Japan and Europe Network for Neutrino and Intensity Frontier Experimental Research 2

Reporting

Project Information

JENNIFER2

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Project website

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Periodic Reporting for period 1 - JENNIFER2 (Japan and Europe Network for Neutrino and Intensity Frontier Experimental Research 2)

Reporting period: 2019-04-01 to 2023-05-31

Summary of the context and overall objectives of the project

The JENNIFER2 project aims to produce synergy and knowledge sharing among experimental particle physics groups searching for signal of new physics in neutrino and flavour physics, exploiting

the discovery potentialities of experimental facilities located in Japan.
The Standard Model of elementary particles has been very successful in explaining a wide variety of existing experimental data, but it does not answer several fundamental questions, such as the origin of the dark matter (which we know from the Cosmological Model it is responsible for 90% of the universe mass), the mater-antimatter asymmetry (which can be explained only with a sizeable violation of the so called CP symmetry) and the observed pattern of fermions mass spectrum.
For all these reasons physicists are looking for the signals of new particles and interactions which can either be directly produced at the energy frontier of the available particle acceleration technology, either appear as tiny deviations from SM expectations in rare processes at lower energy. JENNIFER2 project is dedicated to this second approach, with two different techniques: the so called “intensity frontier”, where very intense particle accelerators produce an enormous number of events which are recorded and analysed with precision detectors, and the neutrino physics, where large volume underground detectors reconstruct the rare interactions of neutrinos with matter, both accelerator produced and cosmic ones. The first technique is represented by the Belle II experiment working at the SuperKEKB accelerator, while the second one is the T2K experiment and its future development in the HyperK project.
JENNIFER2 includes both detector and technology developments for the upgrade and improvement of the experiments in the above stated fields, both the challenging data analyses that will produce stringent limits on new phenomena or evidences for them. Moreover JENNIFER2 puts together the scientist communities working at the intensity frontier and at the neutrino underground experiments, and aims to produce important synergies in several technologic issues.
Finally, JENNIFER2 includes a number of outreach activities towards different societal targets, to promote both the general knowledge of the fundamental physics and its implications, and the promotion of the scientific collaboration between Europe and Japan.

Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far

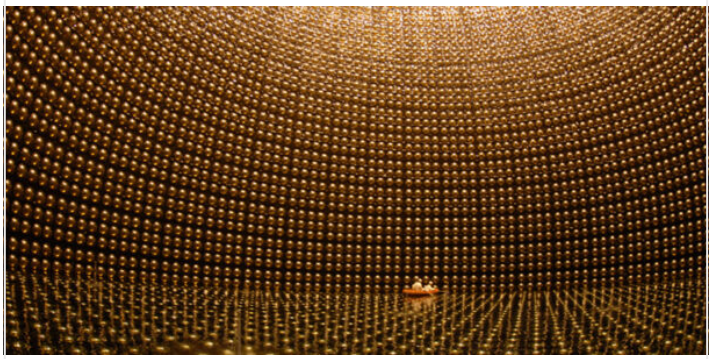
The Belle II detector has been operated at the SuperKEKB accelerator and first data have been collected and reconstructed. Calibration, alignement and detailed study of the performances have been started. First data analyses has allowed to re-discover a number of known particles and already to put limits on the existence of new particles in the so called dark sector.
The upgrade of the T2K near detector has progressed very much, a first prototype of Time Projection Chamber has been tested with cosmic rays, while construction of the FGD scintillator target has started.
Exceptional results have been obtained from the T2K former data analysis, drawing to the first constraint on matter-antimatter CP-violating phase in neutrino oscillations.
An impressive R&D work has been performed towards the construction of the HyperK detector, involving the design of the water system for the Gd-doped water Cerenkov detector, the calibration system, the outer detector design and test, the readout electronics and the trigger system.
New developments in photo-detection have been started, regarding the usage of silicon photomultipliers in high radiation conditions, the designe and test of multi-PMTs and the development of organic photo-detectors.

Important synergies have started in computing between the Belle II and the HyperK data model and a common demonstrator will be realized. Collaborations have started in data taking techniques, statistical analysis and phenomenology.
Masterclasses on Belle II physics have been organized and then cancelled due to the Covid-19 outbreak, as well as a Summer School at KEK laboratory for 15 european students. We hope to be able to reciver these activities soon.

Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

Expected scientific results are precision measurements at the intensity frontier with, possibly, some deviations from the Standard Model expectations, and even more refined neutrino cross section and oscillation parameters measurements. To this aim, we also expect to have better detectors based on improved technologies, and also to produce new developments which can be used in future experiments and devices.
Societal impact will be produced first of all through the dissemination and communication of the project activities, and through collaboration with industrial partners for the production of the needed technologies. Moreover the fostering of the scientific collaboration with Japan will be an added value for European society and innovation.

installation of the Belle II beam pipe



SuperK detector in Kamioka mine, used as far detector of T2K eperiment

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