NEUtrino DETectors
N-EU-DET

4-years working plan for Neutrino Detector R&D to take place in ~2009-2012

1. objectives and what is in EUROnu?
2. interested groups
3. JRA work packages
4. NA
5. TA
6. requested resources

The nice thing with neutrino beams is that one can have more than one detector on the same beam line!

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.*

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-- detector systems are very important part of the facility and will have a large impact on the choice

-- note the perfect adequation in dates

ECFA study groups
BENE (in CARE)
Int'l Scoping Study (ISS)

Steering group (EU):

A.Blondel (Geneva)
P.Soler (Glasgow)
A.Cervera (Valencia)
A.Rubbia (ETHZurich)
JE.Campagne (Orsay)
E. Radicioni (Bari)
V. Palladino (BENE)

[a] *ICRR, University of Tokyo, Tokyo, Japan*
[b] *CCLRC, Rutherford Appleton Laboratory, UK*
[c] *ETH, Zurich, Switzerland*
[d] *INFN Sezione di Milano, Milano, Italy*
[e] *University of Geneva, Geneva, Switzerland*
[f] *CEA/DAPNIA-Saclay & APC Paris*
[g] *CERN, Geneva, Switzerland*
[h] *FNAL, USA*
[i] *University of Granada, Granada, Spain*
[j] *LAL, Univ Paris-Sud, IN2P3/CNRS, Orsay, France*
[k] *Laboratori Nazionali di Frascati dell'INFN, Frascati (Roma), Italy*
[l] *IFIC, University of Valencia and CSIC, Valencia, Spain*
[m] *Università di Napoli Federico II and INFN, Napoli, Italy*
[n] *University of Bern, Bern, Switzerland*
[o] *Laboratori Nazionali del Gran Sasso dell'INFN, Assergi (L'Aquila), Italy*
[p] *Toho University, Funabashi 274-8510, Japan*
[q] *University of Sofia, "St Kliment Ohridski"*
[r] *Hamamatsu Photonics, Japan*
[s] *Nagoya University, 464-01 Nagoya, Japan*
[t] *Sodankyl Geophysical Observatory, University of Oulu, Oulu, Finland*
[u] *INR, Moscow, Russia*
[v] *Università di Padova and INFN, Padova, Italy*
[w] *SUNY Stony Brook, NY, USA*
[x] *York University, York, Canada*
[y] *Tata Institute, Mumbai, India*
[z] *Università di Pavia and INFN, Pavia, Italy*
[aa] *KEK, Tsukuba, Japan*
[ab] *College of William & Mary, Williamsburg, Virginia, USA*
[ac] *Centre for Underground Physics Pyhäsalmi, Univ of Oulu, Oulu, Finland*
[ad] *Università di Milano and INFN, Milano, Italy*
[ae] *IFAE, Barcelona, Spain*
[af] *Università di Bologna and INFN, Italy*
[ag] *University of Glasgow, Glasgow, Scotland, UK*
[ah] *Imperial College, London, UK*
[ai] *University of Oxford, Oxford, UK*

1. The concept of submitting a neutrino-IA was part of our discussions in the ISS and was well received by ECFA.

2. neutrinos and associated technologies are well known to the EU commissioner and to the contact person for particle physics (Daniel Pasini), in great part due to the important part played by neutrinos in the CERN council Strategy document(CSD). The EUROnu design study did extremely well and Laguna did well.

3. In line with the CSD, the EU does not want to interfere with the choice of future facility
SuperCNGS
Superbeam
betabeam
neutrino factory
thus we should strive to emphasize the synergies between the projects and the fact that we are trying to find the best facility rather than support a priori a particular one.

Detectors for future neutrino facilities

1. Very large (Megaton) Water Cherenkov detectors -- non magnetic
2. Very large (100 kton) Liquid Argon detector
3. Very large (100 kton) Magnetized Iron Neutrino Detector (MIND)
4. Very large (20 kton) Totally Active Scintillator Detector (TASD)
5. Very Large (10 kton) Emulsion Cloud Chambers (ECC or MECC)
6. near detectors for leptonic and hadronic ν interactions, charm

2,4,5 can be embedded in a **Very Large Magnetic Volume** (air-core magnet)

questions concern
performance (e.g. what is the charge separation for 1 GeV muons in MIND)
feasibility and cost
feasibility and peformance of hybrid systems combining the various technologies

JRA Work packages

-- Test beam infrastructure (Radicioni)
-- Photon detectors (near and far detectors) (Soler, Cervera)
-- Cryogenic (liquid argon) detector studies (Rubbia)
-- Silicon detectors for near detectors (Soler)
-- Very large magnet development (NN)

Networking activities: (Cervera) (two NA, management, and:)
-- putting it all together, coordintation of test beam, web master, etc..
-- common simulation and performance and cost evaluation framework work towards forming a community consensus
-- conception of hybrid detectors and combined test beam measurements
-- link to industrial partners and other fields using similar detectors (LHC/LC)

Transnational access (one)
-- access to test beam facilities

Attention will be paid to link to related activities in EUROν and LAGUNA design studies without duplication

Infrastructure for test beam (Emilio Radicioni)

test beam (CERN, perhaps RAL MICE beam for <400 MeV/C beams) needs
a large magnet i.e. H8 magnet or similar size/field
DAQ, trigger, electronics, data storage
hadron, muon and electron beams in energy range
of oscillating neutrinos (0.5 to <~10 GeV)
beam PID and spectrometer
very different than LHC detector development
challenges: high number of channels, cost per channel, mip availability: a few months per year

neutrino beam?
Gran Sasso off axis near detector seems impossible
(too large investment for only detector R&D)
people are presently testing on NUMI beam at fermilab (0.5-20 GeV)
and will test on T2K ND280 (lower energy, 0.5 – 5 GeV)

started filling preparatory forms

FP7 preparation -- detectors Neutrino detector development

Please fill the information below as detailed as you can, in particular also for deliverables and schedule. This will only be used internally and not be used to define the deliverables for the EC. Copy the bordered part as many times as you need for different activities.

Lab/institute: University of Glasgow/Universitat de Valencia Date:

Person in charge (with tel. and email): Paul Soler, Anselmo Cervera

1. Abstract of the planned activity:

WP2. light detectors for MIND/TASD

Used existing infrastructure(s): Laboratory space in institutions, test beam facilities at CERN.

List of deliverables and rough schedule:
- Comparison of performance of photon detector devices (APDs, Silicon PMTs, Multi-anode PMTs and HPDs)
- Quantum efficiency and magnetic field tolerance of photon detectors
- Cost per channel and cost comparison of photon detectors
- R&D on extruded scintillator and optic fibre readout: attenuation as function of length, fibre insertion, optimal geometry
- Comparison of performance of RPC vs scintillator?
- Build prototype with a magnetic field to put in CERN test beam to measure tracking resolution, charge mis-identification, two track separation, ….

Institutions involved: (indicative list, not everyone contacted, could be made shorter if too many institutions)
Glasgow (Paul Soler), Valencia (Anselmo Cervera, JJ Gomez Cadenas), Geneva (Alain Blondel), Barcelona (Federico Sanchez), Brunel (Malcolm Ellis, Paul Kyberd), RAL (Alfons Weber), Imperial (Ken Long), Warwick (Paul Harrison, Gary Barker), Sheffield (Chris Booth), Sofia (Roumen Tsenov), Italian groups such as Napoli, Milano or Bari?, any other?

Resources	Material [€]		Integrated human resources		
	direct [€]	Indirect [€]	[FTE·months]	direct [€]	indirect [€]
Lab contribution (a)					
Requested (b)					
Total (a+b)					

For the lab contribution, please indicate the level of commitment, e.g. "has support of lab director" or similar:

FP7 preparation -- detectors

Neutrino detector development

Implied contribution by other collaborator not included above:
Potential collaboration with:
Fermilab (Alan Bross, Ana Pla-Dalmau) on scintillator extrusion and photon detector R&D,
India (Naba Mondal) on comparison to RPC and construction of prototype for test beam
Japan (need names here, Makoto?) on fibre readout

Any other relevant information:

Lab/institute: ETH Zürich Date:

Person in charge (with tel. and email): André Rubbia, +41227678924, andre.rubbia@cern.ch

1. Abstract of the planned activity:

WP3 : liquid Argon TPC

R&D for large, possibly magnetized, liquid Argon TPCs (GLACIER project), in particular development and optimization of new methods for charge & light readout, HV, feed-throughs, electronics, purification, long drift paths, and magnetization.
Charged particles test beams for calorimetry studies and particle identification and separation. Test with and without magnetic field.

Institutions involved: Bern Univ, ETHZ, IPN Lyon, Zurich Univ + presumably Granada Univ., Polish groups might be interested, also Sheffield

Infrastructure (from CERN): large aperture magnet, test beam space, recycled cryostats

Resources	Material [€]		Integrated human resources		
	direct [€]	Indirect [€]	[FTE·months]	direct [€]	indirect [€]
Lab contribution (a)					
Requested (b)					
Total (a+b)					

For the lab contribution, please indicate the level of commitment, e.g. "has support of lab director" or similar:

next events

-- evaluated budget ~funding request of < 10M€
but too early to be much more precise.

-- need to findMagnet guru and define workpackage

-- regular phone meetings of SG

-- NEUDET Kick off meeting:

NOVEMBER 13 at CERN
(+ visit of test beam areas on 14 November in the morning)