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A collaborative effort toward the design of a Near Detector for the new generation of accelerator long-baseline neutrino oscillation experiments

The next generation long-baseline experiments aim to unprecedented systematic accuracy (better than 3%). As demonstrated by current experiments (MINOS [↗](#), T2K [↗](#), NOvA [↗](#)), near detector(s) will be a key element to achieve this goal, together with neutrino event generators and complementary measurements/simulations as hadron production.

In the past two decades the European neutrino community has acquired significant know-how in detector technology for a wide range of neutrino physics topics, which is a crucial background to define the best design of a near detector.

CERN proposes to act as a forum for the European effort to understand the needs and requirements for the future generation of Near Detectors and in parallel to contribute to improve the existing neutrino event generators. Even though this study group was initially motivated by the DUNE needs, its goals and participation extend to a larger audience. A wealth of experimental and theoretical activities, ideas, collaborations, is emerging in Europe, some of them already connected with CERN, as for instance the Neutrino theory [↗](#) group, the ArgonCube [↗](#) and BabyMind [↗](#) detector activities, and more recently the Expression of Interest [↗](#) for Near detectors based on gas TPC. Developments from all these efforts can be of interest for the entire Neutrino community and thus be part of a wider project.


Organisation

This collaborative effort (CENF-ND) will address the physics needs first, without any assumption on the detector technology. The final design of the detector(s) will be then derived by the compromise of the best technology solutions to achieve the desired measurements. The CENF-ND working group will work in close contact with the DUNE Near Detector Concept Study [\[1\]](#) (see also near detector task force [\[2\]](#) and workshops [\[3\]](#)) with the purpose to actively contribute to the final design. It also aims at fully integrating in this CENF-ND effort the groups active in the preparation and design work of the HyperKamiokande ND system so as to address their needs.

The work will be organised into four working groups. For the various contributions to the current main systematic errors (flux, cross-section modelling, π^0 background) the dedicated WG will address the paths to its reductions and the definition of detector requirements and Monte Carlo generators will be the final deliverable. A fifth working group will identify and support the R&D necessary to implement possible ND concepts.

A preliminary list and purposes of the WG activities is presented below. A separate Twiki page and mailing list have been set up for each WG.

@ Work

If you are interested to join the CERN effort on near detector for neutrino experiments, subscribe to CENF-ND [🔗](#) .

Current list of members here

Meetings in indico [🔗](#) (CERN, Home » Projects » CENF » Near Detectors)

First general vidyo meeting on Tuesday 11th July at 14:00 CEST :

- Agenda: <https://indico.cern.ch/event/652260/> [🔗](#)
- Minutes: CENF-NDintrometing_minutes.pdf

General meeting (via vydio) in September A short mail from each member with expression of interest for one or more (sub) topics would be welcome.

General Meetig at CERN 27th and 28th November * Agenda and registration https://indico.cern.ch/event/674901 [🔗](#)

General Meetig at CERN 18th April * Agenda https://indico.cern.ch/event/718570 [🔗](#)

WG1

Measurement of neutrino flux

Mailing list: [CENF-ND-Wg1](#) 

GitLab: [gitlab repository for CENF-ND-Wg1](#) 

- [Readme](#)

The working group will focus on the neutrino flux measurements. Measurements both in-situ and/or with the help of complementary experiments will be considered. Physics studies will be performed to assess advantages and limitations of each approach and define which detector characteristics would be the most suitable to perform the measurement. The WG1 is expected to work in close contact with the WG4 in order to estimate the reduction of the systematic uncertainties for the oscillation analyses.

We are attempting to gather information in this summary spreadsheet for all relevant projects.

[Summary spread sheet for projects](#)


more infos...

WG2

Cross sections, theory and generators

Mailing list: [CENF-ND-Wg2](#) 

GitLab: [gitlab repository for CENF-ND-Wg2](#) 

- [Readme](#) 

This working group will focus on the capability of theoretical models and Monte Carlo generators to describe neutrino interactions. Starting from a thorough comparison of existing models with experimental data, the group will foster and participate in the improvement of event generators.

more infos...

WG3

Cross sections, experimental

Mailing list: [CENF-ND-Wg3](#) 

GitLab: [gitlab repository for CENF-ND-Wg3](#) 

- [Readme](#)

This working group will focus on the detector effects and designs that are necessary to identify specific neutrino interactions and to measure their cross sections and thus constrain theoretical uncertainties. It will provide input to and work in collaboration with WG4

more infos...

WG4

Sensitivity studies

Mailing list: [CENF-ND-Wg4](#) 

GitLab: [gitlab repository for CENF-ND-Wg4](#) 

- [Readme](#)

This working group will focus on evaluating the impact of experimental and theoretical uncertainties on the experiment sensitivity. It will work in close collaboration with WG2 and WG3 and as part of the [DUNE](#) and [HyperKamiokande](#) experiments and also learn from already existing methodologies and experiments like [MINOS](#), [T2K](#), [NOvA](#).

more infos...

WG5

Requirements for detectors and R&D

Mailing list: [CENF-ND-Wg5](#) 

GitLab: [gitlab repository for CENF-ND-Wg5](#) 


- [Readme](#)

This working group will identify and support the R&D necessary to implement possible ND concepts.

more infos ...

About Computing

Neutrino Computing Cluster for CERN-ND

[gitlab repository for CENF-ND](#) 

Preparation to UESPP

Page dedicated to collect material to prepare a written document to submit for the preparation of the Update of the European Strategy for Particle Physics Input UESPP

[Back to CENF-R&D Projects Twiki Main Page](#)

- [members-CENF-ND.csv: members-CENF-ND.csv](#)

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