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Advances in Slow and Fast Light

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Editors

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Introduction

It has been nearly a decade since the first demonstration of ultraslow group velocity of light using cold atoms. Since then, the field of slow-light has expanded dramatically, with demonstrations of slow light in a wide range of systems. In parallel, there have been important developments in the studies of superluminal group velocities of light (fast-light), starting with the initial demonstration in atomic vapor. The goal of this conference was to present the latest developments around the world in the studies and applications of slow and fast light. The presentations were categorized in several groups: (i) Slow/Fast Light in Waveguides, SOA, and Metamaterials, (ii) Slow/Fast Light in Fibers (iii) Slow Light in Atomic Vapor, (iv) Slow Light for Quantum Information Processing, (v) Novel Ideas and Applications for Slow/Fast Light, (vi) Slow Light in Photonic Crystals and Plasmonics, and (vii) Interferometry and Optical Delays with Slow/Fast Light.

This volume contains some representative papers from these groups. We start with a paper on slow light in metamaterial heterostructures. This brings together two emerging fields, negative index materials and slow light, with an exciting outlook. This is followed by four papers dealing with slow and fast light in fibers and photonic crystals. The paper on nano-fibers shows experimental progress in the study of producing slow light using a single atom. The paper on tunable delay lines highlights significant progress in the use of slow light for controlling time delays in fiber optic communications with great precision. We then have two papers on the study of slow light in atomic vapor. Here, we see the high degree of control that is now achievable in tailoring the shape of slowed data pulses for a wide range of applications. We also see exciting developments in the realization of slow light on a chip scale, and applications thereof.

A particularly promising area of application for slow light is quantum information processing. The paper on slow light with nanowire surface plasmons shows how such a system can lead to ultra-low light level non-linear optics and quantum optics. This is followed by four papers that explore novel ideas and applications pertaining to slow and fast light. Here, we see significant developments in the study of slow and fast light simultaneously. One application of such a system is in realizing a white light cavity with fast light, using a single Raman gain. Such a white light cavity can be used to enhance the sensitivity-bandwidth product of a gravitational wave detector, and for enhancing the sensitivity of an active ring laser gyroscope. Another application explored here is a slow-light enhanced rotation sensor, based on an active coupled resonator optical waveguide structure. Finally, we have two papers on studies of slow light in photonic crystals and plasmonics. The first paper describes important developments in optimizing a photonic crystal coupler for slow light, while the second paper presents an exciting study of slow and backward light in a plasmonic system.

This conference, while representing a wide range of studies in slow and fast light, is certainly not exhaustive. Nonetheless, it presents a broad overview of the state of this field. We hope that the readers will find this volume useful and informative.

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