

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

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| COREnet054 |                                                    | PI: Sachiko Takeuchi |                                                                                                                                                                                                                                                                                               |
| 1          | Title of research                                  |                      | S-wave resonance arising from the quark Pauli-blocking effect — toward the understanding of the exotic hadrons around or above the threshold: the di-J/ψ and Z <sub>b</sub> resonances —                                                                                                      |
| 2          | List of Participants (Name and affiliation)        |                      | Sachiko Takeuchi (Japan College of Social Work)                                                                                                                                                                                                                                               |
|            |                                                    |                      | Atsushi Hosaka (Research Center for Nuclear Physics, Osaka University)                                                                                                                                                                                                                        |
|            |                                                    |                      | Kotaro Miyake (Nagoya University)                                                                                                                                                                                                                                                             |
|            |                                                    |                      | Ya-Wen Pan (Beihang University)                                                                                                                                                                                                                                                               |
|            |                                                    |                      | Manato Sakai (Nagoya University)                                                                                                                                                                                                                                                              |
|            |                                                    |                      | Niu Su (South East University, China)                                                                                                                                                                                                                                                         |
|            |                                                    |                      | Makoto Takizawa (Showa Pharmaceutical University)                                                                                                                                                                                                                                             |
|            |                                                    |                      | Yasuhiro Yamaguchi (Nagoya University)                                                                                                                                                                                                                                                        |
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| 3          | Period of research                                 |                      | From May 2024 to March 2026                                                                                                                                                                                                                                                                   |
| 4          | Main location of collaboration implementation      |                      | RCNP Osaka Univ and KEK Tokai Campus                                                                                                                                                                                                                                                          |
|            | Articles                                           |                      | Sachiko Takeuchi, Makoto Takizawa, Yasuhiro Yamaguchi, and Atsushi Hosaka, "The Impact of Quark Many-Body Effects on Exotic Hadrons," Few-Body Systems, 65(2), 62 (2024). <a href="https://doi.org/10.1007/s00601-024-01932-2">https://doi.org/10.1007/s00601-024-01932-2</a>                 |
|            |                                                    |                      | Manato Sakai, and Yasuhiro Yamaguchi. "Analysis of $T_{cc}$ and $T_{bb}$ based on the hadronic molecular model and their spin multiplets." Physical Review D 109 (5): 054016. ( 2024) <a href="https://doi.org/10.1103/PhysRevD.109.054016">https://doi.org/10.1103/PhysRevD.109.054016</a> . |
|            |                                                    |                      | Effect of a repulsive three-body interaction on the DD*K molecule<br>Ya-Wen Pan, Jun-Xu Lu(Beihang U.), Emiko Hiyama, Li-Sheng Geng, Atsushi Hosaka<br>e-Print: 2502.00438 [nucl-th]                                                                                                          |
|            |                                                    |                      | Investigation on the $\Omega(212)$ from QCD sum rules<br>Niu Su, Hua-Xing Chen, Philipp Gubler, Atsushi Hosaka<br>Nucl.Part.Phys.Proc. 347 (2024) 2-5 • Contribution to: QCD24 • e-Print: 2409.19843 [hep-ph]                                                                                 |
|            |                                                    |                      | Likely existence of bound states and the Efimov effect in the triple-J/ψ system<br>Ya-Wen Pan, Zhi-Wei Liu, Li-Sheng Geng, Atsushi Hosaka, Xiang Liu<br>Phys.Rev.D 110 (2024) 9, 094004 • e-Print: 2407.20017 [hep-ph]                                                                        |
|            |                                                    |                      | Investigation on the $\Omega(212)$ from QCD sum rules<br>Niu Su, Hua-Xing Chen, Philipp Gubler, Atsushi Hosaka<br>Phys.Rev.D 110 (2024) 3, 034007 • e-Print: 2405.06958 [hep-ph]                                                                                                              |
|            |                                                    |                      |                                                                                                                                                                                                                                                                                               |
|            |                                                    |                      | Sachiko Takeuchi, Atsushi Hosaka, Makoto Takizawa, and Yasuhiro Yamaguchi, "Di-J/ψ structures from the quark Pauli-blocking effect," XVIth Quark Confinement and the Hadron Spectrum (Cairns, Aug 22, 2024)                                                                                   |
|            |                                                    |                      | Sachiko Takeuchi, Makoto Takizawa, Yasuhiro Yamaguchi, and Atsushi Hosaka, "Quark Pauli-blocking 効果もたらすdi-J/ψ系の共鳴状態" 日本物理学会 第79回年次大会 (Sapporo, Sep 17, 2024)                                                                                                                                  |
|            |                                                    |                      | Sachiko Takeuchi, Makoto Takizawa, Yasuhiro Yamaguchi, and Atsushi Hosaka, "QDi-J/ψ scattering with the quark Pauli-blocking effect," The 21st International Conference on Hadron Spectroscopy and Structure (Hadron2025) (Osaka, Mar 29, 2025)                                               |
|            |                                                    |                      | Heavy exotic hadrons near thresholds,<br>Yasuhiro Yamaguchi, The Reimei Workshop "Hadron interactions with strangeness and charm", Uni Hotel, Jeju Island, South Korea 6/26-28 2024                                                                                                           |
|            |                                                    |                      | Exotic hadrons: Rich structure of multiparticle state near thresholds,<br>Yasuhiro Yamaguchi, Frontiers in Physics and Material Science, Beihang University, Beijing, China July 1 - August 31 2024                                                                                           |
| 5          | Publication list (Please include DOI if available) |                      |                                                                                                                                                                                                                                                                                               |

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|---|------------------------------------------------------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |                                                      | Talks | Hadronic molecules near thresholds: $T_{cc}$ and its partners,<br>山口康宏, 研究会「対称性と有効模型で切り拓くクォーク・ハドロン物理の最前線」名古屋大学, 愛知, 日本 9/5-7 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|   |                                                      |       | Exotic hadrons as a hadron composite state near thresholds,<br>Yasuhiro Yamaguchi, Universality of Strongly Correlated Few-body and Many-body Quantum Systems, Tohoku University, Sendai, Japan, August 26 - September 27 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|   |                                                      |       | $\bar{D}\Xi_{cc}$ pentaquark as a partner of $T_{cc}$ ,<br>山口康宏, RARIS 研究会「実験・反応・構造計算・格子QCD で解き明かすハドロン分光 2024」, 東北大学先端量子ビーム科学研究センター, 仙台 November 20-21 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|   |                                                      |       | Hadronic molecules near thresholds: $T_{cc}$ and its partners,<br>Yasuhiro Yamaguchi, East Asian Workshop on Exotic Hadrons 2024, Nanjing, China November 8-11 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|   |                                                      |       | Exotic hadrons as heavy hadronic molecules and their partners,<br>Yasuhiro Yamaguchi, KMI2025 : The 6th KMI International Symposium, Nagoya University, Nagoya, March 5-7 2025                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|   |                                                      |       | ヘビーメソン-核子からなるハドロン分子状態とそのスピン構造<br>山口康宏, 日本物理学会 2025年春季大会, オンライン, March 18-21 2025                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|   |                                                      |       | Exotic hadrons as heavy hadronic molecules and their partners,<br>Yasuhiro Yamaguchi, The 21st International Conference on Hadron Spectroscopy and Structure (HADRON2025), Osaka University, Japan, March 27-31 2025                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|   |                                                      |       | KEK-JAEA Joint Workshop 2024/8/1<br>Current Status of the Radiative Decay of $X(3873)$ and Consideration of the Structure of $X(3872)$<br>M. Takizawa in collaboration with A. Hosaka, Y. Yamaguchi and S. Takeuchi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|   |                                                      |       | 日本物理学会第79回年次大会 2024/9/17<br>$X(3872)$ の性質と $D\bar{D}^*$ 間相互作用について<br>瀧澤 誠、竹内 幸子、山口 康宏、保坂 淳                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 6 | Description of the results and outputs               |       | RARIS Workshop on Hadron Spectroscopy 2024/11/21<br>Structure of $X(3872)$ and interaction between $D$ and $\bar{D}^*$<br>M. Takizawa, S. Takeuchi, Y. Yamaguchi and A. Hosaka                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|   |                                                      |       | As the first year, we investigated the double-charmonium scattering states such as $J/\psi$ - $J/\psi$ , $\eta_c$ - $\eta_c$ by a simplified quark cluster model. It is found that the quark Pauli-principle over the $c\bar{c}c\bar{c}$ system causes a rapid increase and a node in the two-meson phase shifts. The increase is not large enough to be regarded as a resonance, but if it is seen experimentally, that is most likely the quark Pauli-blocking effect. To confirm this, we also calculated the cross section and the transfer strength from the $c\bar{c}c\bar{c}$ ( $0s$ ) <sup>4</sup> configuration. The node appears as a dip in the cross section and the peak moves in the strength because of the quark effects. |
| 7 | Amount of budget implemented (for internal use only) |       | 101,820 YEN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |