Need to make deep estimation for background of neutron detection.

- Use Am/Be as a neutron source.
- Use BGO to produce QBEE will be installed into EGADS in the future.

Open a

Background can be efficiently

Summary of
calibration work in pure water.

Achieved <1% QE/gain difference after HV adjustment

Installed Xe scintillation ball as a long period monitor.

Calculate the ratio of farthest PMTs and nearest PMTs charge to check water status in tank.

Basically consistent with water transparency measurement plots.

Why Gadolinium?
- Large cross section (~49,000 barns; 0.3 barns on free proton) of Gd for neutron capture
- 3-4 γ-rays will be produced with total energy of 8MeV.

What will happen if we load Gadolinium into Super-K?

EGADS Evaluating Gadolinium’s Action on Detector Systems

Detection principle for SRN after adding gadolinium

- Background can be efficiently removed by coincident detection of the prompt positron's Cherenkov light and the delayed neutron capture gammas.
- Open a 1000μsec gate when prompt signal is detected, and set lower threshold for delayed signals.

Gate width for delayed signal: 1000 μsec

Neutron detection with Am/Be source

- Use Am/Be as a neutron source.
- Use BGO to produce scintillation light as prompt signal.
- Check Gd capture gammas by comparison with Monte Carlo simulation (glg4Sim).

November 27th, 2014
0.02% gadolinium sulfate loaded.

January 24th, 2015
Added gadolinium sulfate to 0.1%.

April 21st, 2015
Added gadolinium sulfate to 0.2%.

Current gadolinium sulfate concentration is 2115 ± 15 ppm.

Calibration work

<table>
<thead>
<tr>
<th>Calibration item</th>
<th>Source</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-calibration [2011]</td>
<td>Xe/LED</td>
<td>~3 %</td>
</tr>
<tr>
<td>HV adjustment</td>
<td>Xe</td>
<td>&lt;1 %</td>
</tr>
<tr>
<td>pc to p.e. constant</td>
<td>LED</td>
<td>2.502±0.5 p.e.</td>
</tr>
<tr>
<td>I.p.e. distribution</td>
<td>LED</td>
<td>Into MC</td>
</tr>
<tr>
<td>Relative gain</td>
<td>Laser diode (LD)</td>
<td>~9%</td>
</tr>
<tr>
<td>Relative Gd (QE table)</td>
<td>Cf-Ni</td>
<td>~7%</td>
</tr>
<tr>
<td>Neutron capture efficiency</td>
<td>Am/Be Analyzing data</td>
<td></td>
</tr>
<tr>
<td>Rayleigh scattering</td>
<td>LD</td>
<td>Analyzing data</td>
</tr>
</tbody>
</table>

Event reconstruction energy

Neutron capture time
(time difference between prompt and delayed signals)

Summary & Next Step

- 0.2% gadolinium sulfate has been loaded into EGADS tank.
- Basic calibration work has been finished in pure water period.
- Need to make deep estimation for background of neutron detection.
- Rayleigh Scattering measurement is also being conducted.
- QBEE will be installed into EGADS in the future.

Gravitational Wave Physics and Astronomy Workshop, 17-20 June, 2015, Osaka, Japan