**What’s AXEL?**

We are developing a high pressure Xe gas TPC to search for 0νββ from $^{136}$Xe (Q=2.48MeV).

**Feature**
- Good energy resolution: 0.5% (FWHM@82.48MeV)
- Using proportional scintillation mode
- Large mass (1ton)
- Background rejection with tracking
- Reject alpha (very short track)
- Reject compton gamma (multi-site event)
- Reject gamma (single blob at end point)

**R&D Status**

**Prototype Chamber**

Prototype chamber with 64ch MPPCs, two PMTs and up to 10 bar Xe gas.
- Sensitive volume: 6cm-long and 10cm diameter.
- MPPC sensitive only to visible light. An acrylic plate coated with WLS(TPB) is placed in front. Will be replaced with VUV-sensitive MPPCs in November.

**Demonstration as a TPC**

In order to determine t, signal, coincidence of two PMT signals within 150ns is required.
- Succeed to detect scintillation light signal and reconstruct z position.
- Drift velocity was measured.

**Energy Resolution**

Energy measurement using $^{57}$Co gamma source and 4 bar Xe gas.
- Evaluate EL gain using 29.98keV peak
  - Initial electrons: 29980eV / 22.1eV(W-value) = 1347.5 detected photons: 4692.2 photons
  - Over all gain: 4692.2 / 1347.5 = 3.482
  - Consistent with reference: $\frac{dN_{\text{photon}}}{dt \cdot 1/E} = 70(E/p - 1.0)p$
- The energy resolution was evaluated by fitting these peaks with Gaussian.

<table>
<thead>
<tr>
<th>Energy (keV)</th>
<th># of photon</th>
<th>29.78</th>
<th>33.62</th>
<th>92.28</th>
<th>122.06</th>
</tr>
</thead>
<tbody>
<tr>
<td>FWHM (keV)</td>
<td>7.1%</td>
<td>5.6%</td>
<td>6.2%</td>
<td>5.5%</td>
<td></td>
</tr>
</tbody>
</table>

We evaluated FWHM at G-value by fitting the plot of deposit energy vs energy (FWHM) with the function: $\text{FWHM} = \frac{A \cdot V}{E} + \text{BE}$

**For more sensitivity**

Add He gas into Xe to make it easy to search the two end points of 0νββ decay

Simulated event display
- Can reject single-end-blob event.
- Can use X-ray emitted from Xe to reject single electron event
- Cannot use in pure Xe gas because of too short m.f.p.

Now evaluating signal efficiency and back ground rejection ability by simulation.

**Future plan**

Upsizing our detector.

**Basic properties of MPPC**

- **PDE measurement**
  - **Motivation**
    - Want to measure PDE for VUV light (170nm) from high pressure Xe gas.
  - **Experiment**
    - Mini chamber filled with 8bar Xe gas.
    - Scintillation light from α (UV-PMT as a reference).
  - **Setup**

**Results**

Photon spectrum of alpha source detected by PMT
- Alpha ray has mono-energy.

**Linearity of MPPC**

- **Motivation**
  - Linearity is very important to obtain high resolution energy.
  - Many photons (~10^5) may come in long time (~5sec).
- **Experiment**
  - Studied by using LED light and comparing PMT.
  - **Result**
    - Good linearity up to ~4*10^4 photons/5us (50um-pitch pixel, cross-talk suppression).
    - ~5*10^4 photons/5us (25um-pitch pixel, non-cross-talk suppression).
    - We can apply correction with little errors.
    - Correction fluctuation due to non-linear effect: 0.0033% to 1.7% photos.
    - Recovery time τ is evaluated by fitted by the function: $\tau = \frac{1}{\text{F}}$
    - Result: 49.5ns(50um), 89.3ns(25um), consistent with spec sheet.

**202X**

- MPPC: ~40000ch

**2020**

- MPPC: ~50000ch

# PCTP

Kyoto University, ICRR, Tohoku University, Kuebe University

Sei Ban