Experiment E325 at KEK 12-GeV PS

Study of Chiral Property of Dense Nuclear Matter through Measurements of Meson Mass Modification in Medium.

The experiment E325 has been performed at the primary beam line EP1B of KEK-PS from1996 to 2002, to investigate the property of hadron (and then of quark) in a dense matter, naturally existing as nucleus. It is well established that about 95% of hadron mass is generated due to the spontaneous breaking of the chiral symmetry in the strong force. 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 basic experimental concept of E325 is to measure modification of spectral functions of vector mesons, which *are produced and decay in a nucleus*, through the invariant mass spectroscopy in the electron- positron pair channel. Experimental details can be find Ref.1 and 2.

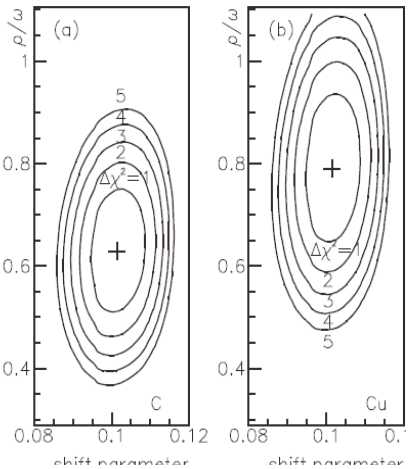

Fig.1: The confidence ellipsoids to the mass shift parameter and the ratio of ρ/ω, for carbon (left) and copper (right) targets.

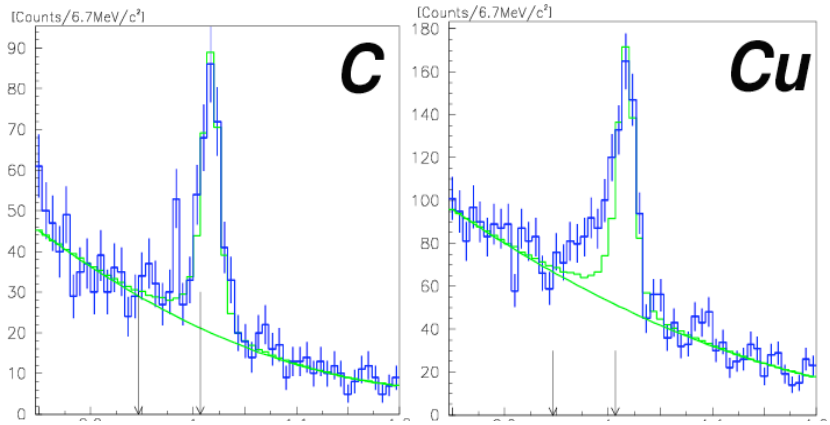

Fig.2: Preliminary invariant mass spectra for ϕ, whose $\beta\gamma$ is less than 1.35, for carbon (left) and copper (right) targets. The green histograms are the expected mass shapes due to the detector response.

From the earlier data we have reported the signature of in-medium modification of ρ and ω mesons [3]. This was the first observation in the leptonic in-medium decay of vector meson at a normal nuclear matter density. In the last years' progress report we have updated the data with improved statistics. The new data were reproduced with a model calculation based on the theoretical prediction in Ref.4, and we have concluded that the ρ and ω mesons decreases their masses by ~10% at the normal nuclear matter density as shown in Fig.1 (Ref. 5).

We have preceded the detail analysis for the ϕ meson. The preliminary data shown in Fig.2 indicate modification of ϕ's in the copper target, especially for those who move slowly in the laboratory frame. We consider that the observed difference between carbon and copper targets is due to the much longer life time of the ϕ meson compared to the nuclear radii, which makes different in-medium decay rates.

References:

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[2] M. Sekimoto *et al.* (E325 collaboration), Nucl. Instrum. Meth. A516:390-405, 2004.

[3] K. Ozawa *et al.* (E325 collaboration), Phys. Rev. Lett. Vol.86 (2001) p5019.

[4] T. Hatsuda and S. H. Lee, Phys. Rev. C46 (1992) R34.

[5] M. Naruki *et al.* (E325 collaboration), to be submitted to Phys. Rev. Lett..