CC/NUMBER 47
NOVEMBER 24, 1980

This Week's Citation Classic

Mandel L & Wolf E. Coherence properties of optical fields. *Rev. Mod. Phys*. **37**:23187, 1965.
[Dept. Phys. and Astron., Univ. Rochester, Rochester, New York]

This article presents a description of coherence properties of optical fields and their measurements. A brief historical outline, and an introduction to the elementary coherence concepts, leads to a general statistical description of electromagnetic fields, and to a detailed treatment of coherence properties of several important kinds of light. [The *SCI*® indicates that this paper has been cited over 435 times since 1965.]

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October 13, 1980

"In 1963 when this review article was being written, three years had passed since the invention of the laser and the idea of coherent light was beginning to arouse the interest of physicists and workers in all areas of optics. Although the concept of partial coherence had already been introduced and considered by von Laue, Wiener, van Cittert, and Zernike in the early part of this century, it nevertheless received relatively little attention from optical physicists until the 1950s when E. Wolf[1,2] introduced a precise measure of the degree of coherence of an optical field. This was followed in the early 1960s by R. J. Glauber's[3,4] quantum mechanical formulation of optical coherence theory, and by the gradual recognition that the laser produced an entirely new kind of light. For the first time one had an optical field characterized by nonGaussian statistics, and one that was truly 'classical' in the sense that the average photon occupation number per mode was a large number. Moreover, laser beams were found to be spatially coherent, so that it became important to distinguish clearly between spatial and temporal coherence effects. Also during this period the photoelectric correlation technique, which had been developed by R. Hanbury Brown and R. Q. Twiss[5] in the 1950s and pointed to several practical applications, was attracting a good deal of interest. Unfortunately, it also proved to be a source of much misunderstanding, until the problem of how coherence is reflected in the statistics of the detected photons was cleared up.[6,7]

"All these developments resulted in an invitation by E. U. Condon, the editor of *Reviews of Modern Physics,* to prepare a review article on optical coherence; it was to start with elementary notions and then go on to the more mathematical and technical parts of the subject. The article we finally completed brought together the classical and quantum mechanical developments of the subject for the first time, and paid equal attention to theory and to experimental work on the photoelectric measurement of light. It also contained a rather detailed bibliography. No doubt the timeliness of the subject contributed to the great popularity of the article. After it was published, we responded to more than 1,000 reprint requests, and from time to time we receive further requests even now.

"The importance of coherence in the treatment of optical fields and their interactions Is now widely recognized, as witnessed by the evergrowing literature on the subject, and by the interest shown in the periodic Rochester Conferences on Coherence and Quantum Optics. We are pleased to think that our article played a role in this development."

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2. .... A macroscopic theory of interference and diffraction of light from finite sources. II. Fields with a spectral range of arbitrary width. *Proc. Roy. Soc. London A* **230**:246-65, 1955.
3. **Glauber R J.** The quantum theory of optical coherence. *Phys. Rev.* **130:**2529-39, 1963.
4. .... Coherent and incoherent states of the radiation field. *Phys. Rev.* **131:**2766-88, 1963.
5. **Hanbury Brown R & Twiss R Q.** Correlations between photons in two coherent beams of light. *Nature (London)* **177**:279, 1956.
6. **Mandel L.** Fluctuations of photon beams and their correlations. *Proc. Phys. Soc.* **72**:1037-48, 1958.
7. ....Fluctuations of photon beams: the distribution of the photoelectrons. *Proc. Phys. Soc.* **74:**233-43, 1959.