

A NEW INTERPRETATION OF LINIK INTERFERENCE EXPERIMENT,
BASED ON DIFFRACTION OF GAUSSIAN SPHERICAL INCIDENT
WAVES

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The diffraction theory of the circular version of the Linik experiment is given. The theory treated the case of Gaussian incident waves. The theoretical results are specialised to diffraction of Gaussian waves on circular aperture and circular opaque screen.

1. Introduction

Following the suggestion of V. P. Linik, the interference lines should be expected as a result of superposition of the waves of light passing through the unbounded part of the plane around the aperture which is partially transparent¹⁾. But, as it has been shown in Ref. 2 in all interference schemas the interferent lines can not be treated separately from the diffraction pattern. On the other hand, the proposed Linik interference schema can be treated only from the diffraction standpoint.

In this article we give a diffraction theory of the mentioned experiment, or more precisely, we treat its circular version for the case of Gaussian incident waves, as the best approximation to the laser beam³⁻⁵⁾, which take wide use in all

diffraction and interference experiments. It should be mentioned that the theoretical interpretation of the experimental results for the linear version of the Linik schema is given in Ref. 6.

2. The diffraction amplitude

Let the waist of the source of spherical Gaussian waves be a distance z_0 apart from the circular aperture of radius R and of constant transmission factor κ_1 . The diffraction pattern is observed on a screen which is a distance z behind from the aperture. The incident wave passing through the aperture surrounding, is κ_2 times weaker (κ_2 is the transmission factor of the diffraction screen around the aperture).

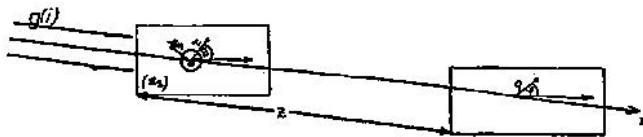


Fig. 1. Geometry of the diffractive scheme.

Using the notation on Fig. 1, and by the Fresnel-Kirchhoff approximation, the complex amplitude of a point $P(\varrho, \varphi, z)$ in the observation plane, is defined by the following diffraction integral

$$\begin{aligned}
 g(\varrho, \varphi, z) = & -\frac{i A \exp(i\delta) w_0}{\lambda w z} \left\{ \kappa_1 \int_0^R \int_0^{2\pi} \exp \left\{ -\frac{r^2}{w^2} - i \left[\frac{k}{2} \left(\frac{1}{z_0} + \frac{1}{z} \right) r^2 + \right. \right. \right. \\
 & \left. \left. \left. + \frac{k}{z} \varrho r \cos(\Theta - \varphi) \right] \right\} dr d\Theta + \kappa_2 \exp(i\delta) \int_R^\infty \int_0^{2\pi} \exp \left\{ -\frac{r^2}{w^2} - i \left[\frac{k}{2} \left(\frac{1}{z_0} + \right. \right. \right. \\
 & \left. \left. \left. + \frac{1}{z} \right) r^2 + \frac{k}{z} \varrho r \cos(\Theta - \varphi) \right] \right\} r dr d\Theta \right\} \quad (1)
 \end{aligned}$$

where A is a constant, $\sigma = z_0 + z - \frac{k\varrho}{2z}$, w_0 is the radius of the incident beam at its waist, w is the radius of the Gaussian spot in the diffracting plane and $k = \frac{2\pi}{\lambda}$ is the propagation constant. If the diffracting media of transmission factor κ_1 and κ_2 are produced on a film of constant thickness, the existing phase difference should be neglected. Marking out

$$\beta = k \left(\frac{1}{z_0} + \frac{1}{z} \right) \quad (2)$$

$$a = \frac{2}{w^2} \tag{3}$$

$$\gamma = \beta - ia \tag{4}$$

$$\eta = \frac{k}{z} \varrho \tag{5}$$

and using the known relation, from the theory of the Bessel function⁷⁾

$$\int_0^{2\pi} \exp[-i\eta r \cos(\Theta - \varphi)] d\Theta = 2\pi J_0(\eta r) \tag{6}$$

the expression (1) becomes

$$g(\varrho, z) = -\frac{i 2\pi A w_0 \exp(i\delta)}{\lambda w z} \left\{ \kappa_1 \int_0^R \exp\left(-i\frac{\gamma}{2} r^2\right) J_0(\eta r) r dr + \right. \\ \left. + \kappa_2 \exp(i\delta) \int_R^\infty \exp\left(-i\frac{\gamma}{2} r^2\right) J_0(\eta r) r dr \right\}. \tag{7}$$

Now let us introduce a new variable ξ , by the substitution

$$r = R\xi \tag{8}$$

and the shorter notations

$$\hat{u} = \gamma R^2 \tag{9}$$

$$v = \eta R \tag{10}$$

$$Q = \frac{\kappa_2}{\kappa_1} \tag{11}$$

(The kape sign \hat{u} in (9) is used to outline that the parameter u is a complex quantity).

Thus

$$g(\varrho, z) = -\frac{i k \kappa_1 A w_0 R^2 \exp(i\delta)}{\lambda z w} \left\{ \left[1 - Q \exp(i\delta) \right] \int_0^1 \exp\left(-i\frac{\hat{u}}{2} \xi^2\right) J_0(v\xi) \xi d\xi + Q \exp(i\delta) \int_0^\infty \exp\left(-i\frac{\hat{u}}{2} \xi^2\right) J_0(v\xi) \xi d\xi \right\}. \tag{12}$$

According to Ref. 8,

$$\int_0^{\infty} \exp\left(-i \frac{\hat{u}}{2} \xi^2\right) J_0(v \xi) \xi d\xi = -\frac{i}{\hat{u}} \exp\left(i \frac{v^2}{2\hat{u}}\right) \quad (13)$$

while the solution of the first integral is found by the use of Lommel functions^{9,10}, and is given by

$$\int_0^1 \exp\left(-i \frac{\hat{u}}{2} \xi^2\right) J_0(v \xi) \xi d\xi = \frac{1}{\hat{u}} \exp\left(-\frac{\hat{u}}{2}\right) \left[U_1(\hat{u}, v) + i U_2(\hat{u}, v) \right] - \frac{i}{\hat{u}} \left\{ \exp\left(i \frac{v^2}{2\hat{u}}\right) - \exp\left(-i \frac{\hat{u}}{2}\right) \left[V_0(\hat{u}, v) + i V_1(\hat{u}, v) \right] \right\} \quad (14)$$

where the n -th order Lommel functions are defined by

$$U_n(\hat{u}, v) = \sum_{l=0}^{\infty} (-1)^l \left(\frac{\hat{u}}{v}\right)^{2l+n} J_{2l+n}(v) \quad (15)$$

$$V_n(\hat{u}, v) = \sum_{l=0}^{\infty} (-1)^l \left(\frac{v}{\hat{u}}\right)^{2l+n} J_{2l+n}(v). \quad (16)$$

Therefore the diffracted wave amplitude in Lommel U -representation is defined as

$$g(\varrho, z) = -\frac{i k \kappa_1 A w_0 \exp(i\sigma) R^2}{w z \hat{u}} \left\{ [1 - Q \exp(i\delta)] \exp\left(-i \frac{\hat{u}}{2}\right) \left[U_1(\hat{u}, v) + i U_2(\hat{u}, v) - i Q \exp\left[i\left(\delta + \frac{v^2}{2\hat{u}}\right)\right] \right] \right\} \quad (17)$$

or in V -representation by the expression

$$g(\varrho, z) = -\frac{k \kappa_1 A w_0 \exp(i\sigma) R^2}{w z \hat{u}} \left\{ [1 - Q \exp(i\delta)] \left\{ \exp\left(i \frac{v^2}{2\hat{u}}\right) - \exp\left(-i \frac{\hat{u}}{2}\right) \left[V_0(\hat{u}, v) + i V_1(\hat{u}, v) \right] \right\} + Q \exp\left[i\left(\delta + \frac{v^2}{2\hat{u}}\right)\right] \right\}. \quad (18)$$

Both expressions (17) and (18) with equal validity define the diffracted wave field in Linik experiment with circular aperture geometry.

3. *The irradiance distribution on the optical axis of the aperture*

On the optical axis $\rho = 0$, and thus $\eta = 0$ and $v = 0$. From (16) it follows that

$$V_0(\hat{u}, 0) = 1 \text{ while } V_1(\hat{u}, 0) = 0.$$

Now the introducing of these values in (18) gives

$$g(0, z) = - \frac{k \kappa_1 A R^2 \exp(i\sigma) w_0}{\lambda z \hat{u}} \left\{ 1 - [1 - Q \exp(i\delta)] \exp\left(-i \frac{\hat{u}}{2}\right) \right\} \quad (19)$$

or referring to (9) and (4)

$$g(0, z) = - \frac{k \kappa_1 A w_0 \exp(i\sigma)}{\lambda z (\beta - i a)} \left\{ 1 - \exp\left(-\frac{R^2}{2} a\right) \left[\cos \frac{R^2 \beta}{2} - Q \cos\left(\frac{R^2 \beta}{2} - \delta\right) \right] - i \exp\left(-\frac{R^2}{2} a\right) \left[\sin \frac{R^2 \beta}{2} - Q \sin\left(\frac{R^2 \beta}{2} - \delta\right) \right] \right\}. \quad (20)$$

The irradiance distribution on the optical axis is given by

$$I(0, z) = g(0, z) \cdot g^*(0, z) = \frac{k^2 \kappa_1^2 A^2 w_0^2}{\lambda^2 z^2 (\beta^2 + a^2)} \left\{ 1 + \exp(-R a) (1 + Q^2 - 2Q \cos \delta) - 2 \exp\left(-\frac{R^2}{2} a\right) \left[\cos \frac{R^2 \beta}{2} - Q \cos\left(\frac{R^2 \beta}{2} - \delta\right) \right] \right\}. \quad (21)$$

In an ideal case when

$$\delta = 0, 2\pi, \dots, 2n\pi \quad (22)$$

this distribution is given by:

$$I(0, z) = \frac{k^2 \kappa_1^2 A^2 w_0^2}{\lambda^2 z^2 (\beta^2 + a^2)} \left\{ 1 + \exp(-R^2 a) (1 - Q)^2 - 2 \exp\left(-\frac{R^2}{2} a\right) (1 - Q) \cos \frac{R^2 \beta}{2} \right\} = I_0(z) \left\{ 1 + \exp(-R^2 a) (1 - Q)^2 - 2 \exp\left(-\frac{R^2}{2} a\right) (1 - Q) \cos \frac{R^2 \beta}{2} \right\} \quad (23)$$

The function

$$I_0(z) = \frac{k^2 \kappa_1^2 A^2 w_0^2}{w^2 z^2 (\beta^2 + \alpha^2)} = \frac{k^2 \kappa_1^2 A^2 w_0^2}{w^2} \frac{1}{\left(\alpha^2 + \frac{k^2}{z_0^2}\right) z^2 + 2 \frac{k^2}{z_0} z + k^2} \quad (24)$$

serves as modulating function to the oscillatory irradiance changes on the optical axis. It is a decreasing function for the positive values of z (Fig. 2).

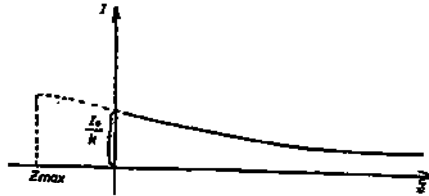


Fig. 2. Function of the oscillatory irradiance changes the optical axis.

i. When $Q = \frac{\kappa_2}{\kappa_1} < 1$, i. e. $\kappa_2 < \kappa_1$ (the lighter circular aperture on a darker screen), the irradiance distribution is given by (23). Thus the loci of maximum irradiance on the optical axis are approximately found when

$$\frac{R^2 \beta}{2} = (2n + 1) \pi, \quad n = 0, \pm 1, \pm 2 \dots \quad (25)$$

i. e.

$$z_{max} = \frac{z_0}{\frac{\lambda z_0}{R^2} (2n + 1) - 1} \quad n\text{-integer } n > \frac{1}{2} \left(\frac{R^2}{\lambda z_0} - 1 \right) \quad (26)$$

while the minima are located at

$$z_{min} = \frac{z_0}{\frac{\lambda z_0}{R^2} 2n - 1} \quad n\text{-integer } n > \frac{R^2}{2\lambda z_0} \quad (27)$$

The values of corresponding irradiances are

$$I_{max}(0, z) = I_0(z) \left[1 + (1 - Q) \exp \left(-\frac{R^2 \alpha}{2} \right) \right]^2$$

$$I_{min}(0, z) = I_0(z) \left[1 - (1 - Q) \exp \left(-\frac{R^2 \alpha}{2} \right) \right]^2 \quad (28)$$

ii. When the transmission factor $\kappa_2 = 0 \Rightarrow Q = 0$ and we have the case of diffraction on transparent circular aperture on an opaque screen. The extrema loci are same as (26) and (27) while the value of the corresponding irradiance are

$$\begin{aligned}
 I_{max}(0, z) &= I_0(z) \left[1 + \exp\left(-\frac{R^2 \alpha}{2}\right) \right]^2 \\
 I_{min}(0, z) &= I_0(z) \left[1 - \exp\left(-\frac{R^2 \alpha}{2}\right) \right]^2.
 \end{aligned}
 \tag{29}$$

iii. The situation changes when $Q > 1$, i. e. $\kappa_2 > \kappa_1$ (the dark circular aperture on a lighter screen), then $(1 - Q) < 0$ which causes the interchanging of the loci of extreme defined by (26) and (27). Now

$$z_{max} = \frac{z_0}{\frac{\lambda z_0}{R^2} 2n - 1} \quad \text{while} \quad z_{min} = \frac{z_0}{\frac{\lambda z_0}{R^2} (2n - 1) - 1}
 \tag{30}$$

and

$$\begin{aligned}
 I_{max}(0, z) &= I_0(z) \left[1 + (Q - 1) \exp\left(-\frac{R^2 \alpha}{2}\right) \right]^2 \\
 I_{min}(0, z) &= I_0(z) \left[1 - (Q - 1) \exp\left(-\frac{R^2 \alpha}{2}\right) \right]^2.
 \end{aligned}
 \tag{31}$$

iv. When $\kappa_2 \neq 0$ and $\kappa_1 = 0$, we have the problem of diffraction on an opaque circular obstacle. This problem has been treated in details in Ref. 11. It is easily seen, from (18), that in this case the irradiance on the optical axis of the obstacle is given by

$$I(0, z) = \frac{k^2 A^2 \kappa_2^2 w_0^2 \exp(-R^2 \alpha)}{w^2 \left[\left(\alpha^2 + \frac{k^2}{z_0^2} \right) z^2 + 2 \frac{k^2}{z_0} z + k^2 \right]}.
 \tag{32}$$

We get a slowly decreasing function, similar to that on Fig. 2. When a classical wave is used instead a Gaussian one, we should put $\alpha = 0$, $\frac{w_0}{w} \rightarrow 1$, $\frac{1}{z_0} \rightarrow 0$, and get the irradiance

$$I(0, z) = A^2 \kappa^2 = \text{const.}
 \tag{33}$$

i. e. we get the famous result predicted by Fresnel and confirmed experimentally by Poisson — the appearance of light spot in the center of the geometrical shadow of the circular screen. As it could be seen the Gaussian wave reproduces the phenomenon, but instead of constant irradiance on the optical axis, there is a tendency of decreasing of the irradiance of the central spot defined by the expression (32).

4. The irradiance distribution in a transversal plane

The most important investigation in this article is the study of the irradiance distribution in the observation plane. Generally the irradiance is defined as the sum of the squares of the real and imaginary part of diffracted wave amplitude

$$I(\varrho, z) = \{\operatorname{Re} [g(\varrho, z)]\}^2 + \{\operatorname{Im} [g(\varrho, z)]\}^2. \quad (34)$$

Having in mind that the parameter \hat{u} in expression (17) is complex, it is not difficult to see that the irradiance in the observation plane is defined by

$$\begin{aligned} I(\varrho, z) = & \frac{k^2 \kappa_1^2 w_0^2 A^2}{w^2 z^2 (\beta^2 + \alpha^2)} \left\{ \exp(-R^2 \alpha) (1 + Q^2 - 2Q \cos \delta) \{[\operatorname{Re} U_1(\hat{u}, v) - \right. \\ & \left. - \operatorname{Im} U_2(\hat{u}, v)]^2 + [\operatorname{Re} U_2(\hat{u}, v) + \operatorname{Im} U_1(\hat{u}, v)]^2\} + \right. \\ & \left. + Q^2 \exp\left[-\frac{v^2 \alpha}{R^2 (\beta^2 + \alpha^2)}\right] + 2Q \exp\left[-\frac{R^2 \alpha}{2} - \frac{v^2 \alpha}{2R^2 (\beta^2 + \alpha^2)}\right] \cdot \right. \\ & \cdot \{[\operatorname{Re} U_1(\hat{u}, v) - \operatorname{Im} U_2(\hat{u}, v)] \left[\sin\left(\frac{v^2 \beta}{2R^2 (\beta^2 + \alpha^2)} + \frac{R^2 \beta}{2} + \delta\right) - \right. \\ & \left. - Q \sin\left(\frac{v^2 \beta}{2R^2 (\beta^2 + \alpha^2)} + \frac{R^2 \beta}{2}\right) \right] - [\operatorname{Im} U_1(\hat{u}, v) + \right. \\ & \left. + \operatorname{Re} U_2(\hat{u}, v)] \left[\cos\left(\frac{v^2 \beta}{2R^2 (\beta^2 + \alpha^2)} + \frac{R^2 \beta}{2} + \delta\right) - \right. \\ & \left. \left. - Q \cos\left(\frac{v^2 \beta}{2R^2 (\beta^2 + \alpha^2)} + \frac{R^2 \beta}{2}\right) \right] \right\} \quad (35) \end{aligned}$$

where according to (15)

$$\operatorname{Re} U_1(\hat{u}, v) = \sum_{l=0}^{\infty} (-)^l \left(\frac{R\beta}{\eta}\right)^{2l+1} J_{2l+1}(R\eta) \sum_{s=0}^l (-)^s \binom{2l+1}{s} \left(\frac{\alpha}{\beta}\right)^{2s} \quad (36)$$

$$\operatorname{Im} U_1(\hat{u}, v) = - \sum_{l=0}^{\infty} (-)^l \left(\frac{R\beta}{\eta}\right)^{2l+1} J_{2l+1}(R\eta) \sum_{s=0}^l (-)^s \binom{2l+1}{2s+1} \left(\frac{\alpha}{\beta}\right)^{2s+1} \quad (37)$$

$$\operatorname{Re} U_2(\hat{u}, v) = \sum_{l=0}^{\infty} (-)^l \left(\frac{R\beta}{\eta}\right)^{2l+2} J_{2l+2}(R\eta) \sum_{s=0}^l (-)^s \binom{2l+2}{2s} \left(\frac{\alpha}{\beta}\right)^{2s} \quad (38)$$

$$\operatorname{Im} U_2(\hat{u}, v) = \sum_{l=0}^{\infty} (-)^l \left(\frac{R\beta}{\eta}\right)^{2l+2} J_{2l+2}(R\eta) \sum_{s=0}^l (-)^s \binom{2l+2}{2s+1} \left(\frac{\alpha}{\beta}\right)^{2s+1} \quad (39)$$

Let us discuss the irradiance distribution, when the phase difference of the diffracting layers are $\delta = 0, 2\pi, \dots, 2n\pi$ and let us introduce a notation

$$x = \frac{v^2 \beta}{2R^2(\beta^2 + a^2)} + \frac{R^2 \beta}{2}. \quad (40)$$

After some rearrangement of the terms in the expression (35) we get

$$\begin{aligned} I(\varrho, z) = & \frac{k^2 \kappa_1^2 w_0^2 A^2}{w^2 z^2 (\beta^2 + a^2)} \left\{ \exp(-R^2 a) (1 - Q)^2 (\operatorname{Re} U_1 - \operatorname{Im} U_2)^2 + \right. \\ & + \left[\exp\left(-\frac{R^2 a}{2}\right) (1 - Q) (\operatorname{Im} U_1 + \operatorname{Re} U_2) - Q \exp\left[-\frac{v^2 a}{2R^2(\beta^2 + a^2)}\right] \right]^2 + \\ & + 4Q(1 - Q) \exp\left[\left(\frac{R^2 a}{2}\right) - \frac{v^2 a}{2R^2(\beta^2 + a^2)}\right] \sin \frac{x}{2} \cdot \\ & \cdot \left. \left[(\operatorname{Re} U_1 - \operatorname{Im} U_2) \cos \frac{x}{2} + (\operatorname{Im} U_1 + \operatorname{Re} U_2) \sin \frac{x}{2} \right] \right\}. \quad (41) \end{aligned}$$

The variable ϱ in the observation plane, enters in the expression (41) through the parameters v , η and x . The expression (41) is a rather transcendental one, and it is very hard to find the irradiance extrema by the usual analytic methods.

It is easily seen, from the expression (41), that the minima should be approximately expected where

$$\sin \frac{x}{2} = 0 \text{ i. e. } \frac{v^2 \beta}{2R^2(\beta^2 + a^2)} + \frac{R^2 \beta}{2} = 2n\pi \quad (42)$$

or for

$$\varrho_{min} = \frac{z}{k} \sqrt{\beta^2 + a^2} \sqrt{\frac{2\pi}{\beta} 2n - R^2} \quad (43)$$

and

$$\begin{aligned} I(\varrho_{min}, z) = & \frac{k^2 \kappa_1^2 A^2 w_0^2}{w^2 z^2 (\beta^2 + a^2)} \left\{ \exp(-R^2 a) (1 - Q)^2 (\operatorname{Re} U_1 - \operatorname{Im} U_2)^2 + \right. \\ & + \left. \left[\exp\left(-\frac{R^2 a}{2}\right) (1 - Q) (\operatorname{Im} U_1 + \operatorname{Re} U_2) - Q \exp\left(\frac{v^2 a}{2R^2(\beta^2 + a^2)}\right) \right]^2 \right\}. \quad (44) \end{aligned}$$

The irradiance maxima should be approximately expected where

$$\sin \frac{x}{2} = 1; \quad \cos \frac{x}{2} = 0$$

or

$$\varrho_{max} = \frac{z}{k} \sqrt{\beta^2 + a^2} \sqrt{\frac{2\pi}{\beta} (2n + 1) - R^2} \quad (45)$$

with

$$I(\varrho_{max}, z) = \frac{k^2 \kappa_1^2 A^2 w_0^2}{w^2 z^2 (\beta^2 + a^2)} \left\{ \exp(-R^2 \alpha) (1 - Q)^2 (\text{Re } U_1 - \text{Im } U_2)^2 + \right. \\ \left. + \left[\exp\left(-\frac{R^2 \alpha}{2}\right) (1 - Q) (\text{Im } U_1 + \text{Re } U_2) + Q \exp\left(-\frac{v^2 \alpha}{2R^2 (\beta^2 + a^2)}\right) \right]^2 \right\}. \quad (46)$$

This approximate determination of the extrema is valid when $Q < 1$ or $\kappa_2 < \kappa_1$. When $Q > 1$, $(1 - Q) < 0$ and the last term in expression (41) changes its sign. It means that the loci of minima and maxima interchange the roles.

The obtained results indicate the existence of dark and light rings in the observation plane. These rings are closely spaced because of the existence of the factor β in the denominator of the square roots (43) and (45) and they are spread over the slowly changing diffraction background in the observation screen.

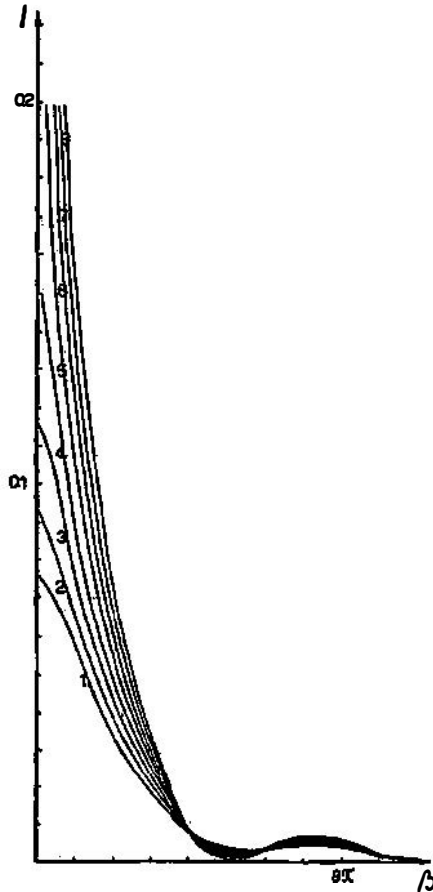


Fig. 3. The numerical results of the irradiance distribution on the optical axis, calculated by Eq. (21).

5. The numerical and experimental verification

Fig. 3 gives the numerical results of the irradiance distribution on the optical axis. It was computed by the formula (21), when $Q = 0.2$ and β changes from 0 to 10π . The curves for different α are marked:

1) $\alpha = 1.6$; 2) $\alpha = 1.4$; 3) $\alpha = 1.2$; 4) $\alpha = 1.0$; 5) $\alpha = 0.8$; 6) $\alpha = 0.60$; 7) $\alpha = 0.40$; 8) $\alpha = 0.20$. The values of the maxima are: 0.0754; 0.0925; 0.1518; 0.2085; 0.3124; 0.5583; 1.6177.

The experimental illustration of the irradiance distribution in the transversal plane for the case of a very wide Gaussian wave is given on the photograph of Fig. 4. The He-Ne laser beam was falling on a diffracting screen consisting of a semitransparent background with completely transparent circular aperture of diameter $2R = 0.45$ mm. The transmission factor $Q = \frac{\kappa_2}{\kappa_1} = 0.23$. The diffraction pattern was obtained by placing the photographic plate a distance $z = 4.5$ m apart from the plane of the diffracting obstacle. As it is seen the irradiance of the diffraction patterns periodically changes with distance from the optical axis. This change of the irradiance of the maxima and minima is in agreement with theoretical result.

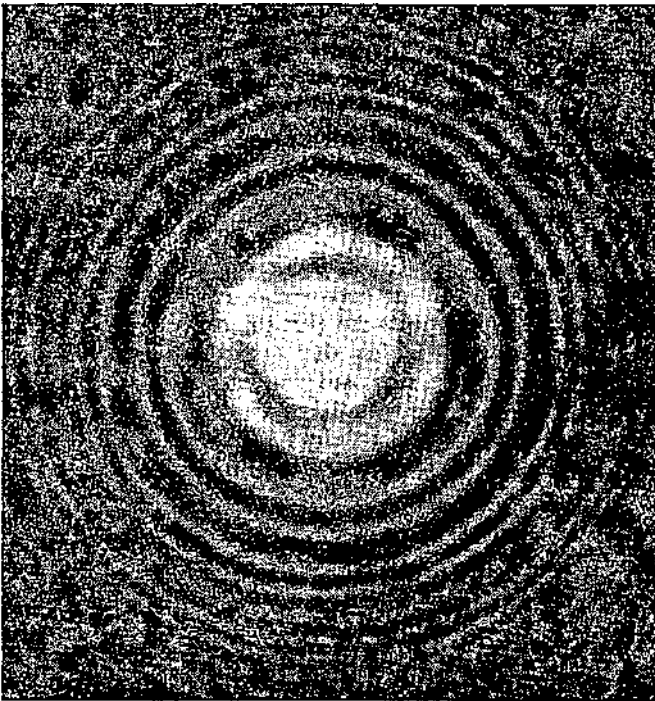


Fig. 4. The experimental illustration of the irradiance distribution in the transversal plane, for the case of a very wide Gaussian wave; $z = 5.4$ m, $R = 0.225$ mm and $Q = 0.23$.

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**JEDNO NOVO TUMAČENJE LINIKOVOG INTERFERENCIONOG
EKSPERIMENTA, BAZIRANO NA DIFRAKCIJI GAUSSOVIH UPADNIH
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U radu je data difrakciona teorija Linikove interferencione šeme. Teorija se odnosi na Gaussovske upadne talase i sfernu geometriju. Izračunata je raspodela svetlosnog polja iza Linikove difrakcione prepreke (kružni otvor na delimično propustljivoj ravni) i posebno diskutovan rezultat duž optičke osi i u ravni normalnoj na optičku osu. Rezultat raspodele svetlosne iradijacije duž optičke osi numerički je verificiran. Data je i eksperimentalna ilustracija slučaja kad se ravina postavi normalno na optičku osu. Teorijski rezultati su specijalizirani za slučajeve difrakcije Gaussovih talasa na kružnom otvoru i na kružnoj prepreki.