TOPICAL MEETING ON
PICOSECOND ELECTRONICS
AND OPTOELECTRONICS


Cosponsored by:
Air Force Office of Scientific Research
Office of Naval Research
and
Optical Society of America
TUESDAY, MARCH 12, 1985

LOWER LOBBY
6:00 PM-9:00 PM REGISTRATION/REFRESHMENTS

WEDNESDAY, MARCH 13, 1985

SIERRA ROOM
8:00 AM-9:00 AM CONTINENTAL BREAKFAST

PROSPECTOR/RUBICON ROOM
8:45 AM-9:00 AM OPENING REMARKS

ULTRAFAST OPTICS AND ELECTRONICS I
Erich P. Ippen, Massachusetts Institute of Technology, Presider

9:00 AM WA1
Ultrafast Optical Electronics: from Femtoseconds to Terahertz, D. H. Auston, K. P. Cheung, J. A. Valdmanis, P. R. Smith, AT&T Bell Laboratories. The use of optical techniques for very high-speed electronic measurements of devices and materials is reviewed with emphasis on the properties of photoconducting and electrooptic materials. (Invited Paper)

9:30 AM WA2
Prospects of High-Speed Semiconductor Devices, H. Morkoc, U. Illinois. Issues facing the high speed FETs and heterojunction bipolar transistors are discussed. New high-performance heterojunction structures are evaluated and contrasted in the light of shrinking dimensions. As the switching speeds are increased (below 20 psec), the parasitics appear to play an important role making it difficult to harness the internal speed of devices. Concepts based on tunneling are also discussed. (Invited Paper)

10:00 AM WA3
The Role of Ultrashort Optical Pulses in High-Speed Electronics, C. V. Shank, AT&T Bell Laboratories. As the speed of electronic and optoelectronic devices moves into the picosecond time domain, optical techniques have the potential of an ever increasing importance in analyzing both device performance and the physical processes necessary for understanding high-speed operation. Optical methods have the advantage of ultrashort time resolution that exceeds all other high-speed measurement techniques. The state of ultrashort optical techniques is reviewed and the areas where these methods are likely to have an important impact are discussed. (Invited Paper)

SIERRA ROOM
10:30 AM-11:00 AM COFFEE BREAK

WEDNESDAY, MARCH 13, 1985—Continued

PROSPECTOR/RUBICON ROOM

ULTRAFAST OPTICS AND ELECTRONICS II
Paul T. Greiling, Hughes Research Laboratories, Presider

11:00 AM WB1
GaAs Integrated Circuit Technology for High Speed Analog and Digital Electronics, Gerard Nuzillat, Thomson CSF, France. (Invited Paper)

11:30 AM WB2
Hybrid Signal Processor for Wideband Radar, I. Yao, E. M. Hauser, C. A. Bouman, A. M. Chiang, MIT Lincoln Laboratory. A radar signal processor based on surface-acoustic-wave, optoelectronic, and charge-coupled-device technologies for processing radar signals with 200-MHz bandwidth is described.

11:45 AM WB3
Two-Dimensional E-Field Mapping with Subpicosecond Resolution, K. E. Meyer, G. A. Mourou, U. Rochester. A contactless technique to measure electrical signals with subpicosecond resolution and spatial resolution of 10 μm, using the electrooptic effect in reflection mode, is presented. This technique is well suited for the future characterization of very high-speed integrated circuits.

12:00 M WB4
Picosecond Electrooptic Sampling and Harmonic Mixing in GaAs, B. H. Kolner, K. J. Weingarten, D. M. Bloom, Stanford U. We describe an electrooptic sampling system, suitable for noncontact characterization of high-speed GaAs integrated circuits, and its implementation as a harmonic mixer.

12:15 PM WB5
Picosecond Pulse Generation in GaAlAs Lasers at a Repetition Rate of 18 GHz, K. Y. Lau, Ortel Corporation; A. Yariv, CIT. An ultrafast GaAlAs laser having a direct modulation bandwidth of 10 GHz is used to produce 12-psec optical pulses at 18 GHz by active mode locking in an external fiber cavity.

12:30 PM-1:30 PM BREAK
WEDNESDAY, MARCH 13, 1985—Continued

PROSPECTOR/RUBICON ROOM

HIGH-SPEED PHENOMENA IN SEMICONDUCTORS
D. Hulin, Ecole Polytechnique-ENSTA, Presider

1:30 PM WC1
Picosecond Processes in Carrier Transport Theory, D. K. Ferry, Arizona State U. Transport on the picosecond, and subpicosecond, timescale in semiconductors samples carrier response on a time comparable to the dominant relaxation processes. In this regime, non-Markovian behavior dominates the relevant equations for energy and momentum balance. (Invited Paper)

2:00 PM WC2
Picosecond Time-Resolved Photoemission Study of the InP (110) Surface, J. Bokor, R. Haight, J. Stark, R. H. Storz, R. R. Freeman, P. H. Bucksbaum, AT&T Bell Laboratories. We report the first use of angle-resolved UV photoemission spectroscopy to study electron dynamics in the picosecond time domain on a photoexcited semiconductor surface.

2:15 PM WC3
Acoustic Phonon Generation in the Picosecond Dynamics of Dense Electron-Hole Plasmas in InGaAsP Films, Jay M. Wiesenfeld, AT&T Bell Laboratories. Picosecond transmission and reflection experiments are performed for InGaAsP films. Oscillatory behavior due to phonon generation is observed and used to measure acoustic properties of these materials.

2:30 PM WC4
Carrier–Carrier Interaction and Picosecond Phenomena in Polar Semiconductors, P. Lugli, U. Modena, Italy; D. K. Ferry, Arizona State U. The influence of carrier–carrier interaction (including plasma effects) is studied using an ensemble Monte Carlo method. The relaxation of monoenergetic electron distributions and the quasi-ballistic motion of carriers are discussed.

2:45 PM WC5
Subpicosecond Raman Spectroscopy of Electron-LO Phonon Dynamics in GaAs, J. A. Kash, J. C. Tsang, J. Hvam, IBM T. J. Watson Research Center. The rate at which hot electrons emit LO phonons and the dynamics of electron screening in GaAs have been directly measured with time-resolved Raman scattering.

SIERRA ROOM

3:00 PM–3:30 PM COFFEE BREAK

WEDNESDAY, MARCH 13, 1985—Continued

PROSPECTOR/RUBICON ROOM

PICOSECOND DIODE LASERS
Geoffrey L. Burdge, Laboratory for Physical Sciences, Presider

3:30 PM WD1
Semiconductor Lasers for Ultra High Speed Applications, Amnon Yariv, CIT. Semiconductor lasers have been modulated at rates exceeding 10 GHz and mode-locked to produce picosecond pulses. The talk reviews these developments as well as the fundamental laser material and structure parameters which are important for further progress. (Invited Paper)

4:00 PM WD2
Properties of GaAlAs/GaAs Quantum Well Heterostructures Grown by Metalorganic Chemical Vapor Deposition, R. D. Burnham, W. Streifer, T. L. Paoli, R. L. Thornton, D. L. Smith, Xerox Palo Alto Research Center. Major advances in growth of GaAlAs/GaAs quantum well heterostructures by metalorganic chemical vapor deposition have been achieved in recent years. This article reviews these advances and their impact on present and future devices. (Invited Paper)

4:30 PM WD3
InGaAsP 1.55-μm Mode-Locked Laser with a Single-Mode Fiber Output, G. Eisenstein, S. K. Korotky, U. Koren, R. M. Jopson, L. W. Stultz, J. J. Veselka, K. L. Hall, AT&T Bell Laboratories. We report the first 1.55-μm mode-locked laser in which pulses shorter than 5 psec and fiber coupled peak powers larger than 100 mW were obtained.

4:45 PM WD4
Fast Multiple Quantum Well Absorber for Mode Locking of Semiconductor Lasers, Y. Silberberg, P. W. Smith, Bell Communications Research, Inc.; D. A. B. Miller, B. Tell, A. C. Gossard, W. Wiegmann, AT&T Bell Laboratories. Proton bombardment is shown to shorten the recovery time of GaAs/GaAlAs multiple quantum well saturable absorbers without substantially affecting the absorption or saturation characteristics.
WE1
Suppression of Timing and Energy Fluctuations in a Mode-Locked Semiconductor Laser by cw Injection, Finn Mengel, Telecommunications Research Laboratory, Denmark; Chinlon Lin, Niels Gade, Technical U. Denmark, Denmark. We demonstrate the suppression of pulse timing and energy fluctuations in an actively mode-locked 850-nm semiconductor laser by cw-injection locking. (Poster Paper)

WE2

WE3
Ultrafast Diffusion-Driven Detector, A. G. Kostenbauder, A. E. Siegman, Stanford U. We present the theory and experiments on a novel ultrafast photodetector whose dynamics are governed by diffusion and whose response time can be subpicosecond. (Poster Paper)

WE4
Optoelectronic Modulation of Millimeter Waves in a Silicon-on-Sapphire Waveguide, Chi H. Lee, Aileen M. Yurek, M. G. Li, Eve Chauchard, R. P. Fischer, U. Maryland. High-speed modulation of millimeter waves in a silicon-on-sapphire dielectric waveguide using an optoelectronic technique is described. Modulation bandwidth in excess of 1 GHz is achieved. (Poster Paper)

WE5
Kilovolt Sequential Waveform Generation by Picosecond Optoelectronic Switching in Silicon, C. S. Chang, M. J. Rhee, Chi H. Lee, U. Maryland; A. Rosen, H. Davis, RCA Laboratories. The generation of a sequential waveform by picosecond optoelectronic switching in silicon is described. By using a pulse bias, a square pulse of two and one half cycles has been obtained with a peak-to-peak voltage of 850 V. (Poster Paper)

WE6
Observation of Modulation Speed Enhancement and Phase Noise Reduction by Detuned Loading in a Coupled-Cavity Semiconductor Laser, Kerry Vahala, Joel Paslaski, Amnon Yariv, CIT; Karn Lau, Nadav Bar Chaim, Ortel Corporation. Simultaneous direct modulation response enhancement and phase noise (linewidth) reduction are produced in a coupled-cavity semiconductor laser by a detuned loading mechanism. (Poster Paper)
WEDNESDAY, MARCH 13, 1985—Continued

WE13
Hertzian Dipole Measurements with InP and InGaAs Photoconductors, P. M. Downey, J. R. Karin, AT&T Bell Laboratories. Experiments are described using ion-bombed III-V photoconductors as radiating sources and receivers of picosecond electromagnetic pulses in two different configurations, back-to-back and face-to-face. (Poster Paper)

WE14
Modeling of Picosecond Pulse Propagation in Silicon Integrated Circuits, K. W. Goossen, Princeton U.; R. B. Hammond, Los Alamos National Laboratory. We performed time-domain analyses of pulse propagation on silicon substrates. Geometric dispersion, conductor linewidth, conductor resistance, conductor skin effect, and substrate conductance effects are included. (Poster Paper)

WE15
Femtosecond Nonlinearities of Standard Transparent Optical Glasses, J. Etchepare, I. Thomazeau, G. Grillon, A. Migus, A. Antonetti, Ecole Polytechnique-ENSTA, France. Nonlinearities with a temporal behavior on the femtosecond time scale are measured on transparent optical glasses. Their values are related to the content and nature of the modifier silica network ions. (Poster Paper)

THURSDAY, MARCH 14, 1985

SIERRA ROOM

7:30 AM–8:00 AM CONTINENTAL BREAKFAST

PROSPECTOR/RUBICON ROOM

OPTOELECTRONICS
John Whinnery, UC-Berkeley, Presider

8:00 AM ThA1
Picosecond Integrated Optics, R. C. Alferness, S. K. Korotky, G. Eisenstein, R. S. Tucker, AT&T Bell Laboratories. We review the principles, current status, and potential applications of high-speed Ti:LiNbO3 optical waveguide switch/modulators as well as the use of such devices as intracavity elements for semiconductor laser mode-locking. (Invited Paper)

8:30 AM ThA2
Study of Exciton and Carrier Dynamics and Demonstration of 1-psec Optical nor Gate Operation of a GaAs/AlGaAs Device, N. Peyghambarian, H. M. Gibbs, J. L. Jewell, U. Arizona; A. Migus, A. Antonetti, Ecole Polytechnique-ENSTA, France; D. Hulin, A. Mysyrowicz, Ecole Normale Superieure, France. Dynamics of exciton screening by either free carriers or excitons in a GaAs/AlGaAs superlattice is investigated. The speed of a GaAs/AlGaAs optical logic gate is time resolved.

8:45 AM ThA3
22-GHz Bandwidth InGaAs/InP PIN Photodiodes, J. E. Bowers, C. A. Burrus, R. S. Tucker, AT&T Bell Laboratories. We describe the fabrication and characterization of an improved back-illuminated PIN mesa photodiode composed of InGaAs absorbing layers on an InP substrate. The measured 3-dB bandwidth is 22 GHz.

9:00 AM ThA4
Ultrafast Traveling-Wave Light Modulators with Reduced Velocity Mismatch, Masayuki Izutsu, Hiroshi Haga, Tadasi Sueta, Osaka U., Japan. The velocity mismatch between light and modulating waves was reduced to build efficient ultrafast traveling-wave light modulators. Fabrication and modulation experiments are also reported.
9:15 AM  ThA5
Direct dc to rf Conversion by Impulse Excitation of a Resonant Cavity, Ming G. Li, Chi H. Lee, A. Caroglanian, E. A. Greene, U. Maryland; C. Y. She, P. Polak-Dingles, Laboratory for Physical Sciences; A. Rosen, RCA Laboratories. Conversion of dc energy to rf pulses has been demonstrated with an impulse excitation of a coaxial resonant structure using a picosecond optoelectronic switching technique. A single excitation pulse is capable of generating more than a hundred rf pulses with an energy conversion efficiency better than 50%.

9:30 AM  ThA6
Subpicosecond Response Times from Ion-Bombarded InP, P. M. Downey, AT&T Bell Laboratories. The limiting speed of response of Fe-doped InP photoconductors irradiated with high doses of He ions has been empirically investigated. Free carrier 1/e relaxation times as short as 0.5 psec have been observed.

SIERRA ROOM

9:45 AM–10:15 AM  COFFEE BREAK

PROSPECTOR/RUBICON ROOM

CRYOELECTRONICS
Tushar Gheewala, Gigabit Logic, Presider

10:15 AM  ThB1
High-Speed Analog Signal Processing with Superconductive Circuits, Richard W. Ralston, MIT Lincoln Laboratory. Analog superconductive devices are described which provide signal-processing functions including pulse compression, convolution, and spectral analysis at bandwidths of 2 GHz and beyond. (Invited Paper)

10:45 AM  ThB2
Picosecond Sampling with Josephson Junctions, Peter Wolf, IBM Zurich Research Laboratory, Switzerland. A review of high-speed sampling with Josephson junctions is given. Principles of operation, sampling systems, and performance achieved are discussed. (Invited Paper)

11:15 AM  ThB3
Transmission Line Designs with a Measured Step Response of 3 psec/cm, Charles J. Kryzak, Sadeg M. Faris, Hynples, Inc.; Kevin E. Meyer, Gerard A. Mourou, U. Rochester. By careful attention to the generation and coupling of ultrafast waveforms, we have predicted theoretically that it is possible to design and realize transmission lines with bandwidths in excess of 100 GHz. To verify this prediction we used a variation of an electrooptical technique to measure a step response of 3 psec/cm.
THURSDAY, MARCH 14, 1985—Continued

9:15 PM ThC5
Time-Domain Measurements for Silicon Integrated Circuit Testing Using Photoconductors, W. R. Eisenstadt, U. Florida; R. B. Hammond, Los Alamos National Laboratory; D. Bowman, R. W. Dutton, Stanford U. We developed ion-beam-damaged photoconductors on silicon integrated circuits for picosecond pulsing and sampling. Measurement bandwidths of 20 GHz were achieved and studies of interconnections are reported.

9:30 PM ThC6
Molecular Beam Epitaxy Materials for High-Speed Digital Heterostructure Devices, D. L. Miller, Rockwell International Corporation. Molecular beam epitaxy material has been used in nearly all the recent advanced high-speed heterostructure digital devices. The reasons for this, and the prospects for eventual circuit production, are discussed. (Invited Paper)

FRIDAY, MARCH 15, 1985

SIERRA ROOM

7:30 AM–8:00 AM CONTINENTAL BREAKFAST

PROSPECTOR/RUBICON ROOM

QUANTUM STRUCTURES
Claude Weisbuch, Thomson-CSF, Presider

8:00 AM FA1
New High-Speed Optoelectronic and Electron Superlattice and Heterojunction Devices, Federico Capasso, AT&T Bell Laboratories. Very recent advances in heterojunction and superlattice structures for high-speed optoelectronic and electron device applications are discussed. (Invited Paper)

8:30 AM FA2
Semiconductor Quantum Wells: Physics and Applications, D. S. Chemla, AT&T Bell Laboratories. We review the physical properties and the applications to high-speed optoelectronics of the room temperature excitonic resonances observed at 0.85 μm in GaAs and at 1.6 μm in GaInAs quantum wells. (Invited Paper)

9:00 AM FA3
Electric Field-Induced Decrease of Exciton Lifetimes in GaAs Quantum Wells, J. A. Kash, E. E. Mendez, IBM T. J. Watson Research Center; H. Morkoc, U. Illinois at Urbana-Champaign. Electric fields perpendicular to the quantum-well plane quench exciton photoluminescence lifetimes. Fowler-Nordheim tunneling is responsible. Exciton screening reduces the quenching at high pump intensities.

9:15 AM FA4
Reduction of Electron-Phonon Scattering Rates by Total Spatial Quantization, M. A. Reed, R. T. Bate, W. M. Duncan, W. R. Frensley, H. D. Shih, Texas Instruments, Inc. Photoluminescence of laterally patterned multiple quantum-well structures exhibits spectra best explained by a reduced electron–phonon scattering rate produced by total spatial quantization.

9:30 AM FA5
High-Speed Phenomena in Resonant Tunneling, T. C. L. G. Sollner, C. A. Correa, P. E. Tannenwald, W. D. Goodhue, MIT Lincoln Laboratory; H. Q. Le, MIT Francis Bitter National Magnet Laboratory. Resonant tunneling processes, shown to respond in times < 100 fsec, have revealed new photoconductive effects with time constants from femtoseconds to days.

SIERRA ROOM

9:45 AM–10:15 AM COFFEE BREAK
FRIDAY, MARCH 15, 1985—Continued

PROSPECTOR/RUBICON ROOM

ELECTRONICS AND OPTOELECTRONICS
Gerald Witt, Air Force Office of Scientific Research, Presider

10:15 AM FB1
Heterojunction Bipolar Transistor Technology for High-Speed Integrated Circuits, Peter M. Asbeck, Rockwell International Corporation. Heterojunction bipolar transistors combine the high transconductance of bipolar structures with the high-speed characteristic of III-V devices. Cutoff frequency, \( f_t \), up to 40 GHz and frequency divider operation up to 8.5 GHz have been achieved to date. (Invited Paper)

10:45 AM FB2
Permeable Base Transistor, R. A. Murphy, MIT Lincoln Laboratory. The development and current status of the permeable base transistor (PBT) is reviewed. Both silicon and GaAs PBTs have been fabricated and have demonstrated high frequency performance. (Invited Paper)

11:15 AM FB3
Picosecond Photoconductivity in Polycrystalline CdTe Films Prepared by UV-Enhanced OMCVD, A. M. Johnson, D. W. Kisker, W. M. Simpson, AT&T Bell Laboratories. Photodetectors with oscilloscope-limited response times of 35 psec and carrier mobilities of 11 cm²/V sec are reported in thin polycrystalline CdTe films with a 200-Å grain size.

11:30 AM FB4
High-Speed Internal Photoemission Detectors Enhanced by Grating Coupling to Surface Plasma Waves, S. R. J. Brueck, V. Diadiuk, T. Jones, W. Lenth, MIT Lincoln Laboratory. The response of Au-InP internal photoemission detectors (\( \lambda \sim 1 \mu m \)) has been enhanced (> 30 \times ) by grating coupling of incident radiation into surface plasma waves. Picosecond response times are attainable.

11:45 AM FB5
Submicron-Gap Photoconductive Switching in Silicon, G. G. Shahidi, E. P. Ippen, J. Melngailis, MIT Department of Electrical Engineering & Computer Science. With submicron gaps and nanojoule optical energies, we have been able to switch pulses of >1 V with durations as short as 27 psec FWHM.