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INTENSITY WAVES AS OBSERVABLE PHENOMENA IN OPTICS

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Abstract. *By the interference of two coherent traveling waves of different frequencies, another traveling wave arises, at the level of the intensity of the field. In optics, the intensity wave, unlike the underground wave, is an observable phenomenon. The characteristics of the intensity waves are established and a photographic recording of the intensity wave obtained by the interference of two different frequency optical waves in a Mach-Zehnder arrangement is presented.*

Keywords: Coherence, interference, multifrequency optical fields

1. Introduction

By the interference of two coherent traveling waves, irrespective of the physical nature of the field, another wave structure arises at the level of the field intensity. Let us consider the simplest example, that of the interference of two coherent traveling waves of the same frequency. Figure 1a illustrates a snapshot of the interference field for two circular or spherical traveling waves of the same frequencies. A (circular or spherical) traveling wave, having the same frequency as that of the interfering waves, occurs, whose intensity is represented in Figure 1b. This intensity pattern can be interpreted as a *standing intensity wave*. In the following we shall see that *traveling intensity waves* can also be obtained, namely by the interference of two waves of different frequencies. For a clear distinction, we shall henceforth denominate the field wave resulting by the superposition of the two waves (Figure 1a) as *underground wave*.

In acoustics, for example, both the underground waves and the intensity waves are observable phenomena; the wave nature of the acoustical field is undoubted. It is not the same for the light.

Firstly, even if the light had a true wave nature, the traveling light waves couldn't be observed. They would travel with the speed of light, so a snapshot as that of Figure 1a couldn't be obtained. The frequencies of their oscillation would be of the order of $10^{14} \div 10^{15}$ Hz; no detection system placed at a point of a light field could detect such a frequency. For a light field, the underground waves are not observable phenomena. Their existence was merely inferred from the wave aspect of the intensity pattern, more precisely supposed on this basis.

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