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### On the Use of the Two-component Liquid in the Critical Point of Stratification for the Optical Detection of the Gravitational Waves

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ON THE USE OF THE TWO-COMPONENT LIQUID  
 IN THE CRITICAL POINT OF STRATIFICATION  
 FOR THE OPTICAL DETECTION OF THE GRAVI-  
 TATIONAL WAVES

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The axis of the vessel  $\overrightarrow{z}$  with the two-component liquid in the critical point of stratification is oriented along the direction of trial mass in the field of gravitational wave. Suppose that vessel sides are less than the wave length and the rate of equilibrium establishment in such system greater than the rate of the gravitational field of the wave in the place of solution arrangement. Mark the coordinate of the liquid stratification boundary in the constant gravitational field parallel to  $\overrightarrow{z}$  as  $\ell_0$ .

If such solution is lighted along  $\overrightarrow{z}$  by the monochromatic light source of the frequency  $\nu_0$  the Mandelshtam-Brillouin component (MBC) scattered by the liquid layer at  $z = \ell$  with test the periodic displacement with the amplitude  $\Delta\nu_G$  which may be easy determined by use of [1-4] :

$$\Delta\nu_G = 0,17 \frac{\Delta\nu_0}{C_1} \left\{ \left[ \frac{6}{B} \left( M_1 - V_1 \frac{M k_p}{V k_p} \right) \right] (\ell - \ell_0)^{1/3} \right\} \left( \frac{K_G T_G}{\pi c} \right)^{1/6} = \\ = A (\ell - \ell_0)^{1/3} (T_G)^{1/6}; \quad \Delta\nu_G(t) = \Delta\nu_G \cos^{2/3} \omega_G t \quad , \quad (1)$$

where  $\omega_g$  - gravitational wave frequency,  $t$  - time,  $K_G$  - gravitational constant,  $I_g$  - amplitude of gravitational flow intensity,  $\Delta V_o = 2nV_o (\mathcal{V}/c) \sin \frac{\theta}{2}$  Mandelshtam-Brillouin displacement,  $n$  - refraction exponent,  $C$  - rate of the light,  $\mathcal{V}$  - rate of the sound in mixture in ordinary (noncritical) state,  $M_{kp} = M_i C_i^{kp} + M_2 C_2^{kp}$ ,  $V_{kp} = V_i C_i^{kp} + V_2 C_2^{kp}$ ;  $C_i^{kp} = 1 - C_i^{kp}$ ,  $M_i$ ,  $V_i$ ,  $C_i$ ,  $M_i$  ( $i = 1, 2$ ) - molecular weight, volume, concentration and chemical potential of the  $i$ -th component,  $kp$  - the corresponding values in the critical point,  $B = (\partial^3 M_i / \partial C_i^3)$ .

In derivation of (1) the attraction force of Earth (or other celestial bodies) is supposed to be compensated (for example, the experiment of Sputnik),  $\theta$  - angle between direction of scattering and  $\overrightarrow{z}$  - axis.

Evaluate  $\Delta V_G$ , which may be provided by cosmic of the gravitational radiation if to use nitrobenzol solution-normal hexane with nitrobenzol concentration  $C_1 = 0,4$  normal parts as in [2].

We find for such mixture near the upper temperature of stratification  $T_c = 20 \pm 0,5^\circ C$  accounting experimental data from (1) given in [2] ( $T - T_c = 1,1^\circ C$ ,  $\ell - \ell_o = 10 \text{ mm}$ )

$$\Delta V_G = 3 \cdot 10^7 \left( K_G I_G / \pi c \right)^{1/6} \text{ c/s} \quad (2)$$

So we find from (2)  $\Delta V_G = 300 \text{ c/s}$  for stars  $\zeta Boo$  and  $\zeta Sge$  which are at a short distance to use and producing the flow of gravitational radiation in the neighbourhood of

Earth  $I_G \approx 10^{-11} \frac{\text{erg}}{\text{cm}^2 \text{sec}}$  with periods  $T_{o1} \approx 0.194 \text{ days}$  and  $40,5 \text{ min.}$  correspondently.

This value exceeds greatly the linewidth of the modern gaseous lasers. If the experimental conditions allow to determine  $\Delta\nu_G = 1 \text{ c/s}$  we find from (2) that radiation flow with intensity  $(I_G)_{\min} \sim 10^{-27} \frac{\text{erg}}{\text{cm}^2 \text{sec}}$  may be registered

by the method suggested. Such flows may be generated even in the laboratories (see, for example, [5-7]).

It is perspective to use the low-temperature and quantum liquid for the noise decrease. For example the analogous effect may be expected in the mixture  $\text{He}^3 - \text{He}^4$  ( $T = 0.84^\circ\text{K}$  at  $c_1 = 0.63 \text{ He}^3$ )

From this example the great possibilities of the use of substances in critical states where their compressibilities are very large for the purposes of registration of gravitational radiation.

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