Master thesis project: Implementation of a timing reconstruction algorithm for the newly installed near detector of the T2K experiment

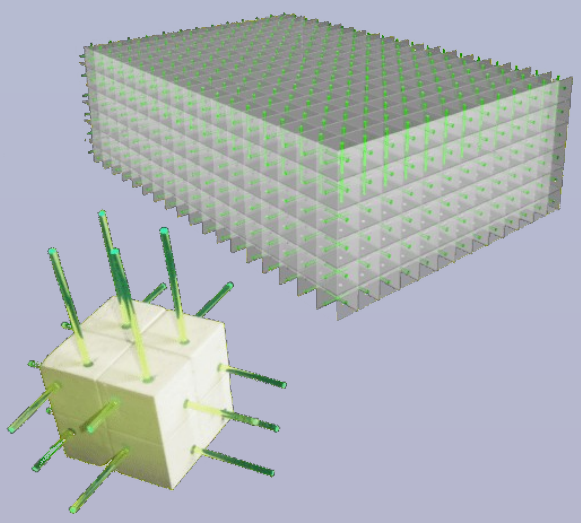
The Super-FGD is a newly installed detector of the T2K experiment, a long baseline neutrino experiment located in Japan, and has a novel detector concept never conceived before. It consists of more than 2 million plastic scintillator cubes of 1 cm^3 dimension. Each one of these cubes is crossed by three optical fibers in order to achieve high granularity and 3D reconstruction. This new detector is mainly designed to detect neutrons produced from a neutrino interaction with the target.

Since neutrons are neutral particles, they travel undetected until they interact with a nucleus of the target itself, depositing energy which can then be detected. High granularity and 3D reconstruction are key requirements to perform such a detection, which can be achieved by measuring the time of flight of neutrons in the Super-FGD. From the time of flight, it is also possible to measure the kinetic energy of neutrons which is a crucial measurement for cross section and neutrino oscillation analyses.

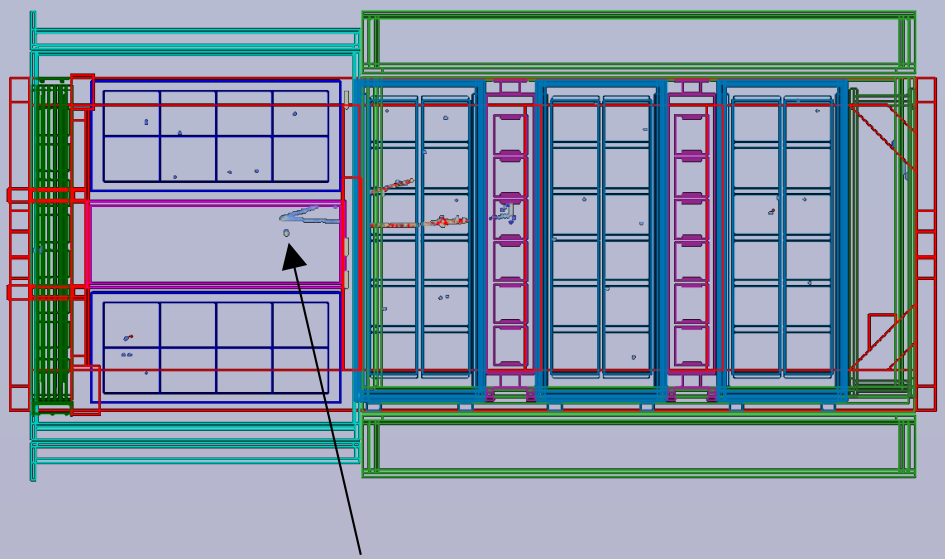
To unlock this capability, we will need to develop and optimize an algorithm to determine the time of localized energy deposition in this novel detector. This is an essential part for the future of the experiment.

The AG Weber group offers a Master thesis topic investigating aspects of this development. This would include interfacing with an experiment software, dealing with simulation and reconstruction algorithms, as well as Data vs Monte Carlo comparison.

Super-FGD design concept



Neutron candidate real event in T2K



Neutron candidate inside the Super-FGD

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