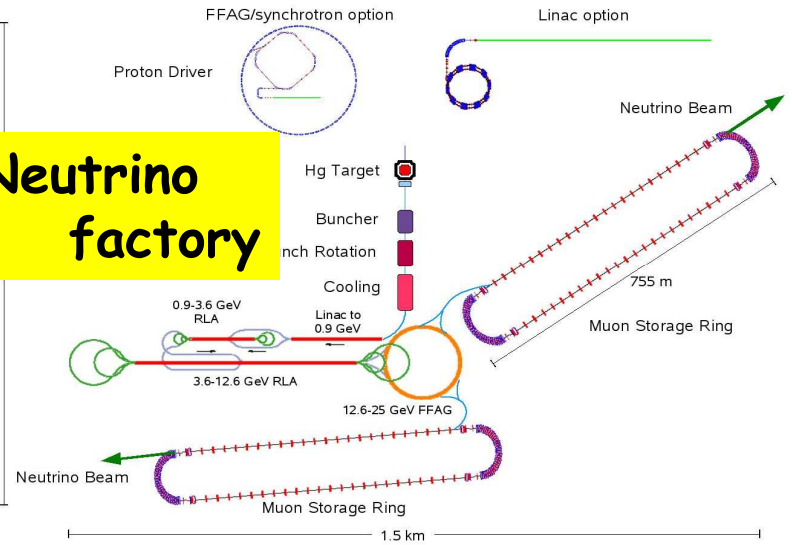
superbeam





betabeam

EUROnu



Neutrino factory

WORKSHOP AGENDA:

Thursday 1 October Morning (P. Dornan)
Welcome and general introduction,
ongoing experiments: accelerator, reactor, $\beta\beta0\nu$, cosmology

Thursday 1 October Afternoon (S. Pascoli)
Theory what is important to measure, new ideas,
Relation with charged lepton physics and LHC physics

Friday 2 October Morning (I. Efthymiopoulos, D. Wark)
Accelerator Beta beam (Baseline and high Q), Superbeam
Future plans in Japan and US; GGM beam at CERN

Friday 2 October Afternoon (D. Autiero, A. Cervera)
Detectors Magnetized iron, TASD, LArg, Water Cherenkov
Deep underground sites (LAGUNA) and electronics

Saturday 3 October Morning (I. Efthymiopoulos, D. Wark)
Accelerator Neutrino factory, target, cooling,
International Design Study and muon collider

Saturday 3 October Afternoon
wishlists from previous sessions
round table and conclusions

Important theoretical points:

-- parameters missing: θ_{13} mass hierarchy, CP phase
-- strategy on oscillations still debated: do we need to know the value of θ_{13} before deciding on the next step?

In other words:

case for neutrino factory or beta-beam in case of large θ_{13} is to be made.

-- most fundamental questions in neutrino physics
  -- majorana or not?
  -- is CP violated?

=> LEPTOGENESIS

  -- But mixing parameters are interesting to measure precisely in their own right

-- is framework complete? (unitarity tests)

=> Non conventional channels:

$\nu_\mu \leftrightarrow \nu_\tau$ OPERA,

$\nu_\mu \leftrightarrow \nu_\tau$, $\nu_e \leftrightarrow \nu_\tau$ and c.c.'s NEUTRINO FACTORY

NEUTRAL CURRENTS

Near and far detectors (Gavela)

ν specific (Europe)

- Reach a shared decision on the next step(s).
- Narrow down the choice of the far detector location
- Narrow down choices for new accelerators.
- Keep stepping up synergies in Europe and abroad for accelerator and detector R&D.

ν specific (@CERN)

- Specify the LHC injector consolidation/upgrade and its coupling to ν roadmap.
  - **Strategy retreat end November**
- Increase support for coordinated R&D, within reality
- An oscillation experiment/R&D at PS?
  - LOI being submitted shortly to the SPSC
  - A possible way to attract local physicists?
- Keep working on accelerator R&D, contributing to the world effort.

In summary

We will need

- Flexibility
- Preparedness
- Visionary global policies

…..and

Choices

CHOICES

-- while we are asked to narrow down options, the devil keeps inventing new schemes!

-- high Q beta-beam

-- superbeam from PS2

-- low energy neutrino factory

most die quickly, but maybe one will live..?

We have two main coherent and powerful 'possibilities'

1. A low energy superbeam + beta beam (^{6}He ^{18}Ne in SPS) aimed at a very large Water Cherenkov d = 125 - 300km (T and CP violation)

2. Neutrino Factory with >=20 GeV muons aimed at (2-5000&7000km) Magnetized Iron Neutrino Detector (MIND) + fine grained magnetized detector (TASD, LArg, MECC) for tau detection

Both require high-power SPL

Which is better/cheaper, competitive in time/performance?
Physicist can ~estimate performance but cost requires professional help!

THE WORKSHOP WAS QUITE A SUCCESS, WITH HIGH ATTENDANCE (254) AND LOTS OF DISCUSSION

IT WAS ONLY A BEGINNING. WE HAVE A PROGRAM OF RESEARCH (EURONU, LAGUNA ETC…) TO PROVIDE INPUT FOR DECISIONS IN 2012

I BELIEVE IT WOULD BE MOST USEFUL TO CONTINUE THE INTERACTION WITH CERN MANAGEMENT TO HELP NARROWING DOWN TO REALISTIC OPTION(s?)

THE POSSIBILITY OF USE OF THE OLD CERN GGM BEAM WOULD BE POSSIBILITY – ANYONE INTRESTED?

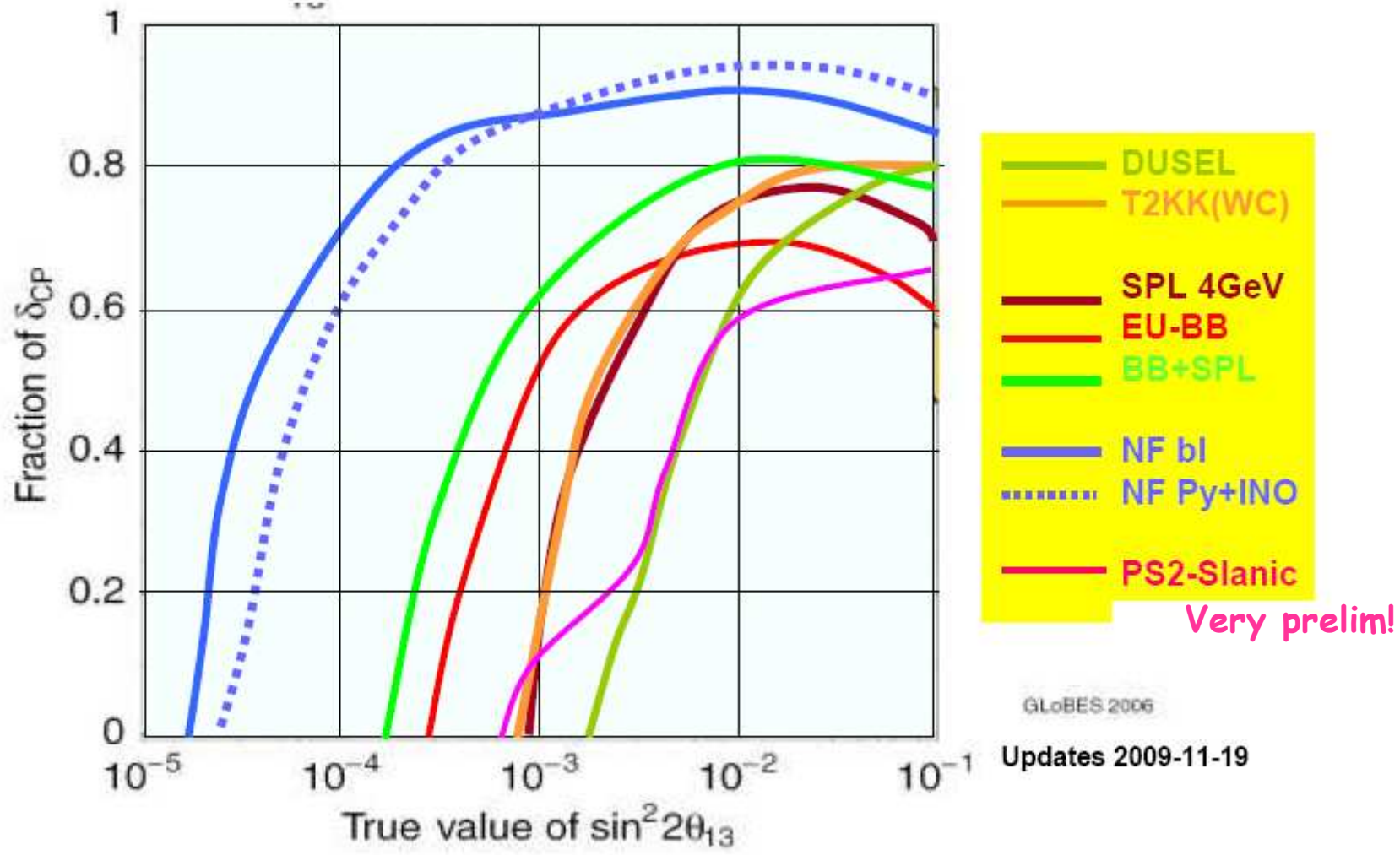
CONTINUATION:

Sequel of Workshop should be envisaged in one (or two?) year(s)

Organization with SPC, ECFA, NEU2012 (involving EUROnu and LAGUNA) *and* CERN.

Workshop proceedings to appear soon. (F. Dufour)

sensitivity plot from the SPC panel report:
note that this includes work from EUROnu, Laguna, IDS-NF, DUSEL, T2KK etc…



To-do list for today

1. **Review the ongoing studies (EUROnu, LAGUNA)**

2. **things have changed at CERN considerably (adapt/react to this)**

   -- **Chamonix➔ prefer LHC injector chain to be consolidated not changed**
   -- **HP SPL study will be continued**
   -- **neutrino must stand on its own feet**

3. **Oversight from ECFA being organized**

4. **preparations for the next workshop on EU strategy and neutrino roadmap**