LAWRENCE LIVERMORE NATIONAL LABORATORY

WEEKLY BULLETIN

WEDNESDAY, APRIL 30, 1986 VOL. 11 NO. 17

Safe drivers honored, page 4

Scholarships are awarded, page 5

By free-electron laser

High efficiency achieved

By MIKE ROSS

Lab researchers have improved the efficiency of free-electron laser amplification of high power microwaves from 5 percent to 40 percent by replacing the straight wiggler with a tapered one.

Dr. Donald Prosnitz, Associate Program Leader for Free Electron Laser Physics, reported the results of the past year's experiments using the Experimental Test Accelerator yesterday in Washington D.C. at the Spring Meeting of the American Physical Society.

"We have amplified 15 nanosecond, 50,000-watt peak power microwave pulses produced by a magnetron 20,000 times to 1 billion watts peak power," Prosnitz said. "This is clearly the most powerful source of coherent electromagnetic radiation at this wavelength with efficiencies nearly as good as the most efficient low-power sources, such as klystrons."

The amplified microwave signal had a wavelength of 8.67 millimeters and a frequency of 34.6 billion cycles per second or gigaHertz.

The recent experiments were conducted at the Lab's Electron Laser Facility (ELF), which uses the 5 million electron volt Experimental Test Accelerator as its source of fast-moving electrons.

A free-electron laser amplifier is a device that can transfer energy from a beam of electrons traveling at nearly the speed of light (186,000 miles per second) to a beam of electromagnetic radiation, such as microwaves or visible light. The energy transfer increases the intensity of the electromagnetic radiation.

The advantage of a free-electron laser amplifier is its efficiency in converting electrical energy into radiation and its ability to be tuned over a wide range of wavelengths. The approach being researched here has the additional benefit of being able to produce very high power pulses of radiation.

High power microwaves from a free-electron laser might be able to drastically reduce the length and power requirements of linear accelerators by using a "two-beam" design proposed by Dr. Andrew Sessler of Lawrence Berkeley Laboratory in 1982. The powerful microwave source could also help heat fusion fuel in some proposed magnetic fusion reactor designs.

The key staff for this effort include theorists Dr. Ernst T. (Ted) Scharlemann, LLNL physicist and chief theorist; Dr. Andrew M. Sessler, physicist and former director, Lawrence Berkeley Laboratory; Don Hopkins, LBL microwave engineer; and experimentalists, Dr. Thaddeus (Ted) Orzechowski, LLNL physicist and chief experimentalist, and John Clark, accelerator physicist.

They are supported by the ELF operations crew: Scott Hawley, electrical technican supervisor; Jim Crawford, mechanical technican supervisor and Lydia Harry, accelerator tuner.

Since research on this project began in 1982, it has received funding from the Department of Energy's Office of Basic Energy Science, the Defense Advanced Research Projects Agency, the Strategic Defense Initiative Office, the Lawrence Berkeley Laboratory Director's Office and internal LLNL funding.

Wiggler magnets

A 10-foot-long array of powerful (5,000 Gauss) magnets with alternating north and south poles, called a "wiggler," is the key to transferring the energy from the electron beam to the laser in the LLNL tests. The high energy "free" electrons (those not attached to any atom) in the accelerator beam must oscillate back and forth when they pass through the

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Tomas Hirschfeld

Noted Lab chemist, innovator dies

Funeral services were held Sunday for Tomas Hirschfeld, a Chemistry and Materials Science Department chemist and an internationally recognized innovator, who died April 24 of heart complications. He was 46.

Hirschfeld came to the Laboratory seven years ago, after spending 10 years with Block Engineering in Cambridge, Mass. He was a native of Uruguay.

"Hirschfeld was a unique and brilliant inventor," said Christopher Gatrousis, Associate Director for Chemistry and Materials Science. "I am sure that only as time goes on, will we fully appreciate what a loss this is to the scientific community. Even more, his is a personal loss to all of us in the Chemistry and Materials Science Department and the Laboratory. He was our friend.

"He was so well known worldwide that people came to the Laboratory constantly to seek his consultation and advice," Gatrousis continued. "His inventions extended over a wide range of scientific and technological projects, from a light-weight infantry weapon and a novel armor concept to microscopic chemical sensors to be used for immuno assay of drug substances with the aid of a laser and fiber optics.

"He would come into my office every month with a six-inch-high stack of reports on work that he had done. I once asked him how he could write so much. He said, 'I don't write at all, I dictate.'"

Herman Leider, head of the Physical Chemistry Section where Hirschfeld worked, described him as an incredibly inventive person. "While his special field was infrared spectroscopy," Leider said, "he was capable of doing outstanding work in any field."

Hirschfeld was ingenious in devising simple, elegant solutions to nagging or unusual problems, Leider recalled.

"He had ideas on every subject. He worked 80 hours a week and his efforts were never wasted. Something always came out of them.

"Tomas would say, 'One person's problem is another person's solution.' Once a particular type of radiation detector would not stay calibrated when not kept at a constant temperature," Leider said. "Tomas used the material from the

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TOMAS HIRSCHFELD
Won five IR-100 awards

More About . . .

Free-electron laser

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wiggler. This regular change of direction causes the electrons to give off electromagnetic radiation characteristic of the oscillation.

If the electron beam is accompanied by a beam of electromagnetic radiation (in this case, microwaves) with a wavelength that, from an electron's point of view, exactly matches the electron's oscillation, the electron gives up some of its energy to the radiation beam. The energy transfer both makes the radiation more intense and slows the speeding electrons slightly.

To compensate for the electrons' energy loss as they pass through the wiggler, the researchers magnetically "taper" the wiggler—reducing the magnetic field along the wiggler's length to match the reduced energy of the electron beam. The result is to keep the electron oscillations in perfect synchronization with the laser wavelength through the entire wiggler.

The properly tapered magnetic field significantly increased the power and efficiency of the free-electron laser amplifier over results reported in 1984 using a simple straight wiggler. The earlier experiments produced 80 megawatts peak power, a 2,500-fold amplification with 5 percent conversion efficiency.

Applications

Sessler's two-beam accelerator concept would use two parallel beams of electrons—one an intense but low energy beam/free-electron laser; the second having compact bunches of very high energy electrons. The microwaves from the free-electron laser would be fed into the high energy beam every foot or so—compared with every 10 feet with today's klystrons—to accelerate the high energy electrons to even higher energies needed for scientific research.

The result would be a high energy linear accelerator that is more efficient than present designs and can also be either 10 times shorter or 10 times more energetic than is now possible.

Free-electron laser amplifiers offer a possible alternative to gyrotrons for heating electrons with microwaves in future fusion reactors. In current "magnetic mirror" designs electrons are heated to create thermal barriers that can help confine a hydrogen gas plasma long enough for nuclei in the plasma to interact. In toroidal "tokamak" fusion reactors the free electron laser amplifiers could be used both to heat the plasma and to drive the electrical current needed to confine it.

Employee serves on panel

Connie Mack, a computer scientist with Plant Engineering, served on a panel to help teachers learn to encourage women to enter computer fields. The panel was sponsored by EQUALS, from the Lawrence Hall of Science, University of California. Mack served on the panel through the LLNL Technical Volunteers Program. For more information about the Technical Volunteers Program, call 3-4902.

Preserve Lab history

If you're about to retire or leave the Lab, don't toss away your records. Lab Archivist Jim Carothers is looking for audiotapes, records, or photos. Call him at ext. 2-7010

More About . . .

T. Hirschfeld dies

From page 1

detector to make a very clever and compact solid state temperature recorder."

"He is irreplaceable, but we will continue his research work with the best quality possible."

Since 1969, Hirschfeld is credited with 110 inventions, giving him an average of seven inventions a year. His long list of achievements includes 185 published papers, 115 patents, 280 contributed oral presentations and 60 plenary and invited talks.

Hirschfeld was recently awarded the 1986 Pittsburgh Spectroscopy Award and was the only American scientist to receive five IR-100 awards from the **Research and Development** trade journal:

- The Optical Tunneling Remote Sensor (1985) to improve 1,000-fold the sensitivity and selectivity of optical sensors for chemical analysis.
- The Microdryer (1983), which continuously pumps water from enclosed spaces, such as those housing delicate electronics components.
- Remote Fiber Fluorimetry (RFF) (1980), which uses optical fibers, special sensors and lasers to analyze chemical samples up to a mile away.
- The Chromatographic Infrared Analyzer (1977), which analyzes complex organic mixtures.
- The Virometer (1975), which rapidly detects and identifies viruses.

He was also the recipient of the 1978 Meggers Award and the 1984 Louis Strait Award from the Society for Applied Spectroscopy. He is listed in **American Men of Science, Who's Who in America, Who's Who in Technology** and **Who's Who in the World.**

Hirschfeld was a fellow of the Optical Society of America, a senior member of the Institute of Electronic and Electrical Engineers, and a member of numerous other scientific societies.

In addition to his work at the LLNL, Hirschfeld was also an Affiliate Professor of Chemistry at the University of Washington. His academic degrees included a Bachelor's Degree from Vasquez Acevedo College, a Ph.D. in chemical engineering, a Ph.D., Summa Cum Laude, in chemistry from the National University of Uruguay.

Hirschfeld is survived by his wife, Judith, and three daughters, Noemi, Dinorah and Susan.

Lab volunteers honored

Seven Lab workers were among the thousands of volunteers honored in National Volunteer Week observances last week.

Candy Simonen, LLNL Technical Volunteer coordinator, said the seven were named to represent all volunteers who had participated in any of the organized volunteer programs—the Speakers Bureau, Tutorial Program and Technical Volunteers.

Tom Ramos and Sue Stephenson attended a dinner in San Francisco on Monday, April 21, as a part of the Bay Area Corporate Volunteer Council observance while the others—including Ramos—attended a luncheon at the Pleasanton Hilton on Friday sponsored by the Valley Corporate Volunteer Council.

Those honored at the luncheon and their volunteer organizations were: Ramos, Mike Ross and Tom Thomson representing the Speakers Bureau; Mike Moran, the Tutorial Program; Virginia Leimbach and Joe Galkowski, Technical Volunteers.

The Laboratory also recognized its workers' volunteer efforts at a reception on Tuesday in the South Cafeteria. LLNL Executive Officer Phil Coyle thanked more than 175 volunteers for their work on behalf of the Lab.

Weekly Bulletin Classified Advertisements

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VACATION RENTALS

So Lake Tahoe, 3 bdr chalet, nicely furnished, convenient location, sleeps 10, laundry, tv, $100/wknd. thru 5/22 209-957-2059

So Tahoe Heavenly Valley, 3 bdr chalet, nicely furnished, 3 blocks from the tram, nice location 209-957-7690

So Tahoe/Heavenly, lg 4 bdr, 2 bath chalet, sleeps 12, 1/2 blk to tram, 2 mi to casinos, cable/tv, phone, laundry, dishwasher, firewood 634-3069

Squaw Valley ski cabin, 4 bdr, 2 bath, cable tv, phone, deck, firewood & snow removal provided 339-1442

Strawberry, 3 bdr, cabin, clean, well equipped, near Pinecrest Lake & Stanislaus River 447-8753

Summer days in Santa Cruz, rent a weeks in a beach house for $300, sleeps 6, fully equipped 829-8974

Tahoe City Cabin sleeps 6, close to town, stores, beach, restaurants, $65/night. 447-2586

Tahoe Donner cabin for rent, 2 bdr, & loft, slps. 9, furn, aek, tennis, golf, lg. deck, pvt. beach $270/wk. $150/wknd 273-4323

Townhouse Incline Village Nevada, North Shore, 3 bdr/3 ba. 828-1299 eves

Twain Harte, fully furn A frame cabin, sleeps 8, color tv, BBQ, loft, view, $100/wknd, $275/wk. 447-1853

WANTED

Accordion, any size or age 209-836-4036

Aluminum cans, for a junior field hockey club to help travel expenses 447-8498

Baby walker/bouncer in excellent cond. 455-1321

Babysitter needed, occasional days 7:30–5, 3 month old & 3 yr old, my Livermore home. 443-8889

Bicycle trailer for kids, used 443-8276

Commodore 128 or 64 computer, software also wanted 443-9166

Dependable young person 14–18 yrs old to do yard work, perhaps painting, etc in Livermore, off Portolla. 443-1778

Fishing rods to repair, modify, improve, exchange, trade in. 447-2473

Hedge trimmer. 443-5549

Honest reliable teenager to do yardwork, including weed removal, good pay to right person. 462-5498

Looking for someone to repair heater on my spa, experienced please. 443-9254

Need small or medium size helium tank for inflating balloons. N Wilt 443-9254

Old bricks for my herb garden 449-4636

Old tokens & coins wanted, will pay cash. 928-4469

Perforated drain pipe 866-0222

Porta-crib needed by end of May, good cond. reasonable 635-2078

St. Bernard dog, prefer mature, but consider younger one, guaranteed super room & board all expenses paid 443-9795

Sunset swim club needs coach for summer league, halftime job, weekdays & Sat. June 2–July 26, prefer experience coach, good w/children 449-4276

Swing set, good cond. 443-4161

Teenager for a Saturday yard clean up, Oakland, Montclair district, call evenings for details of the job. 339-0780

Trees, bushes (that are transplanted) 866-0222

Tutor for adult, beginning electronics, attending class at Chabot, would like additional assistance. 443-8855

Used weights &/or weight bench. 889-6395 after 4

Witch Ditch, ditch digger, trenches 866-0222

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