Short Courses

Short courses are a wonderful way to enhance your knowledge of the optical field. ASSP selects experts in their fields to provide you with an in-depth look at intriguing topics. The courses are designed to increase your knowledge of a specific subject while offering you the experience of knowledgeable teachers. An added benefit is the availability of continuing education units (CEUs). CEUs are awarded to each participant who successfully completes the short course. The CEU is a nationally recognized unit of measure for continuing education and training programs that meet established criteria. To earn CEUs, a participant must complete the CEU credit form and course evaluation and return it to the instructor at the end of the course. CEUs will be calculated and certificates will be mailed to participants.

- Tuition for short courses is a separate fee, and advance registration is recommended: the number of seats is limited.
- Short course materials are not available for purchase.

Schedule

Sunday 29 January 2012

SC380: Laser Noise

12:30-15:30

Rüdiger Paschotta, *RP Photonics Consulting GmbH, Germany*

Rüdiger Paschotta started his career in scientific research. In 2002, he achieved the habilitation in applied physics at ETH Zürich and received the Fresnel Prize of the European Physical Society (EPS). In 2004, he started RP Photonics Consulting GmbH. His full-time occupation is now to serve companies in the photonics industry worldwide. Typical tasks are to work out feasibility studies and designs for lasers and other photonic devices, to identify and solve technical problems, to find suitable laser sources for specific applications, and to do tailored staff training courses on specialized subjects.

Course Level:

Advanced Beginner (basic understanding of topic is necessary

Course Description:

This course gives an introduction into laser noise with an emphasis on an intuitive understanding and practical application. It begins with an overview on basic mathematics for describing noise. Thereafter, the properties of quantum noise and technical noise sources are discussed. Their effects are then studied for continuous-wave lasers, pulsed lasers and mode-locked lasers. It will also be discussed how lasers can be optimized for low-noise operation.

Benefits and Learning Objectives:

This course should enable you to:

- Understand and use basic mathematical descriptions of noise, particularly for quantifying laser noise
- Explain differences between quantum noise and technical noise sources
- Distinguish different types of noise in the output of lasers
- Understand the effects of quantum noise and technical noise sources on the output of different kinds of lasers

Intended Audience:

This course is designed for researchers and engineers for whom noise in the output of lasers is relevant.

SC381: High-energy Fiber Lasers

12:30-15:30

Almantas Galvanauskas, *CUOS, University of Michigan, Ann Arbor, USA*

Almantas Galvanauskas is a professor at the Electrical Engineering and Computer Science Department, University of Michigan. He has been working in the field of fiber lasers for approximately twenty years, and has more than 200 publications, including approximately 30 patents and patent applications. He had pioneered ultrashort-pulse fiber CPA and his work had resulted in demonstrating several record-breaking achievements in performance of fiber lasers. Prior to joining University of Michigan he spent eight years in industrial R&D. His current work spans areas from novel fiber designs to advanced fiber laser systems, including beam combining of pulsed and ultrashort pulse lasers, and new fiber laser applications such as high-intensity laser plasma produced EUV and X-ray generation. He is also a co-founder of Arbor Photonics, Inc.

Course Level:

Advanced Beginner (basic understanding of topic is necessary to follow course material)

Course Description

This course provides with a comprehensive introduction to high energy pulsed fiber laser systems with an emphasis on designing them and understanding achievable performance characteristics, such as pulse energy, duration and average power. It starts by an overview of fundamentals of rare-earth doped fiber gain medium, such as basic spectroscopic properties, rate-equation description of gain dynamics, energy saturation and limits to energy extraction, optical nonlinearity limitations on peak power, and fiber thermal properties at high powers. Then it proceeds to description of key components constituting a fiber laser system, such as large core optical fibers, including advanced designs for single-mode operation with large cores, fiber polarization properties, double-clad fibers and basic pumping considerations to match pump-diode brightness and fiber geometry, monolithic pump combiner designs and operation. After this detailed analysis of basic pulsed laser architecture will follow, starting with a basic layout, seed pulse source choice, different multiple-stage design options, comparison between co- and counter pumping configurations, pulse-shape control, and specific aspects of implementing ultrashort pulse amplification. We will then proceed to survey published state-of-the-art results achieved with different types of pulsed lasers, including long pulse, nanosecond pulse and femtosecond pulse systems, with an objective to explore achievable performance characteristics. After this we will consider advanced high-energy laser designs based on different beam-combining approaches. At the end we will briefly review applications and future outlook for this technology.

Benefits and Learning Objectives

This course should enable participants to

- Design a pulsed fiber laser system
- Specify required components to built such a system
- Identify design trade-offs and challenges
- Define achievable performance characteristics
- Acquire knowledge of state-of-the-art achievements in the field
- Understand applications and direction of further development of this technology

Intended Audience

This course is intended for graduate students, engineers and researchers who need to build or use high energy pulsed or ultrashort pulse fiber lasers, or those who are interested in pulsed laser applications, the current state of the art and future of this technology. Undergraduate training is assumed.

SC382: Ultrafast Optical Parametric Amplifiers

16:00-19:00
Giulio Cerullo, *Politecnico di Milano, Italy*

Giulio Cerullo is a full professor with the Physics Department, Politecnico di Milano. His research activity (240 publications in peer-reviewed journals) has mainly focused on the generation of tunable few-optical-cycle light pulses and on their application to ultrafast spectroscopy, tracking primary photoinduced events in biomolecules and solids. He has pioneered the Non-collinear Optical Parametric Amplifier (NOPA) concept and its extension to the near and mid-IR. He is Topical Editor for the Journal Optics Letters (Optical Society of America) for the area Ultrafast Optical Phenomena. He has been in the Technical Program Committees of the most important international conferences in optics and photonics (CLEO USA, Cleo Europe, EQEC, Ultrafast Phenomena, HILAS, Photonics Europe). Prof Cerullo has delivered numerous invited talks and tutorials at scientific conferences and schools on the topics of few-optical-cycle pulse generation and applications

Course Level:

Advanced Beginner (basic understanding of topic is necessary to follow course material)

Course Description:

This course will present a comprehensive introduction to the topic of ultrafast optical parametric amplifiers (OPAs), starting from the basic principles and progressing to the more advanced applications. OPAs allow not only to generate broadly tunable pulses starting from a fixed frequency source, but also, thanks to their broad gain bandwidths, to dramatically shorten the pulse duration, down to the few-cycle limit.

The course will start by reviewing the nonlinear three-wave interaction equations which describe optical parametric amplification, and deriving from them the main OPA properties, both in the stationary and short-pulse regimes. The design principles of standard OPAs working in the visible, near-infrared and mid-infrared ranges will be presented. We will then describe ultra-broadband OPA architectures, allowing the generation of tunable sub-10-fs light pulses, and review dispersion compensation techniques. We will finally cover more advanced applications, such as passive carrier-envelope-phase stabilization and the generation of ultrahigh peak power pulses by optical parametric chirped pulse amplification.

Benefits and Learning Objectives:

This course will enable you to:

- Understand the nonlinear wave equations describing optical parametric amplification
- Understand how the parameters of the driving laser and of the nonlinear crystal influence the OPA performance
- Design and build an OPA pumped by the fundamental (second harmonic) of Ti:sapphire and generating broadly tunable infrared (visible) pulses
- Design and build a non-collinear OPA for the generation of few-optical-cycle visible pulses
- Explain how OPAs can be used to generate carrier-envelope-phase stable pulses in a passive, all-optical way
- Understand the design principles of optical parametric chirped pulse amplifiers and the limits of energy scaling

Intended Audience:
Students, academics, researchers and engineers in various disciplines who use or build ultrafast optical parametric amplifiers and require a comprehensive introduction to the subject and an overview of future developments. Undergraduate training in engineering or science is assumed.