

EIC activities in Japan

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The Electron-Ion Collider (EIC) is the highest priority future project in nuclear physics field in the United States and is the world's first polarized electron + polarized proton and nuclei collider to be constructed at Brookhaven National Laboratory (BNL).¹⁾ The EIC User Group was established in 2016, with participants from the U.S., Europe, Asia, and other regions numbering more than 1,300 members. In Japan, the EIC-Japan Group was established at approximately the same time and has been very active. The EIC project has now been authorized by the U.S. Department of Energy to begin the project execution phase, and this year we will prepare a Technical Design Report for the next phase. The EIC-Japan group is also participating in the design of the detector for the ePIC international collaboration experiment to be conducted at the first collision point of the EIC.

In 2022, the EIC-Japan Group submitted a proposal to the Science Council of Japan's "Future Science Promotion Initiative" as part of the "International High Energy Quantum Science Frontier: QCD Research at Overseas Facilities." The proposal aims to promote QCD research to be developed at overseas facilities, including high-density QCD at GSI-FAIR, high-temperature QCD at CERN-LHC, nucleon and nuclear structure studies at BNL-EIC, and theoretical research and computational research of QCD. The proposal was discussed and granted by the Japanese Nuclear Physics Committee.

As part of our participation in the ePIC detector, we aim to contribute to three subsystems. (1) For the Zero-Degree Calorimeter (ZDC), we are leading the design (Fig. 1), simulation calculation, and performance evaluation, and further evaluation is underway as the basic design.²⁾ The electromagnetic calorimeter technology in this design uses the tungsten/silicon detector of ALICE-FoCal-E calorimeter,³⁾ which is promoted mainly by the University of Tsukuba group. Test beam evaluations of the prototype detectors are conducted

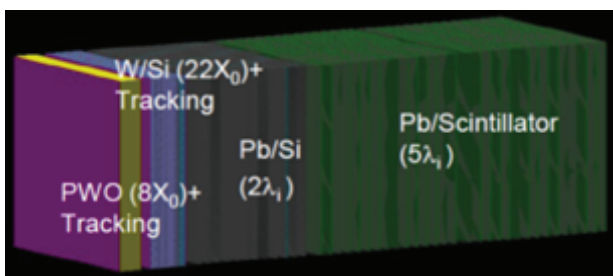


Fig. 1. A design of the ZDC.

at CERN and Tohoku University's ELPH facility, and radiation tolerance tests of the silicon detectors are conducted at the RIKEN RANS neutron facility. (2) The construction of a barrel detector using AC-LGAD (Low-Gain Avalanche Detector), which has excellent timing and position resolution, is intended to be conducted with the contribution of the EIC-Japan Group. We plan to evaluate a test board shown in Fig. 2 that combines a sensor manufactured at BNL and a read-out ASIC manufactured in France. In addition, we will develop a sensor with Hamamatsu Photonics K. K. in Japan. Simulation calculations for design evaluation in combination with the ePIC detector are in progress. (3) Discussion of contributions to the Free Streaming DAQ system will proceed.

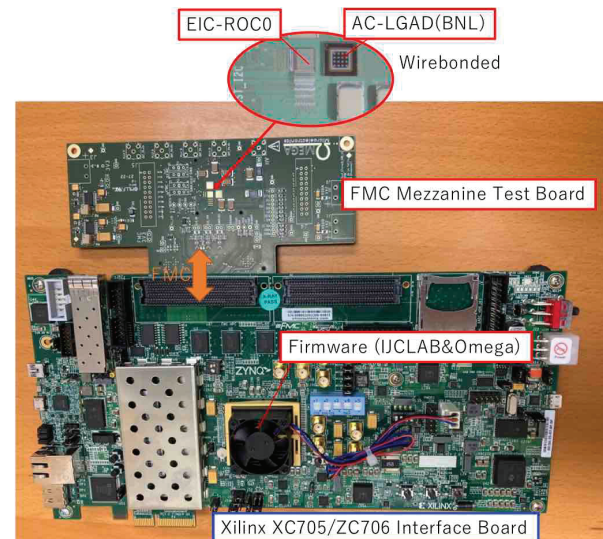


Fig. 2. A test board of the AC-LGAD.

Discussions are underway for cooperation with the Asian region, particularly the South Korean and Taiwanese groups, which began in late 2022. In addition to the three subsystems mentioned above, we will also deepen regional cooperation on projects led by other Asian groups. Cooperation between the nuclear physics and high-energy physics fields will also be expanded and developed in the future.

References

- 1) R. A. Khalek *et al.*, Nucl. Phys. A **1026**, 122447 (2022).
- 2) S. Shimizu *et al.*, in this report.
- 3) ALICE Collaboration, ALICE-PUBLIC-2019-005.

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