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- ∼4.5kg @8bar
- phase-1 : 168 ch
- phase-2: 672ch





AKEL Background

Main BG-source: ²¹⁴Bi from ²³⁸U decay chain

- 2448 keV γ (**-0.4%** from ¹³⁶Xe Q-value)
- Detector component (Rough estimation)

| | Mass (kg) | Total activity of ²¹⁴ Bi (²³⁸ U) |
|---------------------------------|-----------|---|
| Pressure Vessel stainless steal | 948 | < 436 mBq * |
| ELCC | 22 | < 64.1 mBq ** |
| ELCC holders | 347 | < 40.1 mBq * |
| PMT + PMT holders | 13.4 | < 103 mBq |

- Flux from environment: $1.0 \times 10^3 / \text{cm}^2 / \text{day}$
 - based on measurement(*) and simulation (K. Ichimura, private communication)



HP1000L Sensitivity

Signal

At the current limit $(1 \times 10^{26} \text{ yr by KamLAND-Zen})$, ~0.2 ev/yr contained in the fiducial volume (w/ NN efficiency).

Background

- detector components : < 0.1 ev/yr in ROI
- environment
 - ~ 4,000 ev/yr in ROI (w/ NN reduction)
 - ~ 0.06 ev/yr in ROI w/ 20 cm Pb shield (w/ NN reduction)

| Estimation (| with old geon | netry) | | |
|---------------------|-----------------|---|------|---|
| Event generation | Fully contained | Signal acceptance: 50% Bkg rejection: 99.95% | | Signal acceptance: 27% Bkg rejection: 99.9996% |
| (Geant4) | ROI: 0-value + | 0.5% | Sele | ection by NN(CVN) |
| | - 36×36×36 pixe | els | | |





Applying to use a clean room in ICRR Kamioka observatory, U. Tokyo.



Remaining R&D and construction status

AXEL ELCC Unit size change



HP180L detector

Due to area restriction of Front-end board(FEB), 7x8 channels was adapted as `a` unit.

But

- very inconvenient
- FEB channel density needs to be increased to fit the ELCC size.

Adopt 8x8 ch for HP1000L.





- High radio-isotopes in ceramics package
- non-negligible contribution from EL light yield to energy resolution 0.26 % c.f. ioniz. intrinsic 0.26%
 ↓
- Surface mount on Flex. Print Circuit directly
- Enlarge sensitive area $0.26\% \rightarrow 0.19\%$
- Plan
 - MPPC First production in June
 - Unit first production in Nov.







- Need to reduce cross sectional area : $1.45 \text{cm}^2/\text{ch} \rightarrow 0.86 \text{cm}^2/\text{ch}$
- Under design



Gave up to develop ASIC...

<u>AKEL</u> Signal transport – MPPC-¹¹





AXEL Cockcroft-Walton HV generator and field cage



- Discharge at tape. One more step!
- To increase voltage generation efficiency, faster diode will be tried.

Copper field cage test product (180L size)

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To be produced in JFY2022. •

1

vac



In clean room



Signal

At the current limit $(1 \times 10^{26} \text{ yr by KamLAND-Zen})$, ~0.2 ev/yr contained in the fiducial volume (w/ NN efficiency).



AXEL For further improvement : Positive Ion detection

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• To increase efficiency, W wire will be heated up to ~2000 K in April 2022.



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AVEL B01 summary of activity since 2020 April

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Towards $0\nu\beta\beta$ search,

• technologies and performance have been (almost) established by the 180L prototype detector.

- Energy resolution 0.8% (FWHM)
- beautiful track pattern
- Design and construction of 1000 L detector are on-going.
 - Candidate site determined. (Application submitted)
 - New MPPC's to improve energy resolution and decrease radioactive components.
 - 64-ch unit
 - more compact digitizer board
 - Cockcroft-Walton HV generator
 - gas system
 - .
- Other activities
 - Positive Ion detection
 - MIRACLUE experiment : Measurement of Migdal effect