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The Nature of Light: What Are Photons?

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Editors

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Introduction

It is our great pleasure to bring to you the proceedings of the second biannual conference on the fundamental questions relating to the nature of light or photon. From the number of participants and overall quality of the papers, and from the wide variety of sub-fields of optics and expertise, it is clear that we have initiated a successful conference series by raising the right questions to our community.

The concept of a photon as raised by Einstein in 1905 and its mathematical formulation introduced by Dirac in late 1920s have not changed in any fundamental way over the intervening century except for being polished further, often in violation of causality and non-locality. This has been done to the point that often scientists and philosophers are willing to re-define nature's reality to conform to Einstein's and Dirac's formulations.

Yet we can notice that there is a clear sense of restlessness among a minority but an appreciable number of scientists. They have created their own platforms through books and conferences to re-visit the very foundations of 20th century physics. The books by Smolin (*The Trouble with Physics*), Robert B. Laughlin (*A Different Universe: Reinventing Physics from the Bottom Down*) and Penrose (*The Road to Reality*) are good examples. Two noteworthy conference series worth mentioning are organized by (i) the Natural Philosophy Alliance, and (ii) Växjö University, Sweden.

Collectively, we are increasingly becoming proud to intellectually live in the N-dimensional abstract space while, interestingly, our physical bodies and the engineering advancements are thriving in the culturally demeaning but causally congruent three-dimensional reality! Highly ordered, systematically logical and incessantly evolving nature does appear to us as a creative system engineer. We tend to succeed more often when we organize our thinking as humble reverse-engineers, while keeping an ambitious goal to understand all the detail *processes* behind all the interactions that make nature operate. In essence, the questions we as a scientific and engineering community should be asking are these: (i) Is physics heading in the right direction? And, (ii) do we really need to abandon the three-dimensional reality?

Rather than address these very broad difficult questions, our conference series is raising the more focused question, "What are photons?", by staying grounded within the causal three-dimensional reality as indicated by our technological successes through engineering thinking.

Our journey to this conference started with the 2003 October special issue, "The Nature of Light: What is a photon?" published in OSA's *Optics and Photonics*

News. The journey continued in 2005 with the SPIE conference and proceedings of the same title (Proc. of SPIE Vol. 5866). We continue to look at these questions with this second biannual conference, "The Nature of Light: What Are Photons?"

Our choice of the topic is both highly focused for the near-term and very broad for the long-term. Let us underscore the breadth first. Optics is the most important enabler of both the sciences and the technologies since ancient times. Even today the most pervasive and at many times the ultimate in precision measurement tools are provided by optics, whether it is spectroscopy, Bose-Einstein Condensation, atom optics, measuring Graviton, or the decay of protons, etc. Thus understanding the real nature of light is very critical, in not only designing precision optical instruments today, but also extending our understanding of the rules of operation (laws) of nature, and hence inventing more tools that will guide us to the next higher scientific level of understanding.

For the near-term, this conference is focusing on the engineering questions: Does the photonic energy packet propagate out as an indivisible packet like an elementary particle? Or, does it propagate out diffractively by spreading and making itself vulnerable to divisibility through diverse optical components?

For the third biannual conference in 2009, we look forward to enthusiastic participation by our current authors and their friends. We also welcome all those who read this volume and feel resonant with the idea of revisiting the century old fundamental questions regarding the real nature of the radiation packets emitted by atoms. Help us create and make the 2009 conference more effective and ambitious. Contact us with your ideas and comments ahead of time.

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