Report of the RCNP Collaboration Research Network (RCNP-COREnet)

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1	Title of research		Microscopic understanding of nuclear collectivity through collaboration of experiment and theory
2	List of Participants (Name and affiliation)		Yutaka Utsuno (Advanced Science Research Center, Japan Atomic Energy Agency)
			Eiji Ideguchi (RCNP, Osaka University)
			Rudrajyoti Palit (Tata Institute of Fundamental Research)
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3	Period of research		From September/2019 to March/2021
4	Main location of collaboration implementation		RCNP, Osaka University
5	Publication list (Please include DOI if available)	Articles	S. Go et al., "High-spin states in 35S", Phys. Rev. C 103, 034327 (2021), https://doi.org/10.1103/PhysRevC.103.034327. https://doi.org/10.1103/PhysRevC.103.034327.
			A. Kundu et al., New lifetime measurement for the 2+1 level in 112Sn by the Doppler-shift attenuation method, Phys. Rev. C 103, 034315 (2021), https://doi.org/10.1103/PhysRevC.103.034315.
			Md. S. R. Laskar et al., "Structure of the 11/2− isomeric state in 133La", Phys. Rev. C 101, 034315 (2020), https://doi.org/10.1103/PhysRevC.101.034315.
		Talks	E. Ideguchi et al., "Shape coexistence in mass 40 region studied via E0 and gamma transitions", HIAS2019 conference, Sep. 7-15, 2019, Canberra, Australia.
			R. Palit et al., "Structure and isomers odd-A isotopes in A~130 region", XXIII International School on Nuclear Physics and Applications, Varna, Bulgaria, Sep. 22-29, 2019.
			Md. S. R. Laskar et al., "Nuclear moment measurements in Lanthanum (La) isotopes", 3-day theme meeting on Nuclear Reactions Involving Weakly Bound Stable and Radioactive Ion Beams, Anushaktinagar, India, Dec. 1-3, 2019.
			E. Ideguchi et al., Electric monopole transition from the superdeformed band in 40Ca, 5th Topical Workshop on Modern Aspects in Nuclear Structure, Bormio, Italy, Feb. 3-9, 2020.
			Md. S. R. Laskar et al., "Nuclear moment measurements in Lanthanum (La) isotopes", 5th Topical Workshop on Modern Aspects in Nuclear Structure, Bormio, Italy, Feb. 3-9, 2020.
			E. Ideguchi et al., "E0 transitions in superdeformed state in 40Ca", The 75th Annual Meeting of the Physical Society of Japan, Mar. 16-20, 2020.
			Y. Utsuno et al., "Large-scale shell-model calculations of the E0 transitions in 40Ca and their interpretation", The 75th Annual Meeting of the Physical Society of Japan, Mar. 16-20, 2020.
		Theses	
6	Description of the results and outputs		We carried out collaborations between nuclear theorists and nuclear experimentalist concerning nuclear structure in the A~40 and A~130 regions. The main goal for the A~40 region is to better understand the nature of collective states that arise by exciting nucleons across the N=Z=20 shell gap. We picked up two subjects: (1) E0 transition from the superdeformed state to the ground state in 40Ca and (2) high-spin states in 35S. For (1), we have clarified the origin of an ordinary small E0 matrix elements. What is unique in 40Ca is that there are three different deformations coexisting in the low excitation energy: spherical, normal deformed, and superdeformed states. They are mixed with one another as the eigenstates. These mixing contributes to cancel the E0 matrix elements, thus accounting for the very hindered E0 matrix element. For (2), we have clarified that two different excitations coexist in the high-spin state in 35S. While most of the positive-parity high-spin yrast levels are dominated by two-neutron excitations across the N=20 shell gap, the yrast 17/2+ level is interpreted as proton-neutron excitation by comparing shell-model calculations and experimental excitation energies and the decay properties. The main goal for A~130 region is to understand the interplay of single-particle states and collectivity. For this purpose, we concentrated on the determination of single-particle configurations in isomeric states in 137,138La from nuclear moments and lifetimes. For 137La, we analyzed the magnetic and quadrupole moments in the 11/2- state. Its large g factor and quadrupole moment are interpreted as a proton in the h11/2 orbit is coupled to a deformed core. For 138La, we have determined the dominant configurations of the yrast high-spin states by utilizing the half-lives of isomeric states. For instance, the yrast 7- and 8- states are dominated by unpaired proton in the d5/2 and g7/2 states, respectively, thus causing a moderate B(M1) value.