

$E=mc^2$ in the turbulent aether

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Small perturbations of averaged ideal turbulence are known to reproduce the electromagnetic field. A vapor bubble in a turbulent fluid models the neutron. The self-energy of a bubble is defined as the work performed against the pressure of the fluid in order to create the bubble. The mass of the neutron corresponds to the mass of the equilibrium vapor in the bubble. Taking the vapor to be an ideal gas the relationship between the self-energy and the mass of the particle can be established.

Keywords: luminiferous medium, ideal fluid, Reynolds turbulence, perturbation wave, vapor bubble, particle

Perturbation waves in a turbulent medium

Perturbations of turbulence in an ideal fluid were shown [1] to obey equations that are isomorphic to Maxwell's equations. In this event the averaged velocity $\langle \mathbf{u} \rangle$ of the fluid models the magnetic vector-potential, the perturbation of the averaged pressure $\langle p \rangle$ corresponds to the scalar potential, and the elec-

tric field is concerned with a body force arising in the medium due to nonuniformity of Reynolds stresses $\langle u'_i u'_k \rangle$, where \mathbf{u}' is the turbulent fluctuation of the velocity $\mathbf{u} = \langle \mathbf{u} \rangle + \mathbf{u}'$ and $\langle \dots \rangle$ the averaging over a short time interval. The wave of perturbation of the averaged turbulence models the electromagnetic wave. The speed c of the wave is related with the background level of Reynolds stresses as

$$c^2 = \langle u'_1 u'_1 \rangle^{(0)} = \langle u'_2 u'_2 \rangle^{(0)} = \langle u'_3 u'_3 \rangle^{(0)}. \quad (1)$$

Particles as vapor bubbles

Matter, or substance, is concerned with inclusions of cavities into the luminiferous medium. The neutron can be modelled by a vapor bubble that is in equilibrium with the turbulent fluid [2].

Let V^* be the volume of the turbulent fluid evaporated into the bubble. The kinetic energy K^* transferred with the fluid into the gas phase can be found if we know the volume density of the turbulence energy

$$\frac{1}{2} \rho (\langle u'_1 u'_1 \rangle + \langle u'_2 u'_2 \rangle + \langle u'_3 u'_3 \rangle) \quad (2)$$

where ρ is the density of the fluid. It should be noted here that, as a true continuum, an ideal fluid has no heat energy, or in this system the energy of the turbulence can be viewed as in a way similar to the heat energy. Calculating K^* for the unperturbed medium we find from (2) with the account of (1)

$$K^* = V^* \frac{3}{2} \rho \langle u'_1 u'_1 \rangle^{(0)} = \frac{3}{2} \rho V^* c^2. \quad (3)$$

The vapor will be assumed to behave as an ideal gas. The equation of state of the ideal gas can be written in the form

$$pV = \frac{2}{3}K. \quad (4)$$

In the mechanical equilibrium the gas pressure p must be equal to the fluid pressure $\langle p \rangle$. If V is the volume of the bubble then using (3) in (4) we get for a bubble in the unperturbed medium with background pressure p_0 :

$$p_0V = \rho V^* c^2. \quad (5)$$

The mass and self-energy of a particle

The mass of the bubble can be determined from the mass of the gas contained in it

$$m = \rho V^*. \quad (6)$$

The self-energy of a bubble can be defined as the work needed to create the bubble in the unperturbed medium

$$E = p_0V. \quad (7)$$

Using (6) and (7) in (5) we get

$$E = mc^2. \quad (8)$$

Discussion

In the phenomenological theory (see e.g. the textbook [3]) we can deduce for the increment of the kinetic energy of a particle

$$dE = c^2 dm. \quad (9)$$

In order to obtain from (9) the expression for the self-energy we must postulate that all the internal energy of the particle concerned with the mass has a kinetic origin. Indeed, as you see from the microscopic theory above outlined the self-energy (8) of a particle is immediately reduced to a part of the turbulence energy of a luminiferous medium.

References

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