

### 15th International Workshop on the Identification of Dark Matter 2024

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# Status of NEWAGE:

direction-sensitive dark matter search with low background micro-pattern gaseous TPC

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on behave of NEWAGE collaboration 11 / 7 / 2024



Direction Sensitive WIMP-search NEWAGE

Parallel session: Direct detection

# Introduction

## Direction-sensitive DM searches

- Detect scattering angle of nuclear recoils (NR) from the "Cygnus direction"
  - leads a strong signature of WIMP
  - ⇒ allows to explore beyond the neutrino-floor







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**WIMP** 

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# Direction-sensitive search methods

• Particle tracking is necessary to measure scattering angle from Cygnus direction

- → Need to measure < 10 keV nuclear recoil (VERY short track!)
- To achieve < 10 keV nuclear recoil track reconstruction, ...
  - ultra-fine granularity detector (emulsion: NEWSdm, talk by Andrey Alexandrov)
  - → use low pressure gas to extend trajectory



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# NEWAGE

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- 1,000 m underground experiment in the Kamioka mine
- Low pressure gaseous TPC
  - →  $30 \times 30 \times 41$  cm<sup>3</sup> fiducial volume
  - → filled with CF<sub>4</sub> gas (0.1 atm): spin-dependent search





# NEWAGE: 3D track reconstruction



# Latest result

- Null-consistent result in energy and directional distributions
  - Electron recoil rejection analysis updated and exposure increased
  - Limit is approaching DAMA/LIBRA allowed region
  - Head-tail recognition successfully implemented
- Future work: BG rejection and large target volume



# Strategy of BG rejection PTEP 2023 (2023) 10, 103F01

- External BG
  - Ambient gamma (and neutron): shielding
- Internal BG
  - Radon emanation: "clean" detector development

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# Strategy of BG rejection

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  - Ambient gamma (and neutron): s
- Internal BG



Radon emanation: "clean" detector development











# Gamma rejection (Copper shield)

#### Review of ambient gamma-induced electron recoil

- The lowest energy bin is the most sensitive
  - Ambient gamma flux had been measured by Csl
  - Expected events were simulated but 100% unc. assigned
    - Detector response was not completely understood



Rn alpha:  $1.61 \pm 0.28$  events gamma:  $1.53 \pm 1.53$  events



Nuclear recoil-like event in <sup>252</sup>Cf source run

 $E = 160 \text{ keV}_{ee}$ 

Electron recoil-like event in <sup>137</sup>Cs run

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 $E = 72 \text{ keV}_{ee}$ 

(this event was dropped by our event selection)



Rejection power: ~10<sup>-6</sup> but need to reduce the ambient gamma flux into our chamber itself

# Copper shield

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#### 5 cm thick copper





# Copper shield

12





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# Radon BG (Development of clean detector)

# Development of "clean" detector



LBGµ-PIC: <**0.17** [mBq / µ-PIC] (90% C.L.)

arXiv:2403.11736 submitted to NIM A



## Detector installation (Dec. 2023)



 $\mu$ -PIC<sup>1</sup>

←GEM

#### ↓Student





#### ↑ μ-PIC backplane

## Radon measurement

- Alpha from radon progenies can be identified by its energy and trajectory
  - ➡ 6 MeV alpha ray will have a track length of ~17 cm (calculated by SRIM)
  - Events with > 4 MeV are counted as alpha rays from radon and its progenies



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# What is "Dirty" materials?

• One by one suspicious material check started using our radon detector

→ but no BG source materials are found...







Feed through board for µ-PIC

resistor for TPC field cage

<sup>10</sup>B plate for energy calibration, ge and its support material



Next plan is to change feed through flange and its cylinder: inner surface may not be polished. (but radon BG level is not certain...)

New feed through system is ready, planning to exchange it during this summer

and investigation of other possibilities ongoing

### Prospects



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# Summary

- NEWAGE is the direction-sensitive direct DM search experiment
  - Upper limit reached to the DAMA region
- Background reduction campaign is ongoing
  - Copper shield and low radon emanation detector installed
  - Remaining radon background source under investigation



