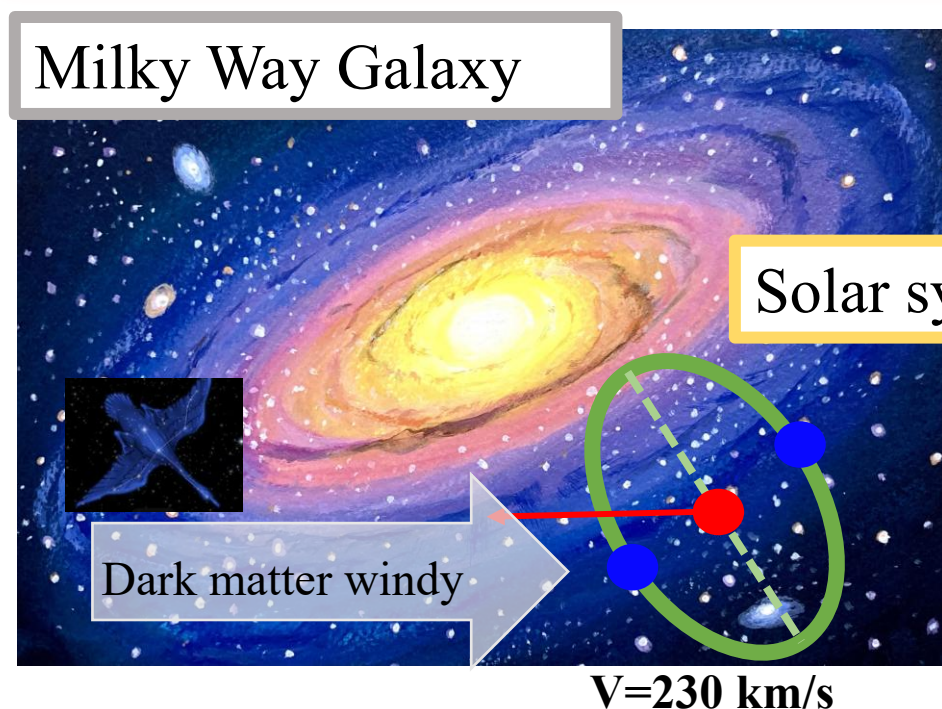


Introduction

Direct dark matter searches



- Direct dark matter searches aim to detect nuclear recoil signals induced by dark matter interactions.

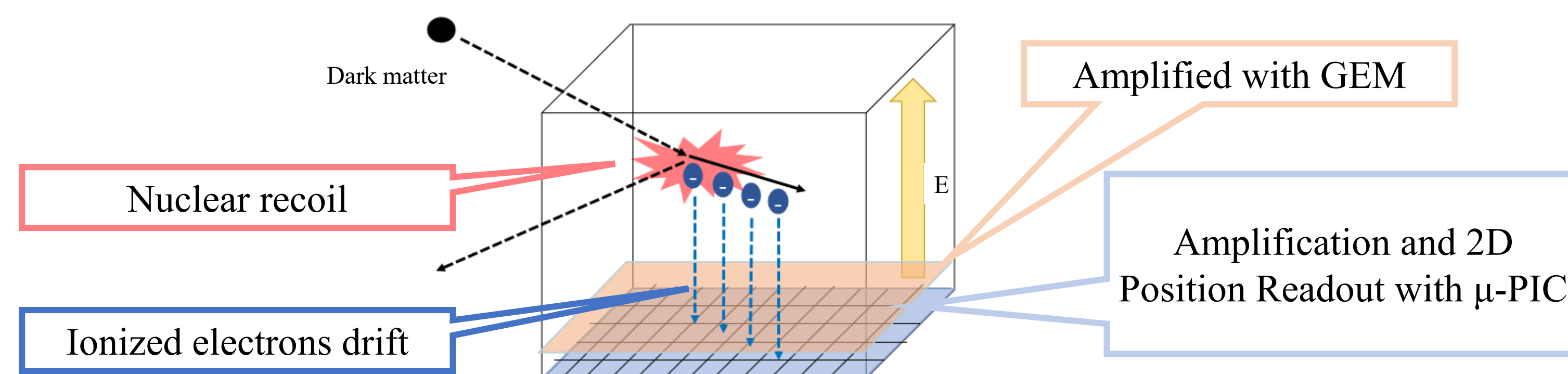
Dark matter envelops the entire Milky Way galaxy

The solar system orbits the galaxy at a speed of 230 km/s

Dark matter appears to be coming from the direction of the Cygnus constellation

Gaseous TPC

- NEWAGE is aiming to detect nuclear recoils in gas caused by dark matter.



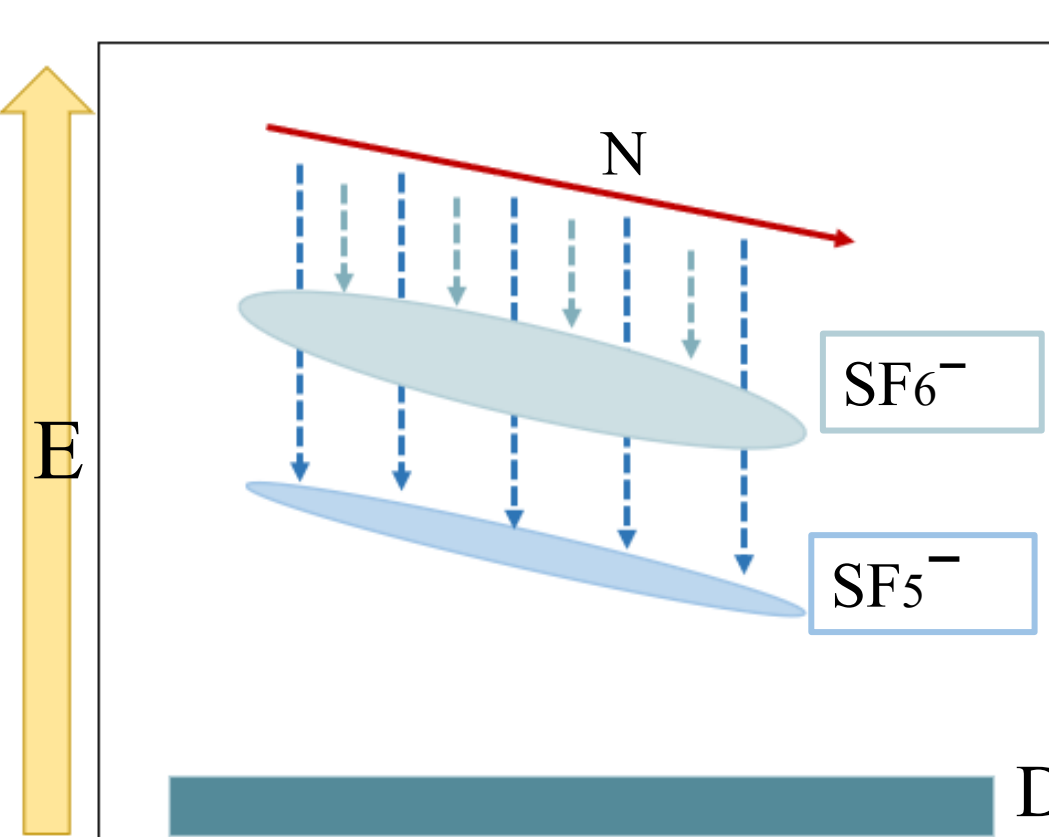
Currently, NEWAGE group uses a CF₄ gas.

Negative ion gas (such as SF₆) can be more attractive!!

SF₆ gas

One of the BG sources in underground experiments
⇒ **Alpha rays** from radon or its progenies inside detectors.

Currently, since we only detect the relative positions of the tracks, it is difficult to determine the absolute position of drift.



- In the SF₆ gas, SF₆⁻ and SF₅⁻ are formed.
- Due to the difference in the drift velocities of the two ions, a time difference occurs before they reach the detection surface.

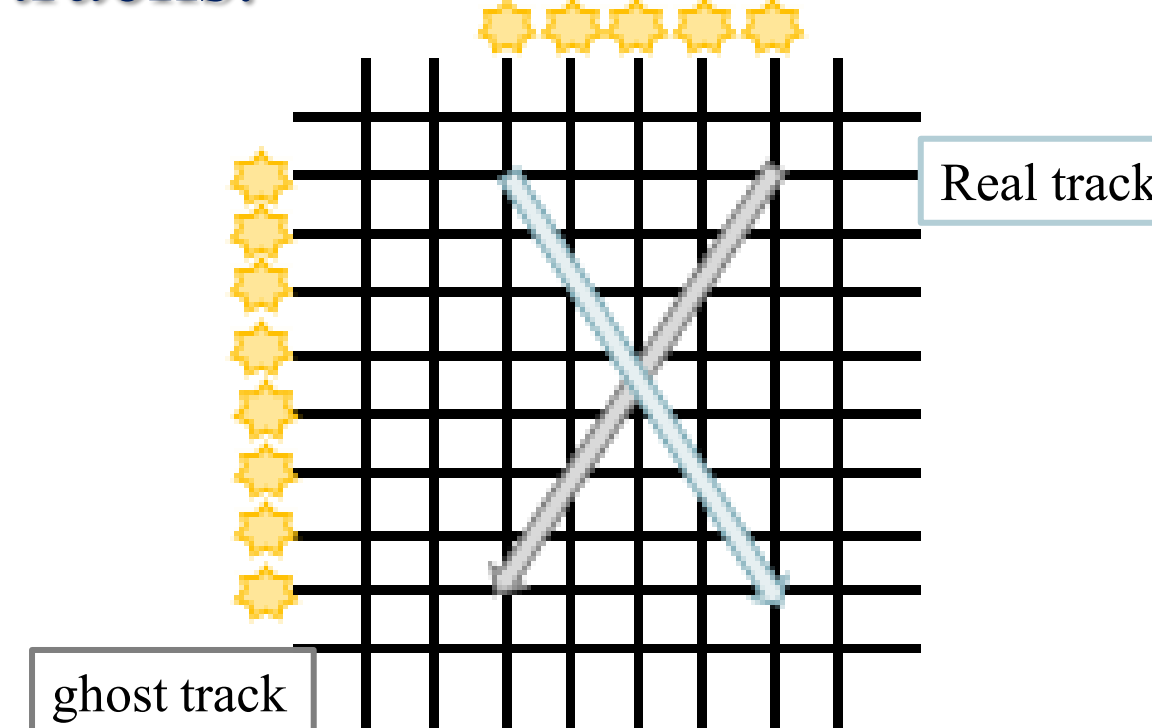
It is possible to reconstruct an absolute position of tracks!!

It is possible to reduce background occurred around detection or drift top surfaces!!

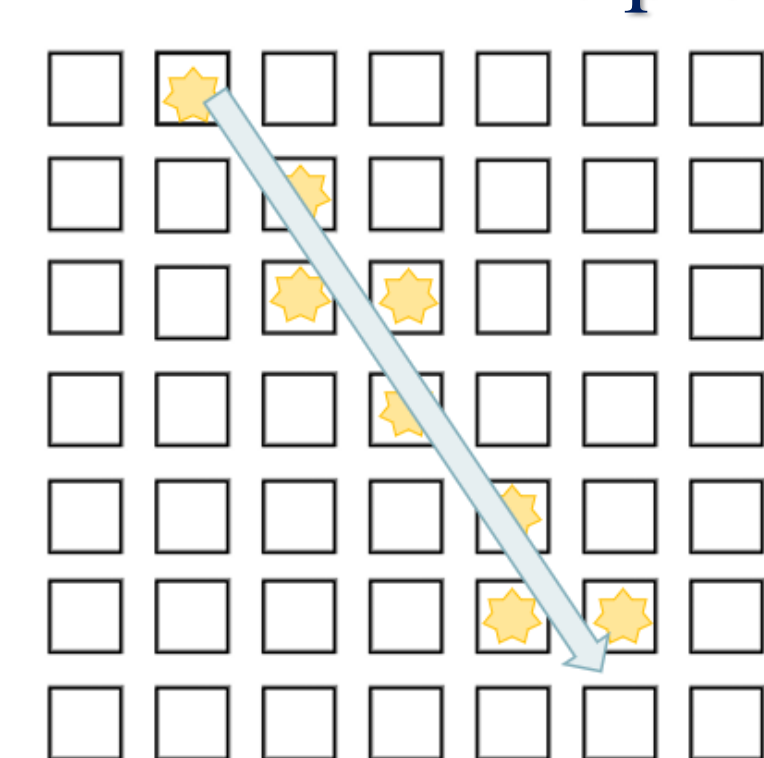
Pixel readout

The current readout is
2-D readout using μ -PIC

Since strip readouts can be reconstruct not only real tracks but also ghost tracks, it is difficult to reconstruct accurate tracks.



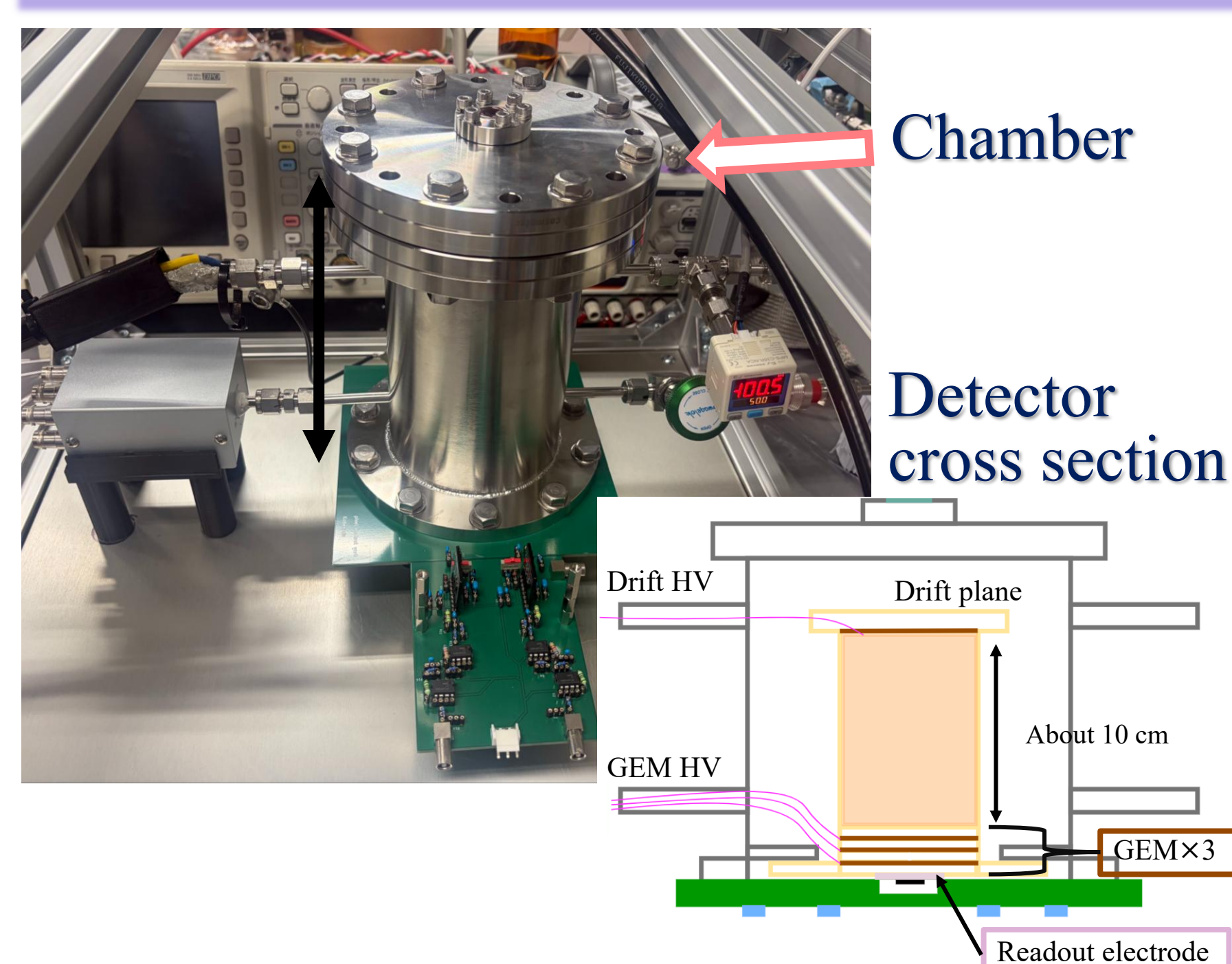
Pixel readout allows to resolve the problem.



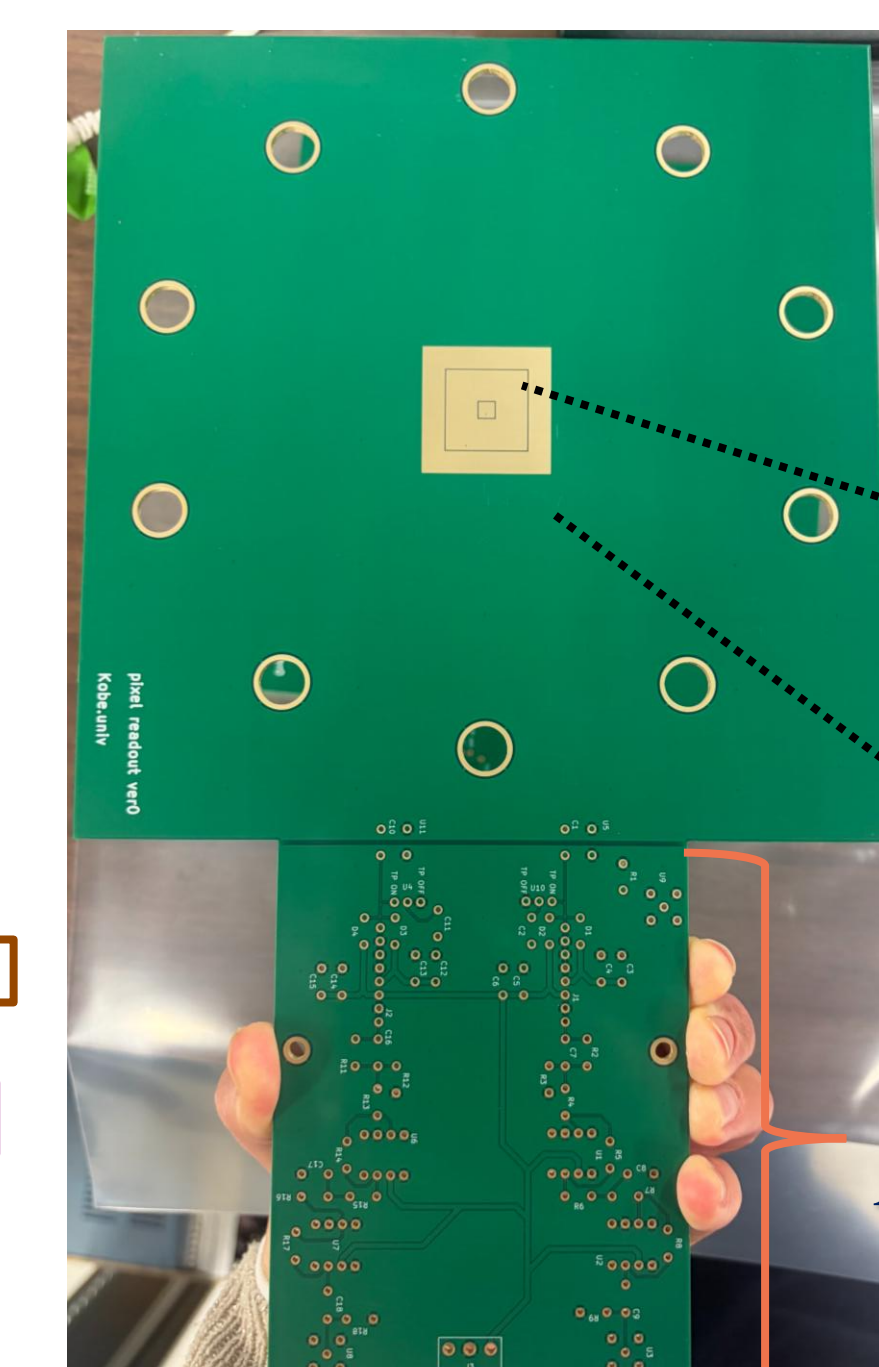
- It can distinguish real track and ghost track.
- Accurate track reconstruction improves angular resolution

The purpose of my research is, developing a prototype detector for future dark matter searches by implementing **SF₆ gas operation** and **pixel readout**!!

Detector

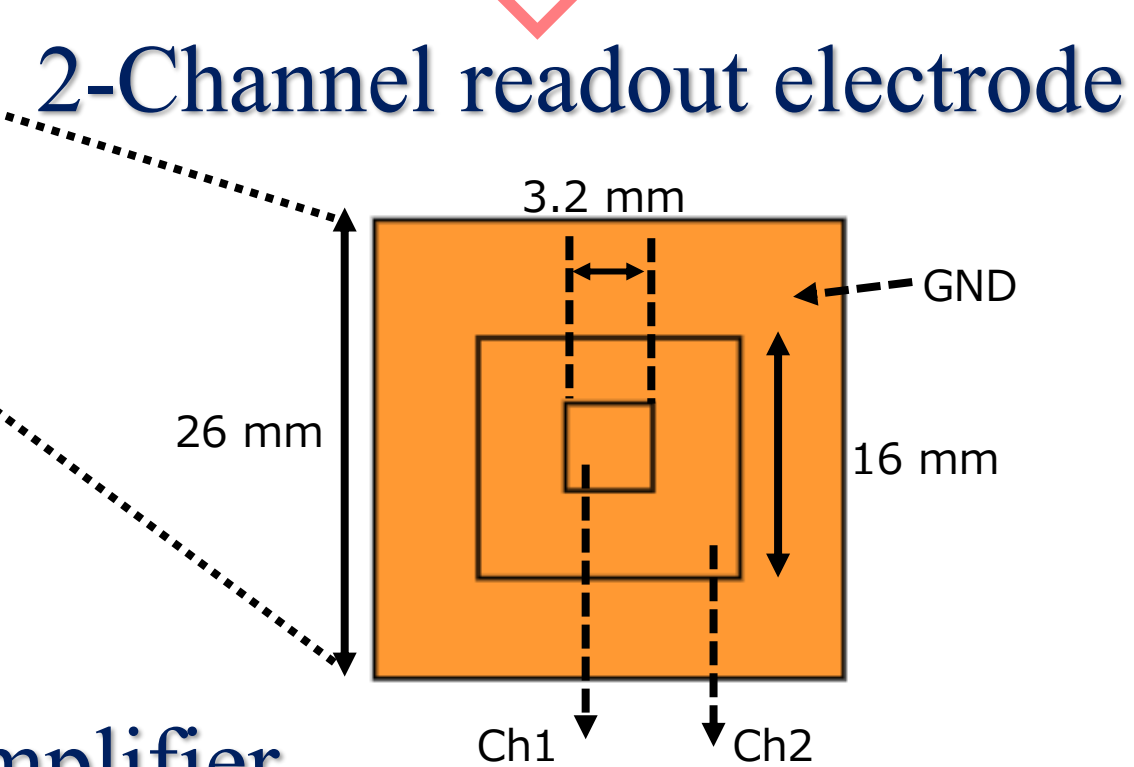


Circuit Board



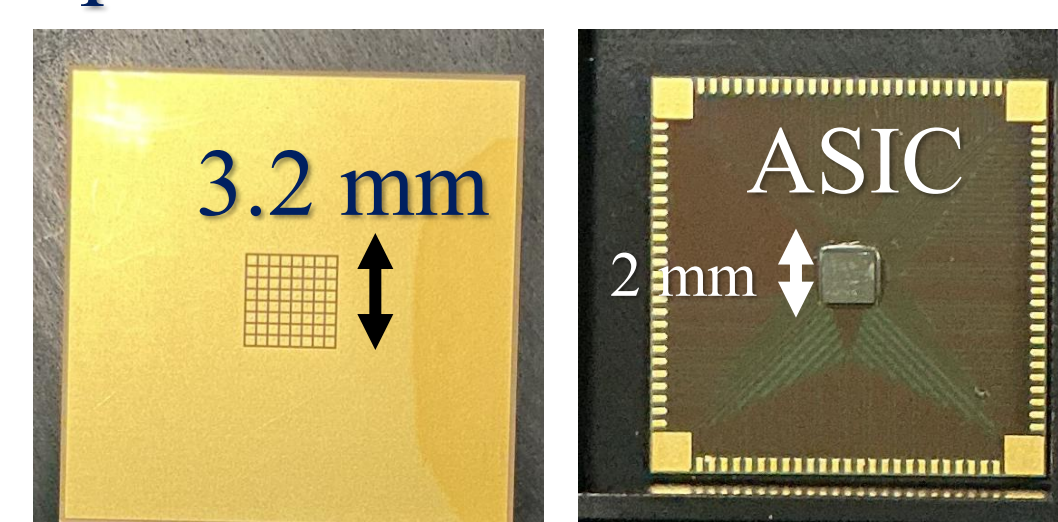
My poster's topic

First, we'll conduct operational tests using simple electrodes!!



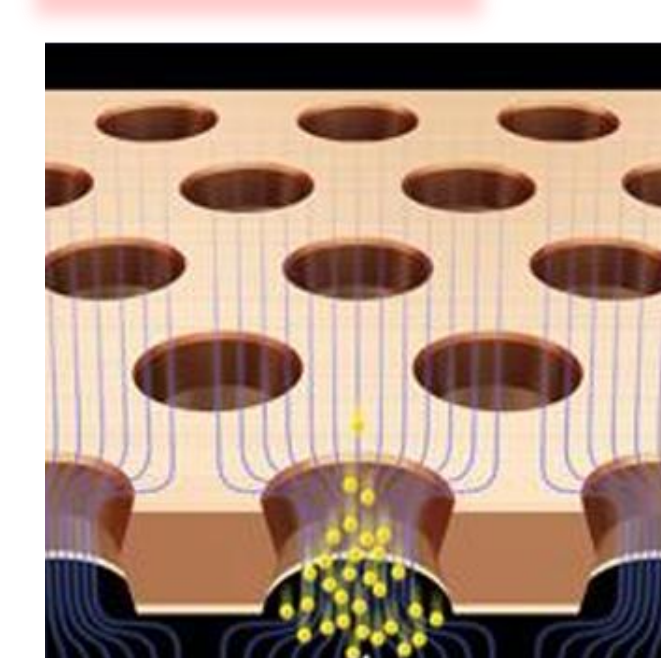
Amplifier

In the future ...
planning to use pixelated electrode

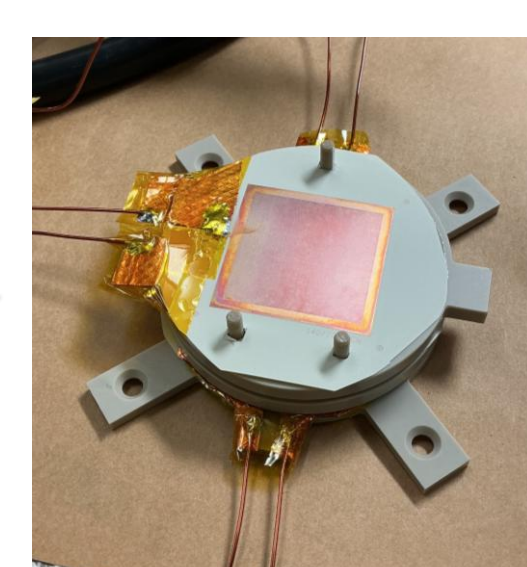


- 400 μ m pitch
- 8 $\times$ 8 channel

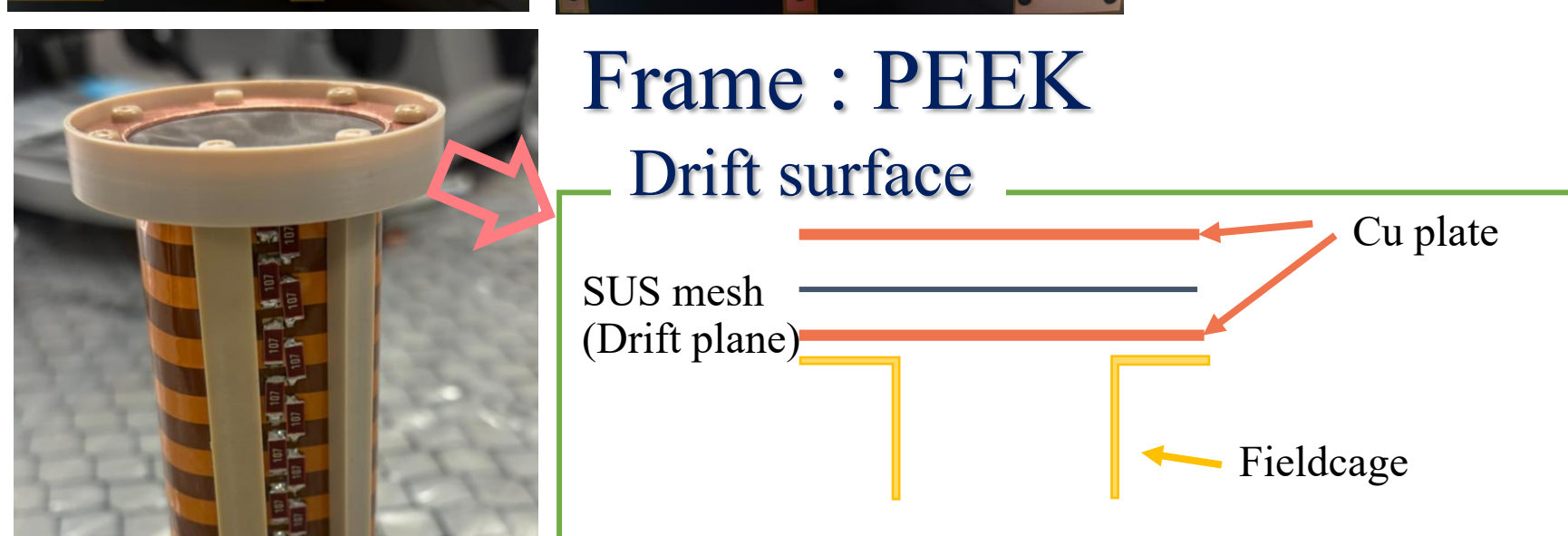
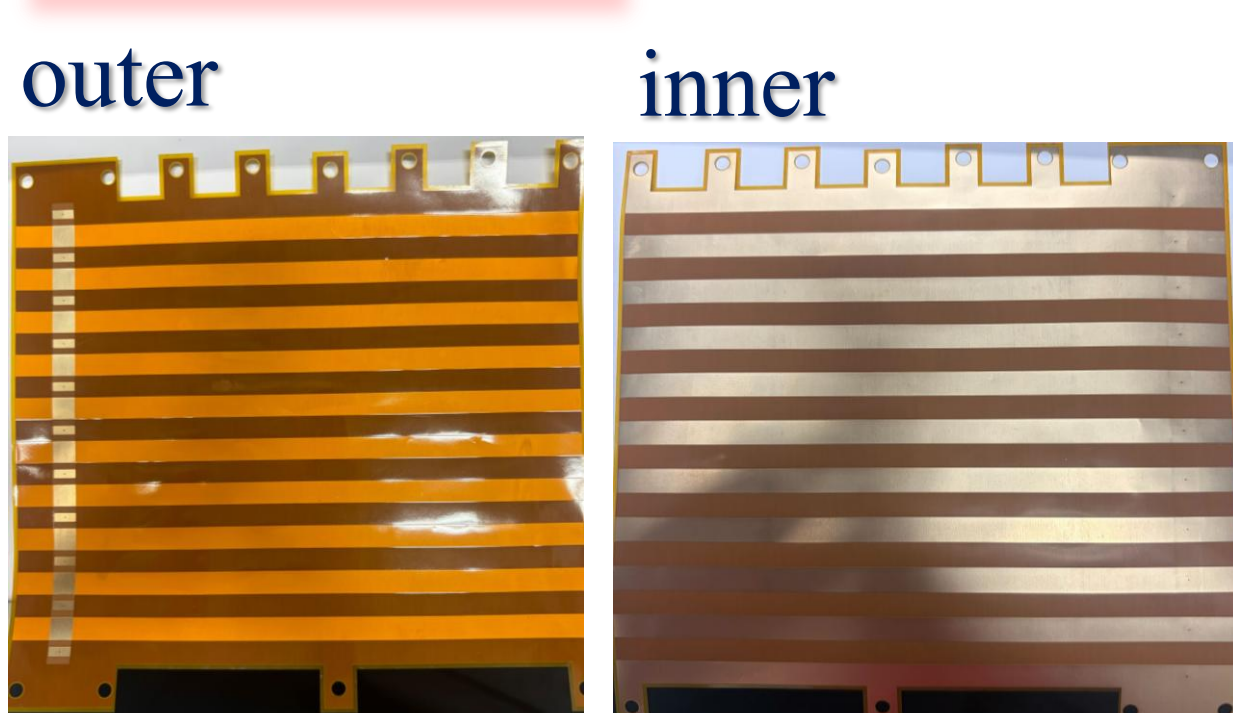
GEM



- 140 μ m pitch
- 2.6 cm square
- 100 μ m thickness
- Three GEMs used



Fieldcage



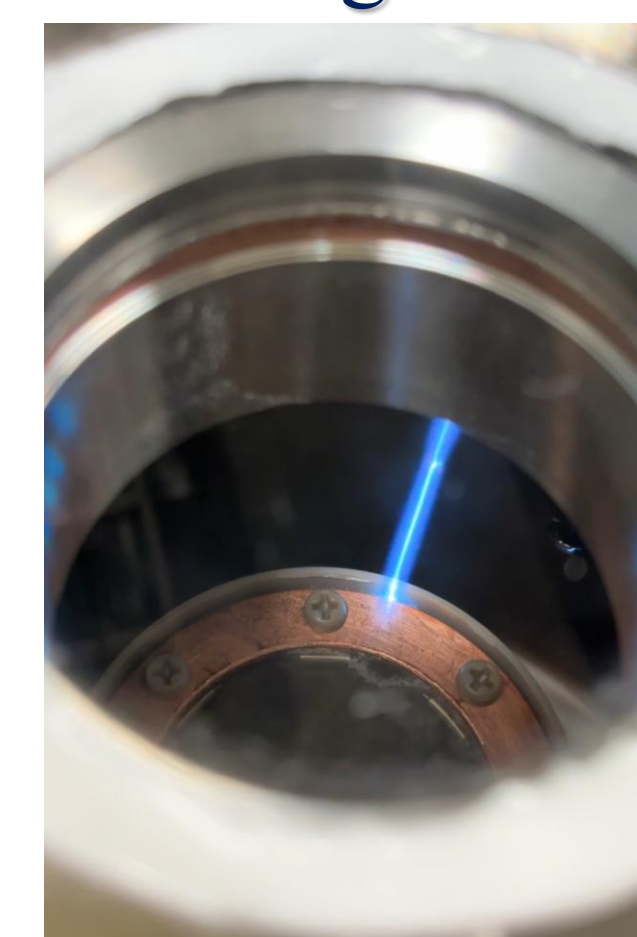
Electrodes are produced with FPC and chained with chip resistors to form a uniform electric field.

Test

Discharge tolerance test

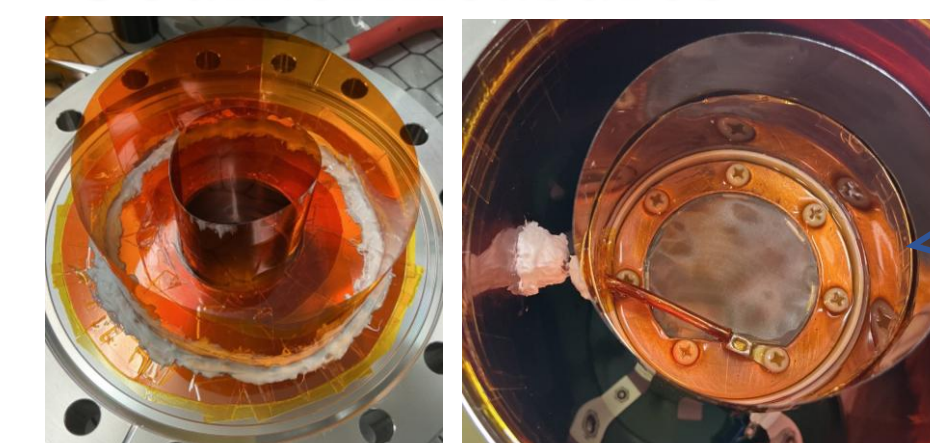
For SF₆ ion drift, an electric field of approximately 1,000 V/cm is ideal...

Discharge



As the countermeasures...
⇒ Extended the path between the electrode and GND.

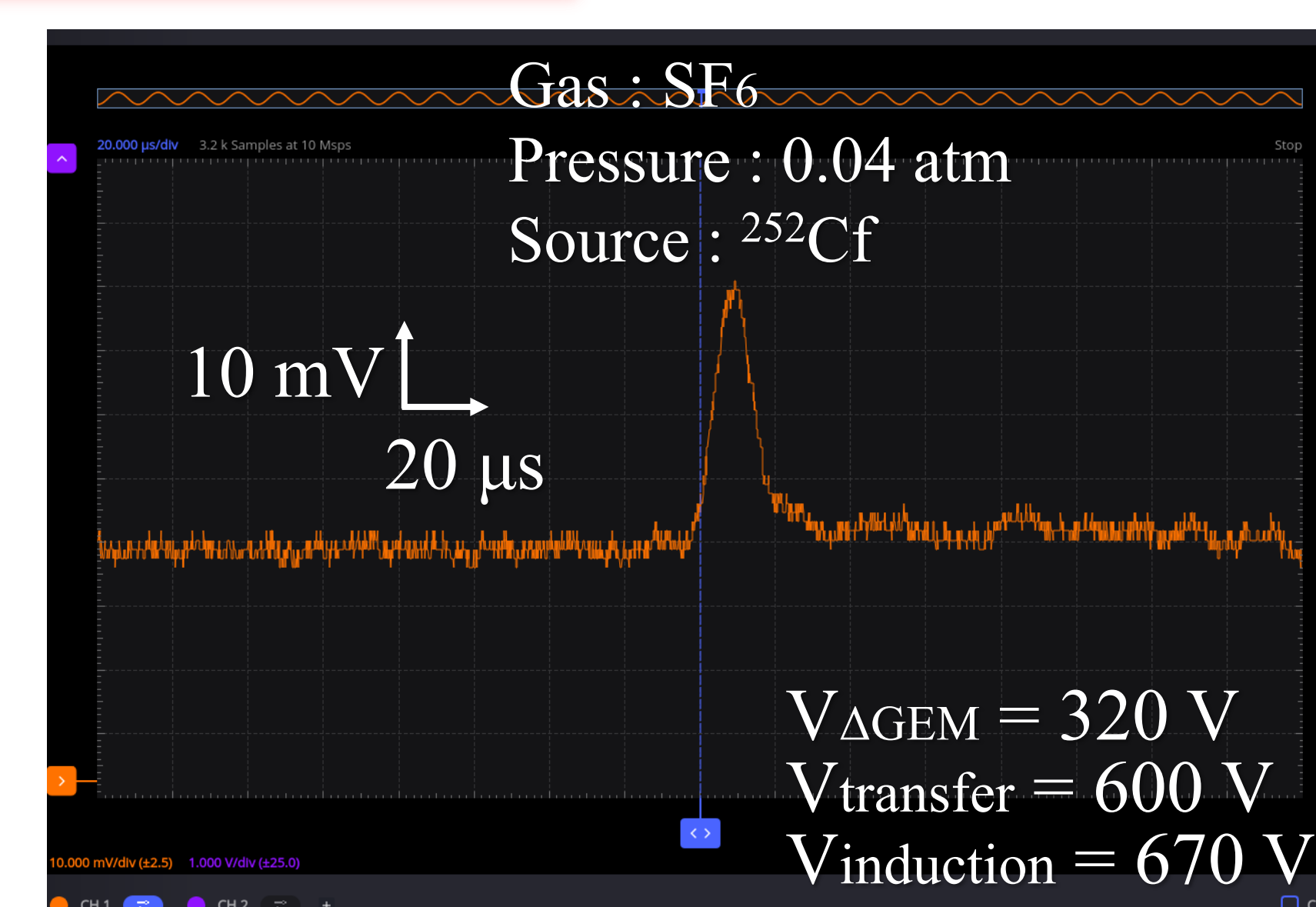
Countermeasures



Mainly, used polyimide sheet

⇒ Finally, achieved about 860 V/cm!!

Operation test



We confirmed the signal of nuclear recoil.
Demonstrated the detector's operation!!

Prospect

- Energy calibration.
- Solving the problem of low gain.
- Observation of minority peaks of SF₅⁻.
- We are also preparing for pixelization!!

Conclusion

- Developed a prototype detector for direct dark matter search experiments with future directional sensitivity.
- This detector is designed to operate with SF₆ gas and to be pixelated.
- Manufactured custom-made chamber, fieldcage, and circuit board.
- Prior to pixelation, we conducted tests using 1-channel pad readout.
- Confirmed signals originating from neutrons from a ²⁵²Cf source using the developed prototype detector.