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|  | **Thèses Internationales - AAP 2020**  Formulaire de candidature |

**Ce formulaire doit être libellé « TheseInternationale2020\_Nomcandidat » et obligatoirement être envoyé par le porteur ou la porteuse du projet par courriel à l’adresse :**

[**dgds.miti-theses@cnrs.fr**](mailto:dgds.miti-theses@cnrs.fr)

**Date limite d’envoi des candidatures : jeudi 30 janvier 2020 à midi (heure de Paris)**

**IDENTIFICATION du directeur ou de la directrice de thèse**

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| Civilité/NOM/Prénom du directeur/de la directrice du projet de thèse | | M. Giganti Claudio  M. Zito Marco |
| Établissement de rattachement (CNRS, Université de Nantes, CEA, etc.) | | CNRS |
| Code Unité (UMR, UPR, EA, etc.) | | UMR 7585 |
| Nom du laboratoire et/ou de l’équipe | | LPNHE – groupe Neutrinos |
| Pour les unités rattachées au CNRS | Institut principal (ex : INEE, INC, INSHS, …) | IN2P3 |
| Délégation régionale (ex : DR02 ; DR12 ; DR17…) | DR Paris-Centre |

**PROJET**

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| Titre long du projet (150 caractères maximum) | Search for charge-parity (CP) violation in neutrino oscillations and upgrade of the T2K Near Detector |
| Acronyme du projet | T2K\_NDUP |

**IDENTIFICATION du laboratoire international**

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| Nom du laboratoire international | Université de Tokyo |
| En l'absence de laboratoire international préciser la nature internationale du projet |  |

**PROJET DE THESE**

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| T2K is a long-baseline neutrino oscillations experiment, taking data in Japan. T2K has been the first experiment to detect the appearance of electron neutrinos and is currently searching for CP violation in the lepton sector by measuring appearance probabilities of neutrinos and antineutrinos. Such measurement requires larger statistics and a better understanding of systematics uncertainties. In order to improve the latter, an upgrade of the T2K Near Detector, ND280, is being conducted and is expected to significantly reduce the impact of systematics uncertainties on T2K oscillation analyses. The proposed PhD thesis will be centered around the ND280 upgrade project that is coordinated by researchers from LPNHE (Claudio Giganti) and University of Tokyo (Masashi Yokoyama). The PhD candidate will work under the supervision of Marco Zito and Claudio Giganti in France and of Masashi Yokoyama during his/her stay in Japan.  The ND280 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.  These detectors are being constructed and will be assembled, mostly at CERN, before being shipped to Japan in the second half of 2021. The installation and commissioning will be carried out at J-PARC and we expect to start the data taking with the upgraded J-PARC beam in 2022. The PhD candidate will then participate to all the phases of the project and it is expected that he/she will be based at J-PARC and University of Tokyo for at least one year during the installation and the commissioning of the detectors in Japan.  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, thus profiting from exciting and stimulating environment of both laboratories.  During the first year he/she will participate to the analysis of test beam data of both, the new TPCs and the Super-FGD, will develop reconstruction algorithms for these detectors and will integrate the reconstruction in the already existing ND280 software framework. He/She will also participate to the work on the neutrino cross-section models in order to reduce the systematics uncertainties in the on-going T2K oscillation analysis.  During the second year, the student will be mostly based in Japan and will participate to the installations of the detectors, their commissioning with cosmic rays and the analysis of the first data collected with the ND280 upgraded detector that is expected to start observing neutrino interactions from the J-PARC neutrino beam in 2022.  The third year will be devoted to the analysis of the ND280-upgrade data, to the inclusion of these data in the T2K oscillation analyses and, of course, to the timely preparation of the PhD manuscript.  In addition, the T2K collaboration is currently working on the combination of the oscillation analysis with Super-Kamiokande and NOvA. Thanks to this combination it will be possible to boost the sensitivity to both, CP violation and neutrino mass ordering, with the already existing data. The PhD student is also expected to participate to this effort. |
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