Report on the JST/ERATO Sekiguchi three-body nuclear force introductory symposium

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A symposium introducing Three-Nucleon Force Project recently approved by ERATO from October 2023 was held. The project, directed by Prof. Kimiko Sekiguchi from the Tokyo Institute of Technology (TITECH), aims to deepen our understanding of nuclear properties—the fundamental elements for constructing frameworks of atomic nuclei—by reasonably and quantitatively incorporating three-body nuclear forces into nuclear force considerations. To achieve the objective, the project has formed four teams, A-D facilitating a broad range of activities from fundamental science to applied development. Prior to the symposium, a preparatory meeting for project participants was held on October 27, 2023 at the TITECH. Following this, the symposium was conducted to introduce the goals of the project to the wider nuclear physics and applied science communities and to discuss the methodologies to be employed. The symposium was held at the RIBF Conference Hall, with Zoom connection for remote participation, on November 23, 2023. It was primarily organized by the ERATO project and co-hosted by Nishina Center.

The symposium program, as summarized in Table 1, included an overview of the project, an explanation of the ERATO initiative, and descriptions of the roles and objectives of teams A-D. First, the project director, Prof. Kimiko Sekiguchi, provided the overview of the project.[1)] She emphasized the significance behind the name of the project TOMOE.

Table 1. Symposium program.

K. Sekiguchi	Overview of the Project	14:00–14:10
S. Nagai	About JST/ERATO	14:10–14:30
K. Sekiguchi	Group A: Three-Body Nuclear Force	14:30–14:50
E. Hiyama	Group B: Precision Quantum Many-Body Systems	14:50–15:20
M. Horikoshi	Group C: Cold Atomic Systems	15:40–16:10
H. Otsu, T. Fukahori	Group D: Applied Science Development	16:10–16:40
E. Epelbaum	Group A: Three-Body Nuclear Force, Theory	16:40–17:00
	Discussion	17:00–17:20
K. Sekiguchi	Closing Remark	17:20–17:30

The term "three-body nuclear force" refers to a force that can be both attractive and repulsive owing to the interactions among three nucleons. This project aims to enhance our understanding of the structure of atomic nuclei and the universe as well as its applications in applied sciences. The project name originates from the "Tomoe" crest, symbolizing the balance and opposition among three forces. Note that this project is colloquially known as the "TOMOE Project," and its logo is shown in Fig. 1.

Fig. 1. TOMOE Project Logo.

Second, Ms. Satoko Nagai from the Japan Science and Technology Agency (JST), who manages the ERATO initiative, explained the strategic goals of all ERATO projects, selection process of the TOMOE Project, and expectations. Third, each team provided its scope. Team A will develop elemental technologies of polarized target system and polarized ion source providing polarized deuteron beams. Using these devices, they aim to determine the three-body nuclear force, including spin-dependent components.

Chiral Effective Field Theory (χEFT) will provide theoretical framework. Team B aims to achieve quantum precision calculations for nuclear systems up to 100 nucleons, providing highly predictive nuclear properties, such as mass and half-life, and reaction cross-sections. Team C will verify the precision of the calculations of Team B by using cold atomic systems, where interactions can be externally controlled to a certain extent. Team D will be responsible for the applied science development, traditionally providing nuclear properties as nuclear database based on evaluated nuclear data to various applied fields. This project aims to incorporate three-body nuclear forces into these calculations and provide evaluated nuclear data that include these interactions for applied science applications.

In summary, the symposium provided objectives of the Three-Body Nuclear Force Project, which will continue for the coming five years, aiming to explore significant experimental and theoretical research from fundamental to applied sciences. We look forward for your support and encouragement throughout this endeavor. Finally, this symposium was supported by JST ERATO Grant No. JPMJER2304, Japan.

Reference

1) JST/ERATO TOMOE project: https://www.jst.go.jp/erato/research_area/ongoing/jpmjer2304.html.

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