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As it is well known the experimental studies of the process of e^+e^- annihilation into hadrons have revealed just unexpected results. The total annihilation cross section has been found to behave approximately as a constant $\sigma^{tot}_{e^+e^-} \approx 20$ nb in the energy interval $E = 3 \div 5$ GeV instead of expected decrease according to scaling law about 3 times.

Such a high value of the cross section does not seem to agree also with the parton model predictions, where the hardon production is due to the conversion of the virtual photon into the quark-antiquark pair and the relative yield of hadrons in comparison with the muon yield $R = \frac{\sigma_{e^+e^- \to hadrons}}{\sigma_{e^+e^- \to \mu^+\mu^-}}$ should not depend upon energy.

The discovery of the ψ -particles (the narrow resonances with the masses of 3.1 GeV, 3.7 GeV and 4.1 GeV) made the situation even more complicated but the problem of understanding of the large e^+e^- -annihilation cross section out of the resonance region does not seem to be solved.

We assume that the cross section of e^+e^-- annihilation into hadrons has the form of the broad resonance with the maximum in the vicinity of 5 - 6 GeV and the width (evaluated from the behavour of the cross section at the energy of 4 - 5 GeV) of the order of 1.5 - 2 GeV. Similar phenomenon is observed in nuclear photoabsorption reactions, where the photoabsorption cross section reveals the unambiguous maximum - the giant resonance - at the energies sufficiently high for the excitation of collective vibrations in nuclear matter.

In the case of e^+e^- - annihilation into hadrons we suppose the generated hadronic matter consisting of the large number of quarks and antiquarks whose big masses are "cancelled" by interaction to be the continuum in which collective vibrations could be excited. Considering quark - antiquark pairs to be weakly interacting quasiparticles of hadronic matter one may expect collective excitations to appear with the energy depending on dimensions of hadronic cluster, a radius of interaction between constituents, specific "ionization" energy of cluster, etc.

For the simplest example let us consider the hydrodynamical model of vibration of two "noncompressible" liquids - that of quarks and antiquarks placed in a special volume of radius R.

In this model as in the model of neutron-proton liquids vibration proposed for the description of nuclear giant dipole resonance [1,2], we assume the force preventing the seperation of centres of masses of two liquids to be proportional to the number of seperated particles (shaded region on Fig.1):

$$F \propto \delta N = \rho \delta V \approx 2\pi R^2 \xi \rho \quad ,$$

where ρ is the density of particles. Hence for the two liquids vibration frequency it follows [1,2] the known formula :

$$\omega = \left(\frac{3}{R r_0} \cdot \frac{V}{M_q} \right)^{1/2} \quad , \qquad (1)$$

where r_0 is the radius of the interaction between the constituents (when the vibration amplitude is equal to r_0 , $\xi = r_0$, there takes place the complete snatch of the quark (antiquark) away from the hadronic cluster), R is the size of the hadronic cluster, M_q - the initial mass of the quark, V is the energy necessary to snatch the quark away from the cluster.

In assumption that the initial big mass of the quark is al-

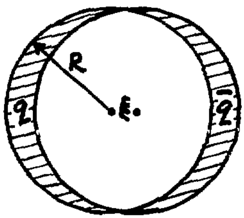

Fig. 1 The schematic picture of vibrations of quark-antiquark liquids.

most completely "cancelled" by the interaction, i.e. $\frac{V}{M_q} \sim 1$, we obtain the formula for evaluation of the frequency of collective vibrations of quark - antiquark matter:

$$\omega_{res} \approx (3/Rr_0)^{1/2}. \qquad (2)$$

Let us characterize the interaction radius r_0 by the mass of quanta mediating the interaction between quarks (the gluon?):

$$1/r_0 \sim M_g . \qquad (3)$$

From the uncertainty relation we have:

$$R \lesssim 1/\Gamma , \qquad (4)$$

where Γ - the total resonance width .

Thus minding Eqs. (2) - (4), we obtain the relation between the resonance frequence, the width of the resonance and the gluon mass:

$$\omega_{res}^2 \lesssim 3M_g \cdot \Gamma . \qquad (5)$$

when recalling our assumptions that $\omega_{res} \sim 5 - 6$ GeV and $\Gamma \sim 1.5 - 2$ GeV we obtain an estimation of the gluon mass:

$$M_g \gtrsim 5 \, GeV/c^2 . \qquad (6)$$

We would like to note that the conditions of coherence of collective vibrations for so high frequences of excitations is provided by the time-like character of the virtual photon.

The collective resonance of the type considered above one may also expect to occur in deep-inelastic lepton-hadron interactions. However, the resonance has to be observed not in the total cross section but in the invariant mass spectrum of that part of the produced hadronic cluster which has the photon quantum numbers.For experimental observations one needs to measure the secondary particle kinematics in order to derive the invariant mass of the hadronic cluster with necessary quantum numbers.Naturally, the threshold energy for the excitation of such a resonance is determined by the minimal center of mass energy of about 5 ÷ 6 GeV , i.e.,the primary lepton energy required to be approximately 20 ÷ 30 GeV.

It has been told in the recent preliminary publication [3] about the observation of some anomalies in the deep-inelastic antineutrino-nucleon scattering at energies > 30 GeV.In the invariant mass spectrum of secondary hadrons at small momentum transfered one can see the broad bump at the value of mass of about 6 - 7 GeV/c^2 .At higher values of momentum transfers this bump becomes somewhat indistinct.

It is not excluded that this observation also provides some evidence on collective resonance excitation.One has to take into account that from the total hadronic mass of about 6 - 7 GeV it is necessary to subtract the mass and the energy of the nucleon which has not been separated in the case, however, at small momentum transfers it could only slightly broaden the bump.

The peak in the hadronic mass spectrum in the neutrino-nucleon scattering could be strongly blurred and therefore non-observable.

In conclusion we would note that the collective resonance in the consideration and the ψ -particles production in the same energy interval may well turn out to be connected phenomena.Comparatively small size of the hadronic cluster in which as we believe the resonance is excited that follows from its supposed large width is just very unusual for all the known up to date hadronic resonances.

On the other hand comparatively large value of the ψ (3.105) partial decay width into leptons could also be considered as an indication on the higher density of "ψ-particle" matter in comparison with that of previously known vector mesons (ρ , ω, φ).

In developing the analogy with nuclear phenomena even further one could as a fancy imagine the $\psi_{1,2,3}$ -particles to be quasi-one-particle excitations and the collective resonance to be a result of the interaction of these excitations in a certain "ψ-matter".

As a result the collective resonance state could contain a considerable admixture of the ψ -state and at the decay it could bring about a considerable yield of ψ -particles as it takes place in the decay of ψ_2(3.695).

The notion of the hadronic matter as consisting of the large number of quark-antiquark pairs differs apparently from the mostly used at present quark models.One could also notice some contradictions of our approach and the known data concerning the total cross-sections of neutrino and antineutrino interaction with nucleons.

In favour of our approach apparently the argument of the weakness of the effective interaction between quarks in hadronic matter could be used which in analogy with nuclear matter could be interpreted as a resulting from collective interaction of the objects of the same kind and the production of quasiparticles - quarks and antiquarks.

In most cases the main role, possibly up to certain energy, must play the interactions with finite number of such "valent" quasiparticles taking part in.And collective phenomena could be observed only for the class of the processes similar to the considered above.

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