Contribution ID: **117** Type: **Poster contribution**

Toward the reduction of ion backflow in a TPC using Flower GEM

Tuesday, 21 October 2025 19:21 (1 minute)

Systematic measurement of isoscalar giant monopole resonances, especially in unstable nuclei, via inelastic scattering in inverse kinematics is one of the important issues for determining the nuclear matter equation of state. An active target TPC, CAT-M, has been developed [1] for such measurement, using high-intensity heavy-ion beams of up to approximately 10^6 counts per second. The incident beam reacts with the detector gas (deuterium) in CAT-M, and the TPC measures the generated recoil particles and reaction products by multiplying electrons with gas electron multipliers (GEMs).
One of the significant challenges in TPC measurements using high-intensity beams—not only for active targets but for many types of TPCs—is the reduction of ion backflow (IBF) from the electron multiplication region to the drift region. Due to the high repetition of the beam particles, slow ions form sufficient space charge that distorts the electric field and ultimately degrades the position accuracy. This becomes a particularly prominent issue under high-rate conditions of around 10^6 counts per second [2].
Various improvements have been implemented in the electron multiplication section of TPCs to reduce IBF. For example, techniques to suppress the IBF by using stacked GEMs with different hole pitches have been developed [3]. In this study, we focused on the so-called Flower GEM, an innovative structure that, when stacked with Normal GEMs, is expected to suppress IBF while maintaining a high gas gain effectively. Our objective is to experimentally evaluate the IBF reduction performance of a combination of Normal and Flower GEMs.
For this evaluation, we used MiniTPC [4], a beam tracking TPC connectable to CAT-M, and conducted a performance evaluation experiment using MiniTPC equipped with both types of GEMs. The experiment was conducted at the Heavy Ion Medical Accelerator in Chiba (HIMAC) last February. The incident particles were 290 MeV/u Xe beams with a periodic structure of approximately 10^4 counts per pulse. In this experiment, we measured the anode current, which corresponds to the number of multiplied electrons, and the cathode current, which corresponds to backflowing ions, to evaluate the IBF rate and gain for the stacked configuration of Normal and Flower GEMs.
In this presentation, the details of the IBF evaluation experiment using the MiniTPC and the results are presented. Moreover, implications for IBF countermeasures in CAT-M irradiated with a high-intensity beam and future perspectives are discussed.

References

[1] S. Ota et al., CNS Annual Report 2017, 97, 41, (2019).
[2] C. Iwamoto et al., Progress of Theoretical and Experimental Physics, 2023, 8, 083H01, (2023).
[3] J. Adolfsson et al., Journal of Instrumentation, 16(3), P03022, (2021).
[4] F. Endo et al., CNS Annual Report 2021, 101, 13, (2023).

Email address

sbkt@rcnp.osaka-u.ac.jp

Supervisor's Name

Shinsuke Ota

Supervisor's email

ota@rcnp.osaka-u.ac.jp

Funding Agency

Classification

Instrumentation for radioactive ion beam experiments

Primary author: SHIBAKITA, Hiroaki (RCNP, Osaka University)

Co-authors: OTA, Shinsuke (Research Center for Nuclear Physics, the University of Osaka); ENDO, Fumitaka (RIKEN Nishina Center); KOJIMA, Reiko (CNS, the Univ. of Tokyo); KOBAYASHI, Nobuyuki (RCNP, UOsaka); KITAMURA, Noritaka (Center for Nuclear Study, University of Tokyo); Dr HANAI, Shutaro (Institute of Science Tokyo); IMAI, Nobu (Center for Nuclear Study, Univ. of Tokyo); Dr TAKADA, Eiichi (QST); TAMII, Atsushi (Research Center for Nuclear Physics, Osaka University)

Presenter: SHIBAKITA, Hiroaki (RCNP, Osaka University)

Session Classification: Poster Session

Track Classification: Instrumentation for radioactive ion beam experiments