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New experiments for study of in-medium vector mesons at J-PARC

The origin of the hadron mass has been drawing strong interests in nuclear and particle physics. Especially in QCD, mass of hadrons is composed of a sum of the effective mass of valence quarks, known as constituent quark mass, and their interaction term. According to theoretical models, the effective mass of valence quarks is determined by chiral property of QCD vacuum. This mechanism is understood as a consequence of the dynamical breaking of chiral symmetry. In hot and/or dense matter, this broken symmetry will be restored either partially or completely and, hence, properties of hadrons, such as mass, decay modes and life time, can be modified. Therefore, we can study the origin of hadron mass and chiral properties of QCD medium by measuring in-medium properties of mesons. Especially, mass spectra of vector mesons are directly connected to anti-quark quark condensates, which is an order parameter of chiral symmetry. Thus, it is important to measure mass spectra of vector mesons in QCD medium, such as Quark Gluon Plasma or nuclear matter.
Even at nuclear matter density, relatively large mass modification is predicted and several experimental efforts using cold nucleus targets are already performed. Among these activities, KEK-E325 reported significant mass modifications for rho and phi mesons and CLAS G7 experiment report only mass broadening for rho meson. Obtained results are different and physics behind these experimental results are not clearly understood.
To understand the physics, clear and high statistics experimental data are essential. We are preparing new experiments to obtain such data at J-PARC. One experiment is an upgrade of E325 and aims to collect 100 times larger statistics in phi going to e+e- decays. Another experiment focus on exclusive measurements of stopped omega meson in nucleus.
In this poster, we will report on details of two experiments and results of detector R&D.

Primary author: Prof. OZAWA, Kyoichiro (KEK)

Presenter: Prof. OZAWA, Kyoichiro (KEK)

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