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Neutrino directionality measurement with the Double Chooz experiment

Double Chooz is a reactor neutrino oscillation experiment which studies anti-nu_e emitted from the two nuclear reactors of the Chooz power plant, in the French Ardennes. Its main purpose is to measure the neutrino mixing angle theta_{13} by observing the anti-nu_e disappearance.

Double Chooz has the ability to test the feasibility of neutrino directionality measurement by liquid scintillator detector. The directionality information could, in principle, be applied when looking at particular sources such as core-collapse supernovae, when searching for geo-neutrinos, with the possibility to discriminate between crust and mantle, or for nuclear monitoring.

The neutrino detection relies on the signature of the inverse beta decay (IBD) interactions anti-nu_e + p -> e+ + n where the positron (prompt" signal) is followed by the neutron capture on Gadolinium (Gd) or Hydrogen (H) (delayed" signal). The initial neutrino direction is then deduced from the reconstructed positions of the prompt and delayed vertices.

Since we know that our anti-nu_e are coming from the two nuclear reactors, we are able to verify the precison of our method. Even if the neutron capture physics is different on Gd or H, we have demonstrated for the first time the validity of our method when the neutron is captured on H. We have achieved a similar resolution to neutron capture on Gd, which could be of interest for future large-scale detector. This poster will present our studies with the Double Chooz far detector.

Primary author: RONCIN, Romain (APC - Université Paris Diderot)

Co-authors: FISCHER, Vincent (CEA Saclay); NIKITENKO, Yaroslav (INR RAS)

Presenter: RONCIN, Romain (APC - Université Paris Diderot)

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