RIBF ULIC Symposium/mini-WS Report

* English only

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Title	[RIBF-ULIC-Symposium: 010] Perspective in Isospin Physics ~ Role of non-central interactions in structure and dynamics of unstable nuclei ~
Date	27—28, August 2012
Place	RIBF 2F Conference Room
Language	[×] English [ ] Japanese
HP address	http://indico.riken.jp/indico/conferenceDisplay.py?confId=869
Contact Person(s) (Name, Affiliation)	T. Uesaka (RNC), N. Itagaki (YITP, Kyoto), M. Sasano (RNC)

Financial support from ULIC	Total : 407,994 JPY [Breakdown] Travel expense and Accommodation fee: 380,208 Naoyuki Itagaki: 28,360 Takahiro Kawabata: 34,516 Hiroshi Masui: 95,922 Masatoshi Itoh: 27,416 Takayuki Myo: 42,540 Kenjiro Miki: 78,394 Satoshi Sakaguchi: 73,060 Coffee, Snacks: 27,786
Co-hosting / any financial support from other organization(s)	-

Summary of discussions and its (expected) results:

The symposium focused on phenomena related to the non-central interactions, such as spin-orbit, tensor, and three-nucleon interactions, in structure and dynamics of unstable nuclei.
The symposium was held in 27—28th of August 2012, as a satellite meeting of the 20th International Conferences on Few-Body Problems in Physics. 6 sessions were organized in two days as shown below.

Structure of light neutron-rich nuclei	4 talks [Navratil, Takaki, Kondo, Myo]
Spin Giant Resonances I (GT transitions)	3 talks [Sasano, Bai, Sato]
Spin Giant Resonances II	3 talks [Miki, Liang, Dozono]
Cluster structures	3 talks [Masui, Ito, Horiuchi]
Single Particle States I	3 talks [Hagen, Kawase, Beaumel]
Single Particle State II (γ -ray spec.)	2 talks [Utsuno, Takeuchi]

About 50 participants (including non-registered participants) joined the symposium and enjoyed active discussions. In the following, the symposium is overviewed by mentioning each presentation and the discussions driven by it.

Recently nuclear structure and reaction calculations based on realistic nuclear interactions, the so-called ab-initio calculations, become feasible, not only for few-body systems but also for light nuclei. Thus, structure and reaction of light nuclei give us a room to investigate direct manifestation of the

non-central force effects. P. Navratil (TRIUMF) has shown his recent results of No Core Shell Model calculations, where realistic interactions derived from the chiral effective field theory are used. He has shown that the effect of three-body nucleon forces is extremely important to explain the energy levels of light nuclei, in particular, to explain the binding energies of ^{6,8}He. The effect of tensor correlations in these nuclei has been also discussed. He also has shown the way to extend his nuclear structure calculations to the physics of continuum states and presented results for unbound and scattering states. Such ab initio type calculations have been also reported by T. Myo (Osaka Tech). Myo has presented his Tensor Optimized Shell Model calculations, where effect of two-particle-two-hole excitation attributed to the tensor interaction is optimized in the shell model framework, and he discussed his results of He and Li isotopes. M. Takaki (CNS/RNC) has shown results from double-charge-exchange experiments at RCNP, Osaka University. He discussed structure of ^{12}Be, putting emphasis on the p1/2 contributions in the first and second 0^+ states. Y. Kondo has shown results from RIBF DAY-ONE experiments on two-neutron halo structure observed in light neutron-rich nuclei. He has discussed the configurations in neutron-rich Ne and Mg isotopes by using momentum distributions in the Coulomb breakup processes.

In many spin giant resonances, non-central force effects, especially tensor-force effects are pronouncedly seen. The first “spin giant resonance” session has been dedicated to Gamow-Teller (GT) transitions. A strong motivation and roadmap for future experimental and theoretical studies on GT transitions have been suggested with a special emphasis on isoscalar and isovector pairing; M. Sasano (RNC) has shown a recent experimental result of GT transition strengths on ^{56}Ni and a newly approved project of (p,n)-reaction measurements on unstable N=Z nuclei at RIKEN RIBF, which is aiming at elucidating the existence of a new collective mode where isovector pairs consisting of like-particle nucleons convert to isoscalar pairs of proton and neutron. C. L. Bai (Sitchuan) theoretically has indicated that a cooperative effect between the isovector and isoscalar paring is needed to reproduce the ^{56}Ni data and naturally leads to this new collective mode, by employing a quasi-particle random phase approximation (QRPA) with the inclusion of the isoscalar pairing effect on excited states. Nuclear density functional theory (DFT) with an arbitrary mixing between protons and n eutrons is a promising theoretical approach to describe these isovector and isoscalar pairing in a consistent way for a variety of nuclear system including isospin asymmetric nuclear matter. K. Sato (RNC) has presented the roadmap and current status of the development of mean-filed and QPRA calculation methods based on the DFT, and clearly showed the description of proton-neutron mixing at the Hartree-Fock level is successfully tested for the cases of A=14 and 48 nuclei.

The second spin-giant-resonance session covered spin-isospin excitations other than the GT excitation mode, including their connections to underlying interactions; K. Miki (RCNP) has given a talk on the clearest experimental identification ever of the isovector spin monopole excitation in the beta+ direction, also showing that the comparison of the data with QRPA calculations with several different tensor interactions gives stringent information on the role of tensor interactions in the spin-isospin excitations. H. Liang (RNC/Peking) has theoretically discussed the role of each meson in the spin-isospin excitations with an employment of a relativistic Hartree-Fock (RHF) theory in conjunction with a random phase approximation (RPA), and showed that the Fock potentials due to isoscalar mesons, sigma and omega, are important for describing GT and Spin Dipole (SD) excitations. He also has presented a new method to reduce numerical efforts dramatically, making it possible to predict spin-isospin excitations in a wide region of nuclei including deformed nuclei. M. Dozono (RCNP) has given a talk on experimental studies on SD strengths with a new method to separate the strengths into each J-pi (0^-, 1^-, 2^-) component, and clarified that the separated strength distributions show different behaviors of hardening or softening when changing not well known part of tensor interactions.

The non-central interactions, spin-orbit and tensor, play essential role in the competition of normal shell structure and cluster structure (where some of the nucleons are spatially correlated). H. Masui (Kitami) has discussed this competition and role of non-central interactions in C isotopes and shown

the breaking of alpha cluster structure around the ground state and the appearance of 3 alpha cluster states in the excited states. For cluster states, M. Ito (CYRIC Tohoku) has shown the observation of a new 2^+ state of ^{12}C. The state is considered to be in a family of famous Hoyle state (second 0+ state), which plays crucial role in the synthesis of Carbon from three alpha particles in starts. W. Horiuchi (Hokkaido) has discussed common feature in structure of ^{2}H, ^{3}H, ^{3}He, ^{4}He originating from the tensor effects. He has applied his ab-initio theory to photo-disintegration of ^{4}He and concluded that data by the RCNP group are inconsistent with the calculations.

Non-central force effects on single particle properties have been subject to extensive theoretical and experimental studies in the last decades. Hagen (ORNL/Tennessee) presented his recent results by the coupled cluster theory. He has pointed out that three-nucleon force effects can be clearly seen in neutron-rich oxygen and calcium isotopes. Kawase (CNS) has presented recent experimental results of the (p(pol),2p) experiments for oxygen isotopes. He has discussed the spin-orbit splitting in oxygen isotopes and claimed that the splitting in ^{18}O is 0.4~MeV narrower than that in ^{16}O, which would be explained by tensor force effects between the p-shell protons and the $d_{5/2}$ neutron(s). Beaumel (IPN Orsay/RNC) has shown results of transfer-reactions experiments with low-energy RI-beams.

In the last session, S. Takeuchi (RNC) has presented results of gamma-ray spectroscopy performed at RIKEN RIBF. His talk covers experiments for the island of inversion, N=50, 82. Golden data which can be obtained only at RIBF have strongly impressed the audience. Based on the data, magicities and its loss in the region far from the beta stability line have been discussed. Y. Utsuno has discussed evolution of the shell structure due to the tensor force, based on his shell model calculation. How the shell gap changes in the neutron-rich side and how the tensor interaction contributes there have been clearly shown.

The non-central force effects appear in a variety of shapes phenomena-by-phenomena. Therefore, it is important to share the issues of interest among theorists with different techniques and experimentalists. The symposium has successfully promoted mutual understandings among them and has opened opportunities for future collaborations.

Registered participants list(Name, Affiliation):

Dr. BAI, Chunlin	Sichuan University
Dr. BEAUMEL, Didier	IPN Orsay
Dr. FURUMOTO, Takenori	RIKEN Nishina Center
Dr. HAGEN, Gaute	Oak Ridge National Laboratory
Dr. HORIUCHI, Wataru	Hokkaido University
Prof. IKEDA, Kiyomi	RIKEN
Dr. ISOBE, Tadaaki	RIKEN
Dr. ITAGAKI, Naoyuki	Yukawa Institute for Theoretical Physics Kyoto University
Dr. ITOH, Masatoshi	Cyclotron and Radioisotope Center
Ms. IWANAMI, Tomoko	RNC
Dr. KAWABATA, Takahiro	Department of Physics, Kyoto University
Mr. KAWASE, Shoichiro	CNS
Dr. KOHAMA, Akihisa	RIKEN
Dr. KONDO, Yosuke	Tokyo Institute of Technology
Prof. KUBONO, Shigeru	Nishina Center
Mr. KUBOTA, Yuki	CNS, The University of Tokyo
Dr. LIANG, Haozhao	RIKEN Nishina Center
Prof. MASUI, Hiroshi	Kitami Institute of Technology
Dr. MATSUBARA, hiriaki	RIKEN
Prof. MOTOBAYASHI, Tohru	RIKEN

Prof. MYO, Takayuki	Osaka Institute of Technology
Prof. NAKADA, Hitoshi	Chiba U.
Dr. NAKATSUKASA, Takashi	Riken Nishina Center
Prof. NAVRATIL, Petr	TRIUMF
Dr. NIIKURA, Megumi	Department of Physics, University of Tokyo
Dr. NISHIMURA, Mizuki	RIKEN Nishina Center
Dr. OTSU, Hideaki	RIKEN Nishina Center
Prof. SAGAWA, Hiroyuki	RIKEN/University of Aizu
Dr. SAKAGUCHI, Satoshi	Kyushu Univ.
Dr. SASANO, Masaki	RIKEN Nishina Center
Dr. SATO, Koichi	RIKEN Nishina Center
Prof. SHIMOURA, Susumu	CNS, University of Tokyo
Prof. SUGAWARA-TANABE, Kazuko	Otsuma Women's University
Prof. SUZUKI, Yasuyuki	Niigata University
Dr. TAKEUCHI, Satoshi	RIKEN Nishina Center
Dr. TERASHIMA, Satoru	Beihang University
Dr. UENO, Hideki	RIKEN Nishina Center
Dr. UESAKA, Tomohiro	RIKEN Nishina Center
Mr. WASHIYAMA, Kouhei	RIKEN

Please attach other documents as needed.