

Advanced Study of New Exotic Hadron Matter at J-PARC

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Abstract

By utilizing the J-PARC hadron physics facility, we explore new exotic forms of matter in universe. We focus on the heavy-flavor hadrons and dense matter produced by heavy-ion experiments at J-PARC.

1. Research Objectives

The aim of this project is to utilize the J-PARC hadron physics facility to explore new exotic forms of matter in universe. This year we focused on the heavy hadrons, which contain heavy flavor (charm/bottom) quarks, and also dense matter, which can be produced by heavy-ion collisions on nuclei. J-PARC is a unique experimental facility for producing excited hadron states with heavy flavor and also hot and dense hadronic matter with intense hadron beams.

2. Research Contents

(A) Studies of exotic and excited heavy-flavor hadrons have been carried out aiming prospective J-PARC experiments, and (B) development of heavy-ion project at J-PARC is progressed for physics of high-density hadronic matter.

The former is conducted mainly by

(A) M. Oka, K. Tanida, K. Imai, T. Sekihara (JAEA), S. H. Lee (Yonsei Univ., Y. Oh (Kyungpook Univ.), A. Hosaka (RCNP, Osaka Univ./JAEA), E. Hiyama (RIKEN/JAEA)

and the latter part is mainly by

(B) H. Sako, T. Maruyama, H. Sugimura, Y. Ichikawa (JAEA), K. Oyama (Nakasaka IAS), M. Kitazawa (Osaka Univ.), H. Harada, P. K. Saha (J-PARC/JAEA).

In order to achieve the final goal, we held three Reimei Workshops:

1. J-PARC Workshop 2016: From Exotic hadrons to QGP, on Jun 7-10, 2016 at Inha Univ. (Incheon, Korea) with 50 participants,
2. Reimei Workshop: Physics of Heavy-Ion Collisions at J-PARC, on Aug 8-10, 2016 at ASRC with 50 participants,
3. Reimei Workshop: New exotic hadron matter at J-PARC, on Oct 24-26, 2016 at Inha Univ. (Incheon, Korea) with 57 participants.

3. Research results

We have established a strong collaboration group in theory between the Korean J-PARC collaboration and the Hadron-Nuclear Res. Gr. at ASRC and constructed an international network with other Korean and Japanese groups (Seoul Nat. U, Yonsei U, Tokyo Inst. Tech., Osaka U, RIKEN) as well as groups in Italy (ECT*), Germany (GSI, Munchen), China (IHEP, Beijing), Serbia (Belgrade), Spain (IFIC, Valencia) and Russia (JINR, Dubna).

We have carried out studies on heavy-flavor (strange, charm and bottom) hadron- and nuclear-physics with close collaboration with the experimental groups at the J-PARC and KEK. The pion mean field approach is employed to describe heavy baryons [1], and predictions are made for K pp final states in the ${}^3\text{He}(K, \Lambda p) n$ reaction [2]. Charmed baryon production and its structure analysis are proposed to use pionic decay modes of baryons [3]. Mass increase of D meson in medium was predicted by QCD sum rules [4] and also strangeness in high density matter has been studied [5].

Design of accelerators and experiments with heavy ions beams at J-PARC and R&D of a fast data acquisition system for heavy-ion experiments have been developed. The white paper for the J-PARC heavy-ion project is published in June 2016 and a Letter of Intent of J-PARC-HI was submitted to J-PARC PAC in June 2016. A few invited talks were given on this subject at international conferences [6].

4. Conclusion

In conclusion, we have achieved theoretical and experimental progress in understanding the structure and dynamics of heavy flavor hadrons as well as dense hadronic matter, which can be produced in the forthcoming projects at J-PARC.

5. References

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