



Summary and discussion of the SK upgrade session

SK-Gd

- Approved by the SK collaboration in June 2015
- 0.2% $\text{Gd}_2(\text{SO}_4)_3$ loading for neutron tagging:
 - Supernova relic ν : suppress invisible μ decay
 - proton decay: suppress atm. ν background
 - long baseline: limited impact on CP? θ_{23} improvement
- EGADS 200ton Test (2009-)
 - Neutron tag, light attenuation, material compatibility
- Schedule to be decided:
 - T0: sealing SK tank (3.5+2 months)
 - T1: 0.02% $\text{Gd}_2(\text{SO}_4)_3$ loading (50% neutron capture)
 - T2: 0.2% Gd loading (90% neutron capture)
- Discussions
 - Impact on T2K: enough atm. ν samples for the estimation of syst. errors?
 - atm. ν : improvement in atmospheric ν CP violation
 - Spallation background from $\text{Gd}_2(\text{SO}_4)_3$?

Enlarging fiducial volume

- Potential to increase fiducial volume by $\times 1.5-2.0$
- Reduce OD (2.6m to 1m) as considered for HK and LBNE?
 - Dismantling/rebuilding the support structure
 - 60 people/day, 1-2 years, \$10-20M (mainly labour)
 - Completely new LBNE-WC type string structure instead?
- Adding PMT in ID and dead space?
 - Finer granularity, veto backgrounds from outside
 - Additional benefits:
 - multi-ring reconstruction (mass hierarchy, p -decay)
 - low energy reconstruction (solar/supernova ν , 6MeV γ in $p \rightarrow K\nu$)
- Discussions
 - Large effort but significant gain on CP sensitivity
 - Additional concern expressed on the dead period for supernova watch
 - Backgrounds for solar neutrino from the rock wall?
 - Fiducial volume cut?

Water based scintillator (WbLS)

- Can observe both Cherenkov and scintillation
 - LAB+water technology developed for SNO+
 - 4% WbLS \rightarrow 4 times more light
- Expanded physics potential with scintillation
 - nucleon decays:
 - K tag in $p \rightarrow K\nu$, Both proton and neutron rejection in atm. ν
 - solar/supernova ν :
 - invisible μ rejection (for both ν and ν -bar events)
 - Long baseline and atmospheric ν
 - Double beta decays
- WbLS interest group (THEIA)
 - Prototyping under way: BNL1-t, ANNIE, WATCHMAN, SNO+
 - Purification studies, material compatibility (potting not compatible)
- Discussions
 - Cherenkov/scintillation separation? Timing shape analysis