1. Abstract
We proposed accurate calculation method called ‘Gaussian Expansion Method using infinitesimally shifted Gaussian lobe basis function.’ When one proceeds to four-body systems, calculation of the Hamiltonian matrix elements becomes much laborious. In order to make the four-body calculation tractable even for complicated interactions, the infinitesimally-shifted Gaussian lobe basis function has been proposed. The GEM with the technique of infinitesimally-shifted Gaussians has been applied to various three-, four- and five-body calculations in hypernuclei, the four-nucleon systems, and cold-atom systems. As results, we succeeded in extracting new understandings in various fields.

2. Major Research Subjects
(1) Structure of Hypernuclei and neutron-rich nuclei from the view point of few-body problem
(2) Structure of exotic hadron system
(3) quantum atomic system and ultra cold atomic system
(4) Equation of state for neutron star

3. Summary of Research Activity
(1) We study Λ hypernuclei of C and B isotopes. We calculated Λ binding energies of these Λ hypernuclei and found halo structure in the Λ 1p state with extended wave functions. In addition, we propose to measure electric-dipole transition between Λ 1p and 1s states to see evidence for this hyperon halo structure.
(2) Bound states of double-heavy tetraquark systems are studied in a constituent quark model. We have two bound states for \( T = 0, J^\pi = 1^+ \) in bbu-bar u-bar system. One is deeply bound state and the other is a shallow bound state. The former state is in good agreement with the result by lattice QCD.
(3) We investigate the miscibility of two kinds of bosons with repulsive interactions. In addition to the known miscible and immiscible phases, we predict a partially miscible phase due to quantum fluctuations. It leads to the formation of mixed bubbles that are similar to quantum liquid droplets found in attractive mixtures and could be observed in experiments.

Members
Director
Emiko HIYAMA

Research/Technical Scientist
Pascal NAIDON (Senior Research Scientist)

Special Postdoctoral Researcher
Tokuro FUKUI

Postdoctoral Researcher
Christiane H. SCHMICKLER

Senior Visiting Scientist
Makoto OKA (JAEA)

Visiting Scientists
Masayuki ASAKAWA (Osaka Univ.)
Kadir Utku CAN (The Univ. of Adelaide)
Jaume CARBONELL (CNRS-IN2P3)
Lorenzo CONTESSI (Hebrew Univ. of Jerusalem)
Jiwei CUI (Xidian Univ.)
Akinobu DOTE (KEK)
Shimpei ENDO (Tohoku Univ.)
Tomokazu FUKUDA (Univ. of Electro-Commun.)
Yasuro FUNAKI (Kanto Gakuin Univ.)
Takenori FURUMOTO (Yokohama Nat’l Univ.)
Philipp GUBLER (JAEA)
Satoru HIRENZAKI (Nara Women’s Univ.)
Atsushi HOSAKA (Osaka Univ.)
Jinniu HU (Nankai Univ.)
Tetsuo HYODO (Tokyo Metropolitan Univ.)

Kiyomi IKEDA (Niigata Univ.)
Yoichi IKEDA (Kyushu Univ.)
Masahiro ISAKA (Hosei Univ.)
Souichi ISHIKAWA (Hosei Univ.)
Daisuke JIDO (Tokyo Tech)
Hyun-Chul KIM (Inha Univ.)
Kei KOTAKE (Fukuoka Univ.)
Toshio MOTOBA (Univ. of Electro-Commun.)
Satoshi NAKAMURA (Tohoku Univ.)
Kei KOTAKE (Fukuoka Univ.)
Takayuki MYO (Osaka Inst. of Tech.)
Kazuma NAKAZAWA (Gifu Univ.)
Hidekatsu NEMURA (Osaka Univ.)
Jean-Marc RICHARD (Lyon Univ.)
Philippe RIIKEN (Univ. Of Nijmegen)
Shoichi SASAKI (Tohoku Univ.)
Hans-Josef SCHULZE (INFN) Chengjun XIA (Zhejiang Univ.)
Shoji SHINMURA(Gifu Univ.) Masanobu YAHIRO (Kyushu Univ.)
Jirina STONE (Univ. of Tennessee) Ulugbek YAKHSHIEV (Inha Univ.)
Tingting SUN (Zhengzhou Univ.) Taiichi YAMADA (Kanto Gakuin Univ.)
Hiroyuki TAJIMA (Univ. of Tokyo) Yasuo YAMAMOTO (Tsuru Univ.)
Hajime TOGASHI (Tohoku Univ.) Nodoka YAMANAKA (Kennesaw State Univ.)
Atsushi UMEYA (Nippon Inst. of Tech.) Takuma YAMASHITA (Tohoku Univ.)
Shin WATANABE (NIT, Gifu College) Ying ZHANG (Tianjin Univ.)
Wolfram WEISE (TU Munich) Xian-Rong ZHOU (East China Normal Univ.)

Student Trainees
Kongyi HU (Nankai Univ.) Qi MENG (Nanjing Univ.)
Dongwook LEE (Kyushu Univ.) Qian WU (Nanjing Univ.)
Jie LIU (Nanjing Univ.)

Part-time Worker
Yoko FUJITA (Administrative Part-time Worker I)

List of Publications & Presentations

Publications

[Original Papers]
Q. Wu, Y. Funaki, E. Hiyama, and H. Zong, “Resonant states of $\Lambda^0$Be with $\alpha + \alpha + \Lambda$ three-body cluster model,” Phys. Rev. C 102, 054303 (2020).

[Proceedings]

Presentations

[International Conferences/Workshops]

[Domestic Conferences/Workshops]
[Seminars & Lectures]


Press Releases

「極低温での新しい量子相 “混合バブル” を予言—混和性・非混和性の中間に存在する部分混和性の発見—」, 2021 年 3 月 22 日.