DISCLAIMER

Materials and Molecular Research Division

Newsletter

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August 1979
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RESEARCH PROFILE

by E. D. Commins

During the past few years my students and I have devoted ourselves to observing parity violation in atoms. This is a miniscule effect, very difficult to detect, and with no practical application; so why do we bother? The answer, broadly speaking, is as follows. Nature seems to work with four fundamental interactions: gravity, electromagnetism, strong, and weak. Everyone knows about gravity, and all of chemistry and molecular and solid state physics (that is, all of MMRD's activities except ours) are governed by electromagnetism. The strong interaction has to do with the very short range, powerful forces between protons and neutrons in the nucleus; and finally the weak interaction governs, among other things, the decays of elementary particles such as nuclear beta decay. Of the four interactions, electromagnetism is the best understood; there are innumerable precise experiments and a detailed quantitative theory in excellent agreement with them. By contrast, the weak interaction is poorly understood and mysterious. For one thing it violates certain symmetries respected by the other interactions, such as particle-antiparticle symmetry and mirror symmetry (parity). For another, because of certain "divergences" it seemed impossible for many years to

(continued on page 5)

IN MEMORIUM:

PROFESSOR MITCHEL MING-CHI SHEN

Professor Mitchel Shen passed away on August 7th after a two month illness. His death brought to an untimely end an extremely active and promising career. A member of the Chemical Engineering Department (UCB) since 1969, Mitch was a highly respected teacher and researcher. His work on rubber elasticity, rheology of entangled liquids, membrane properties, polymer alloys, and plasma-generated polymers was widely recognized and he was frequently sought out to lecture and

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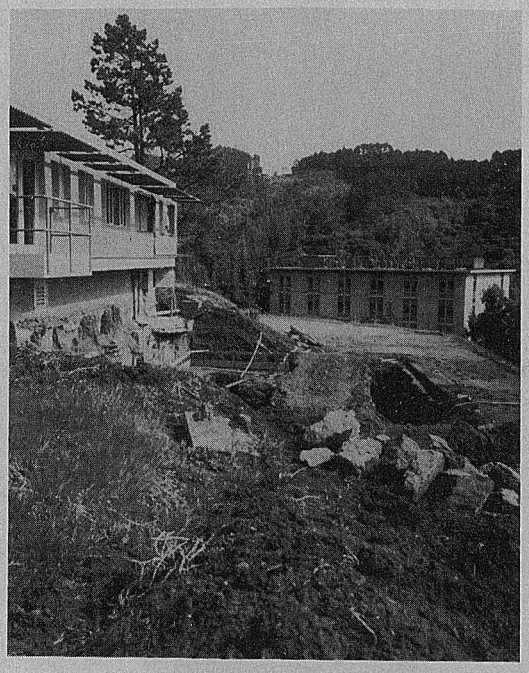
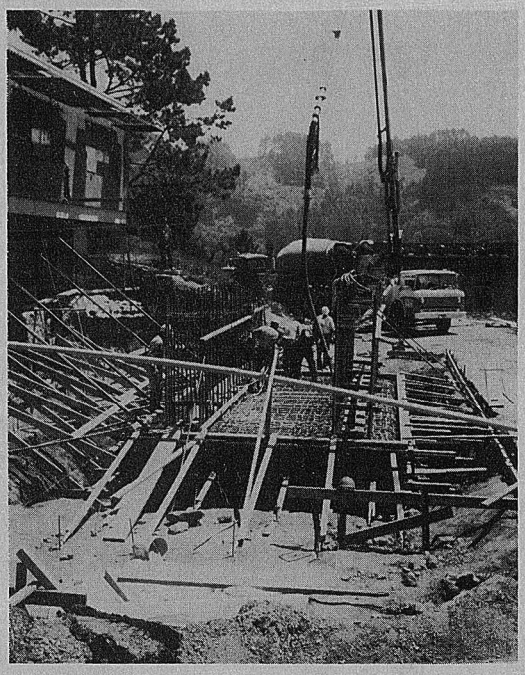


APRIL 1979



MAY 1979

April 1979—Groundbreaking for MMRD's Building 72. Building 62 is visible beyond leveled area. May 1979—Future home of our new electron microscope begins to take shape.

A MOMENT TO SHARE

"The birth was perfect—without medication and without trauma!" Dr. RON GRONSKY was describing the birth of his and his wife ANDREA'S third child and second son last August 2 at 7:30AM. STEFAN MICHAEL, all 8½ lbs of him, joined KRISTIN, six, and DAMIAN, three, already branched from the family tree.

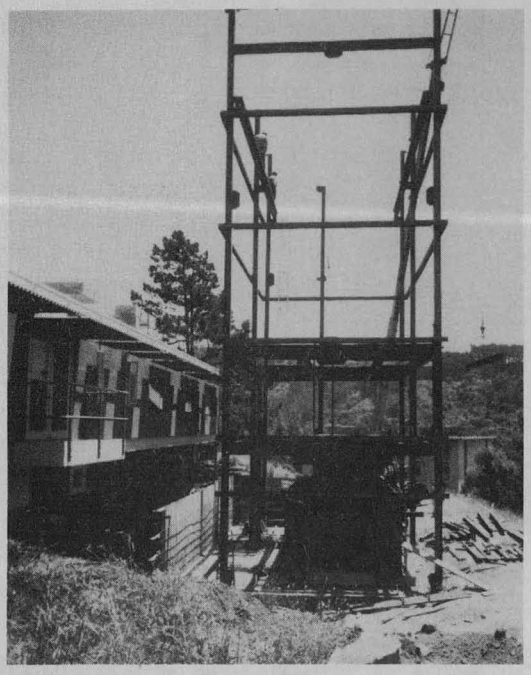
As time for the arrival approached, RON and ANDREA decided on a home delivery. They contacted a San Francisco group called Homecoming and arranged for a midwife. The Homecoming Group also keeps a doctor on call during delivery and brings along to the home equipment for handling any potential, but unlikely, emergency.

"It was, RON recounts still awed and aglow with the experience, "a very rich, natural and special birth. The midwife was really excellent, very personal and human. She alerted me as the moment approached so I could awake the children."

"DAMIAN was concerned at first, but my wife reassured him, and he was the first to exclaim in rapture when the baby's head appeared.

"The whole experience was redolent of family, of togetherness, of sharing. In fact, KRISTIN immediately wanted to call grandpa and tell him the important news. She got him on the phone, but DAMIAN ran to join her and share his excitement also.

(continued on page 3)



JUNE 1979

JULY 1979

June 1979 — The 1.5 MeV High Voltage Electron Microscope (HVEM) will sit inside Bldg 72 which will need its full height to contain the sensitive, mammoth instrument under construction in England. July 1979 — The HVEM requires air conditioning (note silver colored insulation panels). All new air conditioned construction in California must be insulated — a recent change in state building codes resulting from LBL research and recommendations.

A MOMENT TO SHARE (continued)

He wondrously brought us a moment of comic relief when he exclaimed, 'Grandpa, *our* new-born baby has a penis.'"

The sense of mutuality in this family birth and growth process has had an additional effect according to RON. "The two older children's concerned involvement with STEFAN right from birth, has by-passed any feelings of jealousy or displacement that might have arisen from the time and attention his care requires."

Perhaps the idea that STEFAN is an expansion of the whole family and each individual in the family was the essential meaning behind a comment of DAMIAN's as he showed his brother off to a young friend, "He was a little wrinkly when he was born, but he's better now!"

Congratulations, RON and ANDREA — and thanks for sharing such a special moment!

— Roy L. McCollough

SHEN (continued)

present seminars on these topics. Continually active in the polymer community, Mitch served as an assistant editor of *Trans. Soc. Rheol.* (1970-75), co-editor of *Rev. Macromol. Chem.* (1969-), editor-at-large for *J. Macromol. Sci., Part A* (1971-), and chairman of innumerable technical symposia. Furthermore, he was a member of the Advisory Board of the Polymer Research Institute of the University of Massachusetts and a member of the Advisory Panel of the NRC-Solid State Sciences Committee. In addition to these activities, Mitch served as Vice Chairman of our Chemical Engineering Department since 1976 and as the campus Assistant Dean of Foreign Students in 1972-73.

My own association with Mitch began nine years ago when we initiated research on the deposition of polymeric films in the plasma produced by a low pressure electric discharge. This work was highly successful and two years ago led to the discovery that a plasma could be used to initiate the polymerization of a variety of vinyl monomers. Of particular significance was the recognition that polymers produced by plasma-initiated polymerization could achieve molecular weights in excess of 10^7 and that as a consequence materials could be formed which should exhibit superior mechanical properties to those produced by conventional polymerization.

Working with Mitch was always a delight. By nature a creative and inventive person, he was always aware of new possibilities and directions for our research. His broad understanding of polymer physical chemistry provided us with a base for characterizing the unusual materials produced in a plasma. In addition, he was able to call upon his extensive contacts in the polymer field to arrange for the evaluation of our materials by specialized techniques. As a direct result of Mitch's contributions, our research maintained a great deal of vitality and momentum.

In the course of my collaboration with Mitch I had many opportunities to observe his approach with his research students. One of his major concerns was that each student develops not only as a scientist but also as a person. His approach was to give guidance but at the same time provide every opportunity for input by the student. It was his belief that this technique would eventually allow the student to become the director of the research and to gain confidence in himself.

Mitch's death is a great loss for all who knew him. He was a valuable colleague, a profound scientist, and an outstanding person. For me, personally, he was a superb source of intellectual stimulation and encouragement. It will be hard to continue without him but this must be done. The continuation and extension of his research will provide a living memory to his contributions.

— Prof. Alexis T. Bell

QUOTE:

"When some metallurgical wag discovered that by photographing a certain variety of ginger snap under the microscope a design was obtained suggesting the structure of mild steel, it was the source of much gratification in some quarters and it was predicted that a deathblow had been dealt to the microscopical examination of steel. Such innocents are to be found in all walks of life. While they do not add much to the patrimony of mankind, they enliven our existence."

— Albert Sauveur,
Journal of Metals,
June 1979

RESEARCH PROFILE (continued)

make a reasonable theory of weak interactions, even though there were obvious, tantalizing similarities with electromagnetism.

However, in the 1960s a radical new theoretical approach, called gauge field theory, appeared. It seemed to conquer all the old divergence difficulties of weak interaction theory (at the cost of introducing new problems more remote from experience having to do with the "Higgs boson"), and it offered the possibility of unifying weak and electromagnetic interactions. Many persons have contributed to this remarkable development, but two of the principal architects whose specific model seems especially fruitful are S. Weinberg and A. Salam. The Weinberg-Salam model makes many interesting predictions (mostly in high energy physics). For one, there is a whole new class of weak interactions—neutral weak interactions, so called. Moreover, Weinberg and Salam predict parity violation in atoms arising from an interference effect between the neutral weak interaction and the ordinary electromagnetic interaction.

The chart illustrates the neutral weak interactions which have been observed or for which experiments are presently planned (the latter

	ν_e	ν_μ	e	μ	Nucleon
ν_e	1	2	3	4	5 $\nu_e + D \rightarrow \nu_e + D + n$ (Low energy ν_e from reactor: F. Reines and H. Sobel)
ν_μ	6	7 $\nu_\mu + e \rightarrow \nu_\mu + e$ $\bar{\nu}_\mu + e \rightarrow \bar{\nu}_\mu + e$ High energy ν/e scattering	8	9 $\nu_\mu + N \rightarrow \nu_\mu + X$ $\nu_\mu + N \rightarrow \nu_\mu + N + \pi$ $\nu_\mu + p \rightarrow \nu_\mu + p$ Also $\bar{\nu}_\mu$ *	
e	10 $e^+e^- \rightarrow \mu^+\mu^-$ Charge asym. (Z^o - γ interference)?	11	12 $e + N \rightarrow e + N$ a) High energy polarized electron scattering; b) Parity violation in atoms.		
μ	13	14			
Nucleon	15 a) $N + N \rightarrow N + N$? Parity violation in nuclear forces? (but also a contribution from charged weak interaction); b) $p + \bar{p} \rightarrow \omega + \bar{\omega} \rightarrow \ldots$?				

*(High-energy neutrino-nucleon scattering)

RESEARCH PROFILE (continued)

denoted by ?). Box (9) contains the high energy $\nu_\mu, \bar{\nu}_\mu$-nucleon scattering experiments. These first revealed the existence of neutral weak interactions in 1973 and have furnished most of our knowledge about the neutral weak coupling of hadronic matter (quarks).

Box (7) contains high energy $\nu_\mu, \bar{\nu}_\mu$-electron scattering. The data here are still very scanty but do tend to confirm the Weinberg-Salam model. The only neutral current results so far involving ν_e (actually $\bar{\nu}_e$) is that of box (5).

In box (12) are contained the famous SLAC experiment on polarized electrons and the various experiments on parity violation in atoms, including our own. The most direct evidence for the intermediate bosons ("carriers" of the weak interaction) will probably come from charge asymmetry experiments $e^+e^- \rightarrow \mu^+\mu^-$ [box (10)] at PETRA and PEP; and from ω production at the CERN $p\bar{p}$ collider (now under construction).

It turns out that, except for a pathological case (n=2 levels of atomic hydrogen) the conditions for observation of this effect are most favorable in heavy atoms (the magnitude of the effect varies approximately as the cube of the atomic number).

Our atom is thallium (atomic number 81) which has a simple atomic structure amenable to precise calculation. This is important since one must interpret one's results quantitatively once they are obtained. We study certain forbidden (magnetic dipole) optical transitions in atomic thallium vapor (i.e., transitions between two states of a quantum mechanical system which is considerably less probable than a competing allowed transition). The parity violating interference between weak and electromagnetic interactions causes a very small polarization of an excited atomic state which depends on the circular polarization of the exciting light. We have detected this effect and our results agree with predictions based on the Weinberg-Salam model. However, the work is not finished: we are improving the precision and doing different, related experiments to be absolutely sure that we haven't made a mistake.

Our methods are those of atomic physics — lasers, optical interference, polarized light, application of external electric and magnetic fields — and the scale is "large table top." Without any doubt this is the most interesting scientific problem I have ever worked on, and I am privileged to have had the collaboration of excellent research students.

KIM, KOO, THOMAS EXHIBIT WINNERS

Three MMRD staff members, N. J. Kim, and J. Y. Koo, together with metallurgy professor GARETH THOMAS, entered an exhibit in this year's International Metallographic Competition on display at the ASM Materials Show in Chicago, IL. The entry, entitled: "Fracture Behavior of Dual Phase Fe/Si/C Steels" in the Scanning Electron Microscopy class garnered first place prize money, ribbons, and certificates for the trio.

QUOTE:

"Plato said that the most beautiful geometric figure in nature was the circle. He was wrong. The most beautiful geometric figure is a straight line that connects your theory with your facts."

— Joel Hildebrand,
College of Chemistry
Announcement 1979/80

KROPSCHOT & ADAMS VISIT MMRD

Dr. RICHARD H. KROPSCHOT, recently appointed as Deputy Associate for Basic Energy Sciences of the Department of Energy, spent Monday, July 30, 1979, on a working visit to LBL/MMRD. KROPSCHOT, formerly Chief of the NBS Thermophysical Properties Division in Boulder, Colorado, assists in planning and coordinating the overall content and future direction of various basic energy sciences programs.

While here, Dr. KROPSCHOT was greeted by Dr. SESSLER, then spent some time with Dr. W. J. LESTER, JR. before beginning a round of visits with MMRD investigators, including D. A. SHIRLEY, H. HEINEMANN, Y. T. LEE, R. GRONSKY, J. CLARKE, and L. BREWER.

Dr. O. WILLIAM ADAMS of the Fundamental Interactions Branch of the Division of Chemical Sciences of the Office of Basic Energy Sciences, DOE, joined Dr. KROPSCHOT in the visits with LESTER, SHIRLEY, HEINEMANN, LEE and GRONSKY.

DID YOU KNOW?

that

GARETH THOMAS is a member of the Board of Directors of the Metallurgical Society of AIME?

* * * *

that

BILL (J.W.) MORRIS, JR. is Chairman of the TMS Chemistry and Physics of Metals Technical Committee?

* * * *

that

Gasohol is the fastest growing substitute for gasoline today and is sold in 28 states and at more than 800 stations?

that

Reversing the first two letters of nuclear provides a clue to the confusion surrounding support for nuclear power—unclear?

* * * *

that

WILLIAM JOLLY is the secretary of the AAAS Section for Chemistry?

* * * *

BOTHERED BY HIGH PRICES?

The latest edition of the NATIONAL CONSUMER BUYING ALERT is available free from Consumer Information Center, Dept. 681G, Pueblo, CO 81009. Write for your copy.

PEOPLE NEWS

The Division was well represented at the recent Gordon Conference on Solid State Studies in Ceramics at Brewster Academy, N.H. from July 27 - August 3. Prof. GARETH THOMAS presented an invited lecture on "Structures of Grain Boundaries in Ceramics." Prof. LUTGARD C. DEJONGHE also presented an invited lecture: "Gas/ Solid Reactions: Reduction of Metal Oxides." Prof. JOSEPH PASK was a discussion leader for a session during the Conference.

▲

"I have reserved this final space to thank two beautiful ladies, MRS. WINI HEPPLER and MRS. KAREN JANES. They form the nucleus of our group and somehow manage to hold everything together. Without them, many deadlines would not have been met and the atmosphere would not have been nearly as cheerful." — from the acknowledgment section of the Ph.D. thesis of DR. RICHARD A. ROSENBERG (LBL-8948).

▲

Prof. D. A. SHIRLEY served as Vice-Chairman (a title so full of exotic promise and so empty of opportunity!) of the 1979 Gordon Conference on Synchrotron Radiation, July 9-13, at the Holderness School in Plymouth, N.H. STEPHEN D. KEVAN presented a talk at the Conference entitled: "Normal Photoelectron Diffraction Studies of Adsorbed Atoms and Molecules," and GEOFFREY THORNTON and ERWIN POLIAKOFF also attended the gathering. Prof. SHIRLEY presented the summary which closed the Conference on the 13th.

▲

Dr. HOWARD A. SHUGART, recently returned from sabbatical, has been presenting a series of lunch time slide shows on campus under the general title: Cultural Aspects of a Sabbatical (pictures and commentary). Specific presentations have included:

1. Munchen, Bavaria and points south on July 11
2. Turkey and Egypt on July 18
3. Saudi Arabia, Kenya and Nigeria on July 25.

Perhaps we could get HOWARD to repeat the shows for MMRD. We have a projector and conference room in Bldg 62 and we usually brownbag lunch anyway. Maybe, if enough people show an interest and give Dr. SHUGART a call at 182-2-3686, we can obtain a replay up here.

▲

NINA BLAKE is the new secretary for Prof. ROBERT BERGMAN. NINA most recently worked for the San Francisco Opera — yes, she has met all the stars — and is a devoted opera fan. She also is a student of karate, does Nordic (cross-country) skiing and enjoys golf.

▲

Another golfer on our support staff is C. LYNN GLORIA who recently won first place for low net scoring in the Contra Costa Golf Tournament. Congratulations, LYNN, and don't let that dingy, new, hall paint in Latimer affect your game!

▲

Profs. BERGMAN and MUETTERTIES have recently moved into 210 Lewis Hall — space made available by the move of Prof. Williams of Chemical Engineering to Hildebrand. 210 Lewis is a laboratory area.

▲

Dr. HEINZ HEINEMANN has been selected as one of the Welch Foundation Lecturers for 1980.

PEOPLE NEWS (continued)

Prof. DAVID A. SHIRLEY presented the Plenary Lecture at the Fourth International Summer Institute in Surface Science at Milwaukee, Wisconsin. The Lecture was entitled: "Surface and Adsorbate Structural Studies by Photoemission in the hν = 50-500 eV Range."

▲

SARI WILDE, secretary for Prof. M. COHEN, is new to both MMRD and California. She and her husband recently moved out here from Florida where she lived for several years and finished school. Both SARI and her husband play guitar and he writes music while she sings. Style: rhythm and blues. Eventually they plan to make music professionally, but for now, music is an avocation.

▲

Prof. JACK WASHBURN and CARL LAMPERT had an article in the premier issue of a new scientific journal entitled, *Solar Energy Materials*, published by the North-Holland Publishing Co. of Amsterdam. Their article was entitled, "Microstructure of a Black Chrome Solar Selective Absorber." It's nice to have two of our people writing for Volume 1, Number 1 of a new journal!

LBL REPORTS BY MMRD PERSONNEL

To obtain a copy of any of the LBL/MMRD reports listed below, write directly to the writer whose name is underlined, c/o the Editors, MMRD Newsletter, Bldg. 62, Rm. 209, Lawrence Berkeley Laboratory, Berkeley, CA 94720. If several reports are requested, and the underlined names are different — separate requests are necessary. Nothing more than a postcard is needed, and if several are ordered at one time, use 3 x 5 cards in one envelope.

LBL-9094: Selected Topics on the Electronic Structure of Small Molecules ... *W. C. Swope (Ph.D. thesis).* (*H. F. Schaefer III*)

LBL-9095: Semiclassical Statistical Mechanics ... *R. M. Stratt (Ph.D. thesis).* (*W. H. Miller*)

LBL-9108: Fischer-Tropsch Synthesis Over a Ruthenium Catalyst: Infrared and Kinetic Studies ... *J. G. Ekerdt (Ph.D. thesis).* (*A. Bell*)

LBL-9120: Observation of a Collective Excitation in the Ejected Electron Spectra of Yb and Ba ... *R. A. Rosenberg, S.-T. Lee, and D. A. Shirley.*

LBL-9124 Abs.: Energy Disposal in the Photodissociation of CH_3I at 266 NM ... *K. Shobatake, R. K. Sparks, L. R. Carlson, and Y. T. Lee.*

LBL-9127: Heat Pulses in Molecular Solids: Phonon-Induced Delocalization of Trapped Excited Triplet States ... *A. R. Burns and C. B. Harris.*

LBL-9129: Plastic Deformation of $MgO(Al_2O_3)_{1.1}$ Spinel At $0.28T_M$: Preliminary Results ... *S. H. Kirby and P. Veyssière.* (*K. Westmacott*)

LBL-9142: Sulfur Oxide: Low-Lying Bound Molecular Electronic States of SO ... *W. C. Swope, Y.-P. Lee and H. F. Schaefer III.*

LBL-9144: The Role of Environmental Conditions in In-Situ Experiments in the High Voltage Electron Microscope ... *G. Thomas and K. H. Westmacott.*

LBL-9153: Stereochemistry in the Coordination Chemistry of Metal Surfaces ... *E. L. Muetterties.*

LBL-9179: Ceramic Processing - A Ceramic Science ... J. A. Pask.

LBL-9196: Topics in Bound-State and Dynamical Processes: Semi-classical Eigenvalues, Reactive Scattering Kernels and Gas-Surface Scattering Models ... J. E. Adams (Ph.D. thesis). (W. H. Miller)

LBL-9208: Precipitation Hardening in Fe-Ni Base Austenitic Alloys ... K.-M. Chang (Ph.D. thesis). (J. W. Morris, Jr.)

LBL-9209: TEM Studies of P^+ Implanted and Subsequently Laser Annealed Si ... D. K. Sadana, M. C. Wilson, G. R. Booker, and J. Washburn.

LBL-9229: Volatility and Molecular Structure of Neptunium (IV) Borohydride ... R. H. Banks, N. M. Edelstein, B. Spencer, D. H. Templeton and A. Zalkin.

▲ ▲ ▲

POSTAL TIP

Chester Cernac of the LBL postal section passes on the following:

With first class mail now 15¢, writers might seriously consider the use of postcards, but remember that the Post Office no longer accepts postcards smaller than $3\frac{1}{2} \times 5$ inches.

Postcards go as first class mail:

Regular domestic postcards	10¢
Foreign regular mail postcards	14¢
Foreign airmail postcards	21¢

SPECIAL RECOGNITION

The editors want to especially thank the LBL postal division for their excellent assistance in establishing an addressograph mailing arrangement for the MMRD NEWSLETTER and for their very prompt mailing of the Newsletter!

SECOND CLASS MAIL

MATERIALS AND MOLECULAR RESEARCH DIVISION
David Shirley, Head
Lawrence Berkeley Laboratory
1 Cyclotron Road
Berkeley, CA 94720

MMRD NEWSLETTER
Editor: Loretta Lizama
Writer/Editor: Roy McCollough
Bldg. 62, Rm. 209
Phone (415) 486-6062
486-5842
FTS 451-6062

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