V. Palladino
Univ & INFN Napoli
EuCARD11 plenary
11 May 2011

WP3-NEu2012

Neutrinos for Europe in 2012

Structuring the accelerator neutrino community

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Univ & INFN Napoli
EuCARD11 plenary
11 May 2011

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Neutrinos for Europe in 2012

Networking Activity (continuing BENE, along with EUROnu & LAGUNA FP7 DS)

within Integrating Activity EuCARD (continuing CARE)

- 2012 is proving to be indeed our target,
  - ie the CERN Council Strategy update process … July 2011 to late 2012
    - now main concern of the neutrino network and design studies
  - midterm reports May 26, first attempt at a consensual input to that process
    - inevitable iteration next year
  - prepared by two substantial Task2 and Task3 workshops in Mar & Sep 2010
    - the final report of LAGUNA in 2010
    - the EUROnu (and IDS-NF) Design Studies Midterm Reports early this year
    - the approval of the LAGUNA-LBNO Design Study in April
    - the ECFA review of the EUROnu (and IDS-NF) reports last week
- Eu context of options
  - CNGS+ …… turning into LAGUNA LBNO and PS neutrinos options
  - EUROnu …… R&D projects (MICE, EMMA, …
- World wide context of options …. Japan, US …..

as latest revised, yesterday, in our second NEu2012 annual meeting

Council dixit in 2006

…… to be in position to define the optimal neutrino program

…… ….. in around 2012

The European strategy *for particle physics*

Particle physics stands on the threshold of a new and exciting era of discovery. The next generation of experiments will explore new domains and probe the deep structure of space-time. They will measure the properties of the elementary constituents of matter and their interactions with unprecedented accuracy, and they will uncover new phenomena such as the Higgs boson or new forms of matter. Long-standing puzzles such as the origin of mass, the matter-antimatter asymmetry of the Universe and the mysterious dark matter and energy that permeate the cosmos will soon benefit from the insights that new measurements will bring. Together, the results will have a profound impact on the way we see our Universe; *European particle physics should thoroughly exploit its current exciting and diverse research programme. It should position itself to stand ready to address the challenges that will emerge from exploration of the new frontier, and it should participate fully in an increasingly global adventure.*

General issues

1. European particle physics is founded on strong national institutes, universities and laboratories and the CERN Organization; *Europe should maintain and strengthen its central position in particle physics.*

2. Increased globalization, concentration and scale of particle physics make a well coordinated strategy in Europe paramount; *this strategy will be defined and updated by CERN Council as outlined below.*

Scientific activities

3. The LHC will be the energy frontier machine for the foreseeable future, maintaining European leadership in the field; *the highest priority is to fully exploit the physics potential of the LHC, resources for completion of the initial programme have to be secured such that machine and experiments can operate optimally at their design performance.* A subsequent major luminosity upgrade (SLHC), motivated by physics results and operation experience, will be enabled by focussed R&D; *to this end, R&D for machine and detectors has to be vigorously pursued now and centrally organized towards a luminosity upgrade by around 2015.*

4. In order to be in the position to push the energy and luminosity frontier even further it is vital to strengthen the advanced accelerator R&D programme; *a coordinated programme should be intensified, to develop the CLIC technology and high performance magnets for future accelerators, and to play a significant role in the study and development of a high-intensity neutrino facility.*

5. It is fundamental to complement the results of the LHC with measurements at a linear collider. In the energy range of 0.5 to 1 TeV, the ILC, based on superconducting technology, will provide a unique scientific opportunity at the precision frontier; *there should be a strong well-coordinated European activity, including CERN, through the Global Design Effort, for its design and technical preparation towards the construction decision, to be ready for a new assessment by Council around 2010.*

6. Studies of the scientific case for future neutrino facilities and the R&D into associated technologies are required to be in a position to define the optimal neutrino programme based on the information available in around 2012; *Council will play an active role in promoting a coordinated European participation in a global neutrino programme.*

7. A range of very important non-accelerator experiments take place at the overlap between particle and astroparticle physics exploring otherwise inaccessible phenomena; *Council will seek to work with ApPEC to develop a coordinated strategy in these areas of mutual interest.*

NEu2012 planning for 2010 and perspectives for later

2010-11

Proceedings Workshop NEu2012 postdoc, F. Dufour

CERN doctoral student O.M. Hansen

April
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr

EUROnu, Strasbourg

Neutrino 2010, Athens
ICHEP, Paris

LAGUNA ends

Take full stock of SPC & Chamonix
CERN management
Council Strategy Secretariat
ECFA

NNN10, Toyama

NuFact10, Mumbai

LAGUNA-LBNO proposal

EUROnu, RAL

First iteration of road map

2nd "SPC □ Workshop"?

2nd Neu2012 yearly meeting at EuCARD 2011

ECFA review, CockCroft

now

Apr11

Apr12

Apr13

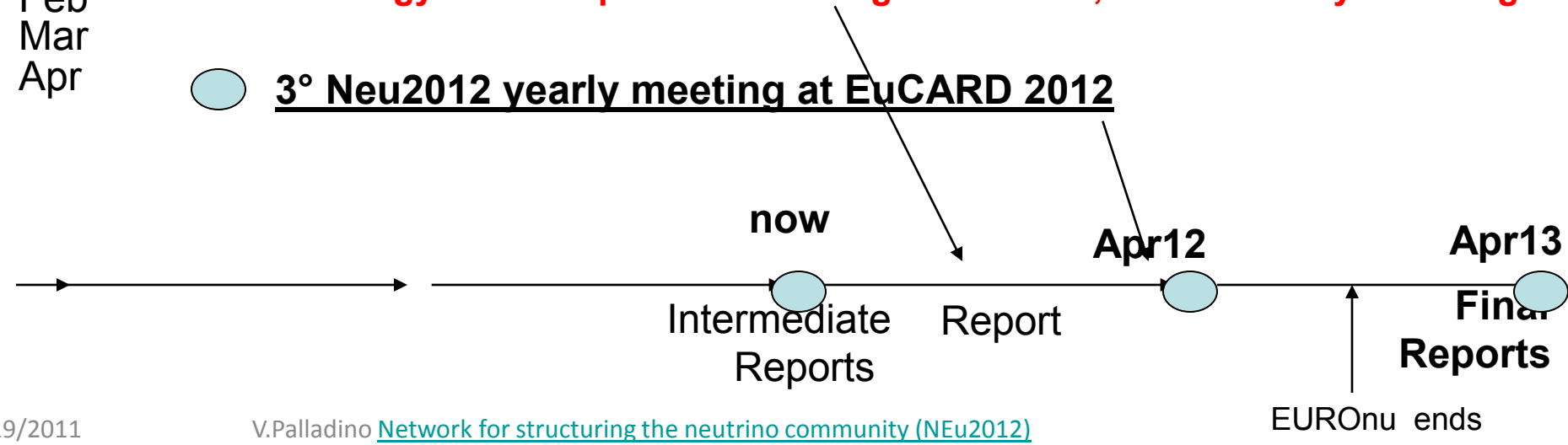
Intermediate Reports

Final Reports

EUROnu □□ ends

2011-12

April
May — Midterm Reports
Jun
Jul — EPS 2011, Grenoble, **July 23**
Aug — **NuFact11** UniGe/CERN
Sep — **NNN11,** Zurich
Oct
Nov
Dec
Jan
Feb — **2nd ν strategy Workshop .. town meeting … at CERN, before "Orsay" meeting**
Mar
Apr — **3° Neu2012 yearly meeting at EuCARD 2012**



2° annual meeting: begin preparation of coherent input to strategy update process

Intro

09:00 Welcome

Presenter(s): PALLADINO, Vittorio *(Univ. & INFN Napoli, Italy)*
Room: Auditorium
Location: CNRS - PARIS (F)

09:05 Introduction

Presenter(s): EFTHYMIOPOULOS, Ilias *(CERN)*
Room: Auditorium
Location: CNRS - PARIS (F)

09:15 Motivation of neutrino physics

Room: Auditorium
Location: CNRS - PARIS (F)

09:15 Motivation for neutrino accelerator experiments

Presenter(s): KING, Steve, *(Department of Physics (SHEP))*
Room: Auditorium
Location: CNRS - PARIS (F)

09:30 Neutrinos and the LHC

Presenter(s): SENJANOVIC, G.
Room: Auditorium
Location: CNRS - PARIS (F)

09:45 The role of neutrino physics in the quest for physics Beyond the Standard Mode

Presenter(s): GAVELA, Belen TBC
Room: Auditorium
Location: CNRS - PARIS (F)

10:00 Eu Strategy update process and role of ECFA Neutrino Review Panel

Task2

10:45 OPERA

Presenter(s): EREDITATO A. TBC
Room: Auditorium
Location: CNRS - PARIS (F)

10:45 NEu2012 Task 2 : Existing Facilities

Room: Auditorium
Location: CNRS - PARIS (F)

11:05 ICARUS, Double LAr

Location: CNRS - PARIS (F)

Location: CNRS - PARIS (F)

11:25 SPL Superbeam, Beta-beam to Fréjus

Presenter(s): MEZZETTO M.
Room: Auditorium
Location: CNRS - PARIS (F)

11:25 NEu2012 Task 3: Future European Neutrino Facilities: Synergetic staged options Europe (both short and long term perspectives). Option I : Low Energy Neutrino

Room: Auditorium
Location: CNRS - PARIS (F)

11:45 LAGUNA detectors at Frejus

Presenter(s): TONAZZO A., PATZAK T.
Room: Auditorium
Location: CNRS - PARIS (F)

Task 3
LE subGeV ν
option

12:05 Fully Active Scintillators

Presenter(s): KUDENKO, Y.
Room: Auditorium
Location: CNRS - PARIS (F)

12:20 EUROnu SPL Superbeam

Presenter(s): ZITO M.
Room: Auditorium
Location: CNRS - PARIS (F)

12:35 EUROnu Betabeam

Presenter(s): WILDNER, Elena *(CERN)*
Location: CNEUROnu BetabeamRS - PARIS (F)

Location: CNEUROnu BetabeamRS - PARIS (F)

:30 NEu2012 Task 3: Future European Neutrino Facilities: Synergetic staged options for Europe (both short and long term perspectives). Option II: High Energy Neutrino

Room: Auditorium
Location: CNRS - PARIS (F)

:30 Conventional beam, neutrino factory

Presenter(s): PASCOLI, Silvia
Room: Auditorium
Location: CNRS - PARIS (F)

Task 3
HE multiGeV ν
option

:50 LAGUNA-LBNO beams

Presenter(s): EFTHYMIOPOULOS, Ilias *(CERN)*
Room: Auditorium
Location: CNRS - PARIS (F)

:10 LAGUNA Detectors at Pyhasalmi

Presenter(s): RUBBIA, Andre *(ETH Zurich)*, *(Eidgenossische Tech. Hochschule Zuerich (ETHZ))*
Room: Auditorium
Location: CNRS - PARIS (F)

:30 EUROnu and IDS-NF Neutrino factory

Presenter(s): LONG K./POZIMSKI J.
Room: Auditorium
Location: CNRS - PARIS (F)

:50 Neutrino Factory Detectors

Presenter(s): SOLER P.
Room: Auditorium

6:45 Discussion: towards a EU neutrino contribution to the strategy process

Room: Auditorium
Location: CNRS - PARIS (F)

14:50 LAGUNA-LBNO beams

Neu2012 – Road map to future facilities

Ad-Hoc Steering Group (**EUvSG**)

NEu2012,EUROnu,LAGUNA-LBNO ..

- Discussions launched within a limited number of colleagues
  - Management of the ongoing DS and R&D projects
- This meeting the first opportunity for a wider discussion with the community
- Strategy:
  - Develop a consensus on a **coherent, staged long-baseline neutrino oscillation programme in Europe**:
    - Medium term oscillation experiments, development of accelerator and detector facilities and R&D for future projects
    - Experimental facilities in Europe and European contributions to long-baseline facilities overseas
- Opportunity:
  - Endorsement of the programme via the European Strategy update
- Propose:
  - **Ad hoc steering group (EUvSG)** to work towards a town meeting in the period **December 2011 to February 2012** at which consensus programme would be discussed

Missions of ah-hoc "EUvSG"

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MISSION 1 : ORGANIZE TOWN MEETING ….. Propose it at CERN, Dec-Jan

-- this was already suggested as a sequel of the neutrino workshop of Oct09

so to

- Develop a consensus on a **coherent, staged long-baseline neutrino oscillation programme in Europe:**
  - Medium term oscillation experiments, development of accelerator and detector facilities and R&D for future projects
  - Experimental facilities in Europe and European contributions to long-baseline facilities overseas

In advance of meeting:

-- Establish list of possibilities, performance, mutual compatibilities & synergies

-- perceived pros and cons

-- Feasibility, risk factors (unknowns or unfinished R&D), safety issues

-- timeline, entry price, program continuity etc…

-- other pros and cons (external funding possibilities etc…)

Also, need to understand view of CERN management and Nat'l Agencies on these

Missions of ah-hoc "EUvSG"

- Propose:
  - **Ad hoc steering group (EUvSG)** to work towards a town meeting in the period **December 2011 to February 2012** at which consensus programme would be discussed

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In advance of meeting:

23 July 2011 EPS Grenoble: Launch of strategy update process
(for neutrinos: presentation by D. Wark & F. Halzen at ECFA session)

NUFACT11 round table discussion Monday 1 August:
Future Neutrino Facilities in the Global Physics Environment
Bertolucci, Myers, Oddone, Spiro, Zwirner, Nishikawa, Womersley and ICFA rep.

- Message: many discoveries in neutrino physics
- Message: most important discovery of last 20 years

Message: Neutrino Mass and Mixing is first physics BSM

Two main lines of long term attack

use of the lower neutrino rate ($10^{18\text{-}19}$/year) and energy (sub-GeV) of
Betabeam + Megaton ("Hyper-Kamioka")

$\beta \Rightarrow \nu_e$

low density detector of very large mass (0.5-1 Mt)
and volume (0.5-1 Mm^3)
non magnetic
(a **Water** Cerenkov detector,
or possibly, again Li-Argon),
a few **100 Km** away

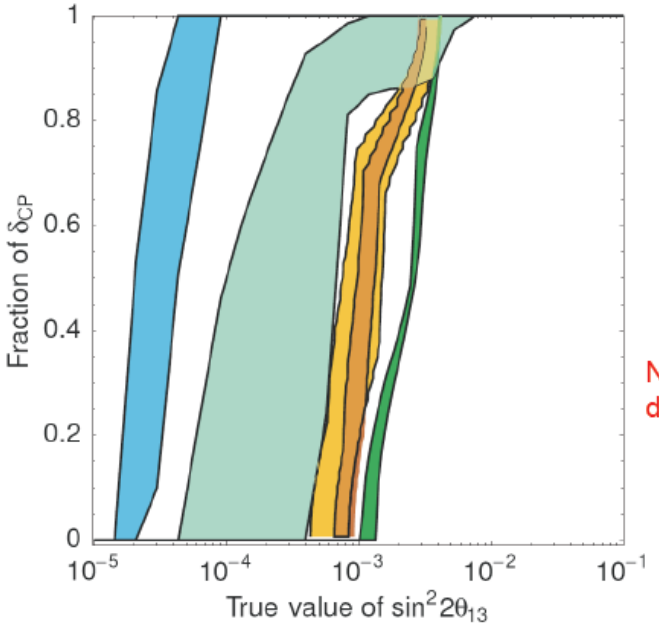
use of the high neutrino rate (>10^{20}/year) and energy (10-50 GeV) of
Neutrino Factory + LMD ("Hyper-MINOS")

$\mu \Rightarrow \bar{\nu}_e + \nu_\mu$

large but not huge (**50-100 Kt**),
necessarily magnetic
(a dense magnetized **Iron** detector,
or, possibly, Li-Argon),
a **few 1000 Km** away.

Prospects to measure θ_{13}

Physics at a future Neutrino Facto
facility. By ISS Physics Working Gr
Rept.Prog.Phys.72:106201,2009
arXiv:0710.4947 [hep-ph]

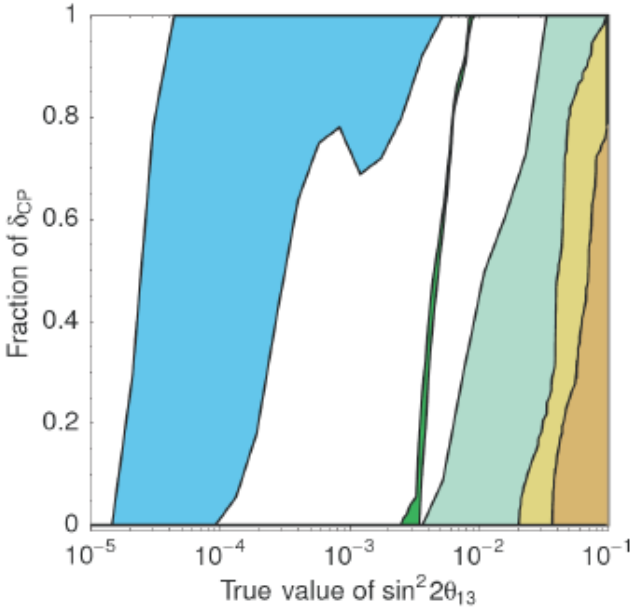


Note: choice of f
depend on θ_{13}

Prospects to measure the pattern of ν m

Physics at a future Neutri
facility. By ISS Physics W
Rept.Prog.Phys.72:10620
arXiv:0710.4947 [hep-ph]

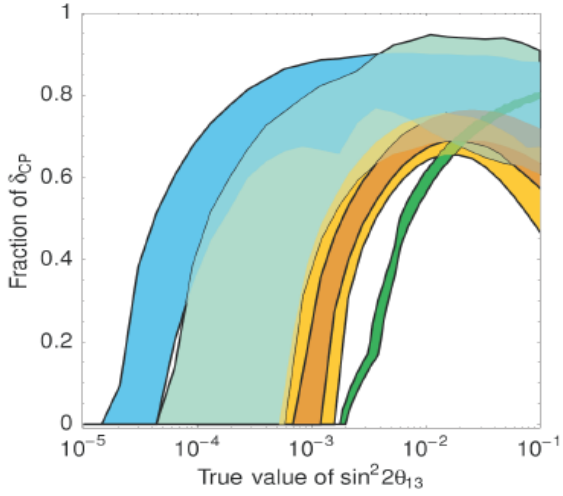
Sensitivity to the Sign of Δm_{23}^2



Note: choice of fac
depend on θ_{13}

Prospects to measure CP Violation

Physics at a future Neutrino Fact
facility. By ISS Physics Working G
Rept.Prog.Phys.72:106201,2009
arXiv:0710.4947 [hep-ph]



Note: choice of facility will
depend on θ_{13}

NEUTRINOS AND THE LHC

Goran Senjanović
ICTP, Trieste

both CMS and ATLAS:

dedicated search for W_R

@ 14 TeV:

W_R

up to 4 TeV mass @ L= 30/fb

up to 5.5 TeV mass @ L= 300/fb

$$100\,GeV \lesssim m_N \lesssim M_{W_R}$$

Ferrari '00

Gninenko et al '06

1,4 TeV with early 7 TeV data

- ECFA Review Panels for Neutrino F. Halzen

ECFA Review Panel for future accelerator based neutrino facilities to review

- EUROnu Mid-term Report and IDS-NF Interim Design Report
- concerning: scientific case, technical feasibility, risk and necessary R&D, cost and planning, organization

and to deliver

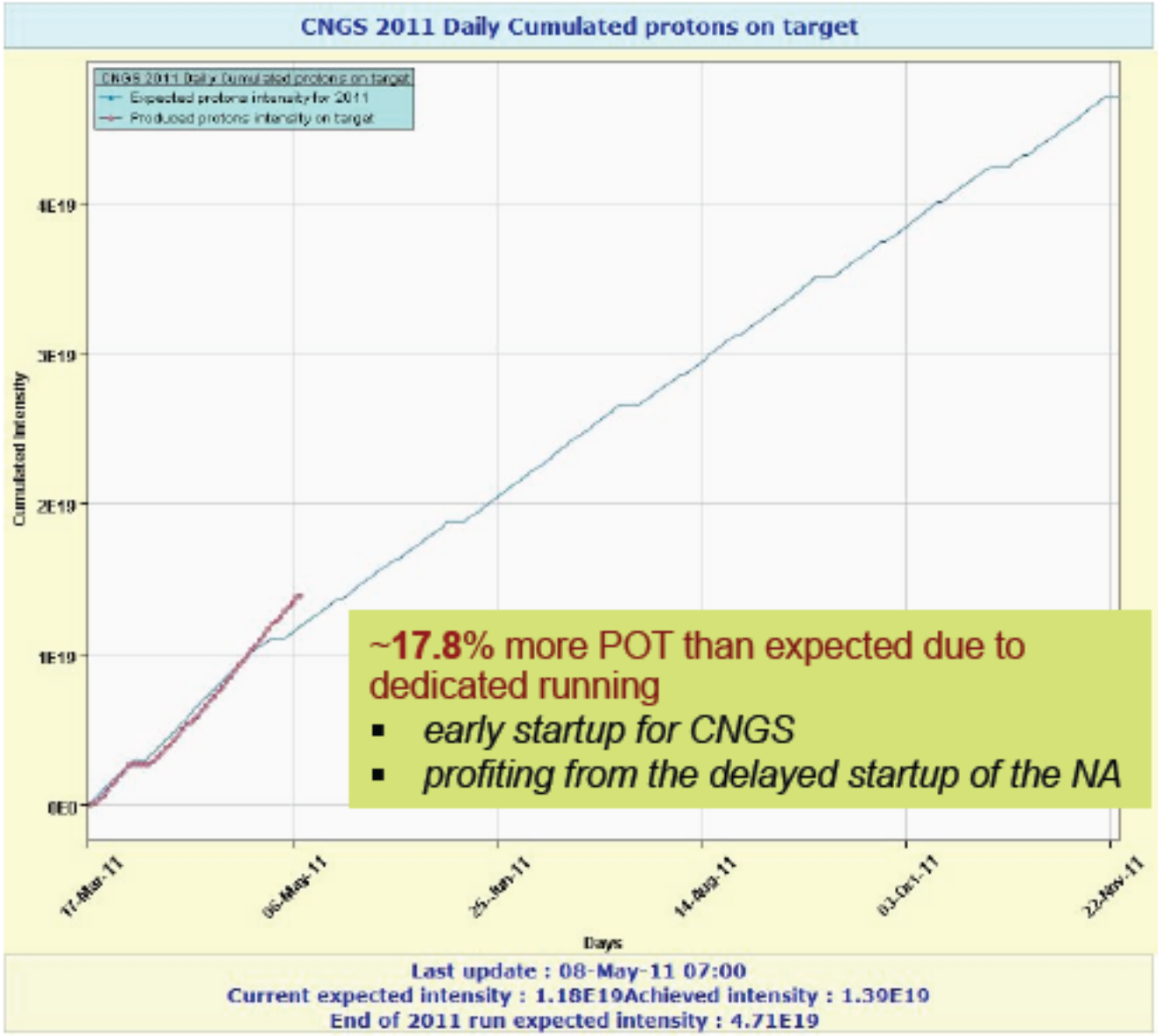
- concise written report by the end of July 2011
- oral presentation by the panel chair at ECFA-EPS joint session on European Strategy Document Update, Grenoble, 23 July 2011 in the afternoon

Remark on the panel activities

- The report will be public and a summary will be communicated to CERN Council
- The main objective of the panel is to review the two documents and not to propose a plan or vision on neutrino activities
  → limited scope, and in the European level
  e.g. Super beam: only the CERN-Frejus option
- Future continuation of the panel activities, still to be decided

eu2012 - Getting the most out of existing v-facilities

CERN Neutrinos to Grand Sasso - CNGS



Year	POT
2008	1.78×10^{19}
2009	3.52×10^{19}
2010	3.48×10^{19}
2011	1.39×10^{19} (4.7×10^{19})
Total	**10.17×10^{19}** (13.48×10^{19})

OPERA

Dear Vittorio,
thanks for the kind invitation.
Unfortunately, due to the short notice, we could not accommodate a presentation for yourevent.
However, I can give you some information that you might desire forwarding to the attendance:

1) OPERA is in the process of completing the analysis of the full 2008-2009 statistics. Results will be disclosed in June.

2) Today we passed 10^19 pot for the 2011 run (for this year, **we expect to exceed the nominal integrated intensity** of 4.5x10^19 pot).

3) **No plans yet for the future**, i.e. beyond the 2012 run.

Kind regards, Antonio

Preliminary results of first CNGS 2010 run

- Analyzed sample: 1494 CNGS triggers, i.e. $4.54 \cdot 10^{18}$ pot = 78 % out of whole sample. Classified by visual scanning into fiducial volume of 434 t.
- Number of collected interactions compared with number of interactions predicted ((2.6 ν CC + 0.86 ν NC) 10^{-17}/pot), in the whole energy range up to 100 GeV, corrected by fiducial volume and DAQ dead-time.

Event type	Collected	Expected
ν_μ CC	94	98
ν NC	32	31
ν XC *	6	-
Total	132	129

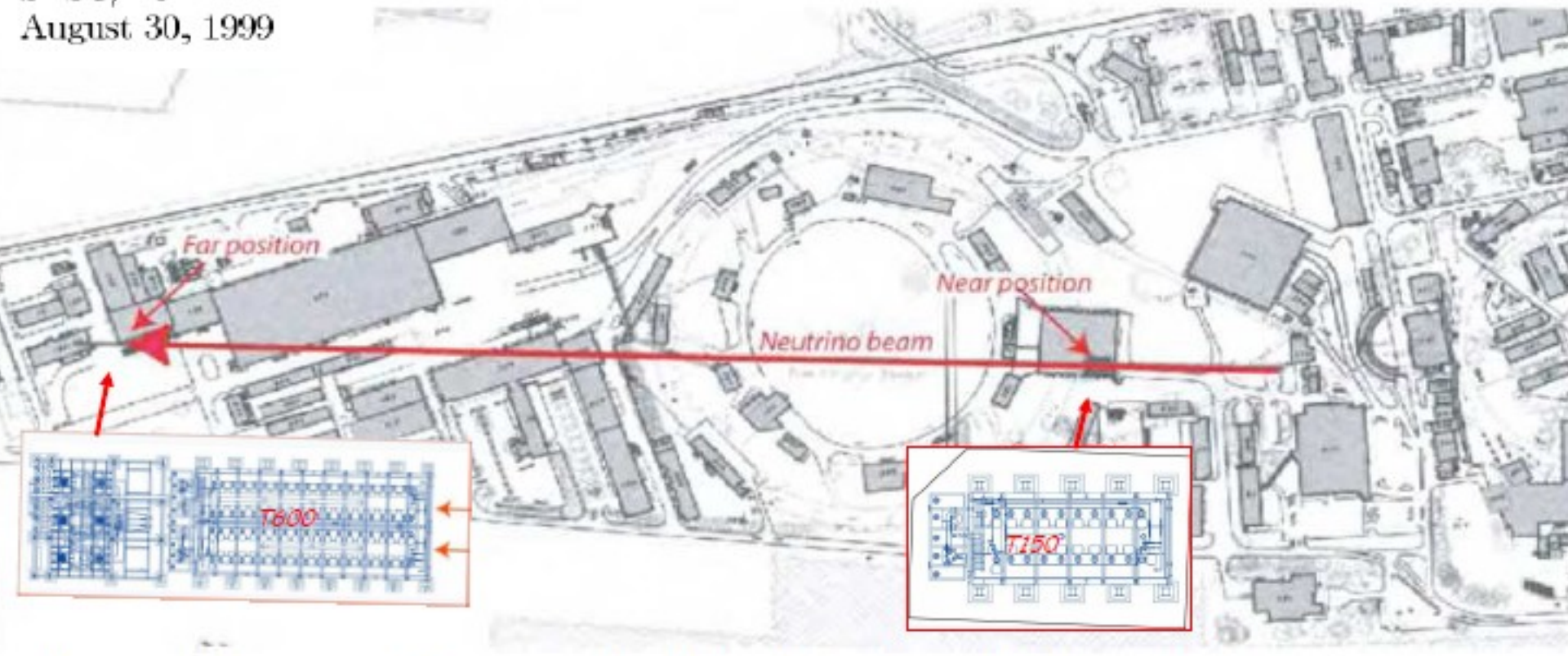
* Events at edges, with μ track too short to be visually recognized: further analysis needed.

On overall statistics in agreement with expectations.

Two LAr-TPC detectors at the CERN-PS neutrino beam

CERN-SPSC/99-26
SPSC/P311
August 30, 1999

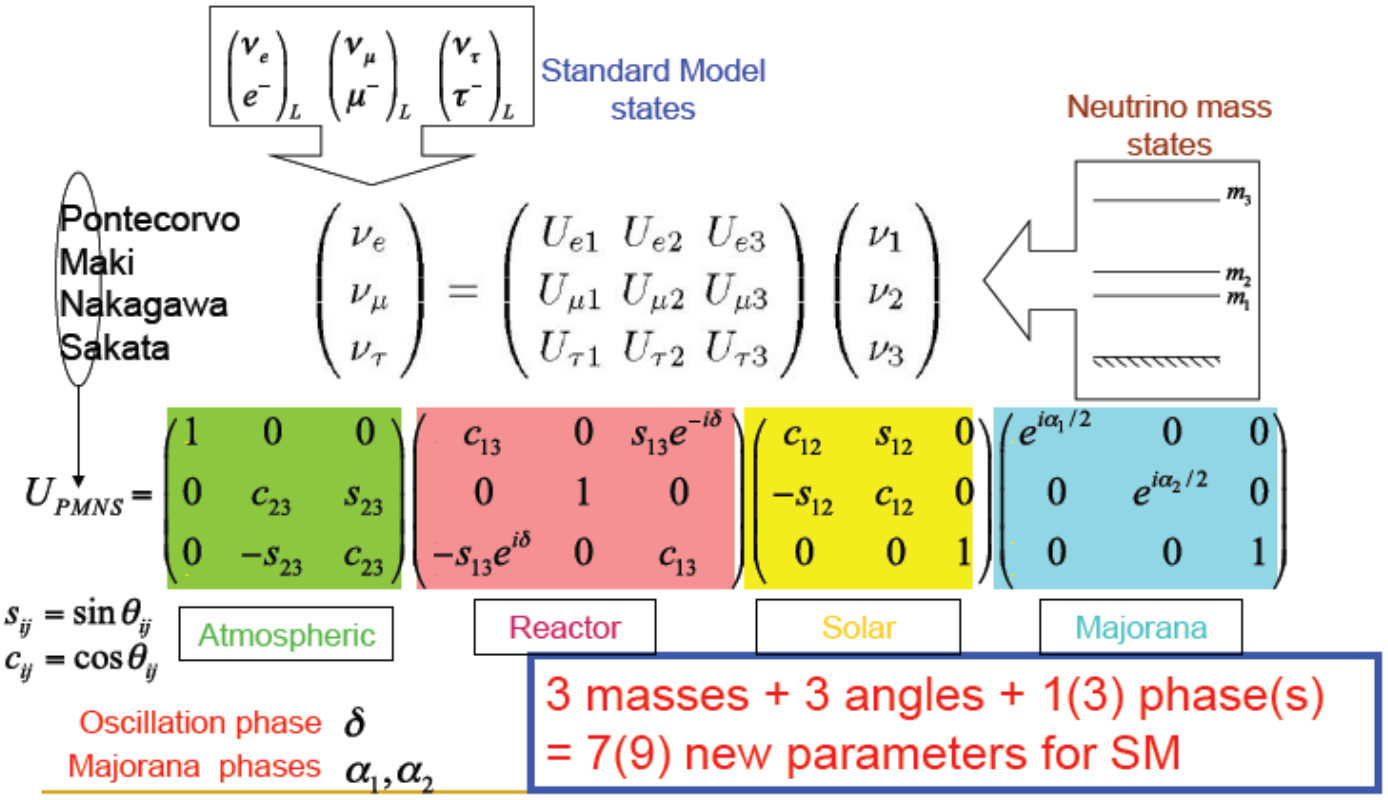
SEARCH FOR $\nu_\mu \rightarrow \nu_e$ OSCILLATION
AT THE CERN PS



Two positions are foreseen for the detection of the neutrinos
The far (ICARUS-T600) location at 850 m from the target: L/E ~ 1 km/GeV
The additional detector and new location at a distance of 127 m from the target: L/E 0.15 km/GeV

Sterile neutrinos

Three Neutrino Mass and Mixing



Beyond 3 X 3

EuCARD 2° Annual Meeting

Paris Workshop 10-13 May 2011

SPECTROMETER(S) Prospects for a CERN-PS Experiment

Luca Stanco - INFN Padova

on behalf of

A. Bertolin (5), R. Brugnera (5,6), S. Dusini (5), R.A. Fini (1), A. Garfagnini (5,6), M. Laveder (5,6), A. Longhin (4), M. Mezzetto(5), M.T. Muciaccia (1), A. Paoloni (4), L. Patrizii (2), S. Simone (1), M. Sioli (2,3), G. Sirri (2), M. Spurio (2,3), L. Stanco* (5)

(1) Bari University and INFN
(2) INFN Bologna
(3) Bologna University
(4) INFN-LNF
(5) INFN Padova
(6) Padova University

* contact

no PhD, no Post-Doc, no "retired" people, included

Status & Future Projects

- The CNGS facility is running extremely well for a third consecutive year
- CNGS OPERA and ICARUS will have a great year in 2011
  - Looking forward to more ν_τ events !!!
- Status and progress from the PS ν-beam and associated physics opportunities
- LAGUNA-LBNO proposal
  - DS approved; expected to start in **September 2011**
  - WP4: studies of possible beams from CERN to LAGUNA sites
    - Profit from CNGS beam experience and present/future SPS beams

Mauro Mezzetto
Istituto Nazionale di Fisica Nucleare, Sezione di Padova

"The case of short long-baselines"

Task 3, option 1

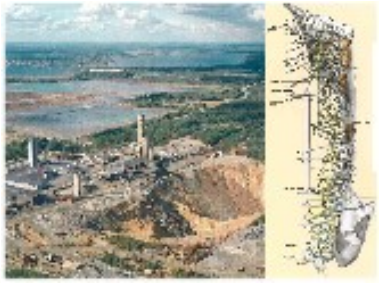
Conclusions

- Short Long-Baselines offer the cleanest possible setup for Leptonic CP Violation studies.
- They have almost null sensitivity to mass hierarchy, that can be partially compensated by a combined analysis with the atmospheric neutrinos.
- The CERN-Frejus scenario could offer a staged approach where a SuperBeam built over the Beta Beam injector (the SPL) can already provide a powerful setup.
- The innovative concept of Beta Beams can guarantee higher sensitivities. More important, they can be upgraded to allow for future searches like non-standard neutrino interactions, checks of the unitarity triangle, searches of CPT violation.
- A Beta Beam setup can make use of existing CERN infrastructures like the PS and the SPS. The injector side can be shared with nuclear physicists (Eurisol). The far detector is the same detector aimed for proton decay searches and astrophysics (Laguna). Under this perspective a super beam built around the SPL could offer very interesting synergies.

LAGUNA

Large Apparatus for Grand Unification and Neutrino Astrophysics

In a



2300 Km, Pyhhäsalmi

2008 - 2011

1,7 M€ from EU

7 canditate sites:

- Boulby
- Fréjus
- Caso
- LSC
- Pyhäsalmi
- Sunlab
- IFIN-HH

Boulby mine
1050 Km

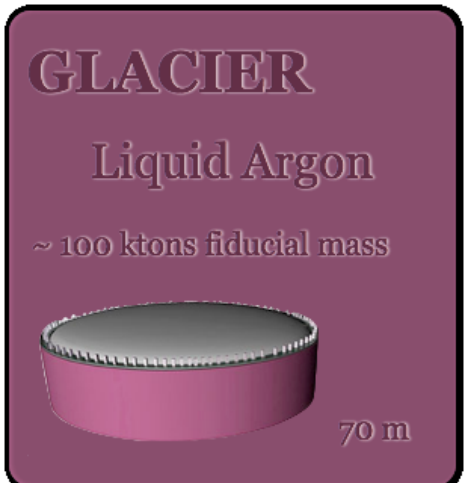
SUNLAB
950 Km

130 Km

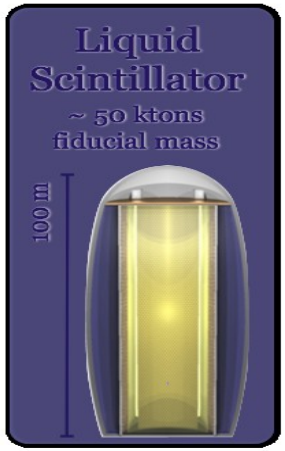
Unirea Salt Mine

630 Km

CASO, 659 Km



LENA



Conclusions

- Fréjus can host all 3 proposed next generation neutrino detectors
- Fréjus is the deepest lab proposed for Laguna detectors (4800 m.w.e.)
- Fréjus has longstanding experience with LSM underground lab
- Fréjus has excellent intellectual and logistic environment (central position in EU)
- The rock quality is good and allows a save operation of the future lab for > 50 years
- Close distance to CERN (130 km) allows clean CPV measurement
- Memphys + β-beam -> covers largest phase-space before NF
- Mass hierarchy will be addresses using atm. ν 's– for free
- Memphys is the mildest extrapolation from any existing detector (1 tank = 10 x SK)
- Fréjus is 2nd choice for LENA du to reactor ν background (give up on geo-neutrinos?)
- Glacier can be hosted @ Fréjus, Glacier collaboration considers longer distance as priority to measure mass hierarchy via MSW

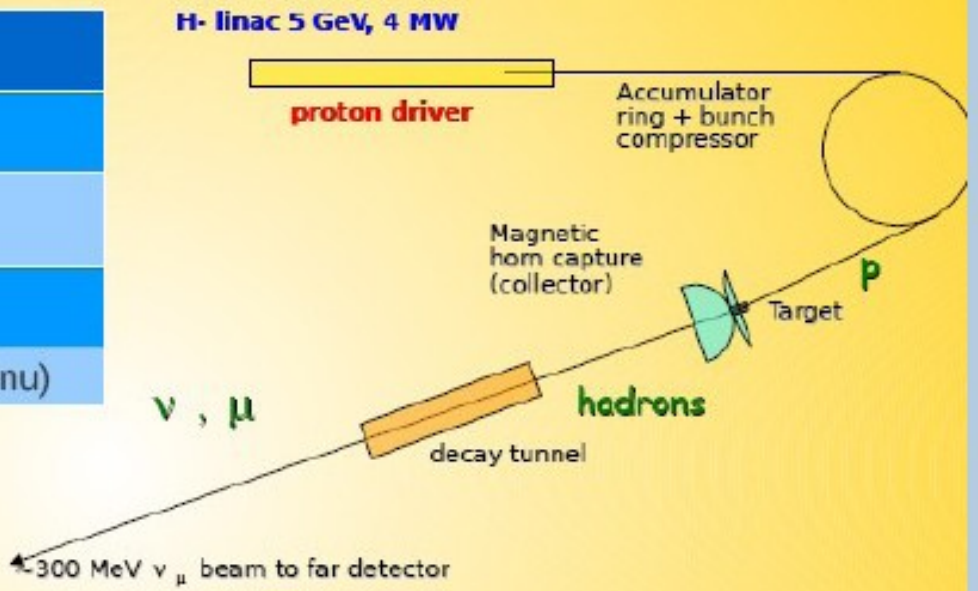
Great flexibility in Europe to choose the best combination Detector – Distance - Beam

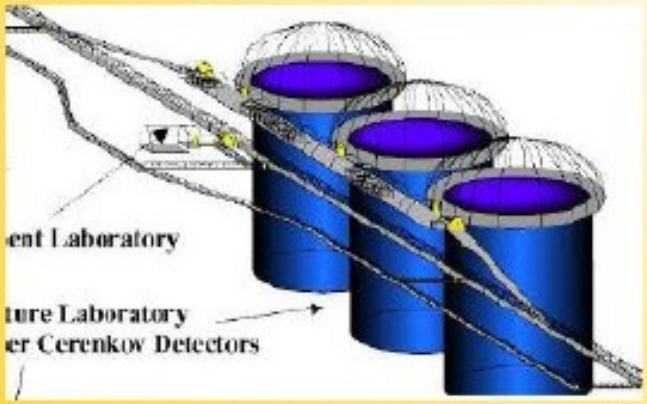
β–beam is a unique European concept in the world competition and has the highest physics potential !

CERN to Fréjus

Basic scenario (detector, proton energy) is well defined

Beam Energy	5 GeV
Baseline	130 km
Far detector	MEMPHYS
Mass	440 kton
Running mode	2 y (nu) + 8y (antinu)





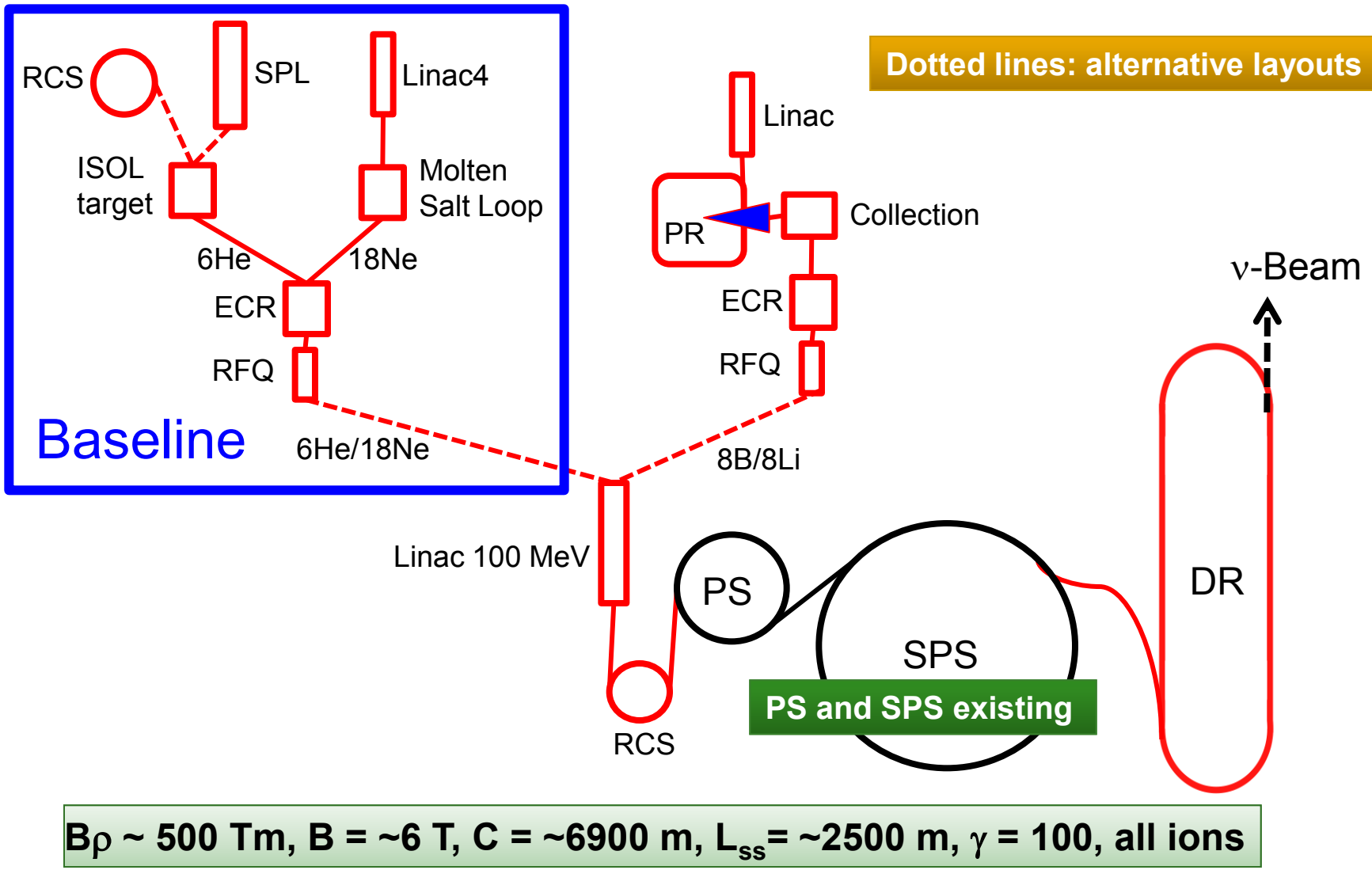
Proton beam

Energy	4.5 GeV
Beam Power	4 MW
N. beam lines	4
Rep. rate	12.5 Hz
Pulse dur.	5 μs
beam gauss width	4 mm

Conclusions

- We have produced a baseline design for a multi-MW neutrino beam based on SPL(recently completed note EUROnu-WP2-11-01)
- It is composed of four identical systems, with a pebble-bed target and a magnetic horn
- We have produced a detailed simulation of the neutrino intensity and composition, event rates and sensitivity
- We are entering the final phase of the EUROnu project, completing the technical studies and will produce a detailed technical report

CERN Beta Beams, Synoptic



Bρ ~ 500 Tm, B = ~6 T, C = ~6900 m, L_{ss}= ~2500 m, γ = 100, all ions

Vast BB progress (see report)

- Ion production: Ne problem solved
  Experimental setup&measurements, Isolde, from May 2011
- Ion production: 8B and 8Li production ring
  liquid film instead of jet target
  8 Li measuremnt i progress (Legnaro)
- Improved design of deacay ring
- Integration with PS and SPS upgrade studies
- Collection device (Louvain)
- Duty cycle compression
- Radiation issues under control
- Progress 60 GHz source

Well defined baseline parameter list

Must tackle safety and costing next

Continuation (2011-

- Experiments on 18Ne production (molten salt loop)
- Cooling and production simulations for 8Li and 8B
- Cross-section measurements of 8B
- Experimental setups for Heidelberg TSR to test P-ring concept
- 8B collection setup and experiment
- ECR fields for plasma -> 30 000A (structures supra…), Gyrotron tests, beam extraction, Proto -> ECR Source
- Collective effects studies, all machines, DR optimization
- Participation in upgrades of injectors for LHC
- Decay Ring RF, technical feasibility studies
- Costing and Safety, for performance/cost evaluation (EUROnu)

High energy long baseline neutrino experiments: from Superbeams to Neutrino Factory

NEU2012 Annual Meeting

CNRS - Paris

09 May 2011

Silvia Pascoli

IPPP - Durham University

Long Baseline ν beams at CERN

LAGUNA-LBNO Design Study

I. Efthymiopoulos - CERN

EUCARD - Neu2012 Meeting
Paris - May 10, 2011

CNGS Technology Upgrade Possibilities

- **Limitations:**
  - key elements of the secondary beam line: target, horns, beam windows
  - layout and RP considerations, SPS RF and beam extraction system
- **CNGS upgrade ⇔ SPS upgrade:**
  - Possibilities will be studied within the LHC Injector Upgrade project (**LIU**) and followed in **LAGUNA-LBNO**
    - **750kW** may be reachable, going beyond would require substantial consolidation of the facility

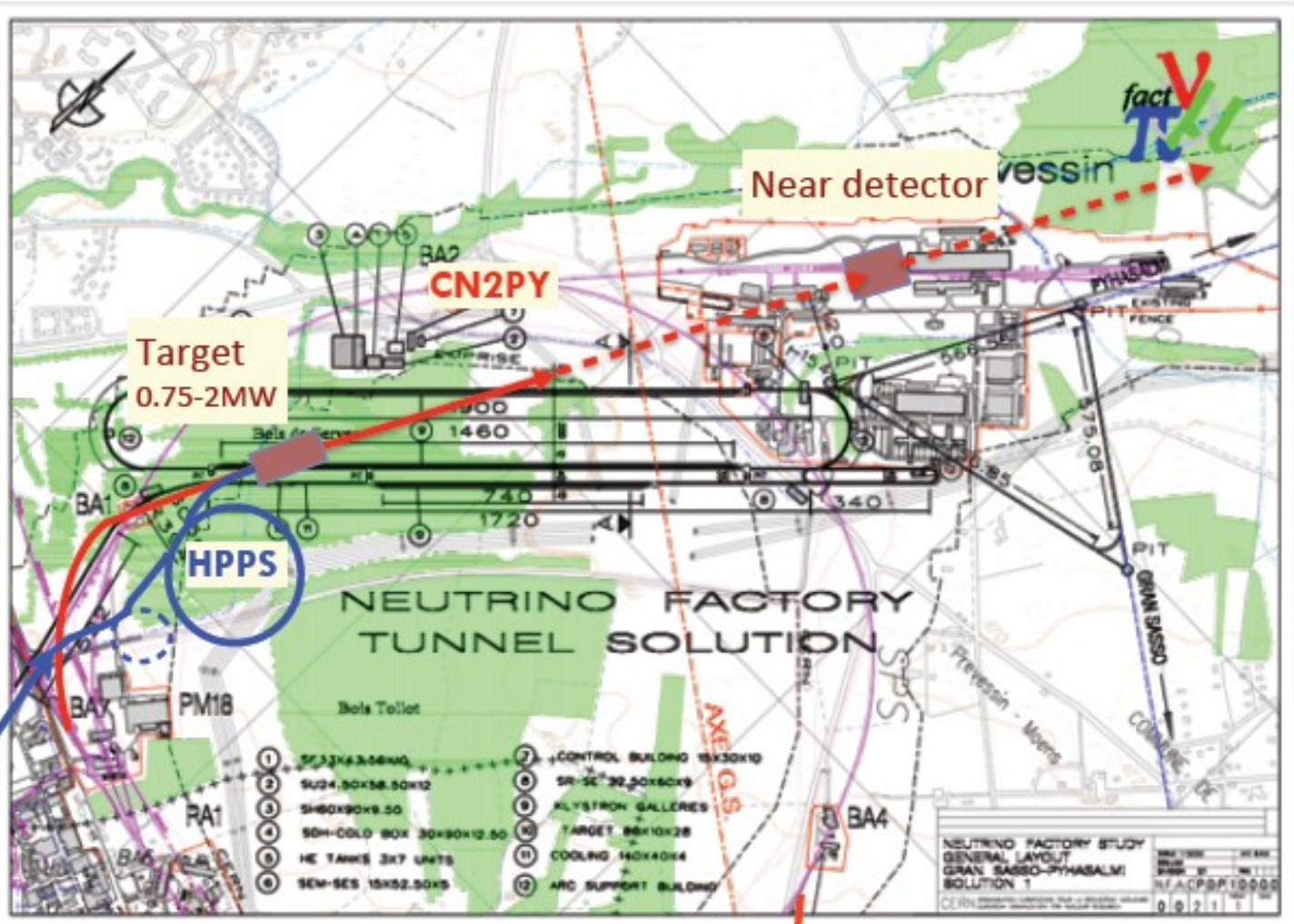
Int. per PS batch	# PS batches	Int. per SPS cycle	200 days, 100% efficiency, no sharing	200 days, 55% efficiency, no sharing	200 days, 55% efficiency, 60% CNGS sharing
		[prot./6s cycle]	*[pot/year]*	*[pot/year]*	*[pot/year]*
2.4×10^{13} - Nominal CNGS	2	4.8×10^{13}	**1.38×10^{20}**	**7.6×10^{19}**	**4.56×10^{19}**
3.5×10^{13} - Ultimate CNGS	2	**7.0×10^{13}**	2.02×10^{20}	1.11×10^{20}	6.65×10^{19}

M.Meddahi, E.Schaposnicowa - CERN-AB-2007-013 PAF

750kW design limit for the target

working hypothesis for RP calculations

CERN ν-beam to Pyhasalmi - CN2PY



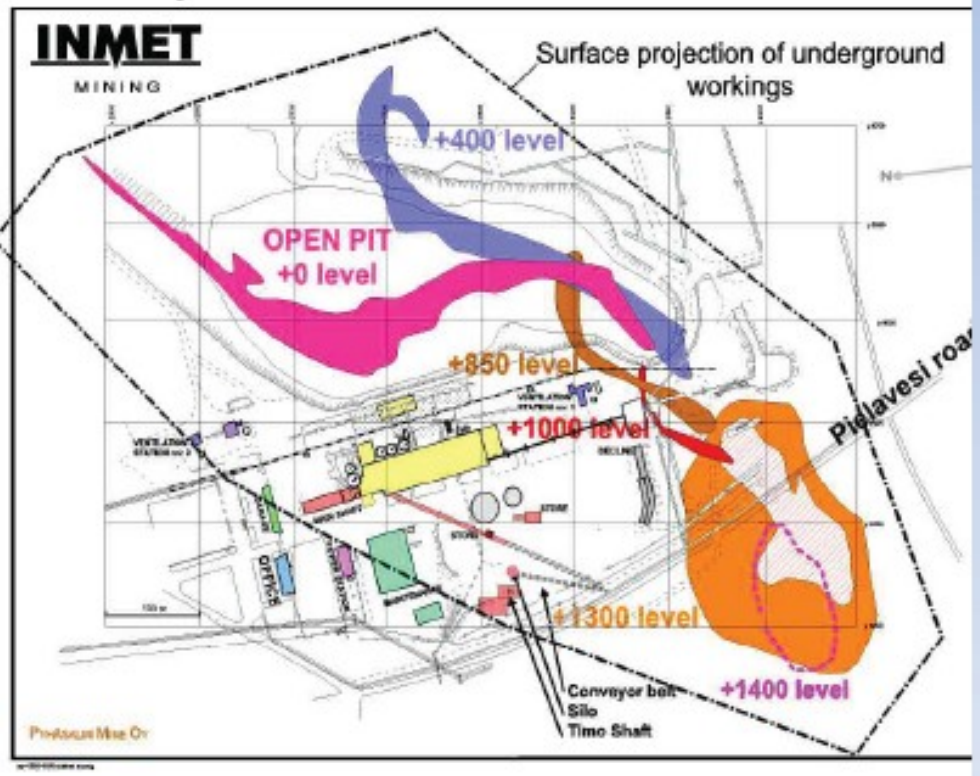
Potential LAGUNA detectors at Pyhäsalmi

André Rubbia (ETH Zurich)

FP7 Research Infrastructure "Design Studies" LAGUNA (Grant Agreement No. 212343 FP7-INFRA-2007-1)

EuCARD 2nd Annual Meeting, CNRS, Paris, May 10th 2011

3-D impression of Pyhäsalmi mine

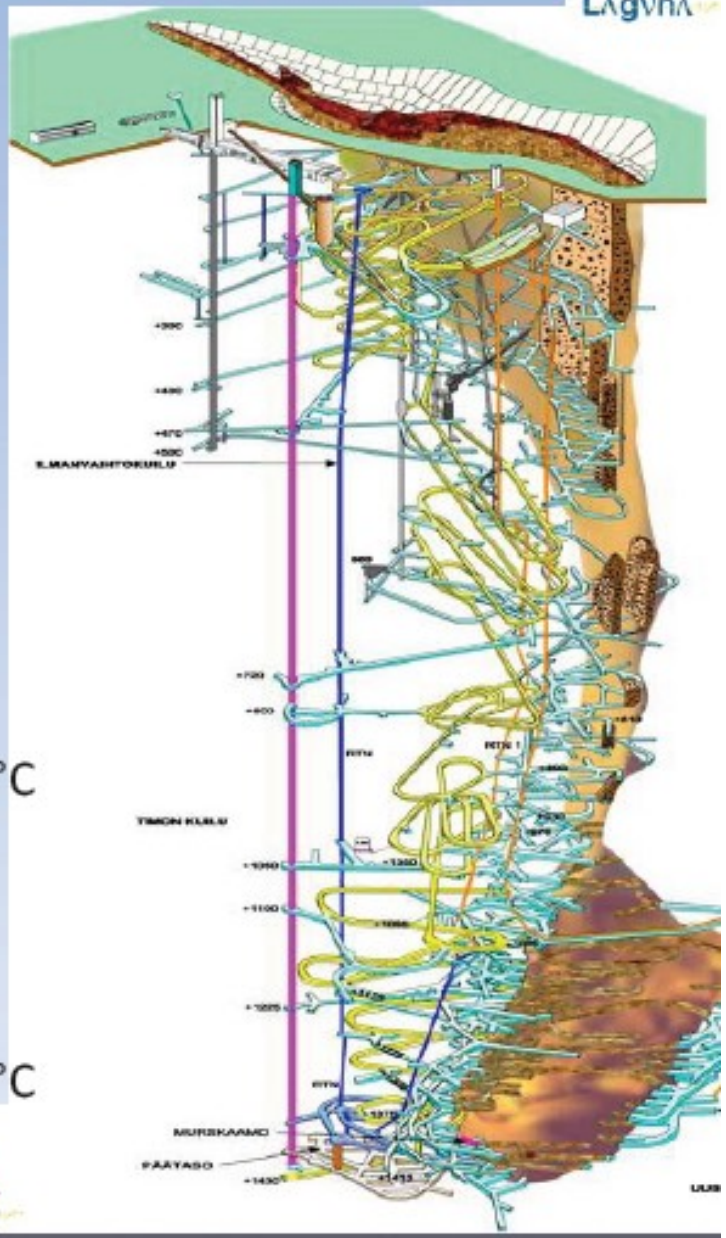


Temperature conditions of in-situ r

T=5°C

T=16°C

T=22°C



LAGUNA physics goals

Primary goals of the next generation experiments are:

1. Accelerator-based (particle)

- ★ Long baseline neutrino oscillation experiment for θ_{13}, CP-violation and neutrino mass hierarchy discovery and precise parameters determination

2. Non-accelerator based (particle + astroparticle)

- ★ Proton decay hunt
- ★ Precise measurement of supernova neutrinos
- ★ Precise determination of solar and (subleading) atmospheric neutrino oscillation parameters
- ★ Supernovae remnants neutrinos
- ★ Precise determination of geo-neutrinos

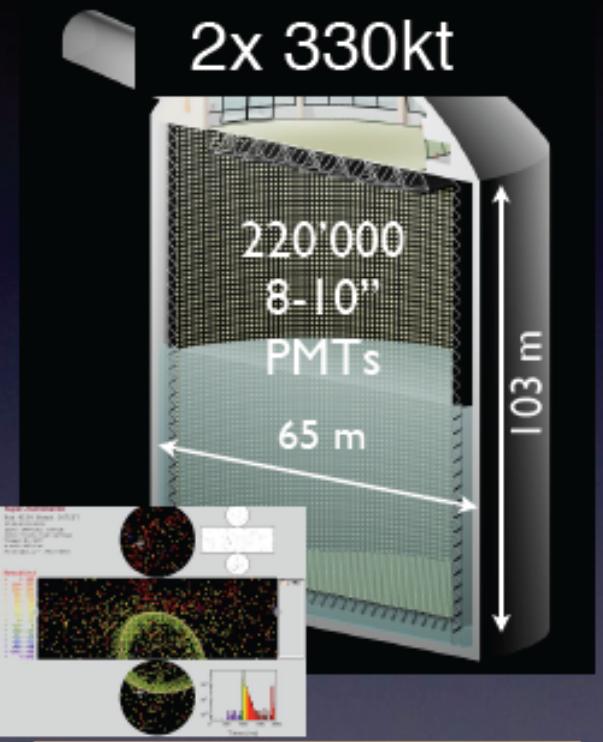
Very broad and rich physics programme recognized by "roadmaps" worldwide

LAGUNA-LBNO detector options

- From the three "liquid detector technology" options, the Pyhäsalmi study within LAGUNA-LBNO will focus on GLACIER and LENA, assuming h.e. conventional beam from CERN
- Prospects to magnetize detectors (e.g. for charge determination) will also be investigated in LAGUNA-LBNO

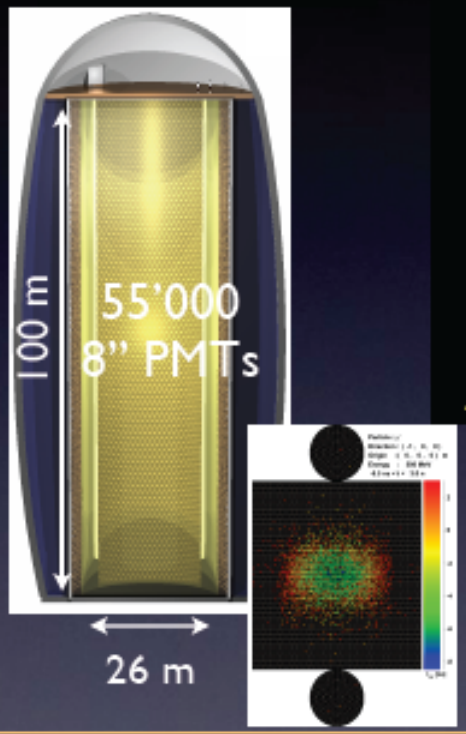
MEMPHYS

2x 330kt



Extensive experience from SK, K2K, T2K, adequate for single ring QE events: low efficiency for CN2PY baseline & limited background suppression

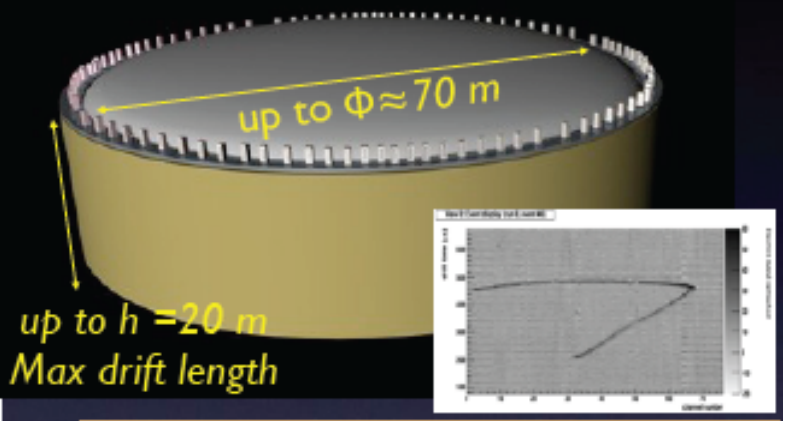
LENA 50kt



Experience from Borexino

MC studies on CN2PY beam event reconstruction
Background suppression to be further studied

GLACIER 100kt



Bubble chamber like imaging well matched to CN2PY beam, high efficiency and strong background suppression

Challenging technology, worldwide R&D (EU,US,Japan) with several prototypes of small scale; extrapolation based on industry support

Undergrou

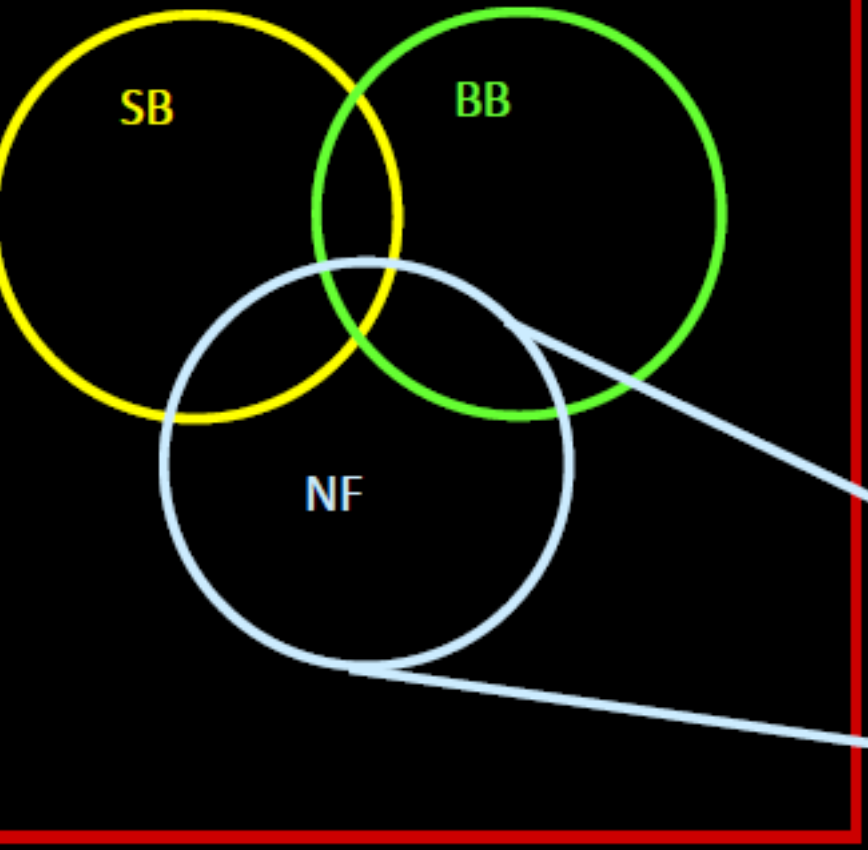
Proposal t
what will be

a home for the first
5 KTon or so
Li-Ar tank

EUROnu and the IDS-N

EUROnu is the European contribution to the IDS-NF

EUROnu



IDS-NF

- The Americas
  - Canada
  - USA
- Asia
  - Japan
  - India
  - (in the future: China …)
- Europe
  - EUROnu

Vast NF progress (see report)

- Proton driver
- Target and radiation shielding
- Muon front end, cooling
- Acceleration
- Storage ring
- Detector optimization

Well defined baseline parameter list
with a few variants

Must tackle safety and costing next

Neutrino Factory roadmap

07Mar10

2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019

MICE

MERIT

EMMA

Detector and diagnostic systems development

EUROnu

ISS

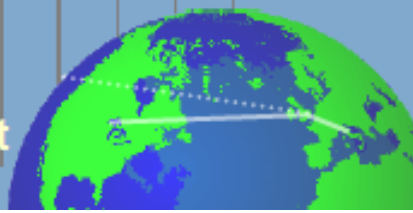
International Design Study

Neutrino Factory project

Physics

Interim Design Report

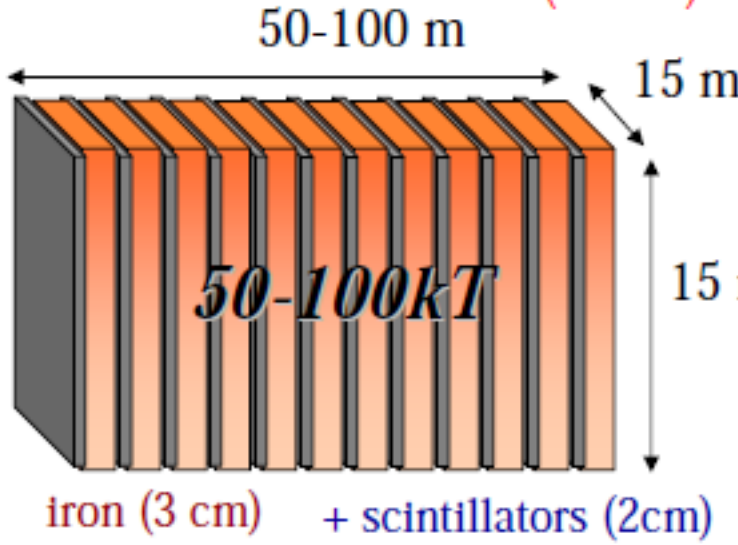
Reference Design Report



Baseline for a Neutrino Factory: MIND

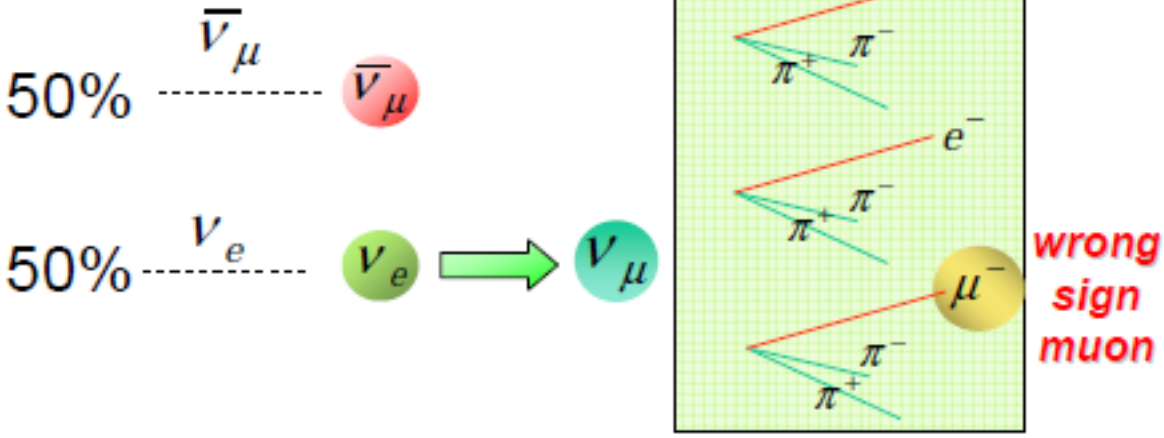
- Golden channel signature: appearance of "wrong-sign" muons in magnetised iron calorimeter

Magnetic Iron Neutrino Detector (MIND)



IDS-NF baseline for 25 GeV NuFact:

- **Two far detectors:**
  - **2500-5000 km baseline: 100 kton**
  - **7000-8000 km (magic) baseline: 50 kton**
- **Appearance of "wrong-sign" muons**
- **Segmentation:**
  - **3 cm Fe + 2 cm scintillator**
- **1 T magnetic field**



Long scintillator detectors

Large volume segmented neutrino detectors:

Totally Active Scintillator Detectors

Magnetized Iron/Scintillator Sampling Detectors

Scintillators of different shape and length, WLS fibers, non-sensitive to magnetic field photosensors

Three main components of tested scintillator detectors:

- extruded scintillator slabs and bars

- WLS fibers: double clad, 1-mm diameter Y11

- photosensors: avalanche photodiodes operating in a limited Geiger mode (MRS APD, CPTA, Moscow; MPPC, Hamamatsu)

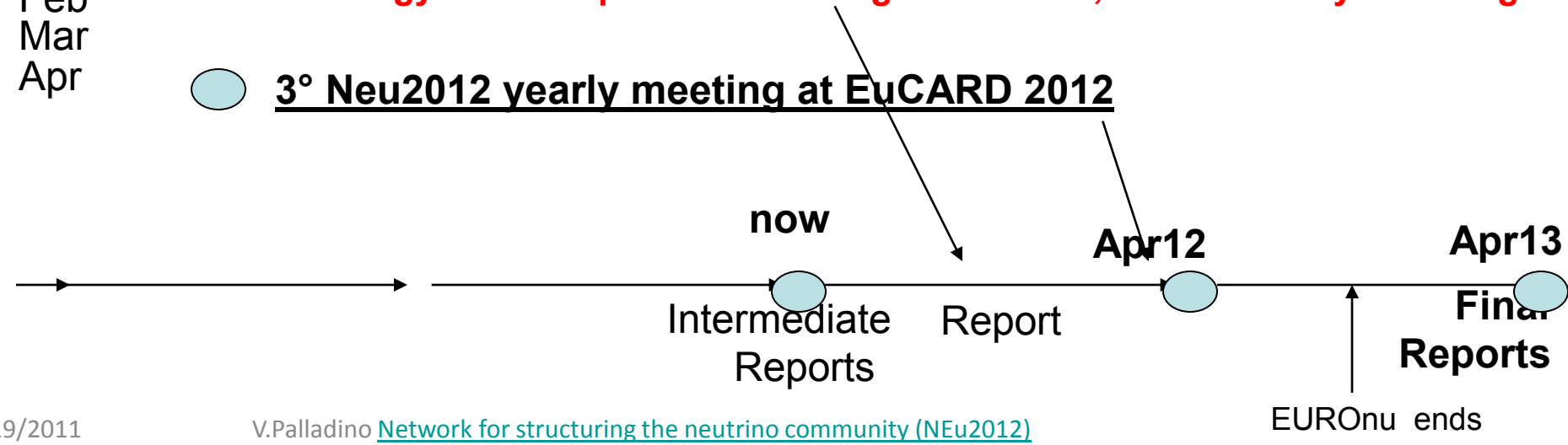
Midterm Reports
of
the EuCARD Networking Activity
NEu2012

(WP3, WP3.2, WP3.3)

DRAFT
report due 26 May 2011
to the EuCARD management

2011-12

April
May — Midterm Reports
Jun
Jul — EPS 2011, Grenoble, **July 23**
Aug — **NuFact11** UniGe/CERN
Sep — **NNN11,** Zurich
Oct
Nov
Dec
Jan
Feb — **2nd ν strategy Workshop .. town meeting … at CERN, before "Orsay" meeting**
Mar
Apr — **3° Neu2012 yearly meeting at EuCARD 2012**



Thank you