

Optical Interconnects

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Dr. Paul Seidler

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Dr. Seidler is the coordinator for the Nanoscale Exploratory Technology Laboratory being built at IBM Research - Zurich in collaboration with the ETH Zurich. Dr. Seidler received a B.S. in Chemistry from the California Institute of Technology in 1980 and a Ph.D. in Chemistry from the University of California at Berkeley in 1985. He joined IBM Research in 1988.

Lab Tour: The IBM - ETH Nanotech Center

The Nanoscale Exploratory Technology Laboratory is a unique facility for exploratory research being created in a public-private partnership between IBM and the ETH Zürich. The talk will describe the leading-edge capabilities of the center, the cooperation model, the planned research activities, and the opportunities for additional partners to join.



Dr. habil. Walter Riess

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Dr. Walter Riess joined the IBM Zurich Research Laboratory in 1995. From 1998 to 2003 he was Manager of the Display Technology Group working on Organic Light Emitting Devices for Display applications. From 2004 to 2008 he was managing the Nanoscale Structures and Device group where he was working on ultimate and post CMOS devices.

Since November of 2008, Dr. Riess has been the Department Head of the Science & Technology Department at the IBM Zurich Research Laboratory. Research activities in the department span: chip cooling, advanced thermal packaging, optical interconnects, silicon photonics, nanofabrication, 3D integration, self-assembly and patterning, experimental biology, magnetism, spintronics, AFM & STM imaging, III-V and Ge on silicon, semiconducting nanowires and molecular electronics.

Dr. Walter Riess studied Physics at the University of Bayreuth, Germany, where he received a Masters, a Ph.D and a habilitation.

Welcome



Dr. Christoph Harder

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Dr. Christoph Harder received the Electrical Engineering Diploma from the ETH in 1979 and the Master and PhD in Electrical Engineering in 1980 and 1983 from Caltech, Pasadena, USA. He is co-founder of the IBM Zurich Laser Diode Enterprise which pioneered the first 980nm high power pump laser for telecom optical amplifiers.

He has been managing during the last few years the high power laser diode R&D effort in Zurich expanding, working closely with a multitude of customers, the product range into 14xx pumps as well as 808 and 9xx multimode pumps for industrial applications. He has published more than 100 papers and 20 patents and has held a variety of staff and management positions at ETH, Caltech, IBM, Uniphase, JDS Uniphase, Nortel and Bookham.

Introduction



Dr. Karlheinz Gulden

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After receiving his PhD degree in Physics, Dr. Gulden joined the Paul-Scherrer Institute in Zurich in 1994 as Staff Scientist. In 1997 he became head of Opto-Electronic Devices at CSEM. During 2000 he founded Avalon Photonics as a spin off from CSEM. He led Avalon in various executive roles until it was acquired by Bookham in 2006. Today Dr. Gulden is responsible for VCSEL and High Power Laser Product Marketing at Oclaro.

VCSELS

VCSELS are the light source of choice for multimode fiber-optical links up to several hundred meters. With increasing data rates, VCSEL based interconnects will further expand into domains that today are served by conventional electrical links. This development provides new and exciting opportunities as well as challenges for VCSEL manufacturers. High volume VCSEL manufacturer Oclaro is well positioned to benefit from this trend.



Tobias Lamprecht

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Tobias Lamprecht received his engineer degree from the University of Applied Sciences NTB Buchs, in 2000. Since 2006, he is pursuing his Ph.D. thesis in cooperation with the University of Twente, NL. After 6 years at IBM Research Zurich, he joined vario-optics in 2010, working on electro-optical printed circuit boards and their commercialization, respectively.

Electro-optical circuit boards

Polymer waveguides integrated in electrical printed circuit boards (PCB) are a solution to overcome limitations in electrical signal transmission. Presented are fabrication and assembly methods for volume production. The potential is demonstrated by successfully realized devices from the information and communication technology and the sensor technology.



Dr. Jörg Wieland

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Dr. Jörg Wieland has spent more than 20 years in the field of opto-electronics, both as entrepreneur and scientist. He was founder, chairman and CEO of Helix AG, which was acquired by GigOptix LLC in January 2008. Under his leadership, Helix became the principal vendor of silicon driver and receiver IC's for VCSEL-based interconnects. He was also founding chairman of Albis Optoelectronics AG, a leading photo-detector manufacturer. Prior to starting Helix, he was a research scientist at ETH Zürich (Swiss Federal Institute of Technology), contributing to several pioneer industrial projects in the field of optical links. He published multiple technical papers, and served as lecturer in various continued education programs. Jörg holds Diploma in Electronic Engineering and Doctor of Technical Science degrees from ETH.

Trends in Optical Interconnects: Size, Power, Cost

Speed and performance have driven the optical communication industry over the last years. Given the maturity of optical devices, especially at 10Gbps, optical links are adopted for shorter distances and in larger quantities per system. Market focus has turned to size, power and cost. We present an SFP+ architecture consuming 4x less power and having 2x less components compared to classic solutions.



Dr. Roger Krähenbühl

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Roger Krähenbühl was born in Aarau, Switzerland, in 1964. He received the diploma degree in physics from the ETHZ, in 1990 and the Ph.D. degree for work on design, fabrication, and optical characterization of InGaAsP-InP integrated optical components for telecommunications from the Institute for Quantum Electronics at ETHZ in 1998.

From 1998 to 2001, he was with the Optical Techniques Branch at the Naval Research Laboratory in Washington, DC, exploring high-speed LiNbO3 modulators, resonators, and digital optical switches. He is currently with HUBER+SUHNER AG, Herisau, Switzerland, working on the development of new fiber-to-fiber and fiber-to-chip connectivity solutions.

Connectivity Solutions for Fiber Optics

The current migration of optical fibers into the home of the end users has increased general interests in the new, promising, optical communication technologies. As a leading global supplier of components and systems for electrical and optical connectivity, HUBER+SUHNER will give here a short overview of past, present, and future solutions for optical interconnects.



Dr. Markus Rossi

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Markus Rossi is CTO and based in Zurich, Switzerland. Before joining Heptagon, he was Head of CSEM Zurich Replicated Micro-Optical Elements. He is a solid expert on fabricating diffractive and refractive micro-optic components for industrial applications in the European and US markets. Markus Rossi holds a Ph.D. from the University of Neuchatel.

Lenses for optical interconnects

Planar optics has been applied in various products for short to medium range optical interconnects. The optical elements in a typical laser to fiber coupling system include high quality aspheric microlenses as well as complex diffractive optical elements. Wafer-scale fabrication technologies are offering high quality and capacity and - in the case of replicated optics - low fabrication costs.



Dr. Bert Jan Offrein

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Bert Jan Offrein received his applied physics (1990) and Ph.D. degree (1994) from the University of Twente, The Netherlands. His dissertation examined the measurement of optical nonlinearities and the design and realization of an all-optical switching device. In 1995 he joined the optical networking group of the IBM Zurich Research Laboratory and worked on the design and characterization of optical components for DWDM networks in SiON technology. In 1998, he changed to the JDS Uniphase 980 nm pump laser facility in Zurich as a technical marketing engineer and yield engineer. One year later, he returned to the Zurich Research Laboratory where he focused on the design and characterization of state of the art adaptive integrated optical components in SiON technology. In 2002, his research topic changed to polymer waveguide based optical backplane technology for next generation server systems. Since June 2004, Bert Jan Offrein is the manager of the photonics group at the IBM Zurich Research Laboratory.

Optical interconnects for computing applications

The performance scaling of supercomputers and servers demands new solutions for ultra-high bandwidth and power efficient interconnects. Optical link technology offers fundamental advantages compared to existing electrical interconnects but suffers from assembly and cost issues. Various approaches will be discussed to overcome these challenges, results will be presented.



Prof. Dr. Ursula Keller

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Ursula Keller became a tenured professor at ETH in 1993. She received the Ph.D. from Stanford University in 1989 and the Physics "Diplom" from ETH in 1984. She was a Member of Technical Staff at AT&T Bell Laboratories from 1989 to 1993. Her research interests are exploring and pushing the frontiers in ultrafast science and technology. She has published more than 280 peer-reviewed journal papers and she holds 17 patents

Noval ultrafast gigahertz high-power semiconductor lasers: MIXSELS and SESAM modelocked VECSELS

Semiconductor lasers are ideal for optical interconnects, and optically-pumped vertical external cavity surface emitting lasers (VECSELS) are most promising for higher-power pulse generation using a semiconductor saturable absorber mirror (SESAM). The integration into a single wafer was demonstrated with the MIXSEL (modelocked integrated external-cavity surface-emitting laser) achieving up to 6.4 W with stable picosecond pulse generation.



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Heinz Jäckel is professor at the Electronics Laboratory of the ETH Zurich since 1993 heading the *High Speed Electronics and Photonics*-group. Before he was with the IBM Research Division in Rüschlikon and Yorktown Heights, USA.

The research of his group covers in Electronics: III/V-technology, InP-HBTs for +100 Gb/s ICs and CMOS designs for multi-10 GHz RF / digital 40 Gb/s ICs.

In Photonics for dense OICs and Tb/s Lightwave Communication: integrated InP mode-locked diode lasers, all-optical switches for Tb/s signal processing and InP photonic crystals.

Evolving Gigabit to Terabit/s Interconnects - a device point of view

Evolving and merging both electronic and photonic devices into relatively complex integrated circuits und systems capable of processing Tb/s data streams with devices of the dimensions approaching the wavelength of the light faces difficult conceptual, physical, technological and finally also economic challenges. The presentation addresses some of these challenges, the status and own research results of the field and closes with an outlook on emerging novel concept.