This application is submitted for consideration within the University of Tokyo - CNRS Collaboration Program

Title: **Preparation of the Hyper-Kamiokande experiment – a unique observatory for rare events in the Universe**

2021-2024

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The Hyper-Kamiokande (HK) experiment will be built in Japan by an international collaboration. The detector will hold 260000 tonnes of ultra-pure water – more than five times larger compared to the existing Super-Kamiokande (SK). The enormous size of the HK will enable it to detect unprecedented numbers of neutrinos produced by various sources — including the Sun, supernovae, cosmic rays and beams artificially produced by an existing particle accelerator. In addition to catching neutrinos, it will monitor the water for a possible spontaneous decay of protons in atomic nuclei, which, if observed, would be a revolutionary discovery.

Profiting from the newly created International Research Laboratory (IRL) a joint team of physicists from LPNHE-Paris and University of Tokyo plans to contribute to the HK detector construction via a precise time distribution and synchronization system and to the physics analysis via data calibration and reconstruction. Developed prototypes will be tested insitu in SK which is also a far detector of the currently running T2K-II experiment. In parallel we also contribute to the ongoing upgrade of the near detector ND280 and to additional hadron production measurements with the NA61/SHINE spectrometer at CERN which would help reducing (anti)neutrino flux uncertainties from the J-PARC accelerator and improve precision of (anti)neutrino cross section measurements. All these improvements would allow to calculate realistic sensitivities of HK experiment for neutrino oscillation parameters, including CP-violation phase.

Introduction

During the last decade the LPNHE-neutrino group has been involved in the T2K experiment which uses the Super-Kamiokande (SK) detector to register (anti)neutrino interactions from neutrino and antineutrino beams produced by the J-PARC accelerator. A close and fruitful collaboration has been established with Japanese physicists, including colleagues from the University of Tokyo, see the list of common publications in the Appendix. Moreover, members of this proposal were aworded the **2016 Breakthrough Prize in Fundamental Physics** for their common work on the study of neutrino oscillations.

Recently, with the final approval of the Hyper-Kamiokande (HK) project by the Japanese government and endorsement obtained from the LPNHE Scientific Council, the LPNHE-neutrino group has also become involved in the HK experiment. The goal is to enlarge and to complement our current activities with studies of neutrinos from astrophysical sources using HK data. Indeed, full participation in the HK experiment will open a possibility for our group to study solar, atmospheric, supernovae neutrinos and by performing combined analyses of accelerator neutrino and antineutrino data with measurements of (anti)neutrinos from natural sources.

Contrary to T2K, which had access only to a subset of SK data in a small time window around the neutrino beam spill, the Hyper-Kamiokande experiment, hosted by the University of Tokyo, has a broad physics program covering many areas of particle and astroparticle physics. Based on the proven technology of (Super-)Kamiokande, its much larger detector volume and additional improvements in key areas like photosensors and near/intermediate detectors make HK a straightforward yet powerful extension of the very successful Japan-based neutrino program.

This common research grant, if approved, would allow us to prepare and submit a detailed proposal for the HK construction and operation funding to our respective funding agencies, in particular CNRS-IN2P3 in France. There is also a possibility to extend our proposed participation to the HK-related activities in the framework of the EU grant JENNIFER-II.

Right from the start of their history, the large Water Cherenkov detectors have been particularly successful in detecting neutrinos from astrophysical sources. Back in 1987, Kamiokande detected a few neutrinos emitted by the famous 1987A supernova (SN) explosion, while in 1998 SK observed, for the first time, flavour oscillations of neutrinos produced in the atmosphere and in the Sun. The former observation opened a new window on neutrino astronomy and other exotic searches such as axion by constraining models describing the SN explosion mechanism, while the later proved the existence of neutrino oscillations predicted about 40 years earlier by Bruno Pontecorvo. More recently, new results from the T2K experiment using the muon neutrino beam from the J-PARC accelerator directed towards the SK detector conclusively showed that muon neutrinos transform to electron neutrinos, discovering appearance of new neutrino type in neutrino oscillations.

As the next-generation Water Cherenkov detector, Hyper-Kamiokande with a fiducial volume 8 times larger than Super-Kamiokande will start data taking by 2027. A new detector of 260 kton of water located 295 km down the muon neutrino beam generated by the J-PARC facility will be equipped with more than 20,000 20-inches photomultipliers (PMTs) with a large quantum efficiency. In addition, it is planned to install several thousands of multi-photomultipliers

(mPMTs) that will enhance the detector capabilities at low energy. Indeed, the main advantage of the mPMTs is their improved timing resolution (from 2.6 ns for the 20-inches PMT to 1.6 ns for the 3-inches ones) allowing a reduction of the dark noise rate and an improvement of the spatial reconstruction efficiency.
One of the team leaders from the University of Tokyo – Prof. Masashi Yokoyama – is the HK detector group leader, while the other – Dr. Yoshinari Hayato – is responsible within the collaboration for the working group developing PMT electronics and DAQ system. The HK project technical coordinator at LPNHE Dr. Stefano Russo has also been recently nominated as a co-convener of the HK-Electronics working group. Dr. Claudio Giganti is the ND280-upgrade project leader within the T2K collaboration, while Dr. Boris Popov is the T2K-NA61contact person and the analysis coordinator for neutrino physics within the NA61/SHINE collaboration.

HK, thanks to its gigantic mass, will detect thousands of electron antineutrinos (via inverse beta-decay) and electron neutrinos (via elastic scattering) from SN bursts in the galactic center. Using the elastic scattering events, it will be possible to reconstruct the direction towards a SN at a distance of 10 kpc with an accuracy of about 1 degree. The events observed in HK will allow to provide detailed information about the time profile and the energy spectrum to further inspect SN explosion mechanism. In addition, it will be possible to detect neutrinos also from extra-galactic SN explosions. Even for distances of 4 Mpc, we will observe few tenths of neutrinos in HK and, at such distances, one SN is expected every three years. HK will also be able to detect the SN relic neutrinos (SRN) that are neutrinos produced by all SN explosions since the beginning of the universe. Such neutrinos fill the present universe and have a flux of few tens/cm^2/sec. The observation of SRN would allow understanding how heavy elements have been synthesized in stellar formation.
On top of that, HK will collect a large sample of atmospheric neutrinos. Such measurements will complement the long-baseline program and joint analyses between beam and atmospheric neutrinos are planned in order to improve the sensitivity to neutrino mass ordering and CP violation in neutrino oscillations. Indeed, the matter effects are rather small for the 295 km baseline of Tokai to HK making the sensitivity to the mass ordering limited, while atmospheric neutrinos emitted on the other side of the Earth and measured at the HK detector have crossed the Earth's core and experienced strong matter effects. Therefore, the HK detector as part of the Japanese long-baseline neutrino program will be extremely useful to further constrain neutrino oscillation parameters.
The success of this experiment relies on the excellent reconstruction of incoming neutrino energies and directions using the PMTs. The detection of SN events strongly depends on the reconstruction of the associated low-energy events and on the synchronization of HK PMTs and other experiments around the world. Moreover, reconstruction of neutrino interaction vertices in the detector requires an accurate timing determination of the event occurrence. It is therefore essential that an excellent clock distribution system is built for distributing and synchronizing time among all the detectors. Preliminary studies indicate that the timing precision should be lower than 1 ns with a maximum jitter of 100 ps RMS along with the capability of sending data using this link thanks to a sufficient bandwidth. Several solutions are under consideration at present, but two of them seem to be the most promising. One is based on the CERN White Rabbit (WR) protocol and the other on a custom solution.

World-wide, several detectors currently running or nearing completion are sensitive to a core-collapse supernova neutrino signal in the Milky Way using the so-called SNEWS (SuperNova Early Warning System) network. The neutrino burst signal emerges promptly from a supernova's core, whereas it may take hours for the first photons to be visible. Therefore, the detection of the neutrino burst from the next Galactic supernova can provide an early warning for astronomers. Requiring a coincident signal from several detectors will provide the astronomical community with a very high confidence early warning of the supernova's occurrence.

For detection of accelerator neutrinos, events registered in a far detector (SK or HK) should also be well synchronized with the J-PARC accelerator timing. Moreover, to enhance physics performance of the HK experiment it is really crucial to reduce as much as possible uncertainties on the knowledge of (anti)neutrino fluxes. For this purpose, additional hadron production measurements with a replica of the neutrino production target currently in use at J-PARC are being considered. The NA61/SHINE spectrometer at CERN has a unique possibility to perform such measurements, and physicists from LPNHE have already accumulated a significant experience in the course of the T2K experiment. We will continue our involvement in this project during the HK era since Dr. Boris Popov is acting as analysis coordinator for neutrino physics within the NA61/SHINE collaboration.

The PhD thesis in France will be dedicated to the development of the time synchronization system for the HK experiment in view of its integration into a worldwide network for SN detection. The implementation and characterization of a suitable solution will be done on several experimental setups, including the existing SK detector. The impact of synchronization precision on the low energy physics including SN will be studied and will provide motivated requirements for HK. In parallel, additional hadron production measurements with the NA61/SHINE spectrometer at CERN will be performed in order to reduce (anti)neutrino flux uncertainties from the J-PARC accelerator. All these improvements would allow to calculate realistic sensitivities of HK experiment for neutrino oscillation parameters, including CP-violation phase.

One should also stress that in the ongoing T2K experiment a multi-purpose magnetized near detector, ND280, is playing a crucial role as it is able to select samples of neutrino and (anti)neutrino interactions. This near detector will also be used during the start of the HK data-taking.

The ND280 is currently being upgraded with a new set of detectors. The Upgrade will consist in replacing one of the sub-detectors, the P0D, the most upstream inner detector of ND280, with two horizontal TPCs and a horizontal fully active carbon target in the middle (Super-FGD). Six Time-Of-Flight (ToF) planes will be installed around the TPCs and the Super-FGD. The upgrade will be installed in Summer 2022 with a start of data-taking planned in Fall 2022.

The ND280-Upgrade will allow to reconstruct with better efficiency muons produced in neutrino interactions (while with the current detector configuration only muons parallel to the beam direction are reconstructed with good efficiency) and the hadronic part of the interaction, largely reducing the threshold for the reconstruction of protons and pions.

The careful description of the hadronic part will help to better reconstruct the energy of the neutrinos and to shed light on the nuclear processes happening when (anti)neutrinos interact with nuclei. This work will be crucial not only to reach the physics goals of the phase II of T2K but also for the next-generation long baseline neutrino oscillation experiment. The ND280 will be one of the near detectors of HK, and the ND280-Upgrade is expected to provide inputs to oscillation analyses and cross-section modeling also in HK.

The proposed PhD thesis in Japan will be centered around the ND280-Upgrade project that is currently coordinated by the LPNHE researcher Dr. Claudio Giganti and was previously coordinated by Prof. Masashi Yokoyama from University of Tokyo. Thus, it would be a great opportunity for a PhD candidate to work under the supervision of Prof. Masashi Yokoyama in Japan and Claudio Giganti and Marco Martini during stays in France.

Research plan in France

This PhD thesis will be co-directed by Boris Popov (DR CNRS) and Stefano Russo (PhD Ingénieur de recherche, HDR, CNRS), members of the LPNHE-neutrino group, and by Yoshinari Hayato from the ICRR, University of Tokyo. The hardware part of the student's work will be devoted to the characterization of the clock distribution and time synchronization system for HK and its tests for the UTC time base generation within the existing SK setup. It will be complemented with the analysis of newly collected NA61/SHINE hadron production data and their usage for improved prediction of accelerator neutrino fluxes in T2K-II and HK experiments.
Sharing common expertise between French and Japanese groups will guarantee full support and guidance to the PhD student who will spend a significant fraction of time at the University of Tokyo and newly created International Research Laboratory (IRL), thus profiting from exciting and stimulating environment of both laboratories.
A detailed research plan is as follows.

First year (2021/2022): studies and development of a time synchronization system for HK; analysis of new NA61/SHINE hadron production data
Since a couple of years, the LPNHE group is working on its main contribution to the Hyper-Kamiokande experiment which is related to the communication block and, in particular, to the time synchronization and clock distribution for both the large PMTs and mPMTs since it represents a critical part of the experiment. Two solutions (custom and WR) are being actively explored.
We have already established close contacts with physicists from the SYRTE laboratory at the Paris Observatory. This is very important for the project described above as SYRTE colleagues have already accumulated a significant experience in precise time determination and clock synchronization between different locations. The HK experiment could largely profit from this know-how. This is crucial for the efficient inclusion of HK detector into the SNEWS network. In addition, a neutrino burst alert may be able to serve as a trigger for detectors that are not able to trigger on a supernova signal by themselves, allowing extra data to be recorded. Precise timing information will be used later for physics analysis.
The PhD student will work on the characterization of the time base production in the context of both SK and HK and the clock synchronization for HK in collaboration with SYRTE and

technical teams at LPNHE. The newly designed equipment will then be produced and tested with HK Front-End electronics being developed in collaboration with our Japanese colleagues. The PhD student will also perform physics analysis to study the impact of precise timing on the quality of reconstructed events in the HK detector especially on low-energy SN events. This will require a development of new reconstruction algorithms. Performance of those algorithms can be checked using already accumulated SK data with the help of colleagues from the University of Tokyo.
The student will also be involved in the data taking with the NA61/SHINE spectrometer at CERN using a replica of the carbon target being used at J-PARC for neutrino beam production. He/she will then participate in the calibration and analysis of these data.

2nd year (2022/2023): Insitu tests at Super-Kamiokande; improved predictions of (anti-)neutrino fluxes for T2K-II/HK
The LPNHE group has already purchased the required GNSS equipment (antenna and receiver) which will be used for a precise time-base definition for the clock distribution system. First prototypes of the time distribution system are being produced now. This equipment can be tested in the current SK configuration in order to characterize the achievable precision of the UTC time base generation under real conditions close to its final location. The second year of the PhD program will then be dedicated to this task.
In parallel, the newly obtained NA61/SHINE hadroproduction measurements will be used for improved predictions of (anti-)neutrino fluxes in T2K-II/HK. The student is expected to participate in these activities.

3rd year (2023/2024): Analysis of SK data; impact of these improvements on the HK projected sensitivity
The last year of the PhD will be dedicated to the analysis of data collected at SK and to the study of the impact of all these improvements (better timing precision and improved flux uncertainties) on the expected sensitivities for the HK experiment. The results of this analysis and the projected sensitivity of the HK experiment will be presented at international conferences and in peer-reviewed papers.
Finally, starting from February 2024, the student will focus on the preparation of the PhD manuscript, with an expected defense in September 2024.

Research plan in Japan

This PhD thesis will be co-directed by Prof. Masashi Yokoyama (University of Tokyo) and Dr. Claudio Giganti (CR, HDR, CNRS) and will be devoted to detailed studies of (anti)neutrino interactions in the upgraded ND280 detector.

The first year (2021/2022) will be devoted on investigations and developments of neutrino cross-section models. In particular the student will work in close collaboration with Dr. Marco Martini, one of the authors of a microscopic theoretical cross-section model which in these last ten years predicted and reproduced with success all the measured neutrino cross-sections at the T2K energies in different channels (like CC0π, CC1π, CC inclusive) and which, as first, raised the crucial role of multinucleon excitations in neutrino scattering. Unfortunately, this excitation channel is as crucial (in particular for the neutrino energy reconstruction) as difficult to treat without approximations. As a consequence, the predictions by the different theoretical models of the cross sections in this channel are different from each other in size and shape. Differences may appear also in the one pion production channel related to the treatment of pionless Delta resonance decay. The student will analyze the analogies and the differences of the several models implemented in the Monte Carlo used by T2K and will investigate the best strategy to test, constrain and eventually improve these models (in particular the one developed by M. Martini and collaborators) in several exclusive channels in connection with the new information in terms of leptonic and hadronic final state variables that will be provided by the imminent ND280-Upgrade measurements.

During the second year (2022/2023) of the PhD thesis, once the ND280 Upgrade data will be available, the student will be responsible for the selection of neutrinos interactions at superFGD with at least one proton in the final state as well as of the interactions with one proton and one pion final states. The student contribute to the estimation of the systematics uncertainties of the new detectors, will develop the analysis tools needed to measure neutrino cross-sections, and will work on the comparison of these data with the cross-section models.

The third year (2023/2024) will be devoted to the finalization of the analysis, to the inclusion of the tuned cross-section models in the T2K oscillation analyses and, of course, to the timely preparation of the PhD manuscript.

In parallel, the student will participate to the installation, commissioning, and calibration of the ND280-Upgrade detectors at J-PARC and it is expected that he/she will spend significant amount of time at Tokai, in the context of the CNRS-UoT funded international thesis.

Appendix

List of most significant COMMON scientific publications

Hyper-Kamiokande Design Report

Hyper-Kamiokande Collaboration • K. Abe (Kamioka Observ. and Tokyo U., IPMU) et al.

e-Print: 1805.04163 [physics.ins-det]

Physics potentials with the second Hyper-Kamiokande detector in Korea

Hyper-Kamiokande Collaboration • K. Abe (Kamioka Observ. and Tokyo U., IPMU) et al.

e-Print: 1611.06118 [hep-ex]

DOI: 10.1093/ptep/pty044

Published in: PTEP 2018 (2018) 6, 063C01, Prog Theor Exp Phys (2018)

[**Constraint on the matter–antimatter symmetry-violating phase in neutrino oscillations**]()

T2K Collaboration • K. Abe et al.

e-Print: [1910.03887]() [hep-ex]

DOI: [10.1038/s41586-020-2177-0](), [10.1038/s41586-020-2415-5]() (erratum)

Published in: Nature 580 (2020) 7803, 339-344, Nature 583 (2020) 7814, E16 (erratum)

[**Observation of Electron Neutrino Appearance in a Muon Neutrino Beam**]()

T2K Collaboration • K. Abe ([Tokyo U., ICRR]()) et al.

e-Print: [1311.4750]() [hep-ex]

DOI: [10.1103/PhysRevLett.112.061802]()

Published in: Phys.Rev.Lett. 112 (2014), 061802

[**The T2K Experiment**]()

T2K Collaboration • [K. Abe]() ([Kamioka Observ.]()) et al.

e-Print: [1106.1238]() [physics.ins-det]

DOI: [10.1016/j.nima.2011.06.067]()

Published in: Nucl.Instrum.Meth.A 659 (2011), 106-135

[**Indication of Electron Neutrino Appearance from an Accelerator-produced Off-axis Muon Neutrino Beam**]()

T2K Collaboration • [K. Abe]() ([Tokyo U., ICRR]()) et al.

e-Print: [1106.2822]() [hep-ex]

DOI: [10.1103/PhysRevLett.107.041801]()

Published in: Phys.Rev.Lett. 107 (2011), 041801

[**Measurements of neutrino oscillation in appearance and disappearance channels by the T2K experiment with 6.6×10^{20} protons on target**]()

T2K Collaboration • [K. Abe]() ([Tokyo U., ICRR]()) et al.

e-Print: [1502.01550]() [hep-ex]

DOI: [10.1103/PhysRevD.91.072010]()

Published in: Phys.Rev.D 91 (2015) 7, 072010

Precise Measurement of the Neutrino Mixing Parameter θ_{23} from Muon Neutrino Disappearance in an Off-Axis Beam

T2K Collaboration • K. Abe (Tokyo U., ICRR) et al.

e-Print: 1403.1532 [hep-ex]

DOI: 10.1103/PhysRevLett.112.181801

Published in: Phys.Rev.Lett. 112 (2014) 18, 181801

Evidence of Electron Neutrino Appearance in a Muon Neutrino Beam

T2K Collaboration • K. Abe (Tokyo U., ICRR) et al.

e-Print: 1304.0841 [hep-ex]

DOI: 10.1103/PhysRevD.88.032002

Published in: Phys.Rev.D 88 (2013) 3, 032002

T2K neutrino flux prediction

T2K Collaboration • K. Abe (Tokyo U., ICRR) et al.

e-Print: 1211.0469 [hep-ex]

DOI: 10.1103/PhysRevD.87.012001 , 10.1103/PhysRevD.87.019902

Published in: Phys.Rev.D 87 (2013) 1, 012001, Phys.Rev.D 87 (2013) 1, 019902 (addendum)

CVs of the project Principal Investigators

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2. Position Associate Professor

Education
3. Academic degrees
March 1998

Ph. D, Physics, Tokyo Institute of Technology;
Supervisor Yasushi Watanabe
Thesis "Search for proton decay into K+ nu-bar "

March 1993
B.A., Physics, Tokyo Institute of Technology

Academic Positions

4. Teaching and research positions
    1. University of Tokyo; Associate professor; November 2005 ~ present
    2. High Energy Accelerator Research Organization (KEK); Assistant professor; July 1999 ~ October 2005
    3. Japan Society for the Promotion of Science (JSPS); Research Fellowship for Young Scientists (PD); November 1998 ~ June 1999
    4. High Energy Accelerator Research Organization (KEK); Postdoctoral Fellow; April 1998 ~ October 1998

Committee etc. (excerpts).

1. System manager of the Kamioka computer system
2. Committee of the ICRR computer system
3. One of the members of the executive committee of the T2K experiment
4. One of the conveners of the neutrino interaction working group of the T2K experiment
5. One of the conveners of the electronics and DAQ system of the SK experiment
6. One of the members of the international advisory committee of the Neutrino conferences 2016 and 2018

Fellowship and Grants

3. Fellowship and Grants
    1. "Exploring new era of particle physics through the observations of natural neutrinos and the search for proton decays", 2018-2022; JSPS Grant-in-Aid for Scientific Research on Innovative Areas (Research in a proposed research area)
    2. "Development of Development of Digitizing Electronics and Readout for PMT Arrays", 2017; U.S.-Japan Science and Technology Cooperation Program in High Energy Physics
    3. "Development of the improved Super-Nova data acquisition system for Super-Kamiokande", 2011 ~ 2014; JSPS Grant-in-Aid for Scientific Research (B)
    4. "Development of the neutrino-nucleus interaction simulation program", 2007 ~ 2009; JSPS Grant-in Aid for Young Scientists (B)
    5. "Development of the neutrino production target for the T2K experiment in J-PARC", 2004 ~ 2005; JSPS Grant-in Aid for Young Scientists (B)
    6. "Study of neutrino induced kaon production", 2000 ~ 2001; JSPS Grant-in-Aid
    7. "Study of neutrino mass in the accelerator based long baseline neutrino oscillation experiment", 1998 ~ 1999; JSPS Research Fellowship for Young Scientists (PD) & Grant-in-Aid for JSPS Fellows
    8. "Study of nucleon decay in Super-Kamiokande", 1995 ~ 1997; JSPS Research Fellowship for Young Scientists (DC1) & Grant-in-Aid for JSPS Fellows

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Education

2. Academic degrees

March 2002

Ph. D, Physics, The University of Tokyo;
Supervisor Hiroaki Aihara
Thesis "Observation of Large CP Violation in the Neutral B Meson System Using $B^0 \rightarrow J/psi\ K_L$ Decay"

March 1997

B.Sc., Physics, The University of Tokyo

Academic Positions

3. Teaching and research positions
   1. The University of Tokyo; Professor; December 2019 ~ present
   2. The University of Tokyo; Associate Professor; November 2009 ~ December 2019
   3. Kyoto University; Assistant professor; February 2003 ~ October 2009
   4. The University of Tokyo; Postdoctoral Fellow; April 2002 ~ January 2003

Major responsibilities

1. Leader, Hyper-Kamiokande Detector Working Group; 2021~ present
2. Elected member, Executive Committee of the T2K experiment; 2015 ~ present
3. Co-leader, ND280 Upgrade project; 2015~2020
4. Member, International Steering Group of Hyper-Kamiokande Proto-collaboration, 2015 ~ 2020
5. Technical Coordinator, Hyper-Kamiokande Proto-collaboration, 2018 ~ 2020
6. Member, Speakers Board, Hyper-Kamiokande Proto-collaboration, 2015 ~ 2020
7. Co-leader, ND280 group of the T2K experiment, 2011~2015

Fellowship and Grants

3. Fellowship and Grants
   1. "Precise measurements of neutrino-nucleus interactions and neutrino oscillations with a new neutrino detector," 2020-2023; JSPS Grant-in-Aid for Scientific Research (A)
   2. "Development of neutrino detectors for T2K and Hyper-Kamiokande experiments," 2020-2021, Japan-Russia Research Cooperative Program between JSPS and RFBR
   3. "ND280-Upgrade and the neutrino cross section measurements in T2K," 2019-2021, FJPPL Japan-France collaborative projects
   4. "Precision measurements of neutrino-nucleus interaction towards understanding of neutrino mixing matrix," 2014-2018; JSPS Grant-in-Aid for Scientific Research (A)
   5. "Development of a Novel 3D-projection Scintillator Tracker Technology for Near Detectors in Neutrino Experiments", 2018; Japan-US Cooperative Program in High Energy Physics
   6. "Precision measurements of oscillation parameters of neutrinos and antineutrinos with

an intense neutrino beam," 2017-2018; Japan-Russia Research Cooperative Program between JSPS and RFBR
7. "Research and Development for Current and Future Long Baseline Neutrino Detectors," 2017-2018; Japan-US Cooperative Program in High Energy Physics
8. "Development of advanced technology for neutrino experiments with high power beams," 2014-2016, Japan-US Cooperative Program in High Energy Physics
9. "Study of neutrino-nucleus interaction with a new fine grained neutrino detector," 2010-2012, JSPS Grant-in-Aid for Young Scientists (A)
10. "Precision study of neutrino-nucleus interaction towards next generation neutrino oscillation experiments," 2006-2007, JSPS Grant-in-Aid for Young Scientists (B)

1. Name **Claudio Giganti**
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2. Position CRCN

Education
4. Academic degrees
September 2010
Ph. D, Physics, University of Paris Sud XI;
Supervisor Marco Zito
Thesis "The Particle Identification in the T2K TPCs and measurement of the electron neutrino component in the T2K beam"
June 2007
Magister Degree in Physics; University of Rome La Sapienza

Positions
5. Research positions
1. LPNHE-Paris; CR CNRS; October 2012 ~ present
2. Post doctoral fellow; IFAE, Barcelone; 2010 ~ 2012
3. PhD student; IRFU/SPP, Saclay; October 2007 ~ September 2010

Main responsibilities.
1. Coordinator of the ND280 Upgrade project; 2019 ~ present
2. Member of T2K analysis steering group
3. Co-convener of the T2K oscillation analysis group (2015 – 2018)
4. Co-convener of Near Detector exotics group (2014 – 2015)
5. Co-convener of Near Detector ve group (2012 – 2014)
6. Responsible of the Near Detector inputs for the first T2K oscillation measurement
7. Responsible for the development of the particle identification methods in the TPCs
8. Installation and commissioning of the ND280 Time Projection Chambers

1. Name **Boris A. Popov**
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Education
3. Academic degrees
May 1998
Ph. D, Physics, University of Paris VII;
Supervisor Antoine Letessier-Selvon
Thesis "Search for nu_mu → nu_tau neutrino oscillations in the tau→e decay channel in the NOMAD experiment at CERN"
June 1991
Graduated with honours from the faculty of General and Applied Physics, Moscow Institute of Physics and Technology

Positions
4. Research positions
1. LPNHE-Paris; DR2 CNRS; October 2013 ~ present
2. LPNHE-Paris; CDD haut niveau (3 ans+); December 2009 ~ October 2013
3. LPNHE-Paris; visiting scientist; October 2007 ~ December 2009
4. DLNP, JINR-Dubna; researcher, then senior researcher; August 1991 ~ October 2007

Main responsibilities.
1. LPNHE-Neutrino group leader; October 2018 ~ present
2. Co-convener of the CENF-ND "Neutrino flux" working group of the CERN Neutrino Platform
3. Software coordinator and analysis coordinator for T2K in the NA61/SHINE experiment
4. Member of the T2K Analysis Steering Group and of the T2K Speaker's Board
5. Convener of the T2K-NA61 group and co-convener of the beam group in the T2K experiment
6. Member of the Steering Committee and of the Editorial Board in the HARP experiment
7. Coordinator of the electron reconstruction working group in the NOMAD experiment
8. Department and neutrino group leader at DLNP JINR-Dubna