FIAP Fall 1999 Newsletter

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FIAP Invited Sessions at the APS Centennial Meeting, March 20-26, 1999, Atlanta, GA

James Kaufman

FIAP has an exciting program in progress for the centennial meeting. We are working on nine special invited sessions and one focus session. The invited sessions begin with our special Centennial Session entitled "Industrial Research", chaired by Cherry Murray of Bell Labs. This session features the leaders of five major industrial research organizations.

Bill Lenth of IBM Research will chair a session entitled "Physicists at Startups" in which we will learn of the experiences of physicists involved in creating small companies. The program includes speakers from relatively new startup companies (3-d labs), from startups bought by larger compainies (Quinta/Seagate), from the high Tc industry, and from a computer networking firm. Duncan MacVicar the noted author and Silicon Valley consultant will give a broad perspective on "Starting Your Own High-tech Company."

In a session cosponsored by the Topical Group on Magnetism, we will learn about many of the important technological applications of magnetism. These applications have become so important in our lives, one speaker suggests the 20th Century has been the "century of magnetism". Magnetic materials and devices are now pervasive in our society and represent several multibillion dollar industries. This symposium entitled "Magnetism in Technology" will highlight both present and future applications of magnetism. The session, chaired by Stuart Wolf of the U. S. Naval Research Laboratory features five experts in the field.

Many of the industrial applications of magnetism require complex control of the magnetic properties of microfabricated ferromagnetic materials. Achieving this control is often challenging, but computing has become sufficiently powerful today that much can be learned from micromagnetic modeling. In a companion session to "Magnetism in Technology", Manfred Schabes of IBM Research will chair a session entitled "Micromagnetics". The speakers will discuss dynamic magnetization processes, magnetoresistive memory devices, and many of the other important physical effects which are critical to the design for present and future magnetic storage technologies.

Physicists who study the "Physics of the Silicon Bond in Electronic Materials" may well debate the assertion that this has been "the century of magnetism". This session, chaired by Francisco Leon of Intel Corporation will address several key applications for silicon (Si). Moore's law predicts not only ever smaller lithographically defined features, but also the denser packing of circuits which can only be achieved with lower dielectric constant materials. The symposium brings together contributions from different areas of technology and academic disciplines which are connected by the role played by the chemical bond that Si atoms form in these and other important materials. These range from the orbitals of a Si-C bond in porous organosilicon compounds to the effect of the Si-N or Si-O bond on the polarizability in dielectric materials, to the core electron energies at the Si/SiO2 interface. The speakers, both physicists and chemists, will give overviews of the field from their own perspectives.

FIAP and the Division of High Polymer Physics are cosponsoring a session entitled a "Polymers for Displays" chaired by Glenn Held of IBM Research. The featured speakers will discuss applications of polymer organic light emitting diodes, cholesteric liquid crystals, switchable gratings made from polymer dispersed liquid crystal films, as well as new composite materials which could enable a flexible reflective display.

In the session entitled "Industrial Applications of Advanced Optical Techniques" chaired by Hans Coufal of IBM Research, we will hear about many new applications of advanced optics including interferometric lithography, photothermal analysis of semiconductors, laser texture of disk substrates for magnetic recording, optical data storage technology, as well as applications of spectroscopic ellipsometry.

Two additional invited sessions are still in progress. We welcome suggestions for invited speakers for a session entitled "History of Physics in National Defense" (contact J. Kaufman at kaufman@almaden.ibm.com) and a session entitled "History of Industrial Physics" (contact G. Fisher at gfisher@cmsa.gmr.com) with suggestions for outstanding public speakers on these subjects.

Finally, Stefan Zollner (Motorola r37595@email.sps.mot.com) and Bill Weber (Ford) are organizing a focused session entitled "Industrial Applications of Optical Spectroscopy". This will feature one invited speaker and many contributed talks on Industrial Applications of optical spectroscopy (such as modulation spectroscopy, ellipsometry, photoluminescence, FTIR, and Raman scattering) for process, yield, and materials analysis, metrology, or technology development. Please be sure to get your abstracts in early if you would like to submit a paper for inclusion in this session.

FIAP Sponsored Sessions

1. The Centennial Session "Industrial Research: Past, Present, and Future"; VP Speakers from Large industry: C. Murray, chair (Bell Labs), Joel Birnbaum (HP Labs), William Brinkman (Bell Labs, Lucent), Lewis Edelheit (GE), Paul Horn (IBM Research), Neil Ressler (Ford).

2. Physicists at Startups; W. Lenth chair (IBM Research), Gary Bjorkland (Optical Networks inc.), "Experiences of a Physicist at a Small Computer Networking Company", Elizabeth Downing (3d-labs), "Physicists at Start-Ups-the Women's Perspective". Duncan MacVicar (MacVicar Assoc), "Starting Your Own High-tech Company." John Rowell (Superconductor Industry Consultant), "Superconductivity - numerous Nobel prizes, many small companies" Jeffrey Wild (Quinta), "Applying New Ideas to Data Storage - The Making of a Disk Drive Start-Up"

3. Magnetism in Technology (With TMAG), S. Wolf chair (U. S. Naval Research Laboratory), M. Coey (Trinity College), "The 20th Century-Century of Magnetism", Stuart Parkin (IBM Research), "Coming of Age of Magnetic Multilayers: Giant Magnetoresistance Field Sensors and Magnetic Tunnel Junction Memory Elements", Jimmy Zhu (Carnegie Mellon), "Understanding the micromagnetics of patterned magnetic thin film devices", Mark Kryder (Carnegie Mellon), "Physics Challenges in Achieving 100 Gbit/sq. in. Density in Magnetic Recording" Conrad Bussman (U.S. Naval Research Laboratory), "CPP-GMR Magnetoelectronics: From Metallic Multilayers to Hot Electron Devices"

4. Micromagnetics, Manfred Schabes, chair (IBM Research), H. Neal Bertram (UCSD), "Dynamic Magnetization Processes in High Coercivity Magnetic Thin Film Materials", Byron Lengsfield (IBM Research), "Numerical Studies of the Role of Exchange in the Design of High Performance Magnetic Media", Donald R. Fredkin (UCSD), "Micromagnetics: Deterministic and Stochastic Dynamics", Josef Fidler and Thomas Schrefl (Vienna University of Technology), "Micromagnetic Simulations of Hard Magnets", Michael Scheinfein (Arizona State University), "Micromagnetic Simulations of Magnetoresistive Devices"

5. "Physics of the Silicon Bond in Electronic Materials", Dr. Francisco Leon, chair (Intel Corporation), Udo Pernisz (Dow Corning Corporation), "Photoluminescence of Organically Modified Si Containing Materials", Galen Stucky (UCSB), "Structures and Properties of Si-based Thin Film Materials", Mark Banaszak-Holl (U. Mich.), "Structural and Spectroscopic Understanding of Silicon Oxide Based Electronic Materials: What do we know? What do we need to know?", Kelly J. Taylor (Texas Instruments), "Silico-dielectric thin films for Integrated Circuit Manufacturing", Bob Miller (IBM Research), "Porous organosilicates derived from silsesquioxanes: A new route to ultralow dielectric constant materials for microelectronic applications."

6. Polymers for Displays (With DHPP), Glenn Held chair (IBM Research), J. William Doane (Kent Displays, Inc.), "Reflective Cholesteric Liquid Crystal Displays: From the Physics Lab to Commercial Products." Timothy J. Bunning (Wright Patterson Air Force Base), "Switchable Gratings from Polymer Dispersed Liquid Crystal Films." Paul S. Drzaic (E Ink), "Composite Electrophoretic and Composite Liquid Crystal Systems for Flexible Reflective Displays." Satyendra Kumar (Kent State Univeristy), "Electro-optical Properties of Phase Separated Composite Films of Polymer and Ferroelectric Liquid Crystals." Campbell Scott (IBM Research), "Materials and Modeling for Polymer Light Emitting Diodes."

7. Industrial Applications of Advanced Optical Techniques, Hans Coufal, chair, (IBM Research), S. Brueck (Univ. of New Mexico), "Interferometric Lithography", A. Rosencwaig (Thermawave), "Photothermal Analysis of Semiconductors", John Woollam (Univ. of Nebraska), "Spectroscopic Ellipsometry", Glenn Sincerbox (Univ. of Arizona), "Optical and Optically Assisted Data Storage", Andrew Tam (IBM Research), "Laser Texturing of Magnetic Media"

8. History of Physics in National Defense, J. Kaufman (organizer), In progress.

9. History of Industrial Physics, G. Fisher (organizer), In progress.

Centennial Exhibits

In the Convention Center exhibit hall during the APS Centennial Meeting the FIAP will sponsor a Centennial Exhibit entitled "Physics in Industry', coordinated by Cherry Murray from Bell Labs and Matt Richter from On-Line Technologies, Inc, which will include exhibits from such industrial giants as IBM Research, General Motors, Ford Motor Company and Bell Labs, Lucent Technologies. The exhibits will include interesting historical records of inventions and technology driven by physics research in industry as well as historical objects including an ancient model of the first disk drives, one or two concept cars of 2010 and a working demo of an optical communication network. FIAP and TIP are also co-sponsoring an exhibit coordinated by Ken McNaughton of The Industrial Physicist and Craig Davis of Ford and FIAP, called "The Hidden Physicist" , which will be an exhibit focussed on physicists who have had interesting careers in industry.

FIAP Sponsors Focused Sessions at APS Centennial Meeting

William Weber

Industrial Applications of Optical Spectroscopy

With the development of user-friendly instrumentation, optical spectroscopy techniques find increasing use for industrial application. These methods include Raman and infrared (FTIR) spectroscopy, spectroscopic ellipsometry, and modulation spectroscopy, photoluminescence and new forms of ultrafast laser spectroscopy based on photoacoustic effects. Two invited talks highlighting new techniques (Peter A. Rosenthal, Online Technologies; Keith A. Nelson, MIT) will be followed by contributed papers. Abstracts are solicited on studies of materials with industrial applications (semiconductors, complex oxides, metals, magnetic and superconducting materials, organics, catalysts, etc), but also on the successful application of established methods for inline metrology, sensors, process development, reliability and failure analysis, and yield enhancement.

Polymers for Display Applications

FIAP is jointly sponsoring focused sessions on "Polymers for Display Applications" with the Division of High Polymer Physics (DHPP). An invited symposium with five invited talks will be integrated into the DHPP program, to be followed by contributed talks on this topic. FIAP members are encouraged to submit talks in this area, using the special sorting category 4.9.3. Further questions may be addressed to the DHPP programing chair: Wes Burghardt; w-burghardt@nwu.edu

Session Organizers:

Dr. W. H. Weber

Dr. Stefan Zollner

APS and AIP Prizes and Awards

John M. Rowell, Chair, FIAP

The American Physical Society and the American Institute of Physics recognize the contributions of physicists to science, technology, and education through a large number of prizes and awards. Some of these have a history that extends over decades, while others were first awarded in 1998. Of these prizes and awards, members of FIAP might be particularly interested in the following.

The Joseph F. Keithley Award for Advances in Measurement Science. This award, first given in 1998, is for the "development of measurement techniques or equipment that have impact on the physics community by enabling new physics advances through new or significantly improved measurements".

The James C. McGroddy Prize for New Materials is "to recognize and encourage outstanding achievement in the science and application of new materials".

The George E. Pake Prize, which is the only APS prize to specifically mention work in industry, is given "to recognize and encourage outstanding work by physicists combining original research accomplishments with leadership in the management of research or development in industry".

For the award and two prizes above, the deadline for nominations is July 1st of each year.

The Prize for Industrial Applications of Physics. This prize is awarded by AIP every 2 years on behalf of its Corporate Associates "to recognize outstanding contributions by individuals in the industrial applications of physics". Its rationale is to "publicize the value of physics research in industry, to encourage physics research in industry, and to enhance students' awareness of the role of physics in industrial research". The contribution cited in the nomination must have been made while employed in industry, and the application of the contribution must have resulted in a significant industrial development within the ten years prior to the award. The nomination deadline for the 1999-2000 prize is May 31st 1999.

All members of FIAP are encouraged to nominate candidates for these prizes+and awards. Further details of how to do so are on the APS and AIP web pages (http://www.aps.org/praw and http://www.aip.org). If you know someone you believe is worthy of such recognition, please do not hesitate. From my experience on a number of prize committees, I believe that more nominations are always welcome.

An Alternate Point of View

Jeffrey H. Hunt (jeffrey.hunt@west.boeing.com)

I have just finished reading the chairman's last message to the FIAP membership(Ed. What issue was this in?). It seems that there is still a good deal of discussion and confusion regarding the sort of employment physicists can (and should) aspire to when seeking jobs in the non-traditional (pronounced "industrial") sector. Are graduate students to be directed towards areas where skilled technicians are needed? Should we be encouraging universities to de-establish exotic-technical areas in favor of those where jobs are plentiful? What are the special qualities that a physics background can bring to company?

First, I begin with a short note. When, exactly, did industrial labs become non-traditional? If you look back to the applied journals in the 40's and 50's (and even 60's) most of the exciting new developments were not coming from universities and not even from national labs. They were coming from companies. This included the obvious, Bell and IBM. But additionally, Xerox, GE, Hughes, Varian, etc. all had R&D development within their own companies, if not separate divisions all together.

Things changed in the 70's when companies stopped hiring, due to less than optimum economic conditions. At that time, many graduating Ph.D.'s had to abandon their dreams of working in exciting research areas, and were forced to take low paying jobs as professors. There, they spent many years toiling away in poorly equipped labs with untrained students, forced to watch the company-sponsored research labs from the sidelines. (Don't laugh, you'd be surprised how many 50-something physics professors have told me that this privately. At the time, being a professor was the fall-back position in a weak economy.)

But, times change, and, nowadays, only the failed academics are supposed to go to industry. Or, so some grad students and professors have told me.

But, I digress. Coming back to the employment issue, there are some things which every grad student in the business should know, but most professors will not tell you.

Looking to answer rhetorical questions, I always look to the big picture, this time in terms of "educating" physicists. In order to answer the question, you have to start off by looking at the relative skill base and then asking a different question.

Seven undeniable facts:

1. Physicists cannot do electrical engineering as well as electrical engineers.
2. Physicists cannot do chemical engineering as well as chemical engineers.
3. Physicists cannot do mechanical engineering as well as mechanical engineers.
4. Physicists cannot do software engineering as well as software engineers.

5. Physicists cannot do optical engineering as well as optical engineers.
6. Physicists cannot do aeronautical engineering as well as aeronautical engineers.
7. Physicists cannot do mathematics as well as mathematicians.

This brings up a global question. Why the hell would anyone want to hire a physicist?

Answer: Physicists can do 80% as well as the experts on ALL these tasks. Each of the experts' abilities goes quickly to zero once outside their discipline.

If you look, even in my company, there are engineers of many types on many tasks, but the guys at the top are disproportionately Ph.D.s in physics. (OK, there are a couple of engineers and maybe even a chemist.) Why? Because they are the ones who can comprehend the big picture and make sure that all the sub-disciplines are exchanging the right information with each other.

Now, we're ready to address the question. Am I in favor of directing the workforce (using your example) away from optoelectronics and microelectronics and toward rf and microwaves?

Of course not! I'm against physicists being directed to ANY one area of specialization. From the time you leave high school to the time you receive your doctorate will be at least a decade. Sorry, but today's practical growing industry is tomorrow's out of date technical assembly line.

What I do favor is making graduate school what it is supposed to be, an apprenticeship at working independently. Too many students these days do experiments with equipment that is all commercially manufactured. They never learn electrical control and design; they never learn machining. These things are indispensable skills in an industrial environment. If you're being paid the big bucks that industrial physicists make, you're not getting them because you only know how to work with things that already exist commercially. You're being paid to come up with new ideas and adaptations on a daily basis. This is the sort of thing you learn to do if you have a "home-made" project as a Ph.D. dissertation. Even though your experiment may look primitive by industrial standards, the skills you learn stay the same. Only the complexity changes. Put another way, the sophistication and expense of the things that don't work increases.

On the other hand, while in school, I did a measurement in which I

1. Designed the optical system
2. Machined most of the set-up
3. Designed and built the electronics
4. Integrated the system
5. Programmed the (simple) computer controls

Oh yeah, I did a neat experiment too. The truth is, in most cases, no one will give a damn about your thesis 6 months after you leave school. But the abilities that you learn stay with you. Who cares it you have no rf or microwave experience after leaving school? The fact is, a good Ph.D. should be able to hit the library, read up and be able to start making contributions within a few weeks, if he knows what he is doing. Since your schooling should be concerned with making you a generalist, you should be able to come into a scenario that you do not understand at all, get the background under your belt and be able to start to contribute quickly. That is what a Ph.D. is about. It is not about whether you're an expert within some given area of specialization. This is the message that we really should be sending to faculty who are training students. The students have to do things on their own. Even if things are available commercially, they should still go out and do as much as they can from scratch. It's the thing that makes you useful and dare I say, employable, down the line.

The Future Role of FIAP

John M. Rowell, Chair, FIAP

Like any young and growing entity, FIAP is searching for new responsibilities and its role within APS appears to be evolving. We need your help to define our future. In its first few years, one of FIAP's primary concerns was the underemployment of physicists, particularly recent graduates. However, the job situation, at least in a number of industries, has changed quickly from an over-supply to an under-supply of candidates for the positions available. Also, within APS, the Committee on Applications of Physics (CAP), which was actively involved in the creation of FIAP, has now been renamed the Committee on Career and Professional Development (CCPD), and will provide the primary APS focus on employment related issues. Thus FIAP is at a turning point, growing from its initial role and questioning its future.

A factor that is relevant to the future of FIAP is the growing evidence that there is a sizable community of physicists that were not previously identified and hence, were neglected by APS and AIP. The first indication of the existence of this community was the rapid growth of FIAP itself. However, members of FIAP are also members of APS, so at least this part of the community was known to APS. The second indication, much more surprising, is the size and demographics of the readership of "The Industrial Physicist" (TIP). That readership is now over 50,000. Remarkably, only 23% of the readers of TIP also read "Physics Today" (PT). Thus, it appears that roughly 38,000 readers of TIP have either a physics degree, or some active interest in the impact of physics in industry, but they are not members of APS, and are most unlikely to attend any APS meetings. The only contact between APS/AIP and this community, which is more than seven times larger than the current FIAP membership, is through TIP. For them, the "flagship magazine " of physics is not PT, it is TIP!

A recent article in TIP by John Rigden, entitled "The Hidden Physicist", resulted in a far larger number of letters to the editor than any other topic. Unknowingly, John touched a nerve in this 38,000 strong community. (I assume, maybe wrongly, that the 12,000 or so readers of both TIP and PT do not feel that they are "hidden"!).

What has this discovery of 38,000 hidden physicists to do with FIAP? A great deal, it seems to me. The community that FIAP could represent appears to be at least 7 times larger than it does through its current membership. If we could identify the needs of both the present FIAP membership, and its much larger potential membership, clearly we could better define the future role of FIAP.

So FIAP faces two challenges in defining its future. The first is to define how we can best serve our present membership, which has at least some contact to the (as presently defined) community of physicists through APS. But we suspect that many of you that are current members of FIAP do not attend APS meetings, so efforts that go into our activities there (e.g., the symposia arranged at the March meeting) are of value to only a fraction of you.

The bigger challenge is to identify, understand and serve the 38,000 (or more - we have little idea of the true number) physicists that have been discovered as readers of TIP, but have no other contact to FIAP, APS or AIP. Does that community represent a role for FIAP that goes far beyond any we have imagined to date? Of course, the same question can be asked for APS and AIP. Will they serve, or how are they going to serve, this hidden community, that they were not aware of until AIP began the publication of TIP?

We can not effectively define the future of FIAP until we better understand both your needs, as a current member of FIAP, and also the needs of the hidden community. It will take time to discover the characteristics of the 38,000. But as a current member of FIAP, you can easily make your views known to us. The email addresses of the executive committee of FIAP are listed on the masthead of this Newsletter (page 12). Please communicate with us. If you wish to express your opinions through an article in a future edition of this Newsletter. please let us know. If you wish to become actively involved in FIAP, say by running for office next year, do not hesitate. Please take seriously your responsibility to nominate "FIAP Fellows" and your colleagues for APS and AIP Prizes (for details, see elsewhere in this edition). Above all, let us collectively begin to try to discover the broader community of physicists working in industry, and identify our common needs.

Synergy 2010 Concept Car to be Exhibited at APS Centennial

L. C. Davis, Ford Research Lab (LDAVIS7@ford.com)

Adapted from Ford Motor Company publicity material.

Understanding of fluid flow and advanced materials contribute to advancement of automotive design. These are topics that are discussed in this article as well as the upcoming FIAP sessions at the APS Centennial Meeting in March. Experimental 1.0-Liter Engine, Flywheel Provide 'Hybrid' Power

The Synergy 2010 is a "hybrid electric" vehicle, meaning it contains two power sources - usually an internal combustion or gas turbine engine or fuel cell, and a second power source, such as a flywheel or battery.

In the Synergy 2010, a small, 1.0-liter, direct-injection, compression-ignited engine mounted in the rear would power a generator that produces electricity for motors located in each wheel. Up front, a flywheel would collect excess engine and braking energy, which in turn would be released to augment the engine when the car needs to accelerate quickly. In a direct-injection, compression-ignited engine, high pressure is used instead of spark plugs to ignite the fuel, resulting in higher efficiency. Theoretically, the Synergy 2010's performance would be comparable to today's mid-size family sedan because of the concept car's decreased weight, improved aerodynamics and lower rolling resistance.

Lightweight Materials Improve Efficiency

At 2,200 pounds, the Synergy 2010 weighs about 1,100 pounds lighter than a mid-size sedan today. Trimming weight from the concept car with the use of advanced materials also is critical to improving its fuel economy.

All-aluminum unibody construction of the car is the primary contributor to weight savings, cutting about 400 pounds. Components such as the engine, flywheel, radiator and brakes are downsized according to vehicle mass, reducing weight by about 300 pounds.

Ford expects that aluminum could be used in the construction of other key components on the Synergy 2010 - including the suspension and brakes- for additional weight savings. Ford foresees using more high-strength, low-alloy steel and other advanced, lightweight alternative materials, including composites and magnesium, on key components.

Spoilers and 'Air Fences' Manage Airflow

The car's most distinctive design element - the fin-shaped vertical front fenders - begin as 12-inch-high, half-inch-wide light manifolds, then sweep back toward the car's streamlined body to create an air extractor for the cooling system. They also house the rear-view cameras that replace rear-view mirrors, and they function as air management devices - like 'air fences' in Formula One racing - to control the air along the sides. The fenders surround a front bumper that also acts as a spoiler - as in many race cars - to help cut aerodynamic drag and improve fuel economy.

Synergy 2010's coefficient of drag is 0.20. This, along with a reduced frontal area, results in a 40 percent improvement in aerodynamics compared with the most streamlined Ford car, the Taurus. The Synergy 2010 also features an all-glass roof, which is vacuum- coated with layered solar load reduction films that reflect summer heat and retain heat in winter.

Solar cells in the roof power a fan that purges hot air from inside when the car is parked - a technology concept borrowed from Ford's Ecostar electric vehicle demonstration program.

Futuristic Features

Synergy 2010 designers explored other features that could potentially be found on a 2010 family car. They include:

Voice activation:

To maximize spaciousness and minimize information overload, virtually all the electronic controls are voice-activated, resulting in an instrument panel devoid of switches, levers or buttons. The driver monitors the vehicle's operation by checking a display projected onto a glass card from a computerized "sourced image" at the back of the steering wheel. Here, colorful computer animation updates vehicle speed, tachometer, temperature and other functions. Designers also demonstrate how this system could act as a futuristic video answering machine.

A separate liquid crystal message center positioned in the middle of the instrument panel comes alive through voice activation. Here, the driver accesses features such as an advanced navigation system, entertainment system, climate controls - even the Yellow Pages. This message center is flanked by screens relaying video from the rear-view cameras.

Aircraft design:

The steering wheel design resembles an aircraft yoke, with the top third and bottom third of the rim removed, providing the driver an unobscured view of the electronic displays and easier entry and exit.

Left- or right-hand-drive:

Also reminiscent of an aircraft, the car's steering column attaches to a cantilevered arm mounted in the center of the vehicle. This makes the vehicle easily adaptable for manufacture as either right- or left-hand drive.

New seating concepts:

The driver's seat is fixed, but the accelerator and brake pedals adjust up to six inches forward or back. The steering column telescopes. The seat moves vertically and reclines, taking the armrest with it. The driver and front passenger seat also are lightweight, foregoing thick padding for see-through webbing at strategic points, while still providing comfort and support.

Safety features:

The Synergy 2010 features integrated seat restraints, seat belt pretensioning, an automatically retracting rear headrest, an advanced integrated child safety seat and a design that would accommodate future head-and-chest side-impact air bags.

Lighting:

The dramatic front headlights feature high-intensity discharge lighting. Taillamps and turn signals stand out in neon. Projection lighting is featured on the fog lamps.

FIAP Executive Committee

Past Chair, L. Craig Davis, ldavis7@ford.com

The FIAP is the newsletter of the Forum on Industrial and Applied Physics, a division of the American Physical Society. Contributed articles are welcome. Send them to the relevant editor by email.

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