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NEW METHOD OF OBTAINING HIGH-RESOLUTION HOLOGRAMS

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We describe in this preliminary communication a new method of obtaining high-resolution holograms.

It is known [1] that the use of a reference beam improves greatly the quality of the hologram and of the reproduced picture. The reconstruction, however, contains in this case a large amount of noise. The level of this noise is reduced usually by decreasing the vibration of the experimental setup during the recording of the hologram, by decreasing the exposure time, and by using fine-grain emulsions. The reference beam must have an undistorted wave front. The use of plates is recommended to allow a decrease in the emulsion thickness [1-5]. It is believed that the action of some of the foregoing factors can be eliminated by using diffuse illumination [1]. But even this does not yield high-grade reconstructions. The noise due to vibration affects strongly the reconstruction quality. The use of a beam-splitting mirror, ground glass, a mirror for the reference beam, and a lens system bring about differences in the physical conditions of the reference beam and the beam scattered by the object [1, 6]. Since a rigid optical system is unattainable, the least vibrations will cause great distortion and there can be no talk of identity of the reference beam and the beam incident on the object. It seems to us, however, that when diffuse illumination is used the noise is uniformly distributed over the entire area of the hologram and the resultant improvement in the hologram is illusory.

To reduce the noise due to vibrations of the experimental setup, we used a Fresnel biprism (FBP) to take the role of the beam-splitting plate. In such a setup, the physical conditions for the beam scattered by the object and the reference beam are strictly identical, and the vibrations of the FBP do not affect the image quality.

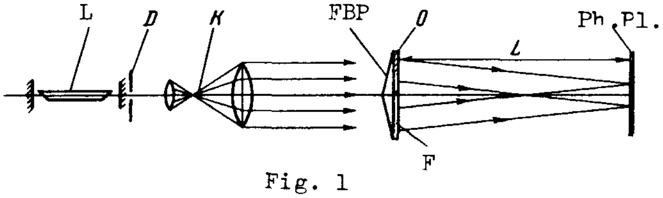

Fig. 1

The experimental setup is illustrated in Fig. 1. A collimated light beam from a laser struck the FBP, was split into two beams, one of which was incident on the object and the other served as the reference beam. The intensity ratio of the scattered and reference beams could be varied in arbitrary fashion by filters which were made integral with the FBP by optical contact. The interference pattern of the rays diffracted from the object yields, in conjunction with the field of the reference beam on the photographic plate, the hologram of the object. As a result, the photographic plate records only the changes experienced by the beam

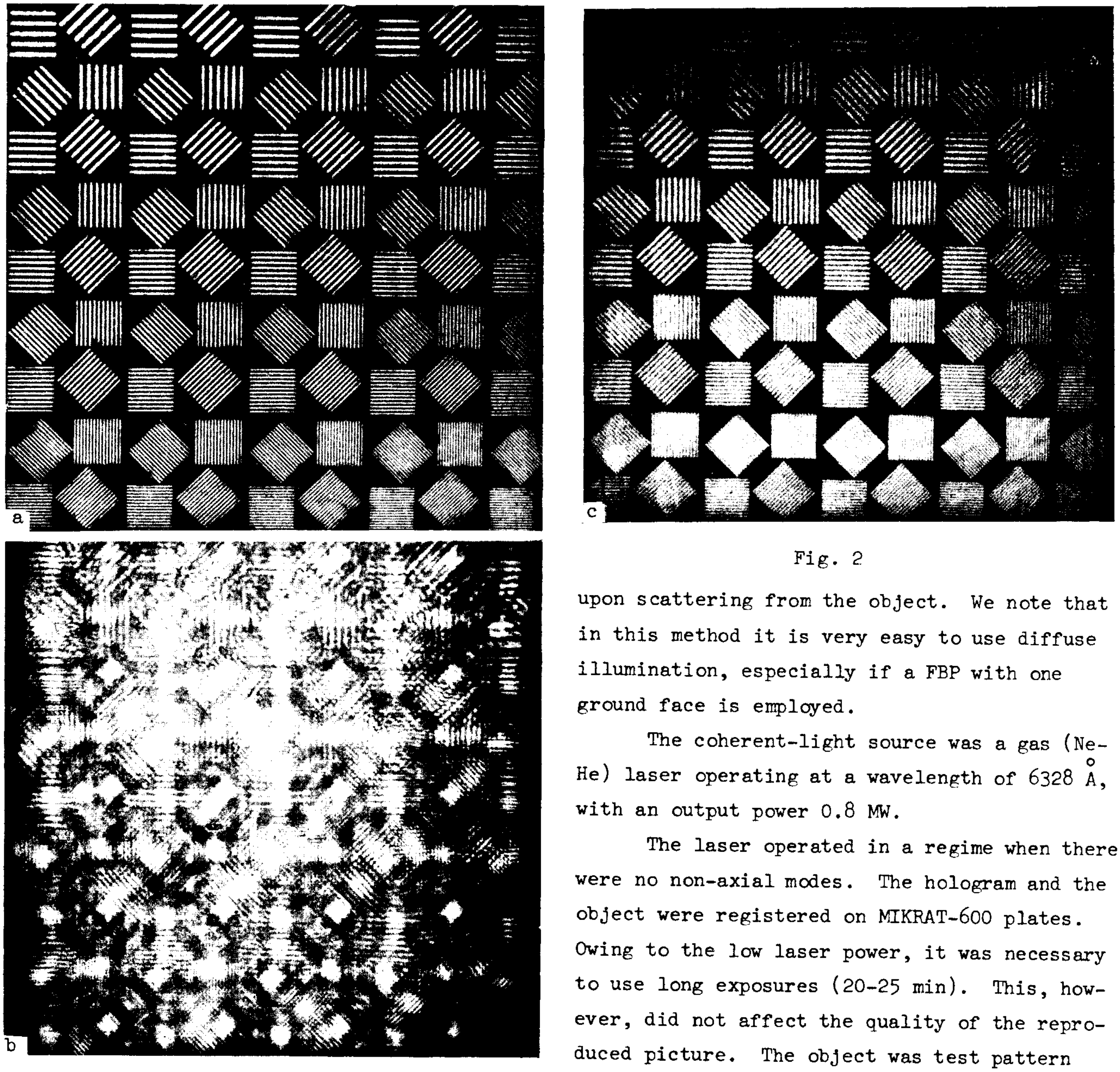

Fig. 2

upon scattering from the object. We note that in this method it is very easy to use diffuse illumination, especially if a FBP with one ground face is employed.

The coherent-light source was a gas (Ne-He) laser operating at a wavelength of 6328 Å, with an output power 0.8 MW.

The laser operated in a regime when there were no non-axial modes. The hologram and the object were registered on MIKRAT-600 plates. Owing to the low laser power, it was necessary to use long exposures (20-25 min). This, however, did not affect the quality of the reproduced picture. The object was test pattern No. 5 from the OSK-2 set. The distance from the object to the emulsion was 90 cm. Figure 2 (a, b, c) shows photographs of the object, the hologram, and the reproduced picture (magnification 5x). As seen from Fig. 2c, all lines on the test pattern are resolved with contrast on the image (the smallest distance between lines is 0.08 mm). Thus, the attained angular resolution exceeds 8×10^{-5} rad. The exact limit of the angular resolution will be given in a succeeding paper.

In conclusion, the authors thank V. V. Chavchanidze for valuable hints a discussion of the results.

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DEVELOPMENT OF STIMULATED MANDEL'SHTAM-BRILLOUIN SCATTERING WITH TIME IN NITROGEN GAS AT 150 ATMOSPHERES

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The stimulated Mandel'shtam-Brillouin scattering (SMBS) previously observed in hydrogen, nitrogen, and oxygen at increased pressure [1] was produced in the focused beam of a ruby-laser giant pulse, and plasma production was observed at the same time. It is therefore important to ascertain in which time interval the SMBS arises and develops relative to the time of plasma occurrence.

On the other hand, up to four Stokes components and one anti-Stokes component of SMBS were observed in the earlier experiment [1]. If we attribute the appearance of these components to successive scattering [2] then, taking into account the conditions of the experiment in [1], the appearance of all the component would call for a long time. It is therefore necessary to explain the mechanism that produces these components.

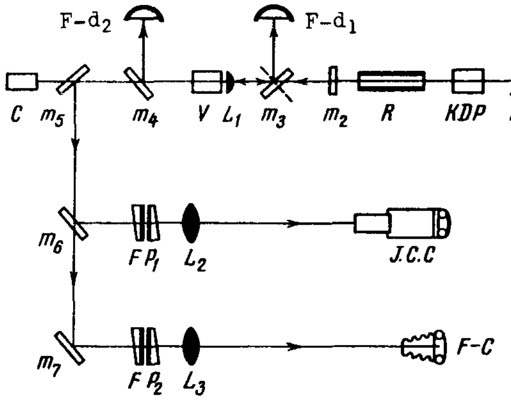

Fig. 1. Experimental setup: m$_1$ - dielectric mirror (R 100%); B - Brewster stack, KDP - Pockels cell (KDP crystal); R - ruby, 120 mm long, 12 mm dia.; m$_2$ - dielectric mirror (R 30%); m$_3$, m$_4$ - plane-parallel glass plates; F-d$_1$, F-d$_2$ - photodiodes; V - gas chamber; L$_1$ - lens (f = 3 cm); m$_5$, m$_6$, m$_7$ - silvered mirrors (R = 80, 50, 96%, respectively); C - calorimeter, F-P$_1$, F-P$_2$ - Fabry-Perot interferometers (dispersion region 0.166 cm^{-1}); L$_2$, L$_3$ - objectives (f = 80 and 70 cm, respectively); J.C.C.- electron-optical converter; F-C - photo-camera.

We report in this letter an investigation of the evolution of the SMBS and the plasma in time. We used a high-speed time-scan method with an electron-optical converter, developed in [3]. The apparatus was of the same type as described in [4].

The experimental setup, which is shown in Fig. 1, has made it possible to record simultaneously, with the aid of photodiodes (FEK-09), the time variation of the integral intensity of the transmitted and back-scattered light, and to obtain with the aid of Fabry-Perot interferometers and an electro-optical converter (PIM-3) both the integral and the time-scanned spectrograms of the SMBS.

The over-all time resolution was 1.5 - 2 nsec and was determined by the time necessary to establish the interference pattern in the Fabry-Perot interferometer. The power of the giant