Miller and LiKamWa Achieve Ultrashort Pulses in Solid-State Lasers

Professor Alan Miller and Dr. Patrick LiKamWa have reported three significant advances in the mode-locking of solid-state lasers. They were instrumental in the effort by Schwartz Electro-Optics to mode lock their Ti:sapphire laser, an achievement reported at the 1991 CLEO meeting. This was accomplished using a newly developed technique, Kerr-lens mode-locking.

In two forthcoming publications, the generation of 150-fs pulses tunable over the range 800-900 nm has been reported by Professor Miller and Dr. LiKamWa with the use of two new solid-state laser materials. These two crystals have been grown by CREOL Professor Bruce Chai and have the chemical composition $\text{Cr}^{3+}:\text{LiSrAlF}_6$ and $\text{Cr}^{3+}:\text{LiSr}_{0.9}\text{Ca}_{0.1}\text{AlF}_6$.

Two benefits of these fluoride lasers over Ti:sapphire are the longer pumping wavelength and lower pump threshold, qualifying them for use in diode-pumped miniature systems, as demonstrated by CREOL’s Jeff Dixon. There are several applications possible in the immediate future. The high efficiency afforded by mode-locking provides efficient up-conversion, thus enabling use in submarine communications in the blue-green range. Scientific applications may be found in x-ray lithography and in the study of optoelectronic multiple-quantum-well devices. The short pulses may find use as an optical computing source and in optical communications.

Of local interest is the all-Central Florida heritage of these lasers. The pump was borrowed from Laser Ionics (Orlando); the Ti:sapphire laser base and other optics were loaned by Schwartz Electro-Optics (Orlando); the acousto-optic mode locker was made by NEOS (Melbourne); Lightning Optics (Tarpon Springs) polished the crystals; the frequency-doubling crystal was from Quantum Technology.

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Laser Ionics

Situated in southeast Orlando, Laser Ionics is a small, laser systems manufacturer, with a staff of 16, that has been in existence in various forms for 25 years. Now privately held by an investor group in Southern California, their products consist of gas ion lasers, which operate in the visible and ultraviolet.

In 1991 the company received two honors: the Circle of Excellence Award from Photonics Spectra and New Product of the Year from Lasers and Optronics, both for their neon laser. Three of Laser Ionics’ lasers are in use at CREOL, one (argon) with Professor Martin Richardson and two (argon and krypton) with Professor Alan Miller (see lead story). While several other companies produce similar high-power lasers, Laser Ionics’ strength is in efficiency and beam quality.

Among the more spectacular applications of systems from Laser Ionics is in the laser light show at Walt Disney World’s EPCOT Center. A medical system used in the first laser angioplasty device employs one of their lasers, which heats a metal tip via an optical fiber and opens blocked arteries. Under clinical trials right now is a photodynamic therapy system, in which the laser is used to activate a drug attached to tumor cells and thus causes the tumor to separate from the organ on which it is growing.

Laser Ionics prides itself on reliability and flexibility, with excellent support services and product warranties. They have built their reputation on cost and efficiency and are a valuable asset to Central Florida’s high-technology community.

[This is the first of a planned series of articles featuring Central Florida high-technology industry.]
In the last issue of **Highlights**, I mentioned that the summer of '91 was a busy time during which we wrote three major multi-investigator proposals. Two were for the University Research Initiative (URI) program and one for the National Science Foundation (NSF) Materials Research Laboratory (MRL) program. The good news is that we were selected for site visits for both the URI proposals. These site visits were conducted in August and September, and the results were to be released in late October. We now understand that the results will not be known until after the Congress approves the FY92 budget. So it may be a long wait. We don't expect to hear about the NSF proposals until the end of the year.

We are doing all we can to increase the name recognition of UCF and CREOL in the international scientific community. Two recent activities included co-sponsoring and hosting the IV Topical International Conference on Nonlinear Optics in Liquid Crystals (OLC'91), and co-organizing and providing administrative support for the annual international Symposium on Optical Materials for High Power Lasers (aka Boulder Damage Symposium). In both cases Donna Wilson, my admin assistant, carried the load. I have been inundated with praise for Donna's outstanding work on these two meetings. Many leading scientists from around the world have increased knowledge and respect for CREOL because of Donna's work. Thanks, Donna, for a job well done.

This issue of **Highlights** focuses on the recent work of Alan Miller and Patrick LiKamWa in the area of ultrashort pulse generation. This work is a good example of good science, teamwork, and university/industrial collaboration. Alan and Patrick need a good, short pulse, tunable laser for their work on all-optical switching and the physics of transport in multi-quantum-well semiconductors. They took a Schwartz Electro-Optics CW Ti:sapphire laser, pumped by a Laser Ionics argon laser and modified the system to produce 100 femtosecond pulses. We then invited the SEO folks in to see what had been done, and thus helped them to have a femtosecond Ti:sapphire system operational for the 1991 CLEO meeting held in Baltimore.

Next, Alan and Patrick turned their attention to the Cr:LiSAF family of crystals grown in Bruce Chai's lab in CREOL. The results thus far are two papers submitted to Optics Letters and Electronics Letters reporting the first mode-locked pulses of 150 femtosecond durations from two crystals of that family.

The chief advantages of this family of crystals, which were invented by scientists at the Lawrence Livermore National Laboratory, over Ti:sapphire include: 1. they are diode pumpable (first demonstrated by Jeff Dixon at CREOL); and 2. they are flash-lamp pumpable (first demonstrated by Mike Bass and co-workers at CREOL). Congratulations to all who have contributed to this work.

**Congratulations...**

...to the CREOL Volleyball Team, who were the 1991 Rectemberfest Champions. The team accumulated the highest number of points among all the UCF faculty and staff teams represented. The team members, shown here are:

**Standing, from left:** Charla Themenos, Fred Smith, Kristen Levotsky, Mansoor Sheik-Bahae. **Sitting, from left:** Donna Dixon, Alain Villeneuve, Ali Said.
CREOL Hosts International OLC '91 Meeting

The Fourth International Topical Meeting on the Optics of Liquid Crystals (OLC '91) was held at Cocoa Beach, 7-11 October, and was hosted by CREOL. The specific topic of the conference concerned "Optical Properties and Applications of Liquid Crystals and Organic Materials."

CREOL was represented by Director M.J. Soileau, who welcomed the approximately 100 attendees and chaired the opening session; Dr. Silvia Mittler-Neher, who presented a paper on polysilane film orientation; Dr. G. Assanto, who presented a poster on third-order nonlinearities in organic polymers; and Mr. T.H. Wei, who presented a paper on excited state nonlinear absorption and refraction in organic solutions.

On Thursday, 10 October, a group from the meeting visited CREOL. Dr. Soileau provided an overview of the research programs, and then the attendees were escorted through various laboratories, where brief introductions of each project were given.

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(Lake Mary); and the nonlinear refractive index, \( n_2 \), was measured by CREOL. Professors David Hagan, Eric Van Stryland, and their group.

These announcements once again demonstrate CREOL's emerging position in the scientific and technological community, not only working at the cutting edge of optics research but also fostering a symbiosis with high-technology industry.

Sweet Honored by SPIE

Mr. Brooks Sweet, a CREOL graduate student working with Professor James Harvey, was awarded the William H. Price Scholarship in Optical Engineering at the SPIE Annual Meeting in San Diego this summer.

The scholarship, established in 1985, is granted on the basis of the candidate's original research work in optical design and engineering. Mr. Sweet's report concerned the limitation of wide-field imaging phased telescope arrays.

Kudos ... Kudos ... Kudos ...

PROF. KARL GUENTHER has been invited to chair an optics coatings conference as part of the International Optical Systems Design Conference, 14-18 September, 1992, in Berlin. He was also recently asked by Dr. Brian Thompson (University of Rochester), general editor of SPIE's Milestone Series, to serve as volume editor for "Optical Coatings for Laser Applications." His three-volume subseries in Springer-Verlag's Topics in Applied Physics is expected to appear next year.

MARTIN SENSIPER, a graduate student of Dr. Glenn Boreman, spent 10 weeks during the summer of 1991 at the Air Force Armament Lab, Eglin AFB, performing research on resolution measurements of solid-state imaging cameras using laser speckle techniques.

KEN BARNARD, a Ph.D. candidate in EE under Dr. Boreman's supervision, chaired a session on infrared scene projection at the SIMTEC '91 conference in Orlando held October 21-23.

PROF. DAVID HAGAN was awarded a NATO travel grant with which he spent six weeks working at Herriott-Watt University, Edinburgh, Scotland.

PROF. ALAN MILLER was awarded a NATO travel grant, working for one week each at University College, London, and CSELT (the Italian telephone research laboratories) in Turin, Italy. As a followup, one visitor from each of these institutions will visit CREOL. Professor Miller has also been invited to organize a Summer School in Erice, Sicily, in 1993 on Nonlinear Optics and to present a talk, coauthored with Bruce Chai and Patrick LiKamWa, at the Advanced Solid State Lasers Conference in February, 1992.
The 23rd Annual Symposium on Optical Materials for High Power Lasers was held in Boulder, Colorado, 23-25 October. CREOL was one of the sponsors for this meeting, where the physics and technology of materials for high-power lasers are discussed. CREOL Director M.J. Soileau served as a Co-Chair, and his administrative assistant, Donna Wilson, served as Treasurer and handled registration.


Professor Karl Guenther was also a coauthor on a paper entitled "Laser-induced Damage Threshold Comparison of Reactive Low Voltage Ion Plating and e-beam Coatings," by Robert Chow, Chris J. Stolz, Frank Rainer, Gary E. Loomis, LLNL, and Karl H. Guenther, K. Balasubramanian, and X.Q. Hu, CREOL.

Boreman Receives Awards From Alcoa and PSI

On May 24, Alcoa Foundation, Pittsburgh, Pennsylvania, awarded a donation of $7500 to UCF as an unrestricted grant, in recognition of Dr. Glenn Boreman's research on the analysis and design of infrared thermal-imaging systems.

The Alcoa Foundation was represented by Nabeel W. Sufi, a senior engineer in the Process Control and Measurement Technology Division of the Alcoa Technical Center.

Photonic Systems Inc. (PSI), of Melbourne, FL, received a Phase I SBIR contract from the Naval Weapons Center, China Lake. Dr. Boreman has been awarded a subcontract of $13,200 from PSI, in support of modeling and design efforts for an infrared scene projector using reflective mirror matrix technology under development at Texas Instruments. This work is also supported by the Florida High Technology and Industry Council.

Nabeel Sufi (left) presents donation to Professor Boreman.