EXPERIMENTAL INVESTIGATION OF RADIATIVE-ACOUSTIC EFFECTS IN THE WATER BY THE THERMODYNAMICAL CONDITIONS OF DUMAND.

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Value of the sound pulse produced by high energy neutrino, if thermoacoustical mechanism of sound generation takes place, is proportional to the density of energy emerged so as Grunaisen parameter $\Gamma = kc^2/c_p$ of the substance. Here $k=k(t^o, P_o, S$ ‰ $)$; $c=c(t^o, P_o, S$ ‰ $)$; $c_p=c_p(t^o, P_o, S$ ‰ $)$ are coefficient of termal expansion, sound velosity and specific heat depended on temperature t^o, pressure P_o and saltness S ‰ of sea water /1/.

The acoustical signal initiated by the beam of relativistic electrons was investigated in the distilled /2/ so as in the salt water with the concentration of NaCl varied from 0 to 35 ‰ /3/. It was shown that acoustical signal by the normal temperature has mainly thermoacoustical nature.

In this experiment thermodynamical conditions corresponding to the deep underwater (H=5000 m, P_o=500 atm, t=2^{o}C; S=35 ‰) was realised by helping of high pressure chamber. The chamber has inputs for electron (E=50 MeV) and laser beams, experimental conditions were closed to those in /2,3/. Comprehensive analysis of acoustic signal by the varyation of pressure, temperature and saltness of water was performed using the laser beam. Using the electron beam measurements of acoustic signal was performed in the next conditions: P_o=1 atm, t=16^{o}C and P_o=500 atm, t=1^{o}C and t=16^{o}C. Fig.1 demonstrates experimental values of acoustical signals for laser and electron beams after correction on energy absorbed so as geometry of experiment.

At the same picture iterpolated dependences of Grunaisen coefficient Γ on t, P_0 and S are plotted (solid lines) using tabular data /4/; experimental data from /2,3/ also are shown here. It is seen from the figure that acoustic signal value J follows well Grunaisen coefficient.

Thus one can affirm in the thermodynamical conditions close to deep underwater acoustical signal from the beam of relativistic electrons has mainly thermoacoustical nature. The value of Grunaisen coefficient corresponding to conditions of DUMAND ($t=2^0$, P_0=500 atm, S=35 ‰) is equal to $\Gamma \approx 0,12$.

To model possible contribution of another acoustical mechanisms in the total signal the dependence of sound value initiated by vapour microbubles on hydrostatic pressure was investigated. Ensemble of vapour microbubles was initiated by laser beam striked the polydisperce mixture of grains in water (grain's sizes $\sim 10^{-5}$–10^{-3} cm, grain's number $\sim 10^4$ cm^{-3}, density of laser beam energy 10^{-2}–10^{-1} J/cm^2; full points in fig.2). Acoustical signal value from the single caverne initiated by laser break of water (~ 1 J/cm^2) in dependence on hydrostatical pressure was also investigated (■ in fig.2). It is seen from the figure that the value of soft (evaporating) heterocomponent of acoustical signal becames diminutive at depths greater than $\sim$ 1000 m. The value of hard heterocomponent i.e. acoustical signal from laser break of water is practically independent on hydrostatical pressure. The Grunaisen parameter is shown in fig.2 by solid line taking into account the change of t^0, P_0 and S ‰ of water in dependence of water depth. The experimental data on acoustical signals initiated by laser (▽) and electron (o) beams also are shown in fig.2.

It is nessesary to point out that the sensitivity of hydrophones made of piezoceramic CTS-19 was changed not more than 10 % in the pressure range 1-500 atm.

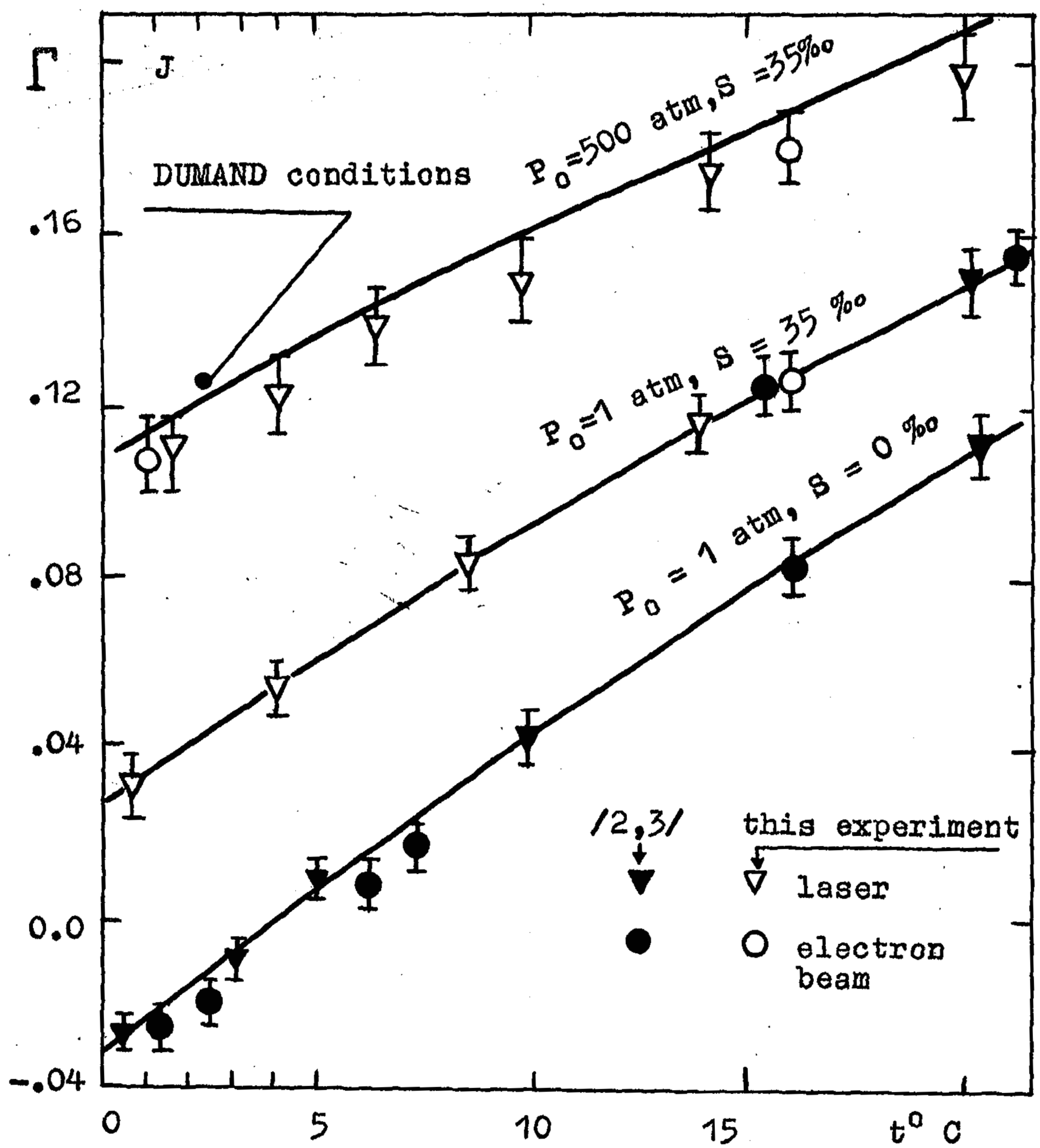

Fig.1 Temperature dependence of acoustical signal J by the different water saltness S ‰ and pressure P_o. Solid lines - tabular /4/ interpolation of Grunaisen coefficient.

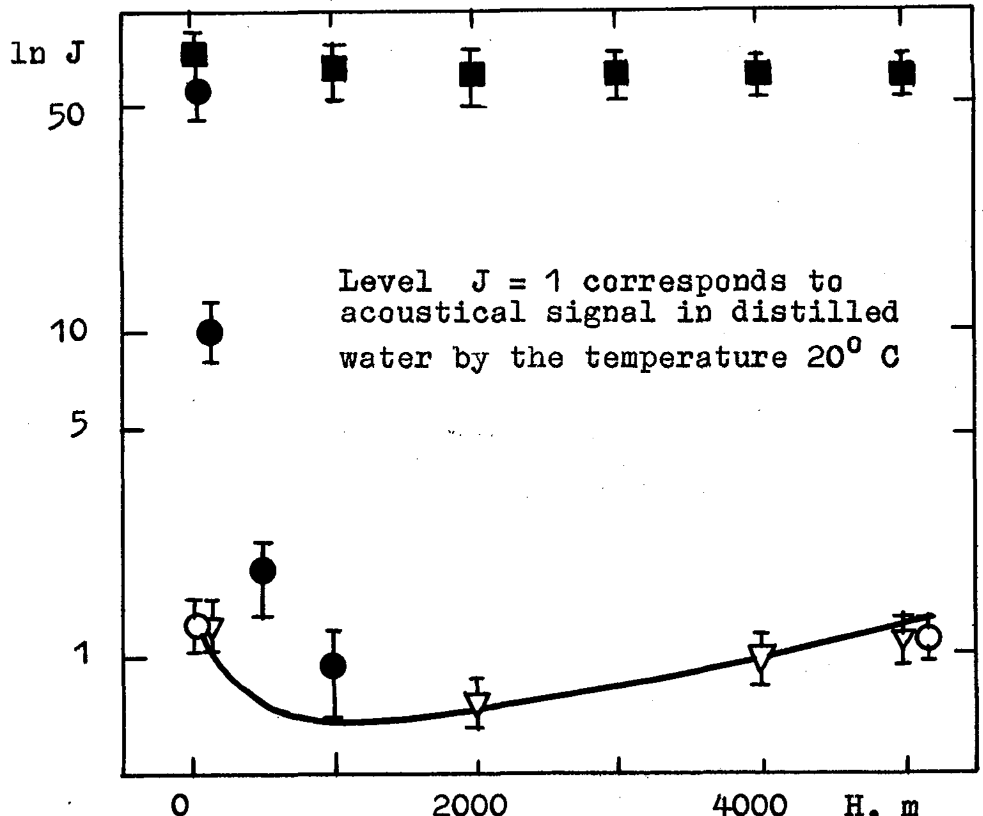

Fig.2 Depth dependence of acoustical signal for : electron ○ and laser ▽ beams by the thermo-acoustical mechanism (solid line - tabular data for Grunaisen coefficient); laser beam, vapour microbubbles ● ; single caverne by the laser break of water ■ .

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