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RECONSTRUCTION OF AN IMAGE FROM A HOLOGRAM IN NONMONOCHROMATIC LIGHT

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The requirements imposed on monochromatic light for satisfactory reconstruction of an image from a hologram may be much less stringent than the conditions necessary to obtain the hologram. When a light source with relatively broad spectrum is used for the reconstruction of the image, a separate image is obtained for each wavelength. The images differ in spatial position and in scale, and this reduces the sharpness of the image and consequently leads to a loss of some of the information contained in the hologram.

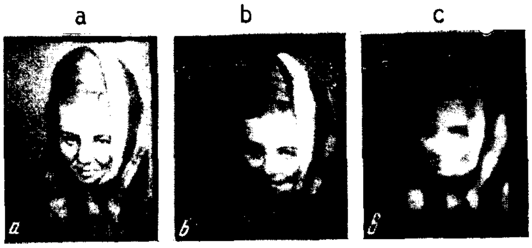
It can be assumed with equal justification that the reconstruction of a hologram in nonmononchromatic light constitutes an incoherent addition of images reconstructed from individual area elements of the hologram. The dimensions of these area elements are determined by the condition that for a given spectral composition of the radiation the difference in travel between the extreme rays from such an area element must not exceed the length of the wave train at the point of the reconstructed image. The volume of information retained in the image will correspond to the information contained in one area element. The action of the entire hologram reduces in this case to an increase of the illumination and the averaging of the graininess of the image due to the limited aperture of the light beam in the case when the hologram area is small.

An elementary analysis, together with a calculation of the corresponding correlation functions, shows that the linear dimension D of the elementary hologram area, which determines the angular resolution, is given for a source of spectral width $\Delta\lambda$ by the formula

$$\frac{\Delta\lambda}{\lambda} = \frac{\lambda}{a}\frac{R}{D}, \tag{1}$$

where R is the distance from the point source of light to the hologram, and a is the linear dimension of the object. The same formula determines the maximum permissible spectral interval at which the information contained in a hologram of given width is completely retained in the reconstructed image.

The figure shows photographs reconstructed from a hologram obtained from a diapositive slide: (a) in laser light (λ = 6328 Å), (b) in the light of the green line obtained from a



DRSh-1000 lamp using two light filters (ZhZS-9 and PS-7), and (c) in the light from an incandescent lamp through a glass light filter (KS-13). The dimensions of the hologram correspond to a 24 x 36 mm frame of a miniature camera.

This raises the question whether it is also possible, by foregoing the redundant information in the hologram, to use a light source of equally broad spectral composition to obtain a hologram on an area corresponding to the value of D in formula (1).

For each point of the object this is indeed so. In this case the problem is fully equivalent to the problem of determining the number of interference fringes seen in the light from a given source. On going over to the entire aggregate of points of the object, it is necessary to take into account the fact that zero phase differences between the reference beam and the beam from a given point of the object do not occur in identical locations on the hologram plane. Therefore broadening of the spectrum leads not to a narrowing of the region where the interference pattern (hologram) is sharp, but to a decrease in its contrast, which eventually vanishes at a certain spectral width. The permissible spectral width depends on the dimensions of the object and on the concrete optical scheme used to obtain the hologram.

Thus, a light source which is perfectly adequate for the reconstruction of an image of satisfactory quality may turn out to be utterly unsuitable for the production of a hologram. At the same time, there may exist a large number of problems and technical solutions in which the loss of information contained in the hologram is offset by the simplicity of reconstruction of the hologram in ordinary light sources.

INSTABILITY OF FERMI SYSTEMS AND SPECIFIC HEAT OF LIQUID He^3

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1. The disparity between low-temperature data on the specific heat of He^3 [1] and the predictions of the Fermi-liquid theory [2,4] has been attracting interest of late. We can attempt to explain this disparity 1) by assuming that at some still-unattained temperature T_c the system experiences a second-order phase transition, as a result of which the specific heat has a peak of width ΔT near T_c. It follows from experimental data that $T_c < 0.01°$, $\Delta T \sim 1°$, and at any rate $\Delta T/T_c \gg 1$. There can therefore be no talk of a transition to the superfluid state that might be produced as a result of long-range attraction forces [5], since for such a transition [6,7] $\Delta T/T_c \sim (mT_c/p_0^2)^4 \ll 1$ (p_0 = limiting momentum, m = particle mass).

We propose in this note a possible explanation of the anomaly of the specific heat of