FIAP February 1998 Newsletter

INSIDE

Chairman's Message

L. Craig Davis, FIAP Chair

The APS Committee on Applications of Physics (CAP) has a new emphasis on career/professional development. CAP, which launched FIAP in 1995, has relinquished many of its former responsibilities to the Forum. This means that FIAP will advise the APS Council on issues and policy matters related to industrial and applied physics. FIAP will continue to carry out its usual programs as a unit of APS. To reflect its new mission, the name of CAP has been changed to the Committee on Career and Professional Development (CCPD). Among its actions, CCPD has recommended that universities set up a career and professional development liaison. The purpose of the liaison is to establish contacts with industry, to provide career and employment consultation for students, to propose curriculum changes that can improve the employment potential of physicists, and more generally to effect cultural change in Physics Departments. CCPD plans to host a Department Chairs Conference, to organize tutorials and workshops at APS meetings (such as "What you need to succeed in physics") and to provide professional development courses (time management, etc.). What courses would be of the most value?

All this brings up a related issue - the mission of FIAP. John Rowell, who will become Chair of FIAP in March, suggests that we rethink our mission. During the first three years we focused many of our activities on the declining job market for physicists. Now, although the number of academic jobs may still be limited, the overall job market has improved considerably. In fact, there appears to be a lack of highly trained technical people, especially in hi-tech areas such as computers and communications. Should we be focusing our attention on educating physicists so they can enter these expanding fields more effectively? John notes an intriguing example: "The wireless industry is growing about 30% per year, and has outgrown its labor force. How many universities have a center for RF and microwave technology, as opposed to the many who have microelectronics and optoelectronics?" In my opinion, such examples tie in with CCPD's suggestion to appoint career and professional development liaisons in Physics Departments. The liaisons should be aware of industrial employment trends and educational requirements. Furthermore, the liaisons should be catalysts for curriculum (and even research emphasis) change in their Departments to meet these requirements. Industrial physicists may want to help local universities respond to these challenges.

I am interested in your thoughts on these matters, both from an academic point of view and from an industry perspective. You may send your comments by email: LDAVIS@ford.com or FAX: (313)-322-7044. I look forward to hearing from you.

Tales of an Industrial Physicist

Neal Butler, Lockheed Martin IR Imaging Systems

Editor's Note: Neal is an Engineering Fellow at Lockheed Martin IR Imaging Sytems (LMIRIS) in Lexington, MA. The company was formerly a division of Loral and, before that and under several different names, a division of Honeywell. This is an edited version of an article in the company's internal newsletter, Focal Point, after Neal had been honored at the 1997 "Engineers' Night" banquet as Engineer of the Year for his successful and pioneering design of the read-out electronics for a new uncooled infrared detector array using Si based bolometers. At the time of the award Neal made an extremely short thank-you speech, breaking a long tradition of longer-duration, somewhat autobiographical speeches.

I started at the Honeywell Radiation Center in the summer of 1975 with a fresh Ph.D. in solid state physics from Purdue. That was not a good year for finding jobs - my only other offer was a temporary teaching job at the University of Western Michigan in Kalamazoo. This turned out to be a pretty good job, but at the time I wasn't real happy about the dearth of choices. And then, as I was making the very last pass through my empty house in West Lafayette to make sure the movers hadn't missed anything, the phone rang. It was someone from Texas Instruments wanting me to come out for a job interview. Every once in a while I wonder what would have happened if he had called a few months earlier. I especially remember that my first week of work here was really nice because it included the Independence Day holiday. I should have suspected something when I got my first assignment - write a proposal. At that point, I barely knew where the restrooms were, let alone how to write a proposal about short wave IR avalanche photodiodes. The instructions were "just copy the last proposal."

Another one of my first assignments was to build a demonstration time-delay-and-integration system for an array of 9 HgCdTe photoconductors operating at liquid nitrogen temperature using one of the latest hot gizmos, a charge-coupled device (CCD). The job was actually quite a bit of fun, and I got to learn about CCDs and about photoconductor electronics and some of the problems therein. However, I never understood the point of it - to me it made about as much sense as building a liquid helium cooled analog computer to add 2 and 2 (or maybe to demonstrate that the square root of 9 is 3). The answer was never in doubt.

This job is where I got my first real introduction to electromagnetic interference (EMI). There was a power line related pulse running through a particular system. After a certain amount of trial and error, I discovered it would go away if, and only if, the preamp case was in direct contact with the metal dewar holding the HgCdTe detectors. A wire between the dewar and the case wasn't good enough. The source of this pulse was the temperature controller for the blackbody. The newer controllers have been fixed so they don't do this anymore. It might be better if they had been left that way - if you could build your system to avoid the problems with those old temperature controllers, it would survive almost anything. At that point, someone had acquired an EMI proof room - a "screen room" to make detector measurements (I wasn't the only one with these problems). It says something that the noisiest measurements in the facility were made inside that room (the blackbody controller was also in the room) and that the technician could listen to his radio inside the room (someone had drilled a clear hole through the wall and put a copper water pipe through it - it worked fine as an antenna).

The nice thing about test equipment problems, though, was that they could be fixed. With a little (very little) understanding of Maxwell's equations, you could kind of figure out where the problems were, and move things around until they worked. The detectors, though, were entirely different. If they didn't work, your only choice was to try again, and again. Staying away from that end of the business seemed like a very good idea.

After two and a half years here, I got restless - there were a lot of things here that could have been better, and there hadn't been such a big set of choices in 1975. I took a job at M.I.T. Lincoln Laboratory designing circuits for a memory group. I lasted there just one year (1978); my old boss offered me my job back every week (accompanied by lots of flattery) until I gave up and did it.

After coming back, I learned that I hadn't been all that popular here - too stubborn, always wanting to do things my own way - which was essentially true. It just goes to show that you don't necessarily have to please all the people all the time to be successful. It's probably not possible anyway; I've always tried to do the best job possible, and not worry overmuch about whether anybody else agreed with my approach to it. That part is much easier these days than it used to be - after all these awards, people don't argue with me nearly as much as they used to. One of my first jobs after coming back was to make the automatic tester for HgCdTe photoconductive detectors work well enough to use for production. The noise was so bad you could even see the readings change depending on which program was running in the computer. After about six months of digging around, I finally figured out where the real problem was (too much loop area between the detector and the preamp). Given the state of the art at the time, that counted as an enormous success. So I spent quite a few years designing test equipment. It was a nice job - the technical problems were interesting but not too hard, I generally got to do things the way I wanted, the deadlines weren't too bad, and there was almost no paperwork. Then, in the early '80s, we finally managed to get some internal and external support for work on uncooled detector system development. Actually, I had dabbled a bit in this earlier when there was a small job to make single element pyroelectric detectors. The preamps for these were a bit different from those for the HgCdTe detectors because the detector impedance was extremely high - at one point we had to have the technician hold his breath so that the line on the curve tracer would stay put. Another really interesting case was the 13 Hz noise spike - the one that went away when you closed the door to the room. It was a fairly small room - 13 Hz must have been its acoustic resonant frequency. Pressure changes due to the sound wave caused a temperature change which the detector measured.

For some reason, detectors operating at room temperature ("uncooled") always interested me. I'm still not sure why. For the longest time (until August of 1993, to be exact) uncooled was always the oddball that never really fit in with anything else. We got a number of small programs to play around with CCDs and pryoelectric detectors. In the meantime, the cooled programs were also looking at CCDs. I did one of the first analyses here of what would fit onto a CCD (now a CMOS integrated circuit). The conclusion was that pyroelectrics were very nice because of the impedance match. Staring midwave [cooled HgCdTe photodiode arrays at about 5 fm cutoff wavelength] looked like a good idea, and scanning long wave [linear arrays at about 10 fm] looked like we could probably do it because there was a reasonable amount of chip area per detector. Long wave staring looked really, really hard if it was going to be possible at all. So naturally, the first cooled multiplexer programs were for long wave staring. It was during the first round of uncooled that I started having responsibility for training new engineers. It was another change - when I first started working here I had to learn to let technicians do the actual wiring; with the co-op students I had to let them do some of the design as well. But it was very rewarding to see them learning the ropes. Even better, they actually respected my opinions about things - which I really wasn't used to at the time. When we got the first big uncooled program in 1984, my reaction was "Oh, no! We'll never make it!" A favorite "Neal" story is that at our first customer review after we were awarded the contract, I told the customer that I didn't understand why he gave us the award - we didn't really have that much of a chance of succeeding. This apparently made a very big impression on everyone there. But we did make something that sort of worked - not very well, but you could actually see something with it - a very remarkable accomplishment, considering where we started from. I was awarded the Honeywell H. W. Sweatt Award [equivalent to the 1997 Engineer of the Year award] in 1985 for this program.

The years between 1986, when this program was finished, and 1992, when I decided to go into ultrasound, were tough ones. The army was not really interested in uncooled, and there was almost no internal support. It was really tough no longer being in the middle of the action, and having my pet project tabled indefinitely. I managed to find enough small jobs to keep busy, including a very interesting project to improve the spin mirror control system on a scanning system; if anyone needs a real expert on second order phase locked loop control systems operating at low pulse rates, I'm the one.

It was also around this time that the marketing people realized that when I was talking to customers, it might be good idea to position me away from the customers and sit next to me so that I could be reminded, with a subtle kick under the table, to shut up.

The ultrasound project was a spin-off from the pyroelectric multiplexer. An independent consultant looked me up at the 1992 SPIE meeting where I presented our last pyroelectric paper and asked if the readout chip could be used for ultrasound. After all, both ultrasonic transducers and pryoelectric detectors are capacitors, right? The fact that one works at 30 Hz and the other at 3 MHz is an insignificant detail. It turns out he was right - there just happened to be a diode in the unit cell of the pyroelectric multiplexer which could be used as a sample and hold. Then the rest of the multiplexer wouldn't know the difference. Our first ultrasound demo actually used some of the old pyroelectric CMOS chips. They didn't work all that well, but they showed the point. Fortunately, we made the videotape before I bumped the pickle barrel, rupturing the latex diaphragm, flooding and ruining the array. Ultrasound is really a nice program - its uses are medical, not military, the customer base is readily identifiable and very willing to spend money for good stuff. I was all set, and then.

In August of 1993, the final license arrangements with Honeywell were completed, and I was doing uncooled. It didn't work to say I wanted to stay on ultrasound - after all, I'd been complaining about no uncooled support for 6 years, and it finally happened. It's like the old Chinese curse - "may you get what you wish for".

This was my second exposure to the microbolometer technology. My first was in about 1988 when we were trying to develop a camera for a 64x128 prototype array from the Honeywell Physical Science Center in Minneapolis (another place with a new name every year). At the time, I was glad this wasn't really my problem - the readout for these devices is very, very difficult. We spent a lot of time trying to get a compact, low power external circuit working around this array, with only limited success. I later figured out that there was a built in EMI problem in the basic approach. This was about the time I finally convinced the Minneapolis guys to include a primitive multiplexer on the next array, which was to be 320x240. Without some kind of multiplexer, the bond pads (320+240) would be a real nightmare. The primitive mux worked OK, and they never used the version with 600 pads.

Back to 1993 - My first reaction was a sinking feeling. I knew just enough about the bolometer readout problem from the Honeywell days to know that it was going to be really, really hard. This was the first time in my career when I agreed with everybody else that my task was really hard. Always before I had succeeded in fooling everybody: first, by pretending to be an electrical engineer (just a hobby - no formal training to speak of) when I was really a physicist, and also by taking jobs they thought were hard but that I knew were not too bad.

I was allowed to design a complete uncooled chip with almost no supervision. So, I went for broke and tried to put 20 bit analog to digital converters (a total of 328) on the chip. This was not exactly a success, and it took two revisions to sort out what the biggest problem was. I had to scale back the design to 14 bit A/D conversion, 6 bit D/A conversion on chip and an off chip self heating compensation circuit. The second (or third, depending on how you count) revision of this second chip is now in production. My last award celebrated this accomplishment with an award for sixth pass success in circuit design. I think my boss has now learned that it might not be such a good idea to let me try everything I can think of the first time out. One of my consolations during this time was that the systems guys and the detector fabrication guys were also struggling with lots of problems. For a long time, we were having a race to see who could stretch the schedule more. I won. In spite of this, I was selected as the division's first guinea pig for the new Lockheed-Martin Nova award in 1996.

LMIRIS is an exciting place to be, and I really appreciate the kindness and friendliness of everyone here, especially when I can get out of doing paperwork. It says something about LMIRIS that I ended up as "engineer of the year" by looking for **the fun, easy, projects and doing them my way.**

FIAP Election Results

Vice Chair:

Member-At-Large

James Kaufman

Eric Moser

Willes Weber

Their terms start at the March Meeting

What's New in APS Career Activity

Barrie Ripin, APS Associate Executive Officer

CAP to become Committee on Careers and Professional Development Last November, the APS Council approved an amendment to the APS Bylaws that would change the name of the Committee on Applications of Physics (CAP) to the Committee on Careers and Professional Development (CCPD). The second APS Council vote on the matter (required for a Bylaw change) will occur in April. The rationale behind the change is that, with the initiation of FIAP, much of the work that CAP used to do, such as organizing sessions at meetings, was taken on by FIAP. In this change, FIAP will take on the added responsibility of advising the APS on matters related to industry and applied physics, previously performed by CAP. The change was initiated because many felt that the APS needs a clearing house for its career activities, and the recent Task Force on Careers recommended that an APS committee be charged with these responsibilities. CCPD lost no time swinging into action; among their activities are:

Job Perception Survey The APS did a survey of its junior members (those within 3 years of their last degree) of their perceptions of the job market in November. Results, published in the February issue of APS News, generally showed that young physicists are pessimistic about their long-term career futures. However, those currently in industry are much more optimistic than most others. The article may befound online through the APS Homepage [www.aps.org] under the APS News Online button.

Career and Professional Development Liaison Workshop, organized by Diandra Leslie-Pelecky and Barrie Ripin, will be held at the March APS meeting in Los Angeles. This is the first step in organizing a nationwide network of physics department Career Liaisons. An invitation to attend and participate in the workshop was sent to all PhD- and MS-granting physics department chairs in the US.

Careers and Professional Development Site Visit Program, a joint APS-AIP proposal, is under review by the CCPD. This program proposes to send a team of physics career experts to about a dozen physics departments for in depth assessments of their career related programs. It is intended both to find examples of innovative programs (good practices) and to advise departments on how they can become more responsive to career issues. When the series of visits are completed, a compilation of "best practices" will be sent to all CareerLiaisons.

Physics Success Stories

The American Institute of Physics has prepared a very attractive set of one-sheet flyers called "Physics Success Stories," featuring the contributions physics has made to society. Each flyer covers a single topic, such as Medical Imaging ("Physics Saves Lives") with visually appealing, full-color illustrations and a good history of the physics advances that led to each contribution, most of which involve industrial physics. A full list of these topics, and links for downloading the images, are on the World Wide Web at www.aip.org/success/. FIAP members may be interested in suggesting additional topics for this series.

Give Us Your Ideas

The following members of the FIAP executive committee would very much appreciate your ideas on how to further increase the usefulness of FIAP for the physics community.

Craig Davis, Chair

John Rowell, Chair-Elect

Galen Fisher, Vice Chair

Harry Atwater, Secretary-Treasurer

Matthew Richter, APS Councillor

Ray Baughman, Member-At-Large

Margaret Weiler, Member-At-Large

Andrew Sessler, Member-At-Large

James Tsang, Member-At-Large

Paul Murphy, Member-At-Large

Cherry Ann Murray, Member-At-Large

Web Sites

Check the FIAP home page at: www.aps.org/units/fiap

The new jobs engins is at: www.cweb.com/fiap

Integrated Measurement Alliance

In response to the semiconductor industry's growing interest in and need for Advanced Process Control (APC), the Integrated Measurement Alliance (IMA) was formed and held its first meeting on January 8th, 1998, in Sunnyvale CA. The purpose of the IMA is to promote the use of and improve the effectiveness of Integrated Measurement and Control Technologies leading to APC by fostering improved communications between the end-users, sensor manufacturers and production equipment manufacturers. In order to encourage a large membership, fees are prorated based on annual gross revenue. Individual memberships are available as well. More information is available from Sally Solomon. She can be reached at On-Line Technologies, 860-291-0719 or by e-mail: s.solomon@afr-olt.com.

New APS Fellows

The following were elected in November, 1997, to Fellowship in the American Physical Society after being nominated by the Forum on Industrial and Applied Physics.

* Joseph John Barrett, Allied Signal, Inc.

For his pioneering contributions in the development and applications of new Raman and infrared techniques and, in particular, photoacoustic Raman spectroscopy for gas analysis and infrared sensors for avionics applications.

* Curt A.Flory, Hewlett-Packard Laboratories

For the imaginative use of theoretical physics in the analysis and creation of precision frequency standards, microwave sources, acoustic signal processing and sensing devices, and mass spectrometry instrumentation.

* Paul Michael Grant, Electric Power Research Institute

For contributions to the fields of organic conductors and high temperature superconductivity.

* Randall Duane Isaac, IBM T. J. Watson Research Center

For outstanding contributions to advanced bipolar technology and the 64Mb DRAM development.

* Lawrence David Jackel, AT&T Bell Labs

For sustained contributions to the fields of microscience and machine learning by increasing scientific understanding and by developing technology and applying it to systems with commercial and industrial significance.

* Tak Hung Ning, IBM T. J. Watson Research Center

For outstanding contributions to the understanding of hot electron effects in MOSFET devices and advances in bipolar technology.

* Abbas Ourmazd, Institute for Semiconductor Physics

For work on the characterization of semiconductor interfaces, the development of fast transistors, and service to the APS via his role in founding the Forum on Industrial and Applied Physics.

* Richard L. Sutherland, Science Applications International Corp.

For his contributions to the understanding and application of non-linear optical materials and switchable volumetric holograms.

* Gregory William Swift, Los Alamos National Laboratory

For pivotal experiments leading to a new understanding of the superfluid state and for the development of thermoacoustic engines.

Speaking of Fellows, here is an example of an industrial physicist who probably should have been honored long ago by the APS. An obituary appeared in the November, 1997, issue of "The Institute", the newspaper of the IEEE, noting that Jenny Rosenthal Bramley, "trailblazing physicist," died 26 May 1997 at the age of 87. She was an IEEE Fellow (the second woman elected) but not even a member of the APS, although she was "the first woman to receive a Ph.D. in physics in the United States" at New York University at the age of 19. According to a short biography in "Women of Science" (G. Kass-Simon and P. Farnes, Eds., Indiana University Press, 1993) she was cited by the IEEE for "achievement in spectroscopy, optics, mathematical techniques and their application for electron tubes, displays and light sources to engineering." A hyperfine structure anomaly that she researched is referred to in the literature as the Breit-Rosenthal effect. She worked as a physicist at U.S. Army and Navy labs, was head of the mathematics department at Monmouth Junior College, and formed a consulting firm which licensed to IBM patents which she held, with her husband, Arthur Bramley, on applications of electroluminescence to solid state display and storage devices. She was not included among either the 1996 or 1997 FIAP Fellow because she was not nominated. One of the goals of FIAP is to identify such cases, of industrial physicists who have lost contact with the APS, and encourage their return to the fold, so to speak, by honoring those among them who have made significant contributions. FIAP members are strongly encouraged to help in this effort by identifying and nominating good candidates.

APS Centennial Plans

The APS is celebrating its 100th birthday in 1999, with the most extensive activities at the March meeting in Atlanta, GA. All of the APS units, including FIAP, have been involved in the planning. FIAP has agreed to create a display on "Physics in Industry"; Cherry Murray and Matt Richter will be getting it together. Cherry has suggested the following panels for a large wall display, with companies identified to provide the exhibit materials:

Physics of Information: IBM, HP

Physics of Communication: Bell Labs

Physics of Transportation: GM, Ford

Physics of Medicine: GE, .

Physics of Imaging: Xerox, Kodak

Physics of Defense: Lockheed Martin, Raytheon

Physics in Start-Ups: Symix, .

Each exhibit will need a coordinator from each company.

Volunteers and suggestions are welcome!

The Two-Body Problem

One of the larger challenges facing physicists today as they seek to achieve their career goals is the "two-body problem"- the difficulty of finding jobs for two scientists in the same location. Since many physicists are partnered with other scientists, creative ways to overcome this problem can enhance their success, especially that of women in physics. The APS Committee on the Status of Women in Physics has prepared a Web-based survey to document the scope of the problem and to discover creative solutions that have been tried by different institutions. All those who have experience with this challenge are urged to visit http://physics.wm.edu/survey and fill out the questionnaire. The responses will be kept entirely confidential, and summary results will be reported to the physics community when the survey is complete. The analysis will be conducted by Laurie McNeil (Past Chair of the CSWP) and Marc Sher (Forum on Physics and Society).