Form 8

**Research Result Report**
**ICRR Inter-University Research Program 2024**

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| Research Subject: Constraining systematics at T2K and SuperKamiokande oscillation analyses using neutrino-nucleus interaction models |
| Principal Investigator: Guillermo Daniel Megias Vazquez, University of Seville |
| Participating Researchers:<br>J. A. Caballero, J. M. Franco Patiño, J. González Rosa (University of Seville)<br>R. González Jiménez, J. M. Udías Moinelo (Complutense University of Madrid)<br>M. Benedetta Barbaro (University of Turin and INFN)<br>T. William Donnelly ( Massachusetts Institute of Technology (MIT))<br>Kimihiro Okumura, Yoshinari Hayato, Seisho Abe (University of Tokyo, ICRR)<br>Laura Munteanu, Stephen Dolan (CERN) |
| Summary of Research Result published in FY 2024: Progresses on development and optimization of neutrino interaction models (SuSAv2 and RMF models) for the analysis of data from T2K and other experiments have been published in FY2024 together with other T2K papers in common with ICRR members:<br>- Parametrized uncertainties in the spectral function model of neutrino charged-current quasielastic interactions For oscillation analyses. Chakrani, J. et al., Phys. Rev, D 109, 072006 (2024).<br>- Combined Analysis of Neutrino and Antineutrino Charged Current Inclusive Interactions Franco-Patino, J. M. et al., Symmetry 2024, 16(5), 592 (2024).<br>- Measurement of the 1/2C(e,e′) Cross Sections at Q2=0.8 GeV2/c2. Mihovilovic, M. et al., Few-Body Syst 65, 78 (2024).<br>- First Joint Oscillation Analysis of Super-Kamiokande Atmospheric and T2K Accelerator Neutrino Data. Abe, K. et al., Phys. Rev. Lett. 134, 011801 (2025).<br><br>Work is in progress with Dr. Abe-san and Prof. Hayato-san (ICRR) to compare the implementation of the DCC model from the Osaka group in the SuSAv2 framework and the results from the DCC approach implemented in the NEUT event generator used in T2K and SuperKamiokande. The different descriptions of the nuclear dynamics in the SuSAv2 and NEUT models are being analyzed in comparison with neutrino cross-section data to validate nuclear models in the resonance regime. Also, in collaboration with different T2K members, a first implementation of the inclusive and semi-inclusive SuSAv2 and RMF-1p1h models in NEUT is also in progress. This will allow the reweight of several parameters for the oscillation analysis, the study of nuclear-medium effects, and a comparison between nuclear optical potentials and cascade models in generators, among other issues. Some outcomes of this research have been recently published and additional works are expected to be published in coming months. They have been also presented at several conferences and meetings, such as: T2K Collaboration Meeting 2025, Workshop at European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT*, Trento, Italy), Neutrinos and Flavour: a stairway to New Physics (Pisa, Italy), JENNIFER3 Meeting (IFAE, Barcelona, Spain), etc.<br><br>With regard to the ICRR Research Program, the Univ. of Seville group has got on FY2024 a 3-year R&D project of the Spanish Ministry of Science in which Profs. Hayato-san and Okumura-san (ICRR) participate as collaborators. The Univ. of Seville considers all these projects a research line of strategic interest, having approved a special allocation to support the participation of their researchers in T2K. We will also continue these projects in FY2025 under the ICRR Inter-University Research Program 2025. |

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