KamLAND: Examination of the LMA solution with reactor neutrinos

KamLAND collaboration

Long standing solar neutrino problem is being solved as a neutrino oscillation by recent measurement of SNO and SK. And combined analysis of all solar neutrino observations strongly favors the large mixing angle (LMA) solution. The solution can be examined by a terrestrial neutrino experiment, KamLAND. KamLAND is a large liquid scintillator anti-neutrino detector located 1000m underground at Kamioka, Japan. Kamioka is surrounded by many nuclear power plants and typical distance to the reactor is about 170 km. Anti-neutrinos coming from nuclear reactors have energies up to several MeV and their flux can be calculated at a precision of better than 2%, if one takes into account thermal power outputs and chemical compositions properly. Feasibility of the calculation has been tested well by previously performed short baseline experiments. This well defined neutrino source is usable to survey oscillation parameters of $\Delta m^2 > 10^{-5} eV^2$ and $\sin^2 2\theta > 0.2$ when combined with 170 km long baseline. It covers the entire LMA solution. This long baseline reactor neutrino measurement can be performed only by a large and underground clean detector and KamLAND is the ideal solution for it. And it is already accumulating physics data since January 2002. Also, an achievement of radio purity is already as good as a few times 10^{-16}g/g uranium and thorium impurity level that is 3 orders of magnitude cleaner than a requirement. And the detector performance is good enough to extract reactor neutrino results. We will summarize these performance and recent status of KamLAND.
Expected event rate of a few events per day (depending on the fiducial volume) enables the discrimination of LMA solution even only with a few month of data. We are to present the first result in this conference.