PROCEEDINGS OF SPIE

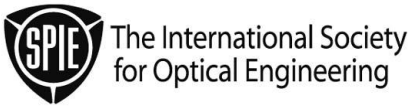
Advanced Optical and Quantum Memories and Computing IV

Zameer U. Hasan
Alan E. Craig
Selim M. Shahriar
Hans J. Coufal
Editors

24–25 January 2007
San Jose, California, USA

Sponsored and Published by
SPIE—The International Society for Optical Engineering

Volume 6482



Proceedings of SPIE—The International Society for Optical Engineering, 9780819465955, v. 6482

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Please use the following format to cite material from this book:
Author(s), "Title of Paper," in *Advanced Optical and Quantum Memories and Computing IV*, edited by Zameer U. Hasan, Alan E. Craig, Selim M. Shahriar, Hans J. Coufal, Proceedings of SPIE Vol. 6482 (SPIE, Bellingham, WA, 2007) Article CID Number.

ISSN 0277-786X
ISBN 9780819465955

Published by
SPIE—The International Society for Optical Engineering
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone 1 360/676-3290 (Pacific Time) · Fax 1 360/647-1445
http://www.spie.org

Printed in the United States of America.

Contents

Pagination: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon they are published online, and connects the same identifier to all online, print, and electronic versions of the publication.

SPIE uses a six-digit CID article numbering system in which:
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MEMORIES AND METHODS FOR ADVANCED COMPUTING

APPLICATIONS OF SLOW AND FAST LIGHT I

APPLICATIONS OF SLOW AND FAST LIGHT II

APPLICATIONS OF SLOW AND FAST LIGHT III

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4 Photonics in Silicon and Organic Materials
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5 Applications of Slow and Fast Light I
Alan E. Craig, Montana State University, Bozeman (USA)

Introduction

This conference addresses the future applications of the interactions of light with matter. Appropriately, this agenda aims to accommodate a moving target. Historically, it served as a venue for exploring the prospects of optically addressed memory: holographic, volumetric two-photon, and spectroscopic. The first of these is now commercial, the second reformatted into multiplayer compact disk. The third still exhibits the penultimate density and transfer rates for memory; the conference continues to present contributions to spectroscopic memory. This ancestry spawned and nurtured many of the leaders in the investigation and application of slow and (ironically, later) fast light, which have become the current mainstays of the conference program. Materials and techniques presented here that will bring quantum computing to reality also derive from this lineage. The program also presented various system-level themes, ranging from demonstration of a cross-gain modulation half-adder in semiconductor optical amplifiers to a non-blocking photonic switch using pseudo-random number encoding.

This year's proceedings report major insights in two areas. First, quantum encryption is a real and commercial technology. Quite likely, quantum routers (or repeaters, or delay registers) will be next, pressed into viability by the accelerating advancement of qubit materials. Specifically, the papers by Philip Hemmer and collaborators describe entanglement initiation, control, and transfer feasibility using long-lived optically addressed spin echoes in room temperature diamond. In other work, Selim Shahriar's group reports ultra-broadband resonators; intra-cavity incorporation of fast-light dispersive material shifts the cavity line continuously with the optical frequency.

Recent discoveries in light-matter interactions address quantum themes: more pronounced effects at lower optical powers and accommodating higher bandwidths in smaller volumes at higher temperatures and lower cost; pick any three. Recent excitement in this arena is evidenced by materials systems, interaction schemes, and applications that commandeer uncommon dispersion effects to slow or accelerate the group velocity of light. Consequently, a large number of proceedings papers discuss these developments. Dispersive atomic and geometric resonances of many types appear in vapors, in fibers, in semiconductors – even incorporated on chips. The properties of dispersive resonances with gain are presented. Quantum switching architectures and two-photon quantum transport are proffered as operations dependent on the success of these schemes. Perhaps surprisingly, new physical effects continue to be predicted, such as backscattering in EIT processes. Analogs to optical interferometry in atom-based gyroscopes make an appearance. Conversely, the issue of enhanced bandwidth single-channel slow light continues to bedevil the field, and perhaps will be resolved by next year's meeting.

Returning to the issue of its beginnings, this conference was founded and promoted through the years by the intuition and energy of one of our staunchest colleagues. During the retrenchment in optics that followed the overzealous Internet expansion, he defended its pertinence to future technologies and retained its viability. Hans Coufal, who led the optical computing and memory investigations for IBM at the Almaden Research Center for nearly twenty years, died this past autumn. This year's proceedings is dedicated to commemorating his insights and leadership, and to anticipating the technologies that will continue to derive from them.

Zameer U. Hasan
Alan E. Craig
Selim M. Shahriar