

PHYAST FLYER

"All the v's

That's fit to Print"

The Department of Physics & Astronomy

The University of Oklahoma

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LIN SYMPOSIUM UPDATE

The Department invites you to attend a symposium in honor of Professor Chun Lin on the occasion of his 70th birthday, and to celebrate the inauguration of the "Lin Graduate Research Fellowship". The symposium is scheduled for Friday and Saturday, October 13-14, 2000, at the University of Oklahoma in the new addition of Nielsen Hall.

The program of the symposium will include invited lectures Friday afternoon, Saturday morning and Saturday afternoon, a banquet Saturday evening, and a public lecture Friday evening by Dr. Neal Lane, the Science Advisor to President Clinton. Invited speakers include Richard Anderson, Wilmer Anderson, Eldon Ferguson, Don Johnson, Mark Pederson, Paul Menzel, Richard Quade, Jerry Soloman, A.T. Stair, and Thomas Winter. An open poster session will be offered Saturday for contributed posters.

Please contact the Physics office (1-800-522-0772 Ext. 3961) or e-mail Linda Christie (christie@nhn.ou.edu) if you would like a registration form and hotel information.

SEARCH AND FIND: *Four New Faculty To Join Department*

After a breathtaking winter of interviews and colloquia, the Department has hired four new faculty members, two each in High Energy and Astrophysics. In High Energy, next fall we will be welcoming Chung Kao a phenomenologist who is currently a Visiting Assistant Professor at the University of Wisconsin, Madison. Also, Brad Abbott is a High Energy experimentalist, currently working at Lawrence Berkeley Lab. The Astrophysics group will be welcoming Yun Wang, a cosmologist who is currently a Visiting Assistant Professor at Notre Dame, and Karen Leighly from Columbia University, where she is currently an associate research scientist. Karen's interests center on active galactic nuclei and massive black holes. Look for a more detailed resume of each of these new faculty members in the fall issue of the newsletter.

NIELSEN HALL ADDITION NOW ON-LINE

After nearly two years of construction, our new, west-end addition to Nielsen Hall has opened for business. The new annex contains a 226-person lecture hall on the ground level and a 310-person lecture hall on the second-floor level. In addition, it has a new woodshop area (with a new loading dock) to replace the space taken by a hallway which bisects the old instrument-shop area, as well as a new lecture-demonstration preparation and storage facility. For the last month of the spring semester we were able to teach large lecture sections in the new hall to see how things were going to work. Although the extensive audio-visual equipment only became operational after classes had ended, we did get to use the magnificent new blackboard system designed after the University of Colorado's "Bartlett" boards and constructed in our instrument shop. We feel very lucky to have such a magnificent new teaching facility and are pleased with the architect, the contractor, and the University's representatives for a great job and for giving us so much input. We are very grateful to President Boren for his strong support of the project and look forward to his accomplishing phases II (faculty office addition) and III (old Nielsen Hall renovation) in the near future. If you are around Norman, come to take a look!

AWARDS AND PRIZES

The annual spring awards at OU have been handed out, and once again the Department has garnered its share. On April 18, David Branch was awarded a Presidential Professorship, making this the fifth year in a row that one of our faculty members has received this distinction. Since the PP has been in existence for only five years, we are batting 1000! In addition, Mike Strauss received an Amoco Good Teaching Award, quite an honor for just a punk Assistant Professor!

The Department's own awards ceremony was held on April 27, and the following undergraduates were honored. In Physics & Astronomy, Julia Suggs was awarded the C. Richard Quade Scholarship, while Kara Chiodo, Jason Collier, Geoffrey Lovelace, Sylwester Ratowt, Bradley Sinor, Matthew Szabo, and Mark Trosper Jr. each received a J.C. Karcher Scholarship. Matthew Szabo was given the Homer L. Dodge Award for Outstanding Scholarship in the 2nd program year in Physics & Astronomy, while Sylwester Ratowt and Zoe Siloti each received the Duane E. Roller Award for Outstanding Scholarship in the 3rd year. Ty Nance was given the J. Clarence Karcher Award for Outstanding Scholarship in the 4th or higher year.

In the area of Engineering Physics, the Roy Adams Scholarship went to Joseph Milton, the Keys Undergraduate Scholarship was won by Lance Oelke, while the Cuba & Ted Webb Scholarship went to Grant Biedermann. J.C. Karcher Scholarships in Engineering Physics also went to Ben Dribus, John Ehrhart, Jack Franklin, Jeremy Graham, James Hilty, and Timothy Nall. The Homer L. Dodge Award for Outstanding Scholarship in the 2nd program year was given to Benjamin F. Dribus, the Duane E. Roller Award for Outstanding Scholarship in the 3rd program year went to Grant W. Biedermann, and the J. Clarence Karcher Award for Outstanding Scholarship in the 4th or higher program year was presented to

Michael A. Ball.

Finally, the Fowler Prize for the Outstanding Senior (P&A or Engineering Physics) went to Tom Farrar and Ryan Ciolli.

Congratulations to all these students and faculty!

CLOSER TO THE GOLD WATCH

Four Department staff members were recently recognized for their extensive service to OU. Bob Littell, who works in the shop, has been with OU for 20 years. Linda Christie of the front office has completed 15 years, while Danette Loyd, also of the front office, and Bill See, who manages the lecture demonstrations and equipment, have each been at OU for 10 years. Congratulations to all four of you for your much appreciated service to the Department!

ON THE DEFENSE

Five students successfully defended their PhD dissertations this year. Names (advisors) and titles follow:

Ted Mansell (Ryan): "Electrofication and Lightening in Simulated Supercell and Non-Supercell Thunderstorms". Ted is currently an NRC Postdoctoral Associate at the National Severe Storms Lab in Norman.

Steve Richichi (Scubic): "Inclusive Production Of Charged Kaons from B Mesons In $Y(4S)$ Decays".

Adam Fisher (Branch): "Direct Analysis Of The Spectra Of Type Ia Supernovae". Adam is a Software Engineer for Telos Federal Systems at the Ft. Sill Military Post, Lawton.

Jackie Milingo (Henry): "Sulfur Abundances In The Milky Way Disk From Peimbert Type II Planetary Nebulae". Jackie has accepted a two-year position as Visiting Assistant Professor at Gettysburg College, where she will begin in August.

John Walkup (Watson): "Branch-point Structure And Energy Level Calculations Of Diamagnetic Hydrogen Using Dimensional Perturbation Theory".

WELCOME RAMIN ABOLFATH

Ramin Abolfath joined the Department as a postdoc for Kieran Mullen in the fall. Originally from Iran, he comes to us from the Hoosier Physics Mafia at Indiana University.

PHI BETA KAPPA

In March, physics majors Ty E. Nance, Carl Fredrik Carlsson, Eric Andrew Wolf, and John Thomas Farrar were elected to membership in Phi Beta Kappa. They were inducted into the Society in a ceremony on April 26. At the same event, Dick Henry was inducted as an honorary member.

PAPER CHASE:

Recent Publications In Print

"Semiclassical perturbation theory for two electrons in a D-dimensional quantum dot," Phys. Rev. B, 61, 4958 Feb. 2000, B.A. McKinney and D.K. Watson.

"Evidence of Multiple r-Process Sites in the Early Galaxy: New Observations of CS 22892-0521", Christopher Sneden, John J. Cowan, Inese I. Ivans, George M. Fuller, Scott Burles, Timothy C. Beers, and James E. Lawler ApJ Letters, 533, L139

"Massive Multi-species, Multi-level, NLTE Atmosphere Models of Novae in Outburst", C. I. Short, P. H. Hauschildt, and E. Baron, Ap. J., (1999), 525, 375--385.

"On the High--Velocity Ejecta of the Type Ia Supernova 1994D", K. Hatano, D. Branch, A. Fisher, E. Baron, and A. V. Filippenko, Ap. J., (1999), 525, 881--885.

"The NextGen Model Atmospheres Grid: II. Spherically symmetric model atmospheres for giant stars with effective temperatures between 3000 and 6800 K", Ferguson, E. Baron, and D. Alexander, Ap. J., (1999), 525, 871--880.

"Direct Analysis of Spectra of the Type Ic Supernova 1994I",. Millard, D. Branch, E. Baron, K. Hatano, A. Fisher, A. V. Filippenko, R. P. Kirshner, P. M. Challis, C. Fransson, N. Panagia, G. Sonneborn, N. B. Suntzeff, R. V. Wagoner, and J. C. Wheeler, Ap. J., (1999), 527, 746-756.

"Spectral Models of the Type Ic SN 1994I in M51",E. Baron, D. Branch, P. H. Hauschildt, A. V. Filippenko, and R. P. Kirshner, Ap. J., (1999), 527, 739--745.

"Metallicity Effects in NLTE Model Atmospheres of Type Ia Supernovae", E. J. Lentz, E. Baron, D. Branch, P. H. Hauschildt, and P. Nugent, *Ap. J.*, 530, (2000), 966--976.

"Numerical Solution of the Expanding Atmosphere Problem", P. H. Hauschildt and E. Baron, *Jour. of Computational and Applied Mathematics*, 109, (1999) 41--63.

"The r-Process Enriched Low-Metallicity Giant HD 115444", J. Westin, C. Sneden, B. Gustafsson and J. J. Cowan, *Astrophys. J.*, 530, 783 (Feb. 20, 2000)

"Evolution of the Light Echo of Supernova 1991T", W. Sparks, F. Macchetto, N. Panagia, F. R. Boffi, D. Branch, M. Hazen, and M. Della Valle, *Astrophys. J.*, 523, 585 (1999)

"Determination of the Hubble Constant Using a Two-Parameter Correction for Type Ia Supernovae", R. Tripp and D. Branch, *Astrophys. J.*, 525, 209 (1999)

"High-Velocity Ejecta of the Type Ia Supernova 1994D", K. Hatano, D. Branch, A. Fisher, E. Baron, and A. V. Filippenko, *Astrophys. J.*, 525, 881 (1999)

"Spectral Models of the Type Ic Supernova 1994I in M51", E. Baron, D. Branch, P. H. Hauschildt, A. V. Filippenko, and R. P. Kirshner, *Astrophys. J.*, 527, 739 (1999)

"Direct Analysis of Spectra of the Type Ic Supernova 1994I", J. Millard, D. Branch, E. Baron, et al., *Astrophys. J.*, 527, 746 (1999)

"Metallicity Effects in NLTE Model Atmospheres of Type Ia Supernovae", E. Lentz, E. Baron, D. Branch, P. H. Hauschildt, and P. E. Nugent,

Astrophys. J., 530, 966 (2000)

"Supernova Resonance-Scattering Profiles in the Presence of External Illumination", D. Branch, D. J. Jeffery, M. Blaylock, and K. Hatano, Pub. Astr. Soc. Pacific, 112, 217 (2000)

"Thermodynamic Phase Diagram of the Quantum Hall Skyrmion System," K. Moon and K. Mullen, Phys. Rev. Lett. v.84, 975 (2000).

"Dual Quantum Electrodynamics: Dyon-Dyon and Charge-Monopole Scattering in a High Energy Approximation", Leonard Gamberg and Kimball A. Milton, Phys. Rev. D 61, 075013-1--19 (2000).

"Guiding laser-cooled atoms in hollow-core fibers", Dirk Muller, Eric A. Cornell, Dana Z. Anderson, and Eric R. I. Abraham, Phys. Rev. A, 61, 033411 (2000).

"A New Look At Carbon Abundances In Planetary Nebulae. IV.", R.B.C. Henry, K.B. Kwitter, & J.A. Bates, Astrophys. J., 531, 928 (2000).

"Atomic Fluorine Beam Etching of Silicon and Related Materials", P.R. Larson, K.A. Copeland, G. Dharmasena, R.A. Lasell, M. Keil, and M.B.Johnson, J.Vac.Sci.Technol.B Vol18, pp307--312 (2000).

FUNDING SUCCESSES

Bill Romanishin received \$20,000 from the NASA EPSCoR program for a Research Initiation Grant. The grant will fund study of near Earth asteroids and other minor solar system bodies.

Mike Morrison's NSF grant was just funded, so work will continue on this and other projects at least for the next three years.

Baron: NSF, "Detailed Spectral Modeling of Supernovae", \$58,000

Baron and Branch, NSF, REU Supplement to Detailed Spectral Modeling of Supernovae, \$12,000

Branch and Baron: "Comprehensive Supernova Spectroscopy", NASA, \$50,000

Mullen: "Solitons in 2D Electron Gases," National Science Foundation North Atlantic Treaty Organization Postdoctoral Fellowship in Science and Engineering for NATO from Partner Countries, with Dr. Ramaz Khomeriki, Tbilisi State University, Georgia. The grant pays Dr. Khomeriki travel expenses, and a year of salary (the amount is not fixed).

Milton: US Department of Energy, "Nonperturbative Quantum Field Theory", \$95,000

COLLOQUIA

Baron: "Type II Supernovae as Cosmological Probes in the 21st Century" Seminar at Lawrence Berkeley National Laboratory, Mar., 2000

Cowan: "Hi-Yo Silver! The Further Adventures of CS 22892--052," invited seminar, University of Texas, Austin, TX (February 2000)

Mullen: "Topological Excitations: When Physics and Topology Tangle", Sept. 2, 1999, OU

Milton: "Julian Schwinger: From the Radiation Laboratory to Renormalized QED", University of Arkansas, November 19, 1999

Keil: "Energy Transfer, Chemical Reactions, and Surface Etching using Atomic, Molecular, and Laser Beams" Ben-Gurion University, Be'er Sheva, Israel, November 9, 1999, and (same title) Technion--Israel Institute of Technology, Department of Chemistry, Haifa, Israel, April 18, 2000.

RESEARCH TRAVEL

John Cowan has been on the move this winter, visiting the University of Chicago (January 2000) to work with Jim Truran on several research projects, the University of Texas (February 2000) to work with Chris Sneden on several telescope (i.e., HST and Keck) projects, and the University of Basel, Switzerland, (March 2000) to work with Friedel Thielemann on several research projects in astrophysics.

Ed Baron visited the Lawrence Berkeley National Laboratory, Mar., 2000, to work with OU graduate Peter Nugent on Type II supernova spectroscopy. In the same month he visited the Univ. of Georgia where he and Peter Hauschildt put in 16 hour days working on the next version of their code to make the world safe for spectral modeling.

MEETINGS ATTENDED

Mullen: March meeting of the American Physical Society. Kieran's postdoc Ramin Abolfath presented a paper there.

Cowan: Tenth Workshop on Nuclear Astrophysics, Ringberg Castle, Tegernsee, Germany (in March, 2000). His paper "Abundances and Ages in Halo (and Globular Cluster) Stars" was presented.

Henry and Milingo: attended the 7th meeting of the Texas-Mexico conference on nebular astrophysics in Austin, April 6-8. Jackie presented a poster entitled: "Sulfur Abundances In The Milky Way Disk From Peimbert Type II Planetary Nebulae", while Dick gave a talk on "On The Cosmic Origins Of Carbon & Nitrogen".

Doezema: Conference of Physics Department Chairs on "Undergraduate Physics in the New Century." Sponsored by the APS and AAPT at the American Center for Physics in College Park, MD. April 14-16, 2000

Keil: "Ultrafast Optical Technologies", Shefayim, Israel, Oct12-13, 1999, and "Quantum Control and Information", N of Genossar, Israel, Nov14-19, 1999. Mark comments, "I didn't present any of our work since I am just learning about this field, and the laboratory in which I am working is just gearing up (I hope I am helping in this endeavour). The first conference was on the Mediterranean shore, the second was by the Sea of Galilee (Lake Kinneret in Hebrew), both delightful locations. The second venue also sports a museum featuring a wooden boat found at the lake bottom a few years ago and dated as being about 2000 years old. Yes, the wood really is almost completely preserved!"

VISITORS HOSTED

Jim Truran, Univ. of Chicago, came to work with John Cowan during the fall on several research projects involving the formation of the heaviest elements.

SUMMER PLANS

Keil: Looking forward to continuing to work with Chris McRaven, OU undergraduate, who is developing a new detector for our molecular beams. His detector will allow us to measure the distribution of initial rotational states in our H₂ and HD beams, as well as to measure the electronic distribution of spin-orbit states in our atomic fluorine beam. The latter may be particularly significant for studying non-adiabaticity in chemical reactions. Many thanks to Andrew Elliott and Neil Shafer-Ray for their help with this detector project. I will return to working on "coherent control" at the Weizmann Institute of

Science in May and will remain there for the summer. I am also hoping to collaborate with Avigdor Persky of Bar-Ilan University, Ramat-Gan, Israel to calculate rate constants for the first chemical reaction to show strong quantum dynamical resonance behaviour in its integral cross section.

Kim Milton plans to attend the International Conference on High Energy Physics (the "Rochester conference") in Osaka July 27-August 2, and Quantization, Gauge Theory, and Strings (in honor of the late Efim Fradkin) in Moscow June 4-10.

Kieran Mullen and Sheena Murphy will oversee the REU program this summer.

Kieran Mullen plans to begin collaborations with people at the University of Arkansas program. In addition, he will visit his collaborator, Mats Wallin, in Sweden, where if the two work from sunup til sundown they'll be working pretty much continuously.

Ed Baron plans to take two graduate students to Italy and hike in the Alps. Presumably, there's a scientific purpose somewhere in this junket, but at press time this detail was unknown.

Eric Abraham plans to write up his team's laser beam work, and load ultracold atoms into atom traps made from Laguerre-Gaussian beams.

PREPRINT RESULTS

Mullen: We've just done some work on how the mass of skyrmions affects the hydrodynamics of a lattice. We're looking at phase transitions in related systems.

Abraham: We now have hard data verifying that our method of making Laguerre-Gaussian laser beams, is better than the theoretical best of the competing method.

Henry: Mike Edmunds (Cardiff), Joachim Koeppen (Strasbourg), and I have been able to demonstrate that stars in the 4-8 solar mass range provide all the nitrogen necessary to explain levels found in galaxies. No massive stars needed. On the other hand, all carbon, another important biogenic element, seems to come exclusively from stars with masses exceeding 10 suns. So, while that carbon in the charcoal in your barbeque grill was forged in a big star, the nitrogen in those refried beans you just ate at Taco Bell came from the more numerous stars which behave like the sun as they evolve.

From Mark Keil: Preston Larson and Matt Johnson performed some etching studies using our atomic fluorine beam apparatus, resulting in holes approximately 70nm in diameter being drilled into silicon through self-fabricated alumina masks. These holes are so small that you could fit a million of them in the diameter of a single human hair! Phrased differently, they are only about 200 atoms across. We like 'em little, and some of the people here at Technion and Weizmann in Israel are excited too! Check it out at Preston's web site:

http://www.nhn.ou.edu/~larson/Files/APS2000_Larson.pdf Greg Parker and Mike Morrison have done some really pretty developmental work on a new co-ordinate system that seems to be tailor-made for reactive scattering calculations. This is a new application of the "tangent hypersphere" co-ordinate system that smoothly follows the progress of a chemical reaction from reactants, through the transition state, to the products. The technique drastically reduces the need for co-ordinate transformations at intermediate stages of the calculations. Andrew Elliott may have developed a "molecular window" in our laboratory. What's this? It's a window that allows molecules to pass through but blocks light. Of course, most windows do exactly the opposite, but here we are using an array with holes whose diameters are roughly those of a wavelength of infrared light. Hence the light is diffracted (its transmitted intensity in a given direction is therefore drastically reduced) while atoms are transmitted unimpeded in the molecular flow (low pressure) regime of a directed molecular beam. We use this to drastically improve the sensitivity of our bolometer detector. Thanks to Neil Shafer-Ray and John Furneaux for very helpful discussions. No thanks at all to bolometer bugs for making our measurements very difficult (hence the "may" have developed at the beginning of the paragraph).

MORRISON'S CORNER

Stephane Mazevet, who worked with my group for three years as a postdoc in our NSF-funded theoretical atomic and molecular physics program, has moved on to a (very prestigious and extremely well-paid) director's-funded postdoc at the Los Alamos National Lab. We continue to collaborate on research on electron-molecule collisions and some new work on the application of density functional theory to continuum states, so we'll see Stephane around from time to time. Shortly after he left, Ron White (from James Cook University in Australia) joined the group for a four-month stay (ending, regrettably, this month). Ron has been working with Bruce Mason and myself on studies of transport theory for electron swarms in molecular gases, a key experimental method for determining electron scattering cross sections at energies too low for more conventional techniques to be applicable. There is a long-standing controversy (of over 20 years) concerning the physics of these collisions which Ron and Bruce and I are tackling from the vantage point of the statistical physics of the problem. In another problem, Greg Parker, I, and a colleague named Eric Layton just published a Physical Review Letter on "Rydberg-Electron Interferometry" (copies available from my web site); this was the culmination of a 10-year research project I initiated while a Visiting Fellow at the Joint Institute for Laboratory Astrophysics. It involves collisions of rare-gas atoms (like He) and Rydberg atoms (in this case, Ca atoms in which one valence electron has been excited to a very-high-lying, barely bound state). We have explained some remarkable and heretofore anomalous behavior in the cross sections for such collisions. This project --which also yielded the thesis research of a former student, Bill Isaacs (who has just gotten a permanent position at the Lawrence Livermore Lab)---has expanded to include quantum mechanical semi-classical, and classical studies. The latter, a collaboration headed by Neil Shafer-Ray and involving Greg as well as myself, has resulted in a paper that's been accepted by Journal of Chemical Physics. My NSF grant was just funded, so work will continue on these and other projects at least for the next three years---and I've got to start looking for a new postdoc!

TEACHING NEWS

Keil: Teaching a graduate-level course at Technion in Haifa, Israel is a real challenge. My course is entitled "Quantum State Preparation and Detection of Molecules" and I teach it in English. This is fortunate, since on the first day when I tried to teach in Hebrew I got as far as saying "Ani lo medaber Ivrit" which means "I don't speak Hebrew", so the students let me switch to English. This is not the only way in which the students tolerate me, I seem to have developed a reputation here as well for wearing shorts.... Good students, lively discussions even joined by some

interested faculty members here.

Baron: Taught a seminar on a subject I had to learn. Lots of work, but I learned it. Hope the students did.

Cowan: I did my annual elementary (sixth grade) school teaching of astronomy. It is still exhausting, but lots of fun! Sample question from this year: "Well what happens if two black holes try and eat each other, which one wins?" (All astronomers know the answer of course, the big one.)

Mullen: I'm trying to assemble a collection of paradoxes and puzzles in physics. I may try to write them up in a book. If you have any to suggest, I'd love to look into them. (mullen@nhn.ou.edu) I'm helping Peter Barker (History of Science) and John Furneaux develop a course on science for the Honor's College. The goal is to teach students about the logic and rationale of scientific research, and how we know what we know about the size and age of the universe, the nature of matter, etc.

PANELS

In November, David Branch served on the Time Allocation Committee for Cycle 9 of the Hubble Space Telescope.

Dick Henry served on a National Research Council postdoc program panel in Washington in February.

SCRATCHPAD

Some of our readers have noticed that there was no winter edition of the *Phyast Flyer*. The editor sincerely apologizes for the lapse in reporting the news. To atone, we have made every effort to bring you up to date with this edition. And, of course, your subscription will be extended by one issue.

But what you should really notice from the above is that we are active and growing. We have four new young faculty members joining us next fall and the addition to Nielsen Hall of two beautiful lecture halls is the envy of the campus. The Department's productivity in terms of publications, external funding, and teaching successes are at high levels.

So we invite you to come visit us and check us out for yourself, particularly if you haven't been back for awhile. Please reread the invitation on the front page to join the Department for the Lin Symposium next October 13-14. Then think seriously about coming. One thing's for sure: the mums will be out in resplendent glory on the South Oval then. Have you counted all the benches around campus lately? How about all the new sculptures and plantings? Now how could you miss all of this? How can you *not* come? Get with it!

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