"All the ν's
That's fit to Print"

ΦYAST ΦLYER

The Department of Physics & Astronomy
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Dick Henry, Editor

FROM THE EDITOR

Those of you on our alumni mailing list will notice that along with this edition of the newsletter you have received a postcard soliciting a response. Since a new and updated version of our Department brochure is now available, thanks to the efforts of **Mark Keil**, we thought this would be a good opportunity to see if you would like a copy. Just think. Having the brochure will enable you to look at the pictures of some of the people you read about in the following pages. Or better yet, update the target on that dartboard. In any case, if you would like a copy of the new brochure, please indicate that on the card and drop it in the mail. It costs you nothing. We would also like to know if you want to remain on the mailing list or if there is a change of address that we need to be aware of. And if nothing else, the cards flooding my mailbox will elicit mountains of envy from my colleagues, because they will think they are preprint requests. So let us hear from you. I hope you will enjoy this edition of the newsletter, and have a great fall.

Dick Henry

INFLOW: New Faces Around Nielsen

As usual, the fall semester has brought a number of new faces to the Department. We welcome 10 new graduate students this year: **Olen Boydstun, Fred Brown, Yingxin Chen, Paul Gracey, Erich Hammer, Jason Lonon, Weiluan Ma, Eric Smith, Jason Smith**, and **Zhonghui Zhang.** We welcome **Danette Miller** as an addition to the office staff (she actually began her position last spring). Undergraduates **Angelo DiGennero** and **Kim Schneider** are helping in the computer lab, while **Allen Houston** is Zora's new assistant in the Department library. Several new postdocs have also joined the Department. We welcome **Anna Golitsyna** (Furneaux), **Dean Miller** (Milton), **Bijan Nemati** (Skubic),**Wayne "can't stay away" Trail** (Morrison), and **Shu Yuan** (McCann-MBE).We also welcome two visiting research scientists for brief stays. **Barbara Whitten** from Colorado College is here for the fall working with **Mike Morrison**. Her husband **Skip Morgan**, a physicist with Kinema Research in Colorado, is also working here during the fall. Finally, our newest faculty secretary, who also happens to teach graduate courses and do research in his spare time, is **Kieran Mullen**, whom you'll read about below.

LINDA CHRISTIE TURNS TEN!

Congratulations to Linda Christie, who is celebrating (and the rest of us are, too) her first decade of service to the Department, where she began working July 2, 1984. Shortly thereafter Linda took over the position of administrative assistant, which she has held since. We all have appreciated Linda's consistent effort and her attention to detail. Thanks, Linda!!

DEPARTMENT WELCOMES KIERAN MULLEN

The department and the solid state research group are pleased to welcome **Dr. Kieran Mullen** to Oklahoma. Kieran is a theorist who received his Ph.D. at the University of Michigan and comes to us by way of postdocs at the University of Illinois and the University of Indiana. With his arrival we have doubled the number of theory professors in solid state. Kieran has a broad background in condensed matter research, ranging from device physics and the electronic properties of small (quantum mechanical) structures, through superconductivity, quantum dissipation, and helium films. His wide ranging interests and enthusiasm will help continue the growth of our group of the past few years. He is interested in joining with us in our quest to understand new and bizarre properties of two-dimensional electron systems. Of course he is also sure to establish an active research program on many of his own interests. Kieran is also involved in many aspects of the department beyond just research. He has joined in an impromptu discussion group on teaching physics at the university level. He's excited about new possibilities for improving our curriculum. We have discussed ways to improve the computing power of and access to the Nielsen Hall computer network. Perhaps most importantly, **Maureen O'Halloran** and Kieran have staged a "coffee revolution" in the department that has greatly improved both the quality and quantity of caffeine consumed. Hmmmm, perhaps Kieran's energy and enthusiasm isn't entirely unaided. Over the summer while he was finishing his postdoc at Indiana and preparing for his move here, Kieran found time to get married. His wife, Theresa, is finishing her Ph.D. in Anthropology and Folk Lore. Although she is currently working here, this will require trips back to Indiana and a stay in Ireland for her field work. We wish her much luck in this endeavor, and hope that both Kieran and Theresa will enjoy their life here in Norman.

Bruce Mason

ALUMNI NEWS

Ed Clark (BS86, PHYS) received an MS in EE from Cal Tech. He currently works for AT&T Bell Labs in a forward looking work group doing software and signaling development for broad band/multimedia switching systems. He can be reached at eac@iexist.att.com.

Paul Tay (BS86,PHYS) now lives in Los Angeles, where he has started his own consulting firm, made the U.S. Olympic Development Cycling Team in '88, gotten married and divorced, attended U.S. Marine Officer Candidate School, and done other non-Physics things. "I really miss all the friends I made in Nielsen Hall. I remember being the first Junior to successfully make a hologram." After graduating, Paul never thought he'd set foot again in a physics lab, but he recently visited the University of Davis' Crocker Nuclear Lab, where the enormous cyclotron brought back fond memories of Nielsen Hall. "Though I never want to do a quantum equation, my brother, Peter, is working on his PhD in Math over in the Blender."

Robert L. Carter (BS41, EP) is Professor Emeritus of Electrical and Nuclear Engineering at the University of Missouri-Columbia. He was a student at OU from 1936-1941, when the Department's faculty included J.R. Nielsen, Dick Fowler, Charles Whitmer, J.O. Hassler, Homer Dodge, William Schriever, Arthur Hemmendinger, George Van Lear, and Harvey Roys. Robert served in Australia and New Guinea during WWII before

joining the Manhattan Project in late 1944. After receiving his PhD in Physics from Duke University in 1949, he worked in several different locations before joining the faculty at MU in 1962. Since retiring in 1988 Robert has taught several graduate courses, done some writing, and excelled at grand fathering (and great-grand fathering!).

John Fowler (MS50, PHYS) did his thesis at OU under Bob Howard before moving on to Johns Hopkins, where he received his PhD in nuclear physics in 1954. He was a member of the Physics Department at Washington University in St. Louis from 1954-1964, after which he directed the NSF-funded Commission on College Physics until 1972. Since then, John has worked at a variety of science education tasks. In 1985, he founded the Triangle Coalition, whose stated goal is to make sure that secondary-school graduates possess the knowledge and skills to enter the highly technical workplace, and that all graduates have sufficient understanding of science, mathematics, and technology to live constructively in a modern world. John retired from TC last June and hopes to write on energy and revise his book *Energy and the Environment*, McGraw-Hill, 1984.

Finally, some alumni briefs concerning recent grads. PhDs: **Majed Khodr** is a postdoc in EE at OU; **Lihe Bu** is working as a Program Analyst for Loral Federal Systems, in Washington, DC; **Chuck Hembree** is a Design Engineer for Texas Instruments, Richardson, TX; **Tim Young** is a postdoc at Wichita State University, Kansas; **Doug Miller** is a postdoc at the University of Pittsburgh; **Dean Miller** is a postdoc in Physics at OU; and **Marios Lymberopoulos** will be returning to Greece soon for military service.

MS: **Adam Fisher**, **Joe Howard** and **Pete Nugent** are still at OU on PhD tracks in Astronomy; **Jim Snyder** is working as an actuary in Oregon; **Brian Taylor** is an Astronomical Instrumentation Specialist, Sr. at Northern Arizona University in Flagstaff; and **Francesca Boffi** will be returning soon to Italy to enter a PhD program in Astronomy.

RESEARCH NEWS

* The Keil Group

This past summer we (**Tommy Ericson, Kyle Copeland** and **Mark Keil**) completed the development and characterization of our atomic fluorine source. With expert help from the instrument shop, this source has proven to be astonishingly intense, and also very easy to use---aside from occasional leaks of fluorine, we are surviving very well! Soon, however, we plan to burn just about anything that we are foolish enough to stick in front of the beam. In particular, we will shortly be trying to etch highly resistant materials like diamonds, so if you have any that you'd like to vaporize, please feel free to donate a few!

We are currently completing development of a variable-energy molecular hydrogen source to react with the fluorine (a reaction that is VERY fast) so that we can (hopefully) begin preliminary reactive scattering experiments this Fall. The atomic source has been submitted by Mark Keil and **Joel Young** to the University as an "invention disclosure", and the University may pursue a patent application for it. An early description of the source is given in a paper to be published in the Review of Scientific Instruments (November 1), entitled "Fluoride Salts as Supersonic Nozzle Materials for Hot Fluorine" by Tommy Ericson, Kyle Copeland, Mark Keil, Y. Apelblat, and Y. B. Fan.

In a collaborative application with **Greg Parker**, Mark Keil has received an NSF grant for experiments in reactive scattering ($91,000 per year

plus $60,700 for first-year equipment). Thus we are actively looking for a Research Associate (an advertisement will appear shortly in Physics Today) and a Graduate Research Assistant. And maybe we'll have some loose change left for diamonds!

Mark Keil

* HEP

The OU High Energy Physics group is working on two major colliding beams experiments. The CLEO experiment, which uses electron-positron beams, is continuing under the leadership of **Pat Skubic** while the other experimentalists (**George Kalbfleisch, Phil Gutierrez**, and **Dave Kaplan**) have joined the D0 experiment at Fermilab, which uses proton-antiproton beams. The CLEO experiment is located at Cornell University and has produced many new results over the past year, including more than 15 publications. Graduate student **Xu Fu** presented, at the APS Division of Particles and Fields (DPF) conference, the current CLEO result (the world's best) on the CKM mixing parameter Vcb which determines the mixing between the charm and bottom quarks. Pat Skubic also presented results at the DPF conference on B meson decay which seem to indicate that the high mass of the b quark may lead to elegant simplicity in calculations of B decay properties. Postdoctoral Research Assistants **Bill Ross** and **Bijan Nemati** have also been invited to give talks on new CLEO results at conferences in France and Italy. Graduate student **Mark Wood** is making progress on his thesis on the measurement of inclusive B to D meson decay. The CLEO group is involved in silicon detector construction for the planned upgrade of the CLEO detector. We expect new graduate students including **Steve Richichi, Qingdong Ge**, and **Kevin Sullivan** to be actively involved in this exciting and challenging hardware project.

Pat Skubic

* SOLID STATE

First, we had a very productive summer. We got lots of very good data indicating that there is a metal-insulator transition in a 2D electron system contrary to the conventional wisdom given by famous physicists such as the 1977 Nobel Prize winner P. W. Anderson of AT&T Bell Labs and Princeton. We are continuing to study this system intensively. This work has lead to five presentations at three international conferences this past summer. I gave the presentation at the International Conference on the Physics of Semiconductors in Vancouver, Canada. My postdoc **Serguei Kravtchenko** gave one presentation and my student **Whitney Mason** gave the other at the 11th Conference on High Magnetic Fields in Semiconductor Physics. The two presentations given at the Symposium of high Magnetic Field Physics in Nijmengen, The Netherlands were given by our English collaborators.

I have also been named to the User's Committee of the Francis Bitter Magnet Laboratory at MIT. Besides the two conferences on the Physics of Semiconductors, I attended the Second International Conference on Intelligent Materials in Williamsburg, VA.

My grant "Dimensionally Self-Regulating Materials" to study the infrared properties of confined electronic systems in semiconductors from the Army Research Office was renewed through DoD EPSCoR. It is for $300,000 for three years with $75,000 match from the state regents. This is a collaborative project with Bennett Goldberg of Boston University. This summer we were very happy to have **George Bowker** from Bowdoin

College working with us. This continues the connection which has been going on for some years. Serguei gave talks at Princeton, Yale, University of Utah and U of Minnesota on the 2D Metal insulator transition which has generated a lot of interest. Francois Peters of the University of Antwerp, a very well known and respected theorist in this area, remarked that this work was the most interesting presentation at the International Conference of Semi Physics, in Vancouver.

John Furneaux

* ASTRONOMY

Encouraging developments regarding the campus observatory have taken place recently. Under the direction of **Tibor Herczeg**, library student Tanya Bresinsky has begun to catalog the holdings of the campus observatory library, starting with periodicals such as Pyeryemyenniye Zvyezdy (Russian, more or less, for Variable Stars), the Bulletin of the Astronomical Institutes of Czechoslovakia, and the Information Bulletin on Variable Stars. The usefulness of the observatory's archive of more than 10,000 photographic plates has been improved thanks to student **Christie Wilson-Blankenship**, who, under Tibor's direction, has written a computer program that provides a list of the plates that cover any specified position on the sky. By early next year a modern campus telescope will have replaced the venerable 10-inch reflector which has served students and the public far above and beyond the call of duty. The new telescope, a 16-inch reflector to be purchased with funds coaxed by **Bill Romanishin** from University sources and from the National Science Foundation, will be more powerful and much easier to use. In response to just a few keystrokes the computer controlled telescope will promptly point to any desired direction on the sky. As soon as the telescope is up and running we will expand our program of public and school viewing nights with the cheerful help of student "volunteers". Bill Romanishin and graduate student **David Minard** continue to analyze images of galaxies taken in infrared light using a state of the art infrared imaging system at the National Optical Astronomy Observatory near Tucson, Arizona. Bill continues to use an image modeling code he wrote to study the host galaxies of quasars and other galaxies with active nuclei. This work has led to Romanishin being co-author on several papers with 10 to 60 co-authors, many of whom Bill has never met!

John Cowan's project with Chris Sneden (Texas) and Jim Truran (Chicago) on the Hubble Space Telescope is underway, data having been obtained in September and now being analyzed. They are using the grating high-resolution spectrometer to look for absorption lines of very heavy elements such as Pt, Ir, Os and Rh in a particular old, metal-deficient, giant star in our Galaxy's halo.

A team of astronomers of which **Dick Henry** is a member obtained new HST images of the Crab Nebula in April. The images will be used to locate prime target regions for subsequent spectrophotometric HST observations. Then Dick and Gordon MacAlpine (Michigan) will work on determining chemical abundances in this rather enigmatic remnant of the Galactic supernova of 1054 AD.

The Supernova Intensive Survey, of which **David Branch** is a member, continues to use the HST to follow the evolution of SN 1987A in the Large Magellanic Cloud as well as three recent bright events including SN 1994I in M51, the Whirlpool galaxy.

Recent research trips by OU astronomers include an August visit by Tibor Herczeg to the Bamberg Observatory where he worked with Horst Dressel to construct three-body orbits for the stellar components of the x-ray source Hercules X-1.

Dick Henry spent a week in June at the Observatoire de Paris, reducing spectrophotometric data on H II regions in two spiral galaxies in the cluster Abell 262. Data were obtained with the Canada-France-Hawaii Telescope (CFHT) by Dick and his Parisian collaborator, Chantal Balkowski. They are looking for evidence of environmental effects on spiral galaxies in clusters by measuring abundance patterns of O, N, and S across the disks and comparing with results of similar studies of spirals that are not in clusters. They have more observing time at the CFHT during the last week of October to finish the A262 phase of the project. Dick also visited Williams College to continue working with Karen Kwitter on carbon abundances in planetary nebulae. Dick and Karen are collecting spectra obtained by the International Ultraviolet Explorer (IUE) of selected planetaries, remeasuring the carbon emission line strengths, combining their measurements with available optical line measurements, and determining abundances of C, N, O, Ne, and S. They are looking for correlations between carbon and other elements, to learn about nucleosynthesis in stars of intermediate mass. Then graduate student **Jim Buell** will apply his theoretical stellar modeling to predict chemical yields for comparison with the abundance patterns.

Eddie Baron claims that when he visited his cohort Peter Hauschildt at Arizona State University this summer, they managed to do a year's work in four days! (Oh how a good lawyer could turn that statement on its head.) Their project on modeling supernova atmospheres, calculating spectra, and determining distances to supernovae by means of the expanding photosphere method received a big boost when they upgraded their fully relativistic radiative transfer code to enable it to include a huge number of spectral lines of singly ionized iron without making the approximation of local thermodynamic equilibrium. Now the limiting factor in Eddie's ability to model supernova atmospheres and spectra has become computer power, and steps are being taken to remedy the situation. Until recently Eddie has been concentrating primarily on the spectra of Type II supernovae (those having hydrogen-dominated atmospheres) and Type Ic supernovae (those dominated by helium, carbon, and oxygen). The new capability to treat iron now motivates Eddie and graduate student **Peter Nugent** to apply the code even to Type Ia supernovae, whose atmospheres are dominated by iron-peak elements.

There has been incoming traffic, too. Mike Edmunds (Cardiff) was here in September to begin writing a paper with Dick Henry and graduate student **Tad Thurston** on nitrogen abundance patterns in spiral disks. Tad has developed an improved algorithm for determining nitrogen abundances in H II regions, and his techniques will be used to revise nitrogen abundances in H II regions in a large sample of spiral galaxies. Grant Matthews (Notre Dame) also was here in September, to use Dick Henry's observational data to constrain models of the chemical evolution of the Galaxy as developed by Grant and John Cowan. As part of a joint project with Andy McWilliam and George Preston (Carnegie Observatories) John Cowan and graduate student **Debra Burris** are analyzing the spectrum of a metal-deficient halo star. John and graduate student **Chris Eck** have been reducing radio data John obtained at the Very Large Array to look for radio emission from the Type Ia supernova 1986G. In a recently submitted paper graduate student **Francesca Boffi** and David Branch have proposed that deep radio observations could test the idea that a Type Ia supernova is the explosion of a white dwarf that accretes matter from the wind of a companion red giant star. David continues to work with students and colleagues toward a better understanding of supernovae and a refinement of their use as distance indicators for cosmology. Strangely enough, perhaps, he is becoming interested in the effects of supernovae on whatever life may be in their vicinity. It has been speculated, for example, that past supernovae as far away from Earth as 30 light years may have had disastrous consequences for both land and marine life as a consequence of temporary destructions of the ozone layer by supernova gamma rays and cosmic rays. David would welcome correspondence on this fearsomely interdisciplinary subject.

David Branch

* THE ATMOSPHERE GROUP

A balloon-borne x-ray spectrometer was developed during the last spring semester. One flight of this instrument was made during VORTEX, a tornado field research project that took place in April, May and June in OK, TX, KS and NE. Ground based testing and measurements were done in NM at Langmuir Laboratory for Atmospheric Research this past summer. Additional balloon flights are planned during VORTEX 95 which will take place this spring.

Ken Eack

THE PAPER CHASE

"Modeling and interpretation of the optical and HST UV spectrum of Supernova 1993J," ApJ, 426, 334 (1994), by E. Baron, P.H. Hauschildt, and D. Branch.

"Convergence properties of the accelerated lambda-iteration method for the solution of radiative transfer problems," Journal of Quant. Spectroscopy and Radiative Transfer, 51, 875 (1994), P.H Hauschildt, H. Stortzer, and E. Baron.

"Finite-element time evolution operator for the anharmonic oscillator", Kim Milton, to appear in Proceedings of Harmonic Oscillators II, Cocoyoc, Mexico, March 1994.

"Finite-element quantum electrodynamics," Kim Milton, Dean Miller and Stephan Siegemund-Broka, in Proceedings of the International Europhysics Conference on High-Energy Physics, Marseille, July 1993, eds. J. Carr and M. Perrottet, Editions Frontiers, Gif-sur-Yvette, 1994, pp. 225-226.

"Effects of nonparabolicity on gain and current density in lead salt semiconductor quantum-well lasers", Proceedings of the International Quantum Electronics Conference 1994, 153 (1994), M.F. Khodr, B.A. Mason, and P.J. McCann.

"Production of heavy elements in homogeneous cosmologies," by T. Rauscher, J. Applegate, J. Cowan, F. Thielemann and M. Wiescher in Ap J, 429, 499.

"Ablation of skin tissue by holmium: YAG Laser", Wei R. Chen, Andrew Holt, and R.E. Nordquist, in Proceedings of Laser-Tissue Interaction V.

"How to calculate rotational and vibrational cross sections for low-energy electron scattering from diatomic molecules using close-coupling techniques", Mike Morrison and Weiguo Sun., a chapter in a book entitled Computational Methods For Electron-Molecule Collisions, edited by W. Huo and F. A. Gianturco (Plenum, 1994)

"Hall Insulator in a Two-Dimensional System in Silicon in the Extreme Quantum Limit", Kravtchenko, S. V. and Furneaux, J. E. and Pudalov, V., Phys. Rev. B, R.C., 49, 2250, 1994.

"Hall Insulator in a Two-Dimensional System in Silicon in the Extreme Quantum Limit", Kravtchenko, S. V. and Furneaux, J. E., and Pudalov, V., Bull. Am. Phys. Soc.", 39, 804, 1994.

"Anomalous Resistance Drop in {Si} Inversion Layers below 1 K", Kravtchenko, S. V., Kravtchenko, G. V., Furneaux, J. E., Pudalov, V. M., and D'Iorio, M. Bull. Am. Phys. Soc., 39, 804,1994

POSTER PRESENTATIONS

"Hall Insulator in a Two--Dimensional electron system in Silicon in the High-Field Extreme Quantum Limit", Kravtchenko, S. V., Furneaux, J. E., and Pudalov, V. 11th International Conference on the Application of High Magnetic Fields in Semiconductor Physics, Cambridge, MA., Aug. 1994.

"Insulator-Metal-Quantum-Hall-Effect Transition Induced by Temperature", Mason, Whitney, Kravtchenko, S. V., and J. Furneaux, 11th International Conference on the Application of High Magnetic Fields in Semiconductor Physics, Cambridge, MA, Aug. 1994.

"Anomalous Resistance Drop in Si Inversion Layers below 1 K", Kravtchenko, S. V., Kravtchenko, G. V., and J. E. Furneaux, 22d International Conference on the Physics of Semiconductors, Vancouver, Canada, Aug., 1994.

"Temperature Induced Insulator-Metal-QHE Transitions", Kravtchenko, S. V., Mason, Whitney, and Furneaux, J., 4th International Symposium on Research in High Magnetic Fields, Nijmegen, The Netherlands, Aug., 1994.

"Hall Insulator in Silicon Inversion Layers in High Magnetic Field, Kravtchenko, S. V. and Furneaux, J. E., 4th International Symposium on Research in High Magnetic Fields, Nijmegen, The Netherlands, Aug., 1994.

John Walkup presented a poster on the use of dimensional perturbation theory for finding energy levels of diamagnetic hydrogen at the International Conference of Atomic Physics in Boulder, CO

COLLOQUIA, INVITED TALKS, SEMINARS

"SN 1993J: One Year Later", Ed Baron, Invited talk, Physics of Supernovae, in honor of Sterling Colgate, Franklin Institute, Philadelphia, PA, April 7, 1994.

"Anomalies in Finite-Element Lattice Gauge Theories", Kim Milton, IITAP, Iowa, September 8.

"Type Ia Supernovae as Distance Indicators for Cosmology", David Branch, Instituto Astrofisica de Canarias, June.

"Loose View graphs", David Branch, 3rd meeting of SINS (Supernova intensive Study using the HST), in Georgetown, Maine, June.

"Supernovae as Distance Indicators for Cosmology", David Branch, 7th Marcel Grossmann Conference on General Relativity, July.

"Heavy Element Abundances in Very Low-Metallicity Stars", John Cowan, at the meeting of Particle and Nuclear Astrophysics and Cosmology in the Next Millennium, held at Snowmass, Colorado, July.

TEACHING NEWS

This semester, **Bill Romanishin** is teaching a "Topics in Astronomy" course to about 10 undergraduate majors called "Introduction to Computers in Astronomy". The course is mostly a collection of assignments and projects that students complete using the UNIX research computers in the Department, with minimal "lecturing". Topics range from basic concepts of computing to using the "Information Superhighway" to obtain information such as the latest images from the Hubble Space Telescope. Bill also spent the summer at Flagstaff, serving as the director of a Research Experience for Undergraduates (REU) program funded by NSF. Astronomy students from across the country spent the summer in the REU program at Northern Arizona University (NAU) and Lowell Observatory. Bill and his family enjoyed Flagstaff, which is really cool, and Bill's wife Janet was able to teach flute at the NAU Summer Music Camp where she was a student some years ago.

Later in the semester, **Mike Morrison** will be running the first-ever (only?) Introductory Mathematica Workshop, which will be held in the PC lab. This will evolve into the first ever OU Mathematica User's Group,which Mike hopes will meet once a month. Because the PC lab has a very limited number of spaces, the Workshop is only open to faculty and grad students who are real novices with Mathematica; the User's Group is open to all who are interested. Information will magically appear in faculty and grad student mailboxes soon.

Enrollment appears to be up for Phys 2414 this term! **Bill See** operates a video camera to put **Mark Keil** in two places at the same time---the main lecture hall in Room 211 and the adjacent cosier Room 209 together accomodate 200+ students. So far the arrangement seems to work reasonably well; **Grettie Bondy** has tried her best to balance the discussion sections so that they also fit into Room 209 and our TA, **Olen Boydstun**, doesn't have to develop a split personality.

Kim Milton is teaching graduate Electrodynamics I this semester, using a manuscript he co-authored 15 years ago with the late Julian Schwinger. Kim hopes to turn this original approach to a familiar subject into a textbook.

* The God Father Plan II (from Mike Morrison)

Several years ago, Dick Henry and I developed an approach to teaching upper-level undergraduate physics and astronomy courses based on a number of what we later learned are called (in the education biz) "active learning" techniques. During the intervening years we both explored a variety of such techniques in courses at other levels (and, in my case, in my courses on "Science in Contemporary Culture").

After some discussions this summer, we decided that the time was right for us to spend a semester in more focused discussion and development of the method. The intent of such approaches is to shift the focus of course activities away from the conventional mode, in which the instructor is the

active member and focus of all class meetings (except examinations) while the students are passive (listening, taking notes, etc.).

The alternative mode is one in which the students are active participants in every class meeting and the instructor serves as a combination guide and consultant---directing students to important material, useful problems, other resources; answering their questions; helping them assess their progress and identify holes in their learning that must be filled before moving on from one topic to the next, etc.

A further extremely high priority in our development of this plan is ensuring a continual flow of feedback every class period between the students and the instructor so the latter can follow in "real time" the students' progress and problems and can respond to those difficulties immediately. (In more traditional teaching methods, problems typically emerge during one of a few hour exams or during the final---by which time it's usually too late to do anything about them.) Consequently students are continually submitting various kinds of materials and receiving written (and, sometimes verbal) feedback about their work.

The core of this method is student activity in small "working groups" consisting of from 3 to 6 students. These groups work together through the semester in class (and are encouraged to do so outside of class) on a wide range of activities, including discussion of questions each student generates as he or she initially studies the material, working on homework problems and/or class projects, and doing "workshop" problems individually and in groups, etc.

In the current incarnation of this method, which both Dick and I are using in courses this semester, the course material is divided into several units, to each of which we devote three class meetings. The first day focuses on the students' initial experience of the material-it includes a short reading quiz designed to see whether everybody picked up the major topics, a brief contextual overview by the instructor, a review of questions students write down as they study the material and submit at the beginning of the period, and open discussion of these questions (led by the students) either by the class as a whole or in working groups. The second day is devoted to helping the students with homework and/or computer problems assigned for that unit. Most of this work is done in the working groups, with the instructor kibitzing, answering questions, helping individuals or groups that are stuck, etc. On the final day of each unit the class does a Workshop Problem designed to wrap up the unit by assessing each students' comprehension of key points, concepts, techniques, etc. Each student works this problem twice: once individually, then as a member of his or her working group. Students hand in and receive credit for both their individual solutions and the group solutions. One of the most exciting occurrences in these workshops is the occasional problem that no one in a group can do individually but that the group as a whole manages to solve.

Fortunately, this year our discussion group for active learning in physics has expanded to include our newest faculty member Kieran Mullen and (during the Fall semester), a visitor to my research group, Barbara Whitten from Colorado College. This group meets once every two weeks (at Godfather's restaurant---hence the name) to critique the plan, explore alternatives, and brainstorm new approaches. (On alternate weeks, Dick and I meet to deal with more specific issues and problems.) This work overlaps the responsibility Kieran, Dick, and I share as the members of the Department's Subcommittee on Teaching Effectiveness.

VISITORS

This semester Barbara Whitten and Skip Morgan are visiting the Department and are being hosted by Mike Morrison. They will return sometime in

1995 (dates to be set).

Carl Bender, Washington University, visited Kim Milton on May 6.

Grant Matthews, LLNL and Notre Dame, visited John Cowan in mid-September.

Mike Edmunds, Cardiff (Wales), visited Dick Henry in mid-September.

Jim Truran (Chicago) and Friedl Thielemann (Basel) visited John Cowan in September.

SUMMER RESEARCH TRAVEL

Kim Milton spent 2-1/2 weeks at UCLA in August. Kim attended the First Workshop of the International Institute of Theoretical and Applied Physics, Ames, Iowa, September 7.

Mike Morrison spent the month of June at JILA in Boulder working again on research on orientation and alignment theory in electron scattering from sodium (with **Wayne Trail,** Barbara Whitten) and on scattering of rare-gas atoms with two-valence-electron Rydberg atoms (a project initiated during his sabbatical and involving Steve Leone and, at OU, **Bill Isaacs**).

In June **Adam Fisher** and **David Branch** visited the Instituto Astrofisicade Canarias for a week. In July Adam Fisher visited the U. of Texas for a week. In June and again in August **Thomas Vaughan** visited LBL for a week at a time.

Dick Henry traveled to Paris, France, and Williamstown, Massacheusetts, to work with collaborators during the summer.

GRANTS AWARDED

"Quantitative Analysis of Supernova Ultraviolet Spectra", **Ed Baron**(co-PI) and **David Branch** (PI), $65,000, NASA.

"Low-disorder two-dimensional electron systems in InSb", **Mike Santos**, $90,000 for 3 years from NSF.

"Scattering Processes Involving Low Energy Electrons", NSF, **Mike Morrison** and group.

"Simultaneous Measurements of X-rays and Electric Fields in Thunderstorms", **Ken Eack**, Physics; William Beasley, School ofMeteorology/Physics Adjunct; and Dave Rust, NSSL/Physics, $38,333.

"UV Spectroscopy and Imaging in the Crab Nebula", **Dick Henry**, Space Telescope Science Institute, $10,000.

TWO ASTRONOMICAL SPECTACULARS

Two interesting astronomical events, visible from the US, have occurred so far during 1994: (1) the annular (ring like) eclipse on May 10; and(2) the collisions between the fragments of the Comet Shoemaker-Levy 9 during the second half of July. The annular eclipse offered a very nearly complete ring as seen from Norman, but for everybody who looked at it, it proved a rare and unusual visual occurrence. Just north of Norman in the NE and NW sections of Oklahoma City, the ring was just barely closed while farther north it became truly spectacular. On the Norman campus we established two observing stations. Near the Observatory the Questar was set up by senior astrophysics student **John Hammond**, showing the sun through the solar filter, while at the north end of the South Oval, close to the Bizzell monument, **Christina Reeves-Shull** and **Robert Shull**, graduate students, demonstrated the eclipse using a projection of the solar image behind the Cassegrain focus of their 8" reflector. An estimated 130 persons observed this "nearly annular" eclipse from the two stations. The weather was fully cooperative. Since observing conditions improved toward the north, our graduate student **David Minard** moved his 8" Meade telescope to a site in Indiana, where the central line of the eclipse passed "over the living room" of his sister. He brought back a series of picture-perfect photographs, showing the eclipse from lunar ingress to egress in its whole course.

A sensational and truly unusual occurrence, a first in astronomical history, was the impact of Comet Shoemaker-Levy 9 with Jupiter. This comet was very unusual, since it was captured in an orbit around Jupiter and not just thrown into a different orbit by the large planet's perturbing effects. To the delight of the astronomers, this comet was attracted into an impact on Jupiter; since Jupiter broke up the comet into at least 20 fragments, a series of impacts was to be expected and very accurately calculated in advance. Most impacts were less favorably observed from the Western hemisphere, since it was usually daytime there. We assembled a small "scouting party" at the Observatory near the time of the first impact (Fragment A) on the evening of July 16. No one really did know what to expect, and we missed the phenomenon, which was a fast-rising and fast fading light-point, a distant fireball behind the illuminated part of the planet. Perhaps we did not watch Jupiter continuously enough around the time of impact. The impacts were hardly suited for observations through small telescopes. On the other hand, the impact left a string of visible scars across Jupiter's disk which remained observable for weeks; this was another surprise. Although the observations were not at all easy, several of our students, in addition to amateur observers, have seen the scars during the following two weeks. Elsewhere, astronomers acquired a number of spectacular images of Jupiter taken with the Hubble Space Telescope, and ground-based infrared instruments in Australia and Spain. They will certainly prove useful for future lectures.

Tibor Herczeg

SCRATCHPAD

The effects of the generally larger solar zenith angle of late may be seen all over Norman right now. A casual walk down the South Oval reveals the resplendent display of chrysanthemums that I look forward to seeing every year. I often toy with the idea of requiring my fall students, no matter the class, to spend some time observing them. But then, how would I enforce that assignment? Require a TA to stand down there and check off names as students come by? At the same time, seeing the flowers often tempts me to enroll in a botany class, or at least go across and talk to a friend of mine in botany, and get to know more about flora. But then I'm afraid it would only ruin the fall display of mums for me. No longer could I look at them without thinking about the chemical structure of chlorophyll, or the function of phloem. Like recently when I went hiking in the Pecos Wilderness in northern New Mexico. Despite the exhilarating surroundings and clear blue skies on the first day, after only a few hours away from my office the fluttering green aspen leaves were nothing but hundreds of harmonic oscillators flashing at me. The rushing mountain streams were

mechanics problems on conservation of energy. By the second day I had experienced a welcomed Gestalt switch, and I now viewed things in a more Wordsworthian fashion. But still, it was an unnerving experience. Sometimes, perhaps, we pay a heavy price for "knowledge". And anyway, do we really need to know why we have Fall to appreciate it?

Dick Henry