AN INTRODUCTION TO PLASMONICS, NANO OPTICS AND SPIN OPTICS

Subhasish Dutta Gupta[1,2,3]

[1]*Tata Centre for Interdisciplinary Sciences, TIFRH, Hyderabad 500107, India*
[2]*School of Physics, University of Hyderabad, Hyderabad 500046, India*
[3]*Indian Institute of Science Education and Research (IISER) Kolkata. Mohanpur 741246, India.*
*sdg@tifrh.res.in

***Abstract*—**The salient topics will be covered in two lectures. In the first lecture we start with a basic comparison of one dimensional quantum and optical systems to bring out the fundamental notions of Wigner delay [1] and fast and slow light [2], [3]. We show how near-perfect transmission and near-perfect absorption can be achieved in stratified systems. An extension to the spatial domain is shown to lead to the beam shifts. We discuss both Goos-Hänchen and Imbert Feodorov shifts arising from different polarizations of the incident light. Next, starting from an elementary discussion of the material properties we introduce the metamaterials, where material properties can be engineered. We demonstrate the nonintuitive properties of negative index materials and hyperbolic materials. Finally, we discuss the guided and surface excitations which lead to enhanced effects due to large local field enhancements and strong localization. We highlight the role of bound states in continuum and PT-symmetric systems in this context.

In the second lecture, we focus our attention on light carrying angular momentum. An analysis of the optical current leads to an in-depth understanding of the orbital and spin momentum of light and how such light interacts with a material medium. For structured light we show the emergence of the transverse spin and the Belinfante momentum [4]. We show the effects of shift and tilt of the beam under diffraction from a circular aperture [5]. We also trace out the evolution of the beam through a stratified medium supporting a bound state in continuum to show giant Goos-Hänchen shift [6]. We end this lecture with few comments on the emerging areas.

Index Terms—Fast and slow light, Wigner delay, Bound states in continuum, negative index media, spin-orbit interaction, transverse spin

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