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Keller J B. Geometrical theory of diffraction.
J. Opt. Soc. Amer. **52**:116-30, 1962.
[Inst. Mathematical Sciences, New York Univ., New York, NY]

The geometrical theory of diffraction is an extension of geometrical optics which accounts for diffraction. It was introduced in 1953.[1] The theory and some of its applications are presented in this review. Some comparisons are made between its results and other theoretical and experimental results. [The *SCI*® indicates that this paper has been cited over 215 times since 1962.]

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"During World War II I worked in a submarine detection group on the 64th floor of the Empire State Building in New York City. Although we never found any submarine there, we did find out a good deal about the theory of sonar, especially about the scattering of sound waves from submarine hulls. My supervisor, Henry Primakoff, had derived a simple formula for the short wavelength sound field reflected from a curved surface. He used an integral equation and a method of asymptotic evaluation of double integrals to do so. I found that his result could be obtained by the methods of geometrical optics plus the law of energy conservation. Several years later I realized that this was a special case of a result of Rudolph K. Luneberg.[2] He had shown how the leading terms in various problems of short wave reflection, transmission, and refraction could be constructed by the methods of geometrical optics.

"A year or so later, in 1950, my student Albert Blank and I solved the problem of diffraction of pulses by wedges and corners using a method which made the properties of the solution quite evident.[3] The result showed clearly the presence of a diffracted wave which was not accounted for by Luneberg's theory. I realized that his theory, and geometrical optics as well, could be extended to account for this diffracted wave. This extension was based upon the introduction of a new class of rays, which I called 'edge diffracted rays.' It also involved a 'law of edge diffraction,' 'edge diffraction coefficients,' and the 'method of canonical problems' to determine these coefficients. This latter method was an abbreviated version of the method of matched asymptotic expansions. Edge diffracted rays immediately suggested 'vertex diffracted rays,' 'surface diffracted rays,' 'complex rays,' 'vertex diffraction coefficients,' 'surface diffraction coefficients,' 'decay exponents,' etc.

"The resulting theory, which I presented at the Symposium on Microwave Optics at McGill University in Montreal in 1953, was not immediately accepted. This was because the theory was synthetic rather than deductive. It showed how to construct the short wave asymptotic solution of any diffraction problem instead of deducing the result from a boundary value problem. However after my students and I had applied it successfully to various problems, it was gradually accepted.

"The theory has turned out to yield good results in all kinds of wave propagation problems. That is why this article has been so frequently cited. Recent work on this theory is reviewed in my Gibbs Lecture to the American Mathematical Society."[4]

1. **Keller J B.** The geometric optics theory of diffraction. (Karasik B S & Zucker F J, eds.) *The McGill Symposium on Microwave Optics.* Bedford, MA: AFCRC, 1959. Vol. 2. p. 207-10.
2. **Luneberg R K.** *Mathematical theory of optics.* Berkeley, CA: University of California Press, 1964. 448 p.
3. **Keller J B & Blank A.** Diffraction and reflection of pulses by wedges and corners. *Commun. Pure Appl. Math.* **4**:75-94, 1951.
4. **Keller J B.** Rays, waves and asymptotics. *Bull. Amer. Math. Soc.* **84**:727-50, 1978.