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Status of GADZOOKS!: Neutron Tagging in Super-Kamiokande

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The GADZOOKS! project pursues the upgrade of the Super-Kamiokande (SK) detector as a way to efficiently detect thermal neutrons. Inverse beta decay reactions, as well as charged current quasi-elastic (CCQE) scattering of low energy anti-neutrinos (up to a few hundreds of MeV) in SK, produce one positron and one neutron in the final state. Being able to observe the final state neutron in coincidence with the prompt positron would mean that SK could identify these reactions as genuine with very high confidence.

GADZOOKS! will open to Super-Kamiokande - and water Cherenkov detectors in general - a wealth of physics currently inaccessible due to background limitations. The most important is observing for the first time the diffuse supernova neutrino background: Super-Kamiokande enriched with gadolinium will discover it after few years of running.

In GADZOOKS! we will dissolve a Gadolinium (Gd) salt in the water of SK at a loading of 0.2% by mass. The Gd has an enormous absorption cross section for thermal neutrons, emitting in the process an ~ 8 MeV gamma cascade measurable by SK. Thus, by a double coincidence in space and time of the signals recorded by SK from the positron and the ~ 8 MeV gamma cascade from the Gd-capture of the neutron, low energy anti-neutrinos interacting in the detector will be identified with a large efficiency, $> 80\%$.

The main R&D program towards GADZOOKS! is EGADS: a 200 ton fully instrumented tank built in a new cavern in the Kamioka mine. EGADS incorporates all the necessary subsystems to make GADZOOKS! a reality, namely pretreatment, selective filtration, monitoring of different parameters (water transparency, Gd concentration...) and Gd recovery. In this contribution we will describe EGADS, we will present its current status and discuss the main results and conclusions arrived at so far. In addition, we will analyze other issues specific to the running of GADZOOKS!, like radiopurity, CCQE reconstruction, and its impact to other SK measurements.

Summary

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