# Gas wire chamber for in-beam charged particle detector in KOTO experiment

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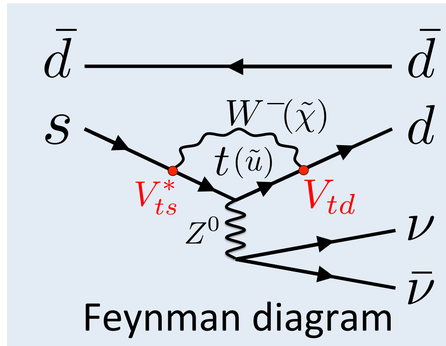
## Introduction to the KOTO experiment

### Goal of the KOTO experiment

Discovery of $K_L \to \pi^0 \nu\bar{\nu}$

- direct CP-violating rare decay
- loop-induced decay
  ➡ BSM particles can contribute
- suppressed decay in the SM ($2\times10^{-11}$)
- small theoretical uncertainty (2 %)

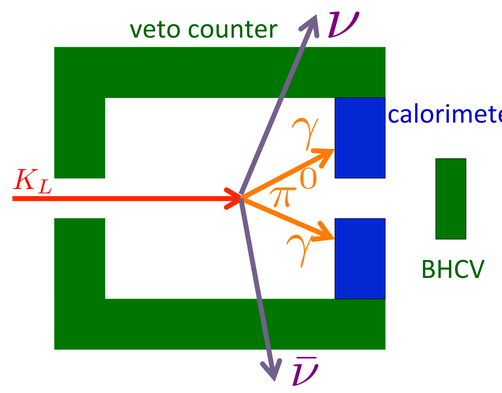
➡ Good probe for New Physics !



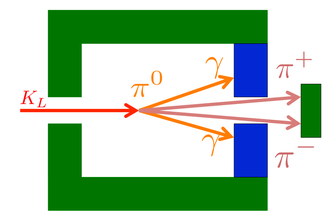
Feynman diagram

### Principle of the experiment

$K_L \to \pi^0 \nu\bar{\nu}$ = 2 γ + nothing
= calorimeter + hermetic veto



signal event



one of the background sources

## Introduction to Beam Hole Charged Veto (BHCV)

### BHCV is …

- in-beam charged-particle veto counter
  ➡ cover downstream in-beam area
- exposed to a high flux of gammas and neutrons
  ➡ generate accidental veto signals
- made of 3mm thick plastic scintillator
  ➡a significant acceptance loss is expected for the planned increase of the beam intensity

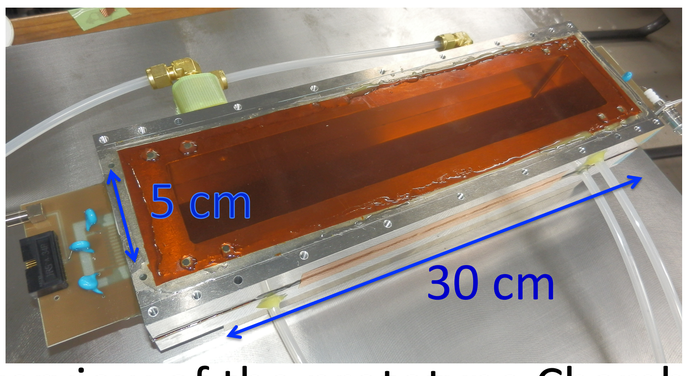
➡ upgrade of BHCV is required !

In order to reduce the acceptance loss, a gas wire chamber, which has a small amount of material in the sensitive region, is a good solution

| | Current BHCV | | UPGRADE | |
|---|---|---|---|---|
| beam intensity | count rate (data/MC) | signal loss (data/MC) | count rate (MC) | signal loss (MC) |
| 15 kW (2013/3) | 5.6 / 3.0 MHz | 11 % (preliminary)/ 6 % | 0.6 MHz | 2 % |
| 24 kW (2013/5) | 8.4 / 4.8 MHz | 16 % (preliminary)/ 9 % | 1.0 MHz | 4 % |
| 300 kW (Design) | - / 17 MHz | - / 30% | 4.1 MHz | 15 % |

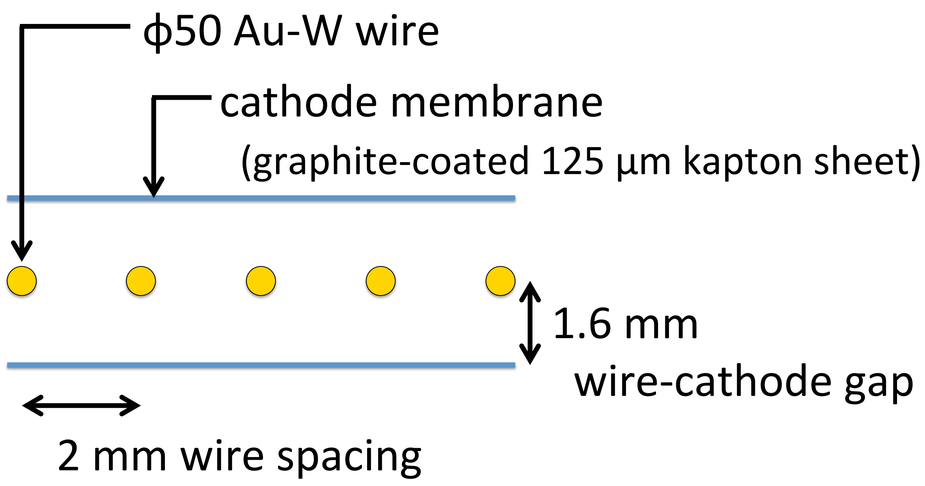
Reduction of the acceptance loss to be a half is expected !

## Prototype wire chamber



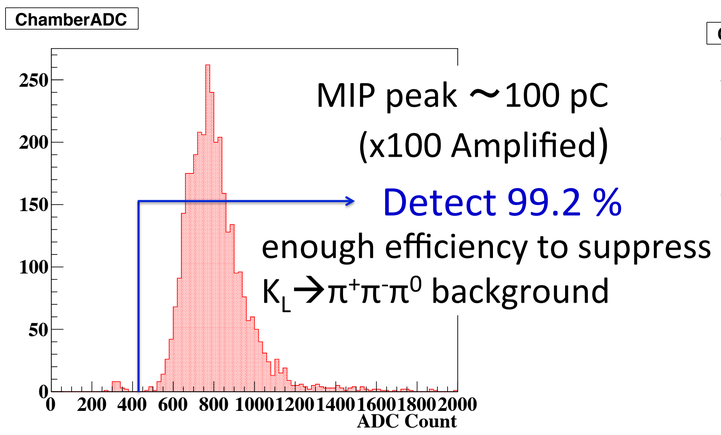
overview of the prototype Chamber

- Multi-Wire Proportional Chamber (MWPC)
- Thin gap for improving the rate tolerance
- CF4:n-Pentane(55:45) gas mixture

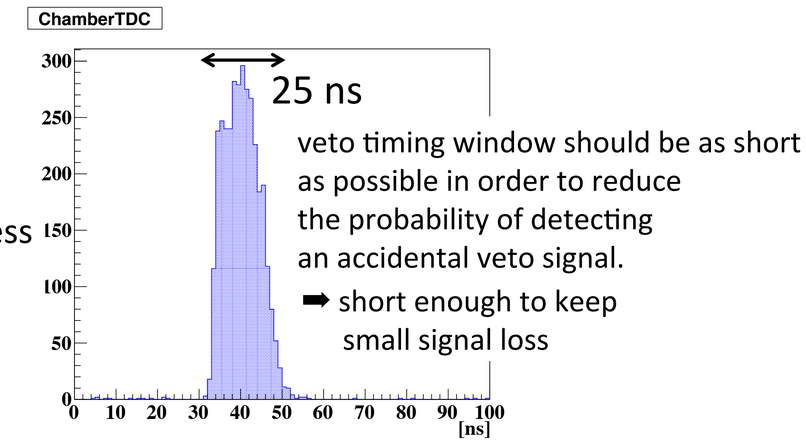



## Evaluation of the Chamber's performance

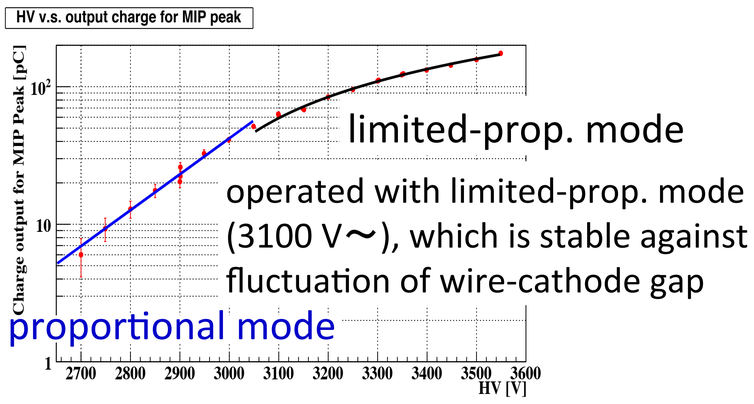
( by using a $^{90}$Sr checking source with putting the chamber between 2 trigger scintillators)



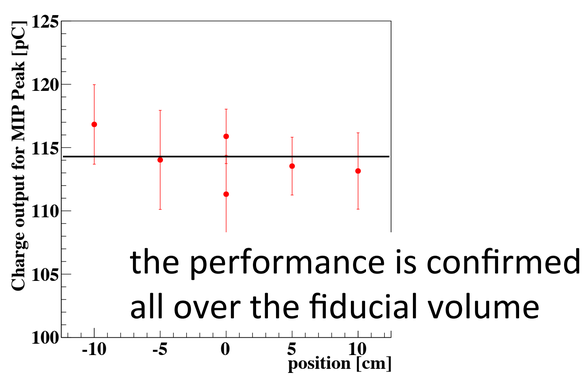
Charge output (@3300 V)



Time jitter(@3300 V)



Charge output - HV



Gain Uniformity
scan along wire direction

## Conclusion & Future plan

Enough efficiency and short time jitter have been achieved.
The rate tolerance of the chamber should be studied.
Construct a 30 cm x 30 cm chamber and install it for the KOTO physics-run early in 2015.