

## *THE PHOTON*

**The Photon**, TRILOCHAN PRADHAN , Nova Science Publishers, Inc., Huntington, New York, 2001.

This monograph on the photon brings out some aspects of the electromagnetic field and its quanta which are often not sufficiently emphasised and even omitted altogether in various texts and books on the subject.

Particularly notable in this respect is the author's lucid presentation of the 'Schroedinger equation for the photon' before moving on to the (second) quantization of the electromagnetic field. To the best of the knowledge of this reviewer the only places where a similar discussion is to be found are "Quantum Electrodynamics" by Akhiezer and Berestetskii and in "Modern Quantum Theory" by Bahram Korsunoglu.

The discussion on the confinement of light rays in orbits in a dispersive medium with a suitable radially varying refractive index about a fixed centre presented in Chapter II of the book is indeed something which this reviewer has not seen worked out earlier. It would be interesting to go further and use the eikonal approximation in order to expose the relationship with the Hamilton-Jacobi formalism which would even further consolidate the author's contention as to what should be called 'The Classical Theory of Light Corpuscles'. Here historical notes from Newton's *Optiks* with which I am sure the author must be very familiar with, would add to the subject. Here Newton's concern about how light corpuscles are partly reflected and partly refracted when light travels from one medium to another would add to the need for what has been described in the book as 'the Wavization of the Corpuscular Theory'. Such connections and different ways of looking at things (off the beaten track) are important for nurturing creativity in physics.

The succinct description of the quantization of the electromagnetic field via the Gupta-Bleuler method has the virtue of being brief and to the point.

However, further on the subtleties of the 'phase operator' [presented in section 2-5.5] and the measurability of fields which was the subject of the famous paper by Bohr and Rosenfeld (often referred to but seldom read)[section 2- 5.7] perhaps could be improved upon with further elaboration. The difficulties associated with the definition of the phase operator and the need to work instead with the sine and cosine of the same could have added to the discussion

It is commendable that the author has included a section on the coherence properties of light, a subject which should not be considered exclusively

as the private preserve of the quantum optician, but should be exposed to all students of physics. Indeed the discussion on the Hanbury-Brown Twiss intensity interference deserves, as the author rightly decided, available in books meant for audiences wider than Astronomists and Opticians.

While most texts only discuss the Lorentz and gauge invariance of Maxwell's equations, the author has wisely presented scale, conformal and duality transforms as well, which does help broaden the outlook of the reader

The analogy between the duality transformation of the Maxwell's equations and the chiral transform of the mass-less Dirac equation provides an interestingly different insight.

The last chapter on the photon as a composite particle may be controversial but does emphasize that one should continue to speculate on the inexhaustible photon and indeed in the reviewer's opinion possibilities should always be left open to provide stimulation to some who wish to think differently (a trend that mostly leads to frustration but is also essential for progress). It is good to see a reference to Fermi's ideas on such composite structures, who faced with the plethora of 'elementary particles' of the fifties and the sixties had remarked: 'If I knew this is what would happen to particle physics, I would have become a Zoologist or a Botanist'. The author's graduate studies as a young man at Chicago (I have seen his meticulous notes of Fermi's lectures) carries forward in my opinion the 'oral tradition of physics' which Victor Weisskopf has called the 'Soul of Physics'.

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