

# KEK-PS E325 Annual Report (JFY2005)

We know that 99% of hadron mass is originated from the spontaneous breaking of the chiral symmetry. Such effective mass of hadron is determined in vacuum, and it is quite natural to expect that *those masses will be modified when their circumstance is changed*. The major scientific interest of E325 is to investigate the property of hadron (and then of quark) in a dense matter, naturally existing as nucleus. The basic experimental concept is to measure vector mesons, which *are produced and decay in a nucleus*, through the invariant mass spectroscopy in the electron-positron pair channel.

In 2005, we have finalized the analyses for most of the physics topics of E325. Two letter papers; 1) Experimental signature of the medium modification for rho and omega mesons in 12-GeV p + A reactions. M. Naruki *et al.*. Published in Phys. Rev. Lett.96:092301, 2006, e-Print Archive: nucl-ex/0504016, and 2) First observation of in-medium modification of phi meson at normal nuclear density. R. Muto *et al.*, Submitted to Phys. Rev. Lett., e-Print Archive: nucl-ex/0511019, are describing our successful observations of meson mass modification at normal nuclear density, as shown in Figure 1. We consider that the goal of E325 has been achieved with these two papers.

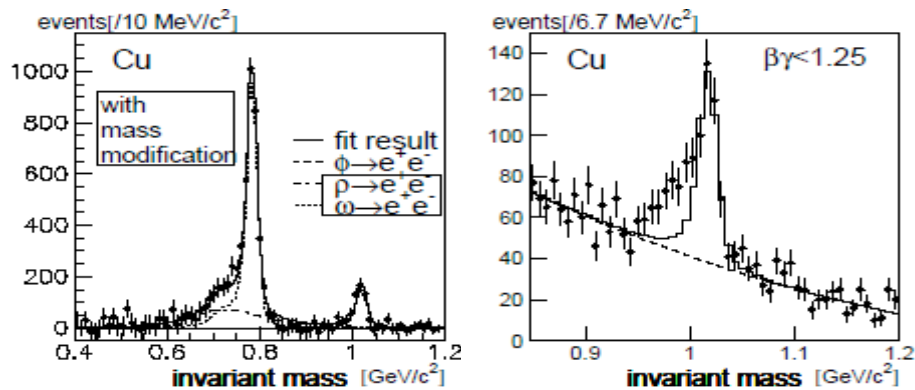


Figure 1. Invariant mass-spectra of  $e^+e^-$  pairs. Left) Background-subtracted spectrum is overlaid with a theoretical model taking in-medium  $\rho$  and  $\omega$  modifications into account (Phys. Rev. Lett. 96:092301, 2006). Right) Close up view for  $\phi$  meson peak, when  $\beta\gamma_\phi$  is relatively slow, showing clear deviation from the normal Breit-Wigner function (nucl-ex/0511019).

Besides these sensational results we have determined production cross sections for these vector mesons, with special interests on the nuclear mass number dependence. The paper; 3) Nuclear mass number dependence of inclusive production of omega and phi mesons in 12 GeV p + A collisions. T. Tabaru *et al.*. Submitted to Phys. Rev. C, e-Print Archive: nucl-ex/0603013, reported absolute cross sections, and discussed on the production mechanism of these mesons by comparing with nuclear-cascade calculations. This paper required very detail understandings for the spectrometer acceptance and the detector efficiencies. Although the results are not surprising, we are proud of that we have reached this stage.

The following paper; 4) Comparison of f meson production through  $e^+e^-$  and  $K^+K^-$  decay channels in

12 GeV p+A reactions. F. Sakuma *et al.*. To be submitted to Phys. Rev. Lett., is in preparation to describe the results of  $K^+K^-$  pair spectrum of  $\phi$  meson. We found that modification of  $\phi$  meson is not observed in the  $K^+K^-$  spectra. This is understood with the difference of the detector acceptance between  $e^+e^-$ , since unluckily the kinematical region where we observed the  $e^+e^-$  spectral modification is not covered in the  $K^+K^-$  channel.

We prepare the full paper for the E325 experiment in JFY2006 which will close this successful experimental activity over the decade. We are grateful for all the support given by KEK.