UNCLASSIFIED

AD 400 778

DEFENSE DOCUMENTATION CENTER

FOR

SCIENTIFIC AND TECHNICAL INFORMATION

CAMERON STATION, ALEXANDRIA, VIRGINIA

UNCLASSIFIED

400 778

41311

S/170/62/005/010/004/009
B104/B186

24324
STEP

AUTHORS: Ivanov, A. P., Berkovskiy, B. M., Katsev, I. L.

TITLE: Reflection and transmission of a plane-parallel layer in the scope of non-linear optics

PERIODICAL: Inzhenerno-fizicheskiy zhurnal, v. 5, no. 10, 1962, 58 - 64

TEXT: The subject of investigation is a plate of thickness l and of small luminance characterized by the absorption coefficient k_o and the [illegible] reflection coefficient on the face r. A luminous flux S_o is incident perpendicularly. Owing to multiple reflection there exist internally two kinds of flux at any point x: S_1 moving parallel to the incident flux, and S_2 moving in the opposite direction. These are described by the differential equations $dS_1 = -kS_1dx$, $dS_2 = kS_2dx$ (1) with the boundary conditions $S_{1(x=0)} = S_0(1 - r) + rS_{2(x=0)}$, $S_{2(x=l)} = rS_{1(x=l)}$ (2). The absorption coefficient can be expressed by $k = k_o/1 + \alpha(S_1 + S_2)$, where

Card 1/4

---

the parameters of non-linearity α and k_o are assumed to be constant with respect to depth. The system (1) is solved by

$$\ln C_2\alpha S_1 + \alpha S_1 - \frac{C_1}{\alpha S_1} = -k_0x,\quad \ln\frac{\alpha S_2}{C_1C_2} + \alpha S_2 - \frac{C_1}{\alpha S_2} = k_0x. \qquad (4)$$

and the relation $S_1S_2 = C_1/\alpha^2$ can be derived additionally from (1), stating that the product of two oppositely directed fluxes is constant at any depth. Hence the reflection coefficient R is obtained by

$$R = \frac{(1-r)C_1}{\alpha S_0 A} + r. \qquad (8)$$

and the transmission factor T by

$$T = \frac{1-r}{\alpha S_0}\sqrt{\frac{C_1}{r}} \qquad (9).$$

On the basis of these formulas the light field was studied inside and outside the medium. For the region where k_o is positive R and T are calculated by

$$R = r + \frac{(1-r)^2 r\exp(-2k_0l)}{1-r^2\exp(-2k_0l)},\quad T = \frac{(1-r)^2\exp(-k_0l)}{1-r^2\exp(-2k_0l)} \qquad (10)$$

Card 2/4

for the condition $\alpha S_0 \ll 1$, and by

$$R = \frac{2r}{1+r} - \frac{2r}{\alpha S_0 (1+r)^2} k_0 l,$$
$$T = \frac{1-r}{1+r} - \frac{1}{\alpha S_0} k_0 l \tag{11}$$

for the condition $\alpha S_0 \gg 1$. For the region of negative values of k_0,

$$R = \frac{2\alpha S_0 k_0 l r - 2r(1-r)(\alpha S_0)^2 - r(k_0 l)^2}{\alpha S_0 [2k_0 l r - \alpha S_0 (1-r^2)]},$$
$$T = \frac{(1-r^2) k_0 l \alpha S_0 - (1-r)^2 (\alpha S_0)^2 - r(k_0 l)^2}{\alpha S_0 [2k_0 l r - \alpha S_0 (1-r^2)]} \tag{14}$$

holds for high luminances. At high values of r the energy density distribution in the plate is virtually constant. At small values, this distribution has a minimum in the interior of the plate which vanishes if $r \to 1$. There are 4 figures.

ASSOCIATION: Institut fiziki AN BSSR, g. Minsk (Institute of Physics AS BSSR, Minsk)

SUBMITTED: January 13, 1962