NEWAGE

Kentaro Miuchi（Kobe University）

IDM 2018 @ Brown University

introduction

negative ION TPC R&D

low BG μPIC development

underground measurement

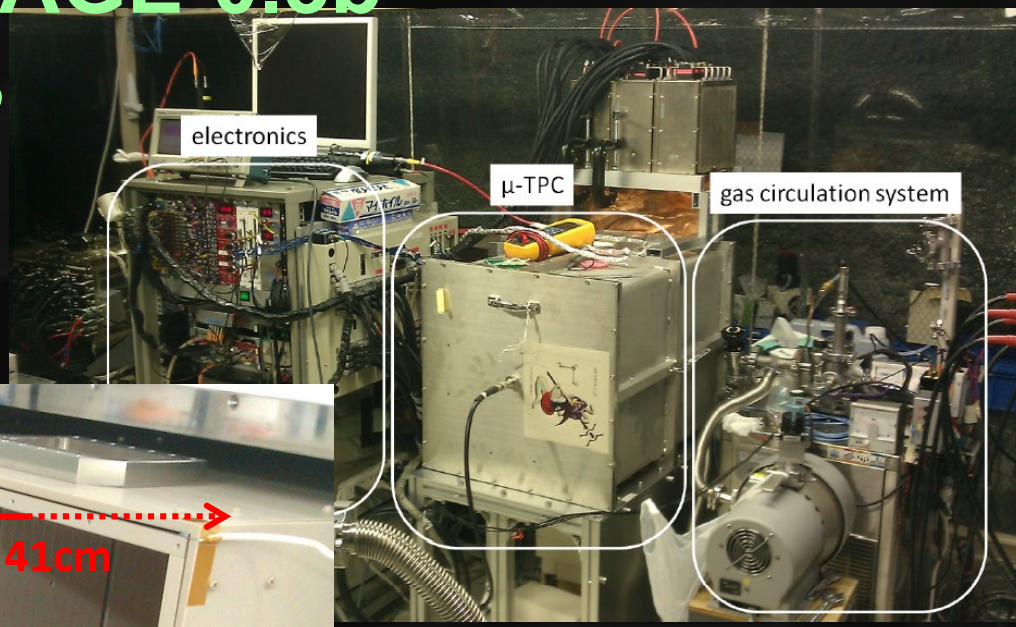
Direction Sensitive WIMP-search NEWAGE

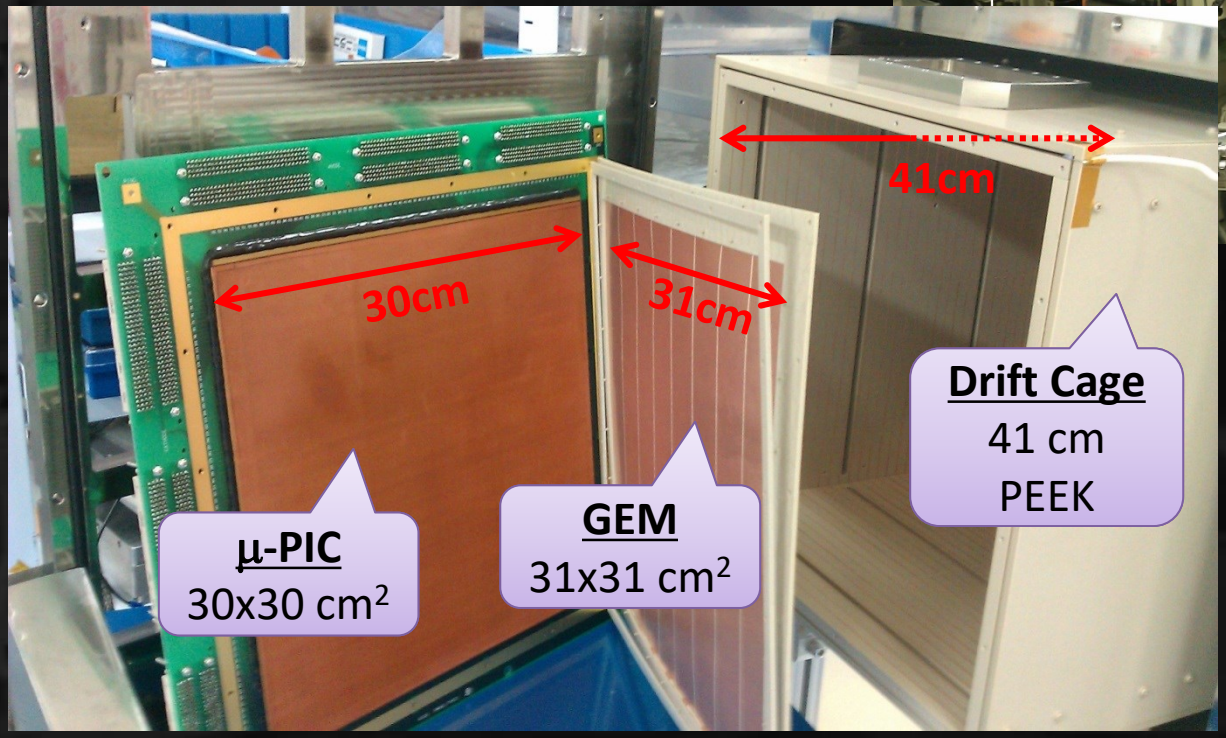
introduction

Direction Sensitive
WIMP-search
NEWAGE

Introduction "NEWAGE-0.3b" @Kamioka Lab-B

- 76Torr CF_4
- $30 \times 30 \times 41 cm^3$



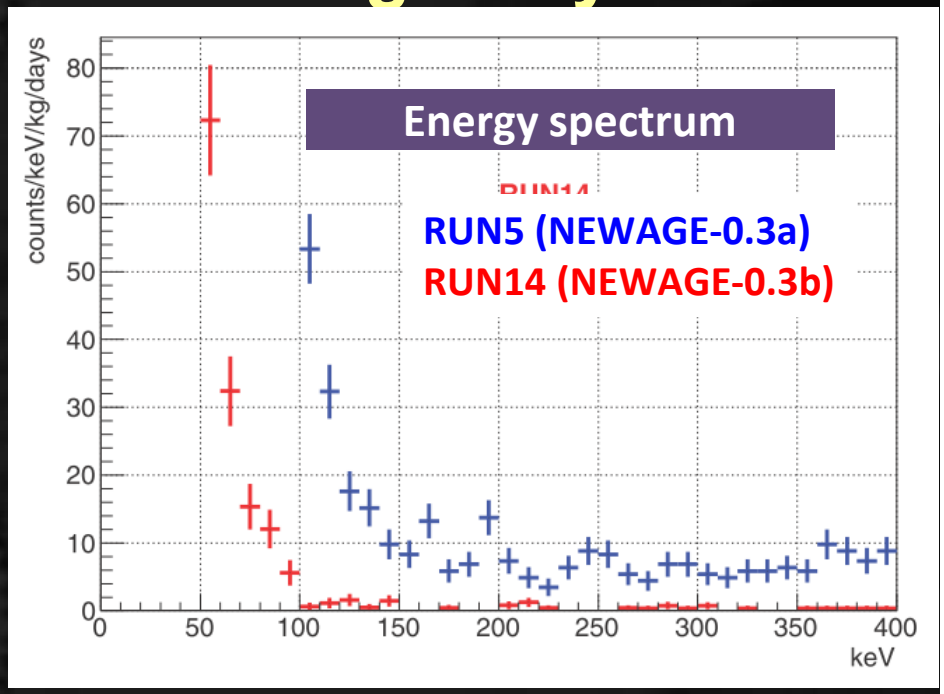


- 3D tracks for "SKYMAP" analysis

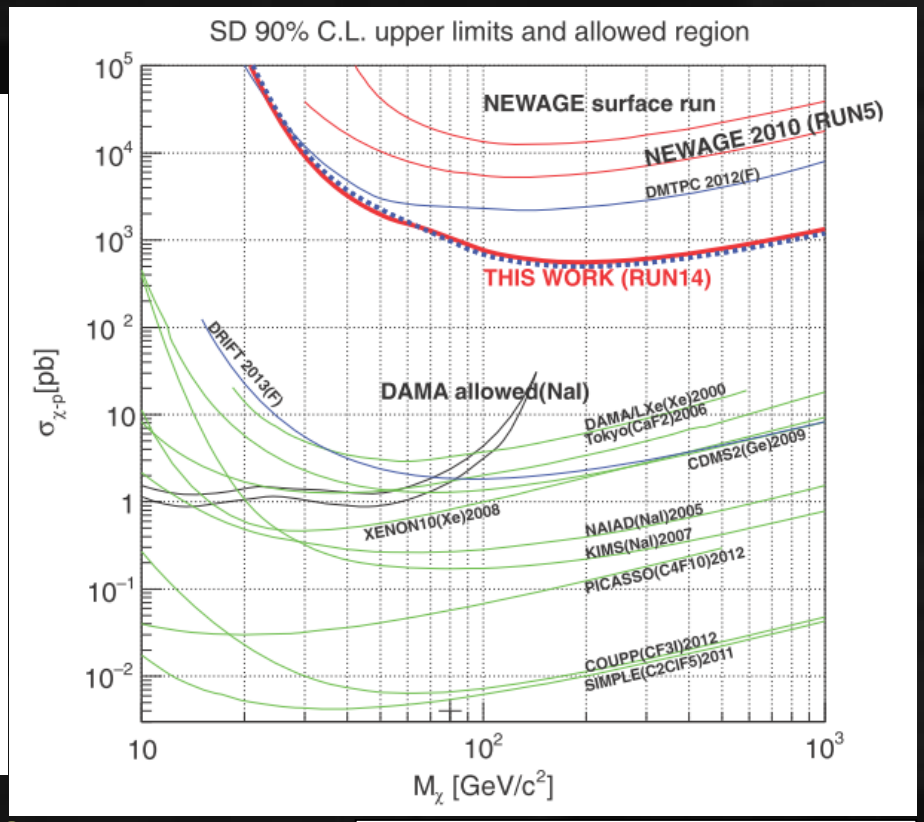
Intdroduction：Kamioka RUN14

（PTEP(2015) 043F01s）

- 2013/7/20-8/11, 10/19-11/12
- live time : 31.6 days
- 0.327 kg・days



limit curve



red : gas, with directional analysis
blue : gas, without directional analysis
green : solid, liquid detector

- Increased exposure
- low BG μ-PIC development
- Negative ION TPC

WIMP-search NEWAGE

underground measurement

Direction Sensitive
WIMP-search
NEWAGE

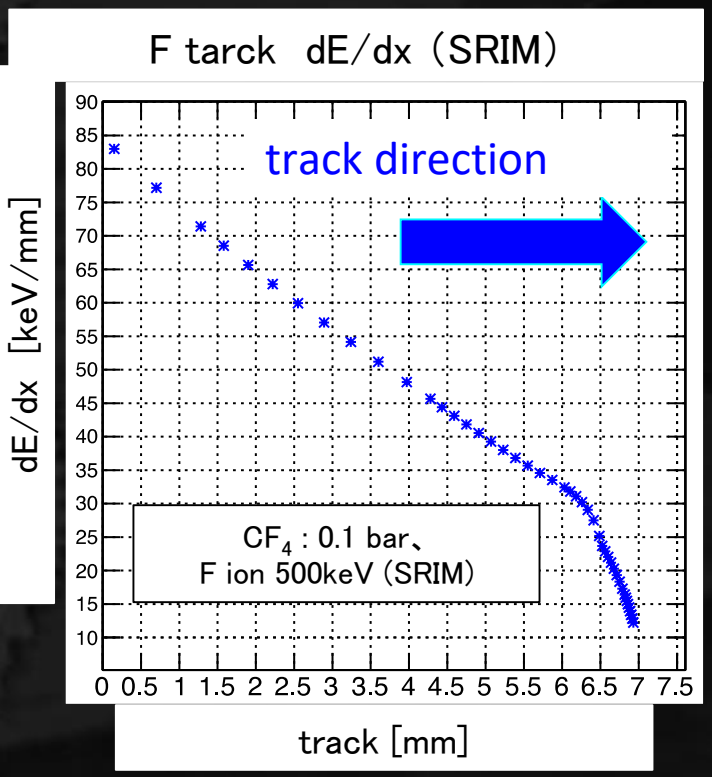
- since RUN14-1,2
  - ～400 days of data　(exposure　×14)
  - analysis update including head/tail（3D-vector）

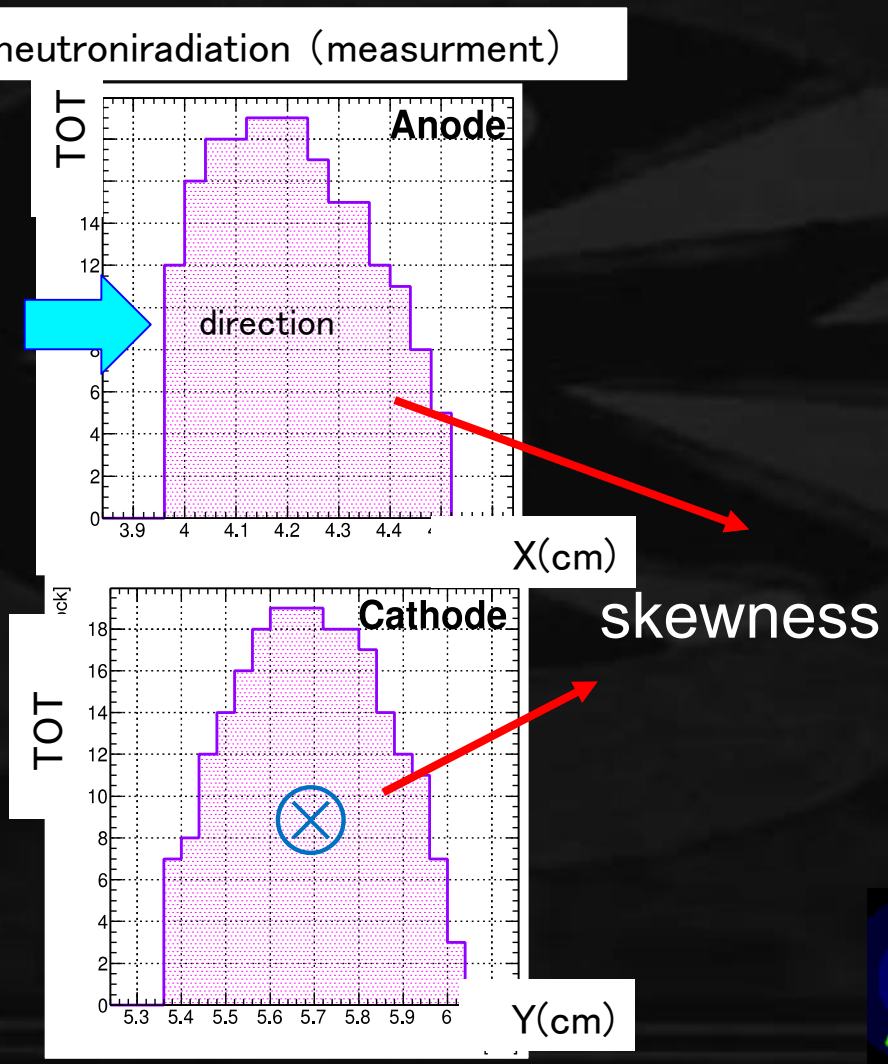
Run number	Measured date	Live time [days]
Run14-1	2013/7/17 - 2013/9/16	17.10
Run14-2	2013/10/17 - 2013/11/14	14.52
Run14-3	2014/01/29 - 2014/3/12	25.34
Run15-1	2015/3/30 - 2015/8/17	N/A
Run15-2	2015/8/17 - 2015/10/27	N/A
Run15-3	2015/11/6 - 2016/1/14	N/A
Run16-1	2016/1/14 - 2016/3/10	42.28
Run16-2	2016/3/25 - 2016/6/28	69.94
Run17-1	2016/6/28 - 2016/8/24	26.16
Run18-1	2016/8/24 - 2016/8/27	N/A
Run18-2	2016/9/1 - 2016/10/19	41.43
Run18-3	2016/10/20 - 2017/1/19	66.86
Run18-4	2017/1/26 - 2017/4/21	49.51
Run18-5	2017/4/27 - 2017/8/8	81.71
Total	2013/7/17 - 2017/8/8	434.85

Direction Sensitive WIMP-search NEWAGE

head/tail

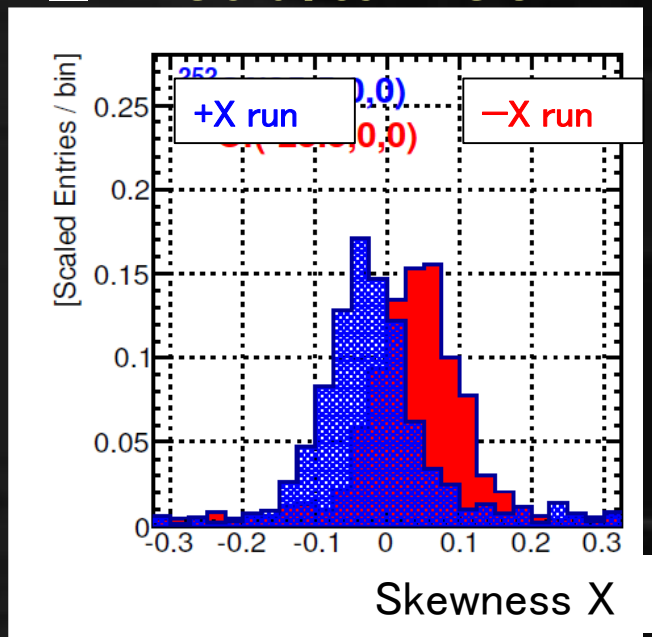
- TOT(time-over-threshold) of each strip

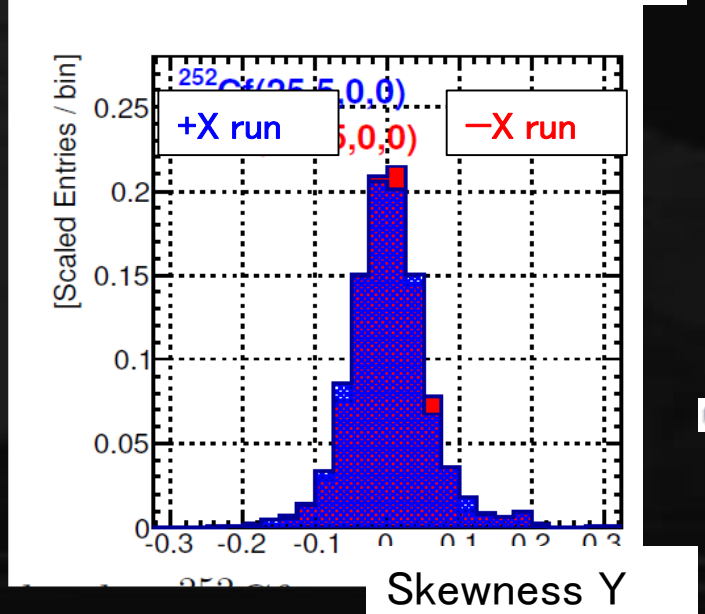


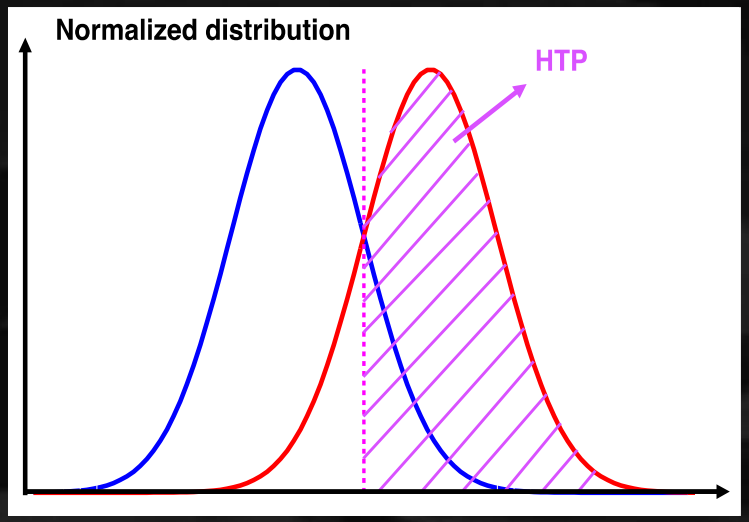


head/tail by TOT strip

- head/tail confirmed for >100keV







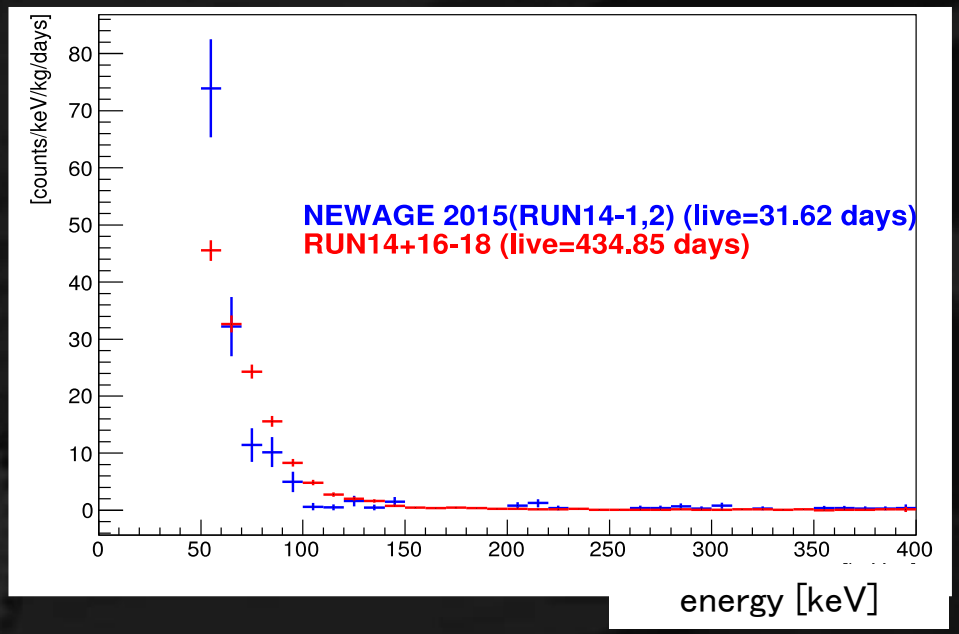
Energy range	HTP [%]
50−100 keV	57±6
100−200keV	64±4
200−400keV	76±8

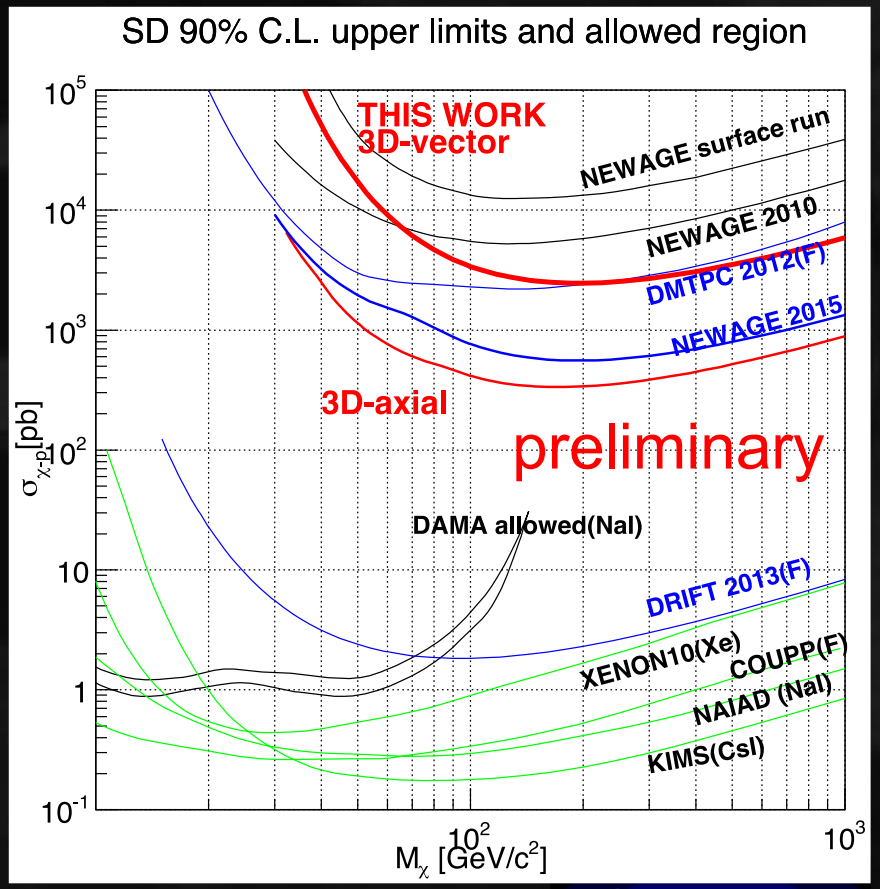
- >100keV：3D vector
  50～100keV：3D axial

Direction Sensitive WIMP-search NEWAGE

underground result

- 4.5kg days (435 live-days) exposure
- limits by 3D-axial and 3D-vector





- to do：3D vector analysis below 100keV

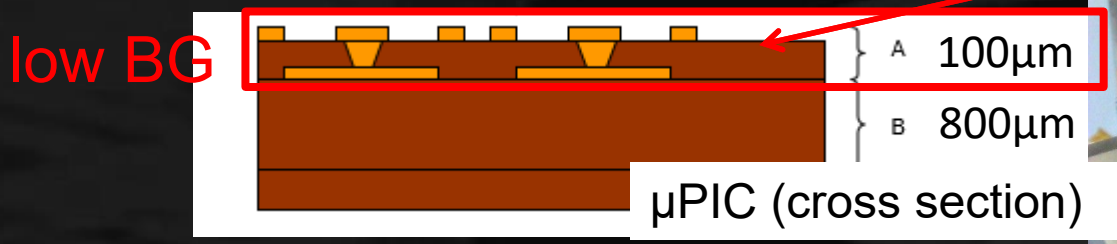
Direction Sensitive WIMP-search NEWAGE

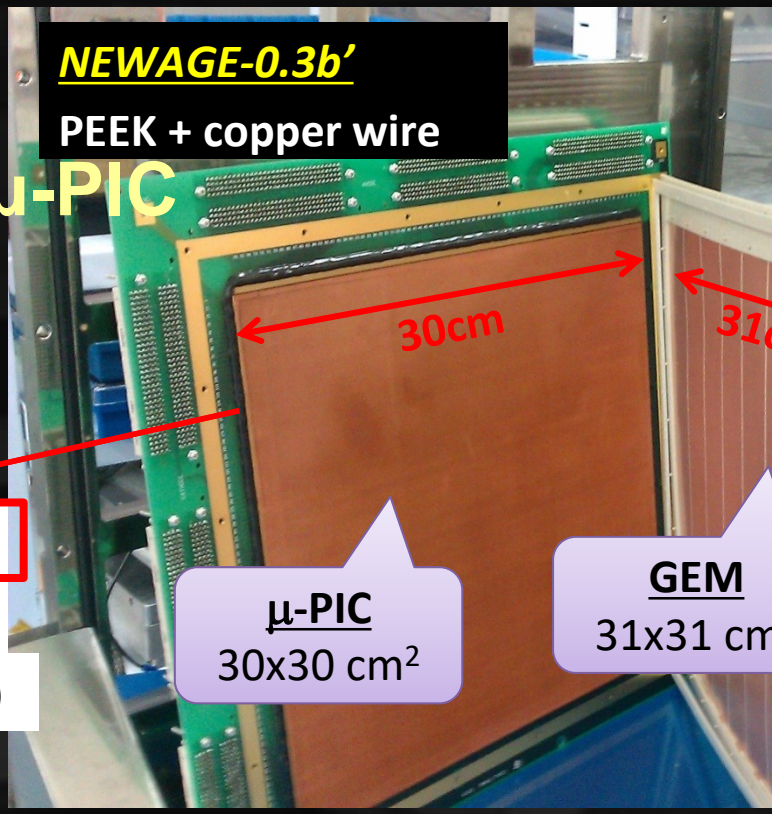
low BG μ-PIC development

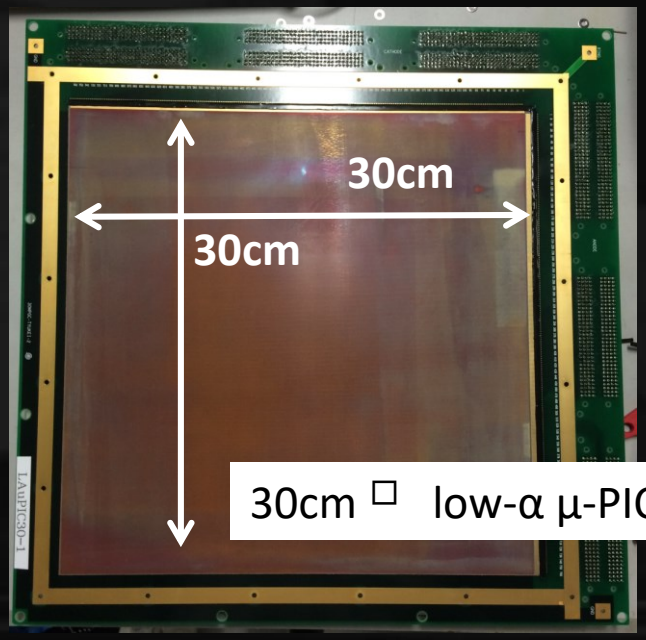
Direction Sensitive
WIMP-search
NEWAGE

low BG μ-PIC

- main BG：α particles from μ-PIC
- "low-α μ-PIC" with clean polyimide (U / Th ×1/100)







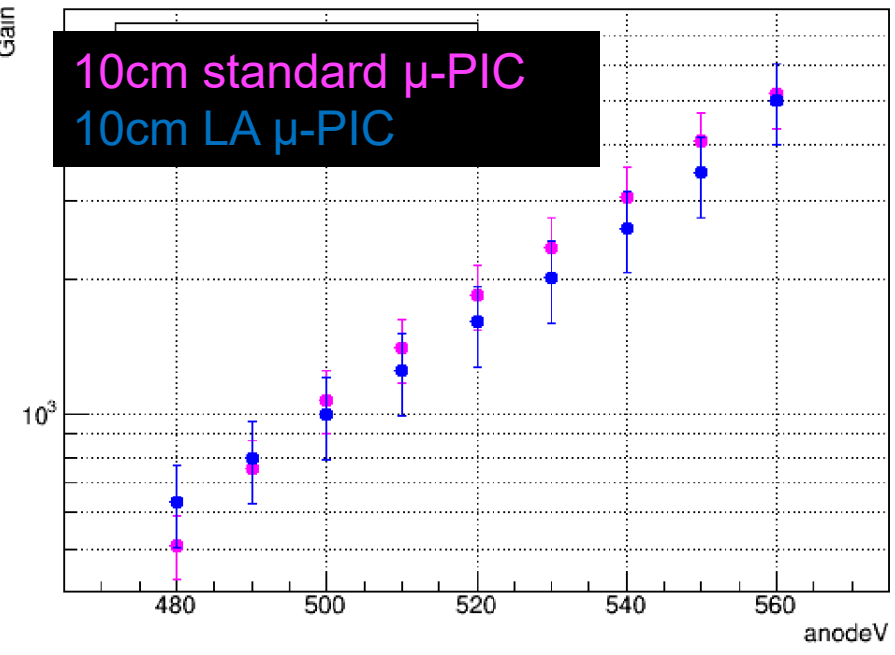
30cm □ low-α μ-PIC

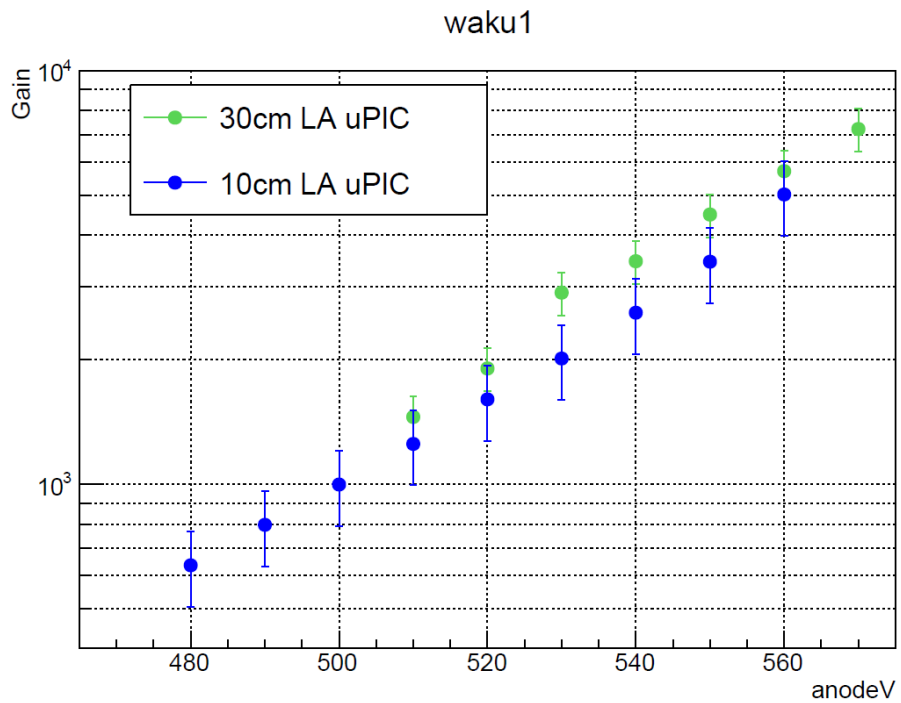
test（～ Oct 2017）
underground measurement
（Nov 2017～）

Direction Sensitive WIMP-search NEWAGE

low-α μ-PIC(LA-μPIC): performance

- gain curve measurement with Ar/C2H6 gas
- similar performance with standard ones

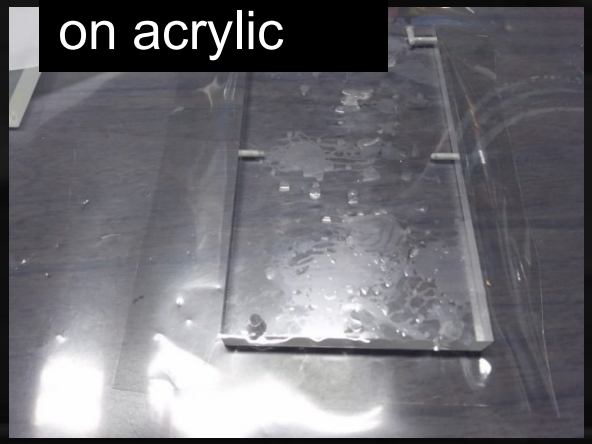


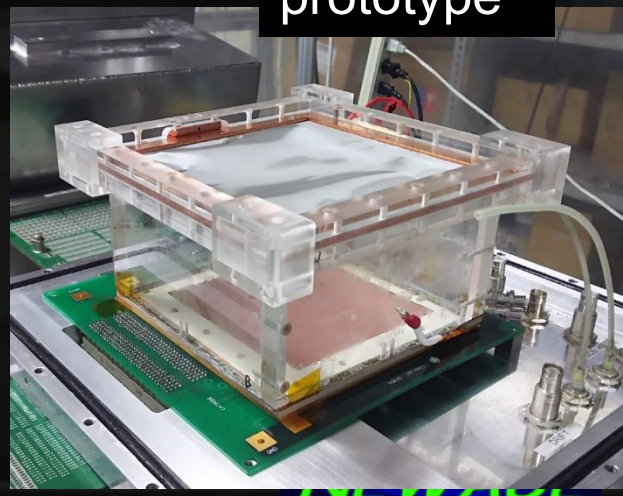


new material for TPC field cage: resistive sheet with ～10GΩ/□

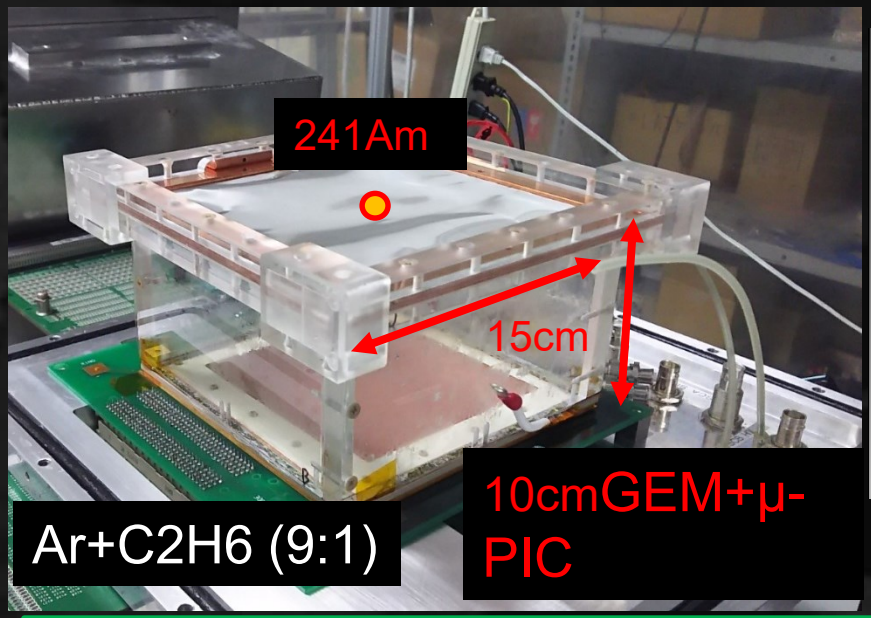
many di-electric sheet candidates
(most of them are to low resistive)

chosen one (in terms of)
resistivity and uniformity

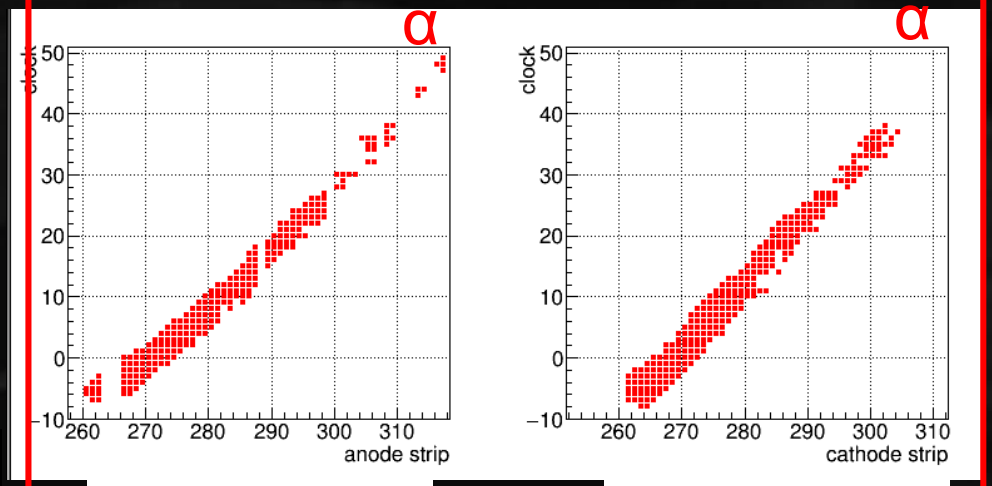


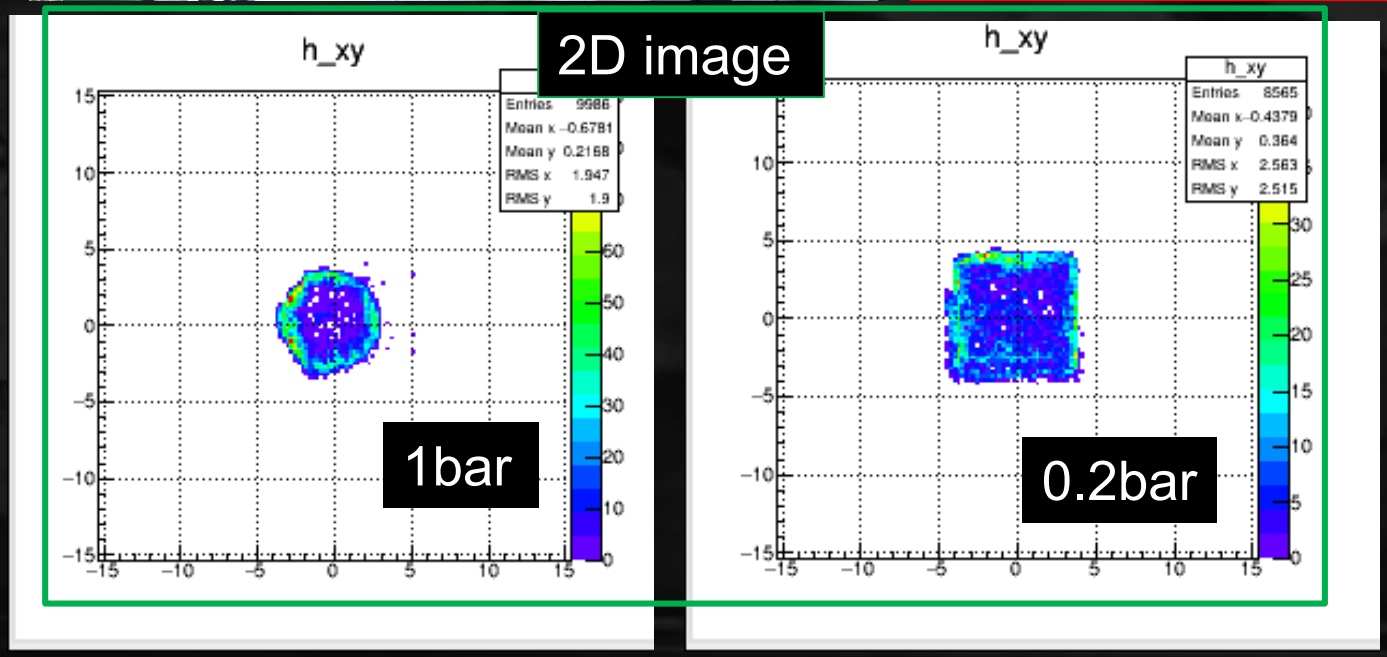


TPC test



α ray data（raw data）





quantitative measurement is going on

Direction Sensitive WIMP-search NEWAGE

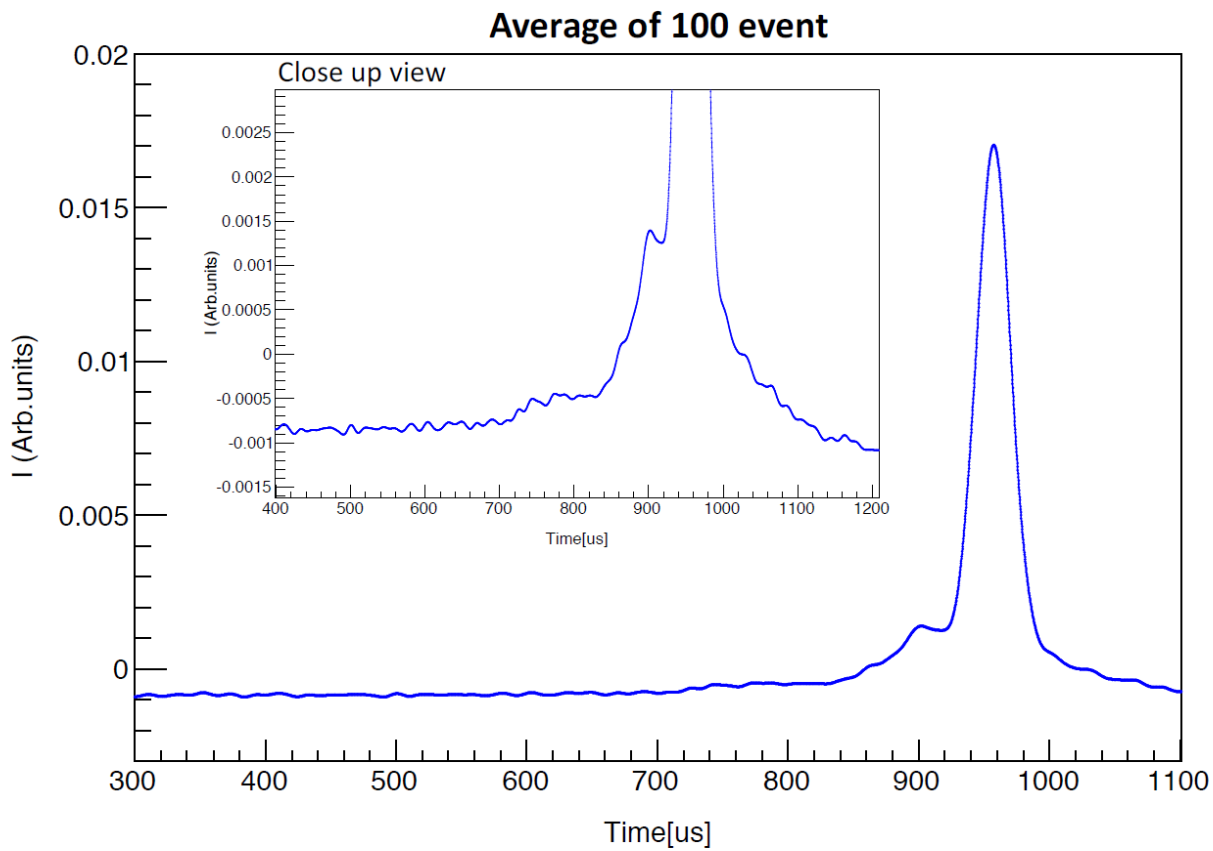
z-fiducializationR&D

Direction Sensitive
WIMP-search
NEWAGE

μ-PIC in SF6

- minority carier for z-fiducialization

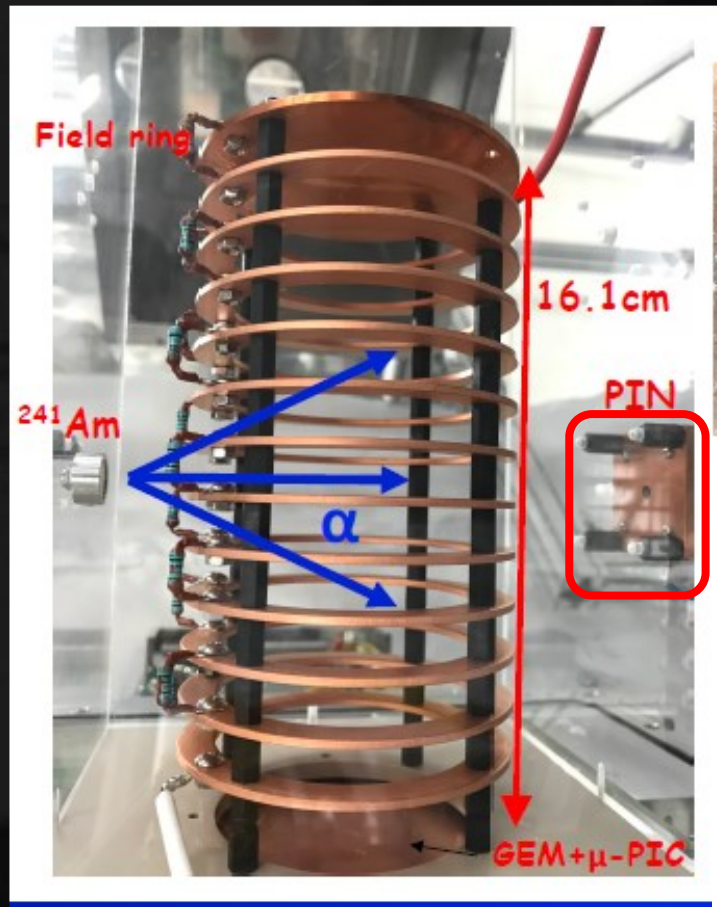
Waveform Feature



μ-PIC in SF6

- tracking test (α-rays)
- SF6 20Torr

Tomonori Ikeda JPS
Mar2018

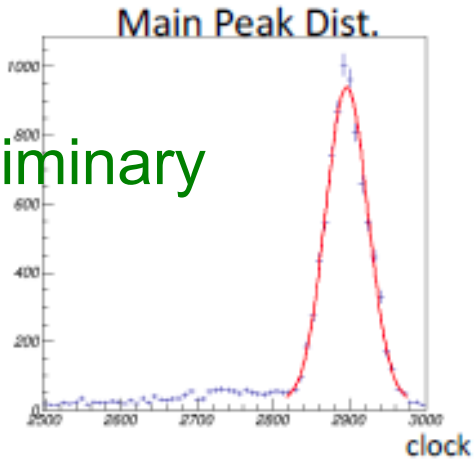


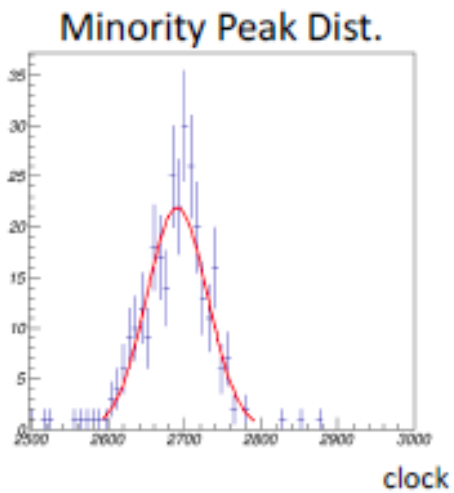
Liq argon electronics (LTARS2014)
GEM (LCP 100um-thick)+μ-PIC
PIN photodiode for trigger
detection volume
1.28×1.28×16.1 cm
anode(32ch) cathode(32ch)

z resolution measurement with PIN trigger

Tomonori Ikeda JPS
Mar2018

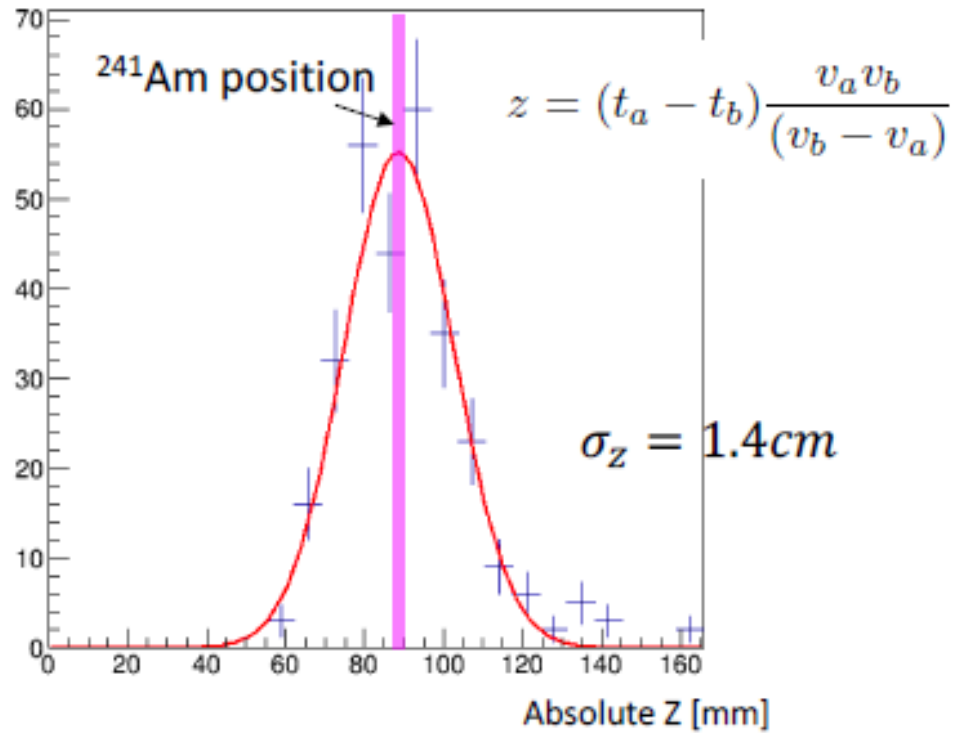
preliminary





SF_6 (Main charge) Drift V : 8.0 [cm/ms]

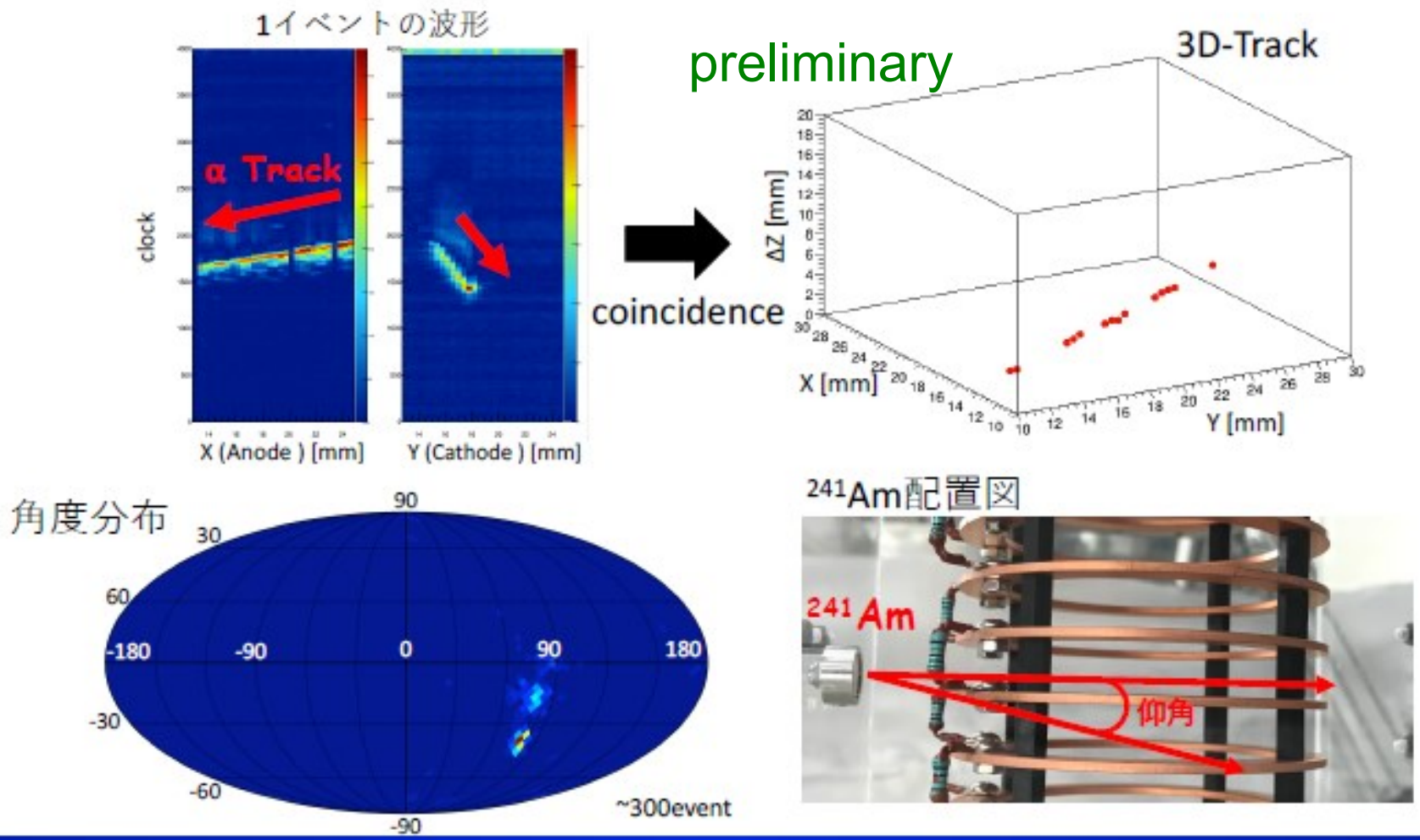
SF_5 (Minority charge) Drift V : 8.6 [cm/ms]



WIMP-search NEWAGE

3D tracking + z-fiducialization (first shown!)

Tomonori Ikeda JPS
Mar2018

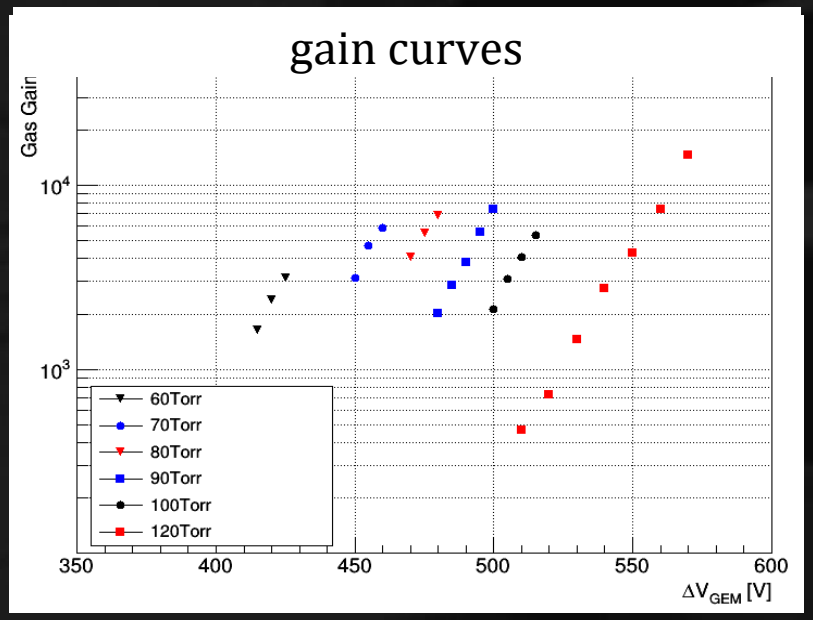


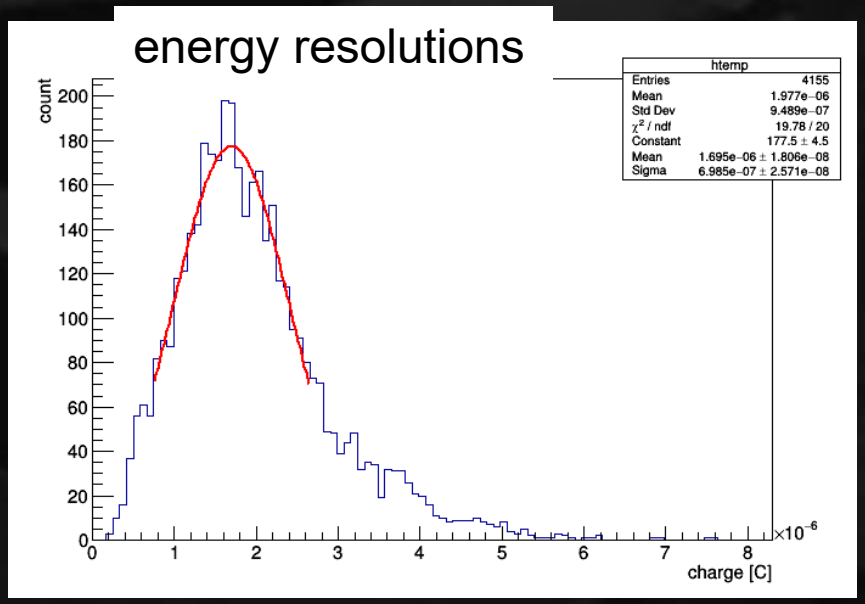
paper in preparation

Negative ION simulation to Garfield++

(Hirohisa Ishiura with Rob Veenhof @ CERN July 2018)

- to optimize/understand the MPGD behavior in negative ion gas
- what we observe:





⇒ to implement avalanche process, detachment process… in Garfield++.

SUMMARY

- >400 days underground measurement
- low BG μ-PIC developed

- SF6: 3D track + fiducialization
- Garfield++ work, just started

Direction Sensitive WIMP-search NEWAGE