1. Hyper-Kamiokande

Hyper-Kamiokande (Hyper-K) is a next generation underground water Cherenkov detector.

<table>
<thead>
<tr>
<th>Detector Design</th>
<th>Super-Kamiokande</th>
<th>Hyper-Kamiokande</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cavens</td>
<td>1 cylindrical cavens.</td>
<td>2 egg shape cavens, 10 compartments.</td>
</tr>
<tr>
<td>Num. of ID/OD PMTs</td>
<td>11,129 / 1,885</td>
<td>~99,000 / ~25,000</td>
</tr>
<tr>
<td>Photo coverage</td>
<td>40%</td>
<td>~20% (to be optimized)</td>
</tr>
<tr>
<td>Total / Fiducial Volume</td>
<td>50 kt / 22.5 kt</td>
<td>0.99 Mt / 0.56 Mt</td>
</tr>
</tbody>
</table>

R&Ds for photo sensor, electronics, detector design, location and physics capability are being performed.

Fruitful physics programs are planned for accelerator, atmospheric and solar neutrinos, proton decays, neutrinos from other astrophysical origins.

E.g. CP asymmetry, mass hierarchy, 

2. Muon and spallation simulation

Simulation studies are performed w/ MUSIC:
- Muon flux at locations
- Muon-nuclear interaction
- Mozumi: x 2.2 µ, x 2 spallation of SK
- Tobachora: x 5.4 µ, x 4 spallation

3. Effects on signal and background

<table>
<thead>
<tr>
<th>Signal Efficiency, keeping same spallation reduction rate</th>
<th>Cosmic µ \times 1</th>
<th>µ \times 2</th>
<th>µ \times 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>N of spallation background, keeping 80% sig. efficiency</td>
<td>79% (90%)</td>
<td>62% (77%)</td>
<td>29% (54%)</td>
</tr>
<tr>
<td>#</td>
<td>3.6</td>
<td>13.2</td>
<td></td>
</tr>
</tbody>
</table>

4. Supernova Relic Neutrino

Supernova Relic Neutrino is diffused supernova neutrinos from all past supernovae. SRN is supposed to be showering on us continuously.

Current status for SRN search
- SRN has been searched with Super-Kamiokande though inverse beta decay, \( \overline{\nu}_e + p \rightarrow e^- + n \).
- Positron + neutron tagging search, using capture on proton. (arXiv:1311.3738)

Close to theoretical assumptions!

Summary

Several R&Ds for Hyper-Kamiokande, a next generation underground Cherenkov detector, are being performed.

- Spallation Background for candidate sites
- Supernova Relic Neutrino search with Hyper-K
- Supernova Burst and Solar neutrino study with Hyper-K are discussed here.

Hyper-K is a promising detector for low energy neutrino studies.

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