

"All the v's

That's fit to Print"

ΦYAST ΦLYER

The Department of Physics & Astronomy

The University of Oklahoma

Volume 6, Number 1 Fall 1997

Dick Henry, Editor

Danette Miller, Production

Website: <http://www.nhn.ou.edu>

WELCOME!

New Faces In The Department

We are happy to announce the arrival of numerous individuals to our Department in various capacities, and give each of them a hearty welcome.

Staff

Seokjae Chung, Research Equipment Specialist - PhD Imperial College in London, England (comes to us from University of Wisconsin at Madison)

Visitors

Stefano Crocchianti, Visiting Research Scientist (Parker) - PhD University of Perugia, Italy

Post-Docs

Leonard Gamberg (Milton) - PhD Tufts University (comes to us from Institute of Theoretical Physics at the University of Tuebingen, Germany)

Stefane Mazevet (Morrison) - PhD Australia National University in Canberra (comes to us from Bob Crompton in Australia via France) Kushlani

Dharmasena (Shafer-Ray) - PhD OU Physics, Spring 1997 Horst Severini (Skubic) - PhD U of Albany (SUNY) - HEP group Timothy Phillips

(Keil) - PhD U of Illinois (comes to us from Space Systems Applications, Inc. New York)

Graduate Students

Peng Gao - Fall 1997 - BS from Peking University in China

Niti Goel - Fall 1997 - BS from St. Stephens College in Delhi and MS from University of Delhi in New Delhi, India

Tom Gower - Sum 1997 - BS from Midwestern State U in Wichita Falls, TX & MS from U of Southwest Louisiana in Lafayette

James Hayes - Fall 1997 - BS from university of Arizona in Tucson, Arizona

Jim Hicks - Fall 1997 - BS from Oklahoma City University in Oklahoma City

Sharon Kennedy - Spring 97 - BS from University of Central Oklahoma in Edmond, OK

Preston Larson - Summer 1997 - BS in Engineering Physics from OU

Brett McKinney - Spring 1997 - BS from University of Tulsa in Tulsa, Oklahoma

Robert Meyer - Fall 1997 - BS in Physics and BS in Math from University of Texas at Austin

Hajime Muramatsu - Fall 1997 - BS from OU Physics Department

Matt Price - Fall 1997 - BS from Oregon State University in Corvallis, OR

Sophie Raymond - Fall 1997 - BS from UFR Blaise Pascal in France

Dean Richardson - Summer 1997 - BS in Astrophysics from OU

Rollin Thomas - Summer 1997 - BS from Purdue University in Lafayette, Indiana

Ivy Winger - Fall 1997 - BS from University of Wyoming in Laramie, WY

Xiaojian Zhang - Fall 1997 - BS from Sichuan University in Chengdu and MS from Academia Sincia in Beijing, China

ALUMNI NEWS

Frank Skaggs (EP: BS 1961; MS 1964) retired last December from Texas Instruments after 35 years of service (that's a lot of chips, Frank!). Frank's graduate work was directed by Professor Broersma in the area of magnetic susceptibility of materials under high pressure. He also worked with Profs. Babb, Burwell, Fowler, Lin, Nielsen, Plint, St. John, and von Engle. Frank was a high school classmate of Neal Lane (current NSF director and OU Physics PhD alum) at SE High in OKC. He writes that he had an opportunity to support George Kalbfleisch's work by providing a few hundred silicon wafers which were needed for the construction of a particle detector about eight years ago. Frank and his wife Sandra live in Dallas, and although he has been enjoying his retirement, he is considering reentering the workforce. In the meantime, he is dusting off his software skills and catching up on his reading of astronomy articles.

Tom Miller (former Professor of Physics at OU) writes, "I went to [astronomer] Pat Thaddeus's home Saturday night to cap his 65th birthday celebration, and met all the best known astronomers east of University Av. I sat next to Charlie Townes (Pat's thesis advisor) for dinner in the garden, and after dinner Charlie went off to talk to Pat, and I slid into the still-warm Nobel chair to talk more with Frances Townes (both in their 80s, still sharp). Alex Dalgarno was there, of course, with his girlfriend. I was surprised how many people I knew -- but most in that category were spectroscopists, not "real" astronomers. I didn't go to all the birthday symposia that day and the previous day, but Amy [Tom's wife] said that the talks consisted of one after another radio astronomer showing contour maps of erratic concentric circles. After staying out late for the Friday night party, the chemists actually fell asleep during the contour map slide show on Saturday. A real astronomer with an Italian name (but based at the U. of Georgia) asked about Ed Baron, and there was one woman from Maryland who asked about certain OU people, and a CfA person asked about your astronomer Deborah Watson, but I began to realize that I'd been gone too long to offer much gossip."

FOCUS ON RESEARCH: Mike Strauss

As Mike Strauss begins his third year at OU, he is enthusiastic about a new line of research for him which involves the use of the D0 (that's "dee zero") detector at the tevatron ring of the Fermi accelerator. The goal of his research is to measure photon production from p^+p^- collisions at 630 GeV in order to compare with predictions from a proton model. The model assumes a proton structure of quarks and gluons which possesses a predictable signature of photon production when protons and antiprotons collide. Thus, accurately measuring the the production rate of photons with different momentums from such a collision helps to verify the model, or at least prescribe ways to tweek the model parameters. Currently, published data are in disagreement with model predictions at the 630 GeV energy level, and Mike is attempting to remedy that by improving the data. One of the new things he's adding to the study, though, is an attempt to detect and measure photons produced by forward-scattering interactions.

The technique, as in any experimental procedure, is loaded with pitfalls. One of these snares, of course, is the high probability of detecting spurious photons, i.e. those that are unrelated to the interaction Mike is interested in. Another problem is the calibration of the detector efficiency. Figuring out these corrections requires a great deal of time and represents a large part of the procedure itself. Currently, senior Christy Liggett is working with Mike on the experiment as part of her capstone project. Ultimately, Mike hopes to learn more about properties of protons and anti-protons.

Mike is a doctoral graduate of UCLA, and before coming to OU in 1995, served as a postdoc at SLAC (Stanford) for a research program based at the University of Massachusetts. Mike and his wife Julie have two children, a first grader and a pre-schooler. If you'd like to know more about Mike's work, contact him at strauss@ou.edu.

PAPER CHASE

Recent Publications

D. Branch, E. Baron, P. Nugent, P. Hauschildt, "The Hubble Constant, Supernova Light Curves and Spectra, and Radiation Transport", *Physics of Plasmas*, 4, 2016 (1997)

- A. Fisher, D. Branch, P. Nugent, E. Baron, "Evidence for a High-Velocity Carbon-Rich Layer in the Type Ia SN 1990N", ApJ, 481, L89 (1997)
- K. A. Milton, "Finite-element quantum field theory" Nucl. Phys. B (Proc. Suppl.) 53, 847-849 (1997).
- W.K. Liu, X.M. Fang, J. Winesett, Weiluan Ma, Xuemei Zhang, M.B. Santos, and P.J. McCann, "Large Mismatch Heteroepitaxy of InSb on Si(111) Substrates Using CaF₂ Buffer Layers," Journal of Crystal Growth 175/176, 853-859 (1997).
- P.J. McCann, X.M. Fang, W.K. Liu, B.N. Strecker, and M.B. Santos, "MBE Growth of PbSe/CaF₂/Si(111) Heterostructures," Journal of Crystal Growth 175/176, 1057-1062 (1997).
- J.F. Buell, R.B.C. Henry, E. Baron, and K.B. Kwitter, On the Origin of Planetary Nebula K648 in Globular Cluster M15 ApJ 483, 837-842
- "Measurement Of Leading Particle Effects In Decays Of Z⁰ Bosons Into Light Flavors", By SLD Collaboration (K. Abe et al.). -includes Strauss Published in Phys.Rev.Lett.78:3442-3446,1997, Erratum-ibid.79:959,1997
- "Measurement Of The Tau Neutrino Helicity And The Michel Parameters In Polarized E⁺ E⁻ Collisions", By SLD Collaboration (K. Abe et al.). - includes Strauss Published in Phys.Rev.Lett.78:4691-4696,1997
- "DIRECT MEASUREMENT OF LEPTONIC COUPLING ASYMMETRIES WITH POLARIZED Z⁰", By SLD Collaboration (K. Abe et al.). - includes Strauss Published in Phys.Rev.Lett.79:804-808,1997
- "LIMITS ON WWZ AND WW GAMMA COUPLINGS FROM P ANTI-P ---> E NEUTRINO JET-JET X EVENTS AT S^{**}(1/2) = 1.8-TEV", By D0 Collaboration (B. Abbott et al.) - includes Gutierrez, Kalbfleisch, Strauss Published in Phys.Rev.Lett.79:1441-1446,1997
- "MEASUREMENT OF THE TOP QUARK PAIR PRODUCTION CROSS-SECTION IN P ANTI-P COLLISIONS", By D0 Collaboration (S. Abachi et al.). - includes Gutierrez, Kalbfleisch, Strauss Published in Phys.Rev.Lett.79:1203-1208,1997
- "DIRECT MEASUREMENT OF THE TOP QUARK MASS", By D0 Collaboration (S. Abachi et al.). - includes Gutierrez, Kalbfleisch, Strauss Published in Phys.Rev.Lett.79:1197-1202,1997
- "STUDY OF THE Z Z GAMMA AND Z GAMMA GAMMA COUPLINGS IN Z (NEUTRINO NEUTRINO) GAMMA PRODUCTION", By D0 Collaboration (S. Abachi et al.). - includes Gutierrez, Kalbfleisch, Strauss Published in Phys.Rev.Lett.78:3640-3645,1997
- "Vibrationally and Rotationally Resolved Angular Distributions for F+H₂-->HF(v'j')+H Reactive Scattering", J of Chemical Physics Vol106, p9950 (1997), a rapid communication by GDharmasena, T.R.Phillips, K.N.Shokhirev, G.A.Parker, and M.Keil
- "Angular Dependence for v'j'-Resolved States in F+H₂-->HF+H Reactive Scattering using a New Atomic Fluorine Beam Source", J of Physical Chemistry Vol108, in press (Oct 1997), a paper published in a special volume dedicated to Nobel Laureate Y.T.Lee on his 60th birthday.

J.W. Howard, R.B.C. Henry, & S. McCartney, "A Detailed Abundance Analysis Of Nine Halo Planetary Nebulae", MNRAS, 284, 465 (1997).

D. Branch, A. Fisher, E. Baron, and P. Nugent, "Low Hubble constant from type Ia supernovae by van den Bergh's method", Ap. J. (Letters), (1996), 470, L7--10.

E. Baron, P. H. Hauschildt, P. Nugent, and D. Branch, "NLTE Effects in Modeling of Supernovae Near Maximum Light", MNRAS, (1996), 283, 297--315.

G. Schwarz, P. H. Hauschildt, S. Starrfield, E. Baron, F. Allard, S. Shore, and G. Sonneborn, "Non-LTE Model Atmosphere Analysis of the Early Ultraviolet spectra of Nova Andromedae 1986, MNRAS, (1997), 284, 669--684.

P. H. Hauschildt, E. Baron, and F. Allard, "Parallel Implementation of the PHOENIX Generalized Stellar Atmosphere Program", Ap. J., (1997), 483, 390--398.

P. Nugent, E. Baron, D. Branch, A. Fisher, and P. H. Hauschildt, "Synthetic Spectra of Hydrodynamic Models of Type Ia Supernovae", Ap. J., (1997), 485, 812--819.

GRANTS RECEIVED

NSF, D. Branch, Supernova Studies, \$50,000

Kim Milton has received internal funding of \$23,000 from the Dean of A&S, International Programs, the Vice President for Research, and from the Department to enable him to invite Igor Solovtsov and Olga Solovtsova to visit the department for six months, starting in November. They will be working with Kim on analytic perturbation theory and QCD. Igor will also be teaching Quantum Field Theory in the Spring, on the subject of QCD.

NSF/Oklahoma EPSCoR, John E. Furneaux, Research Opportunity with Uppsala University, Sweden, \$25,000 for travel and Sabbatical Salary.

STINT, The Swedish agency/foundation for international scientific visitors, Jan Lindgren and John E. Furneaux, Sabbatical visit to the Laboratory and Inorganic Chemistry Institute at Uppsala University, SK 210,000 (\$26,750) for sabbatical stipend SK 25,000 (\$3,185) for travel.

NSF, John Cowan, "The Formation, Evolution and Age of the Heavy Elements," for \$105,000.

AASERT (ASSERT is a student support grant that supplements our DoD, Air Force Office of Scientific Research grant), William Beasley (advisor), Heidi Morris, Alia Long, Balloon-Borne Electric-Field-Change Observations Relevant to Models for Sprites and Jets, \$127,708.

American Chemical Society (Petroleum Research Fund), Sept1/97-August 31/99 "Reactive, Elastic, and Surface Etching Studies using Atomic Fluorine Beams", \$50,000.

National Science Foundation (Experimental Physical Chemistry), Aug1/97-July31/00 "Vibrationally and Rotationally State-Resolved Differential Cross Sections for Reactive Scattering", Mark Keil &

G.A.Parker, \$393,115.

NSF, Eddie Baron, \$43,027.

Grant from Fermilab D-Zero collaboration for "Testing of Silicon Detector for Run 2 D-Zero Upgrade" PI-P. Gutierrez CoPI-M. Strauss & G. Kalbfleisch Amount \$10,000.

MEETINGS ATTENDED/

PAPERS PRESENTED

David Branch attended the Conference on Supernovae and Cosmology in honor of the 65th birthday of Gustav Tammann, Basel University, June, and presented, "Early--Time Spectra of Type Ia Supernovae and the Nature of the Peculiar SN 1991T" He gave the same talk at the Conference on Supernovae, Institute for Theoretical Physics, Santa Barbara, August.

John Cowan attended "Supernovae: Their Causes and Consequences", Univ. Calif. Santa Barbara, August 5-9. Invited talk on "Abundances in Metal-Poor Stars" and poster with Chris Eck and David Branch on "Probable Detection of SN 1923A: The Oldest Radio Supernova or the Youngest SNR?"

Ryan Doezema attended the Conference of Physics Department Chairs: "Undergraduate Education in Physics: Responding to Changing Expectations" May 9-11 at the American Center for Physics, College Park, MD.

Mike Strauss attended the International Europhysics Conference on High Energy Physics, 19-26 August, 1997, Jerusalem, Israel, where he gave an invited talk entitled "The D0 Detector Upgrade". Mike also attended the D0 workshop for D0 collaboration members in Bloomington, Indiana. July 20-25, 1997.

Mark Keil presented "Angular Distributions for Vibrationally and Rotationally Resolved States in $F+H_2 \rightarrow HF+H$ Reactive Scattering", by G.Dharmasena, at the Gordon Research Conference on Molecular Energy Transfer, Ventura Calif, Jun/97. Mark also presented "Angular Dependence for v'_j -Resolved States in $F+H_2 \rightarrow HF(v'_j)+H$ Reactive Scattering" (by T.R.Phillips and M.Keil) at the Dynamics of Molecular Collisions Conference, Gull Lake, Minnesota, July/97.

Eddie Baron attended "Supernova Explosions: Their Causes and Consequences", ITP, Santa Barbara Aug, 1997, where "Progress on Modeling the Spectra of Core Collapse Supernovae" was presented as an Invited talk.

Phil Gutierrez attended two workshops over the summer: 1) "International Workshop on Nucleon Structure Functions" Trento, Italy Paper

presented "High P_T Jets at the Fermilab Tevatron" Author P. Gutierrez for the D-Zero and CDF Fermi Collaborations; and 2) "D-Zero Workshop and b-quark triggering and tagging" Presentation "Proposal for triggering on b-quarks with the D0 detector" Indiana Univ Bloomington, Indiana

COLLOQUIA GIVEN

Kim Milton presented "Nonperturbative Calculation of Symmetry Breaking" June 4, 1997, Bogoliubov Laboratory for Theoretical Physics, Joint Institute for Nuclear Research, Dubna, Moscow Region, Russia, and "Sonoluminescence and the Casimir Effect" June 11, 1997, at the same place.

David Branch gave three lectures on supernovae at International School of Advanced Studies, Trieste, in June, as well as a colloquium on "Type Ia Supernovae and the Cosmic Age Problem" at Universities of Padua, Bologna, and Trieste.

Mike Santos gave seminars entitled "InSb/AlInSb quantum-well structures grown by molecular beam epitaxy" at the Defense Research Agency (Malvern, UK) on July 30 and at Imperial College (London, UK) on August 1.

Ryan Doezema presented "IG Metall: The Original Edge States in Metals and Superconductors", at the 60th Birthday Symposium for Prof. Fred Koch, Technische Universitaet Muenchen, Garching, Germany, June 6, 1997, as well as "The InSb-based Quantum Well Program at Oklahoma" Minisymposium on Current Topics in Low Dimensional Systems, Ludwig-Maximilians-Universitaet, Munich, Germany, June 9, 1997.

Mark Keil talked about "Chemical Reaction Dynamics for a Simple Chemical Reaction: $F+H_2 \rightarrow HF+H$ " University of Oklahoma, Dept of PhyAst, April 19/97.

RESEARCH TRAVEL

Kim Milton traveled to: 1) Bogoliubov Laboratory for Theoretical Physics, JINR, Dubna, Russia, May 31-June 14; collaboration with Igor Solovtsov and Olga Solovtsova; 2) Physics Department, University of Washington, Seattle, July 14-21; consultation with Lowell Brown, David Boulware, and Marshall Baker; and 3) Physics Department, UCLA, July 21-August 2; consultation with Robert Finkelstein and others; work in the Schwinger archives

John Furneaux is currently on sabbatical at Uppsala University, Laboratory, Inorganic Chemistry Institute, Uppsala Sweden with Jan Lindgren, Josh Thomas, and J=F6rgen Tergenfeld from Aug. 20, 1997 - ~Aug. 15, 1998 to study and learn about Li ion conducting polymers and other aspects of Li rechargeable batteries which is the start of a new research initiative for John.

Dick Henry spent a week at Williams College during July working with Karen Kwitter on their project concerning carbon abundances in planetary nebulae.

For two weeks in July, Mike Santos and Kory Goldammer visited Chris McConville at Warwick University in the United Kingdom. Using atomic force microscopy, we studied the surface morphology of various InSb/AlInSb heterostructures grown at OU. We also initiated experiments using

high resolution electron energy loss spectroscopy to study Si dopant diffusion in InSb. This research was supported by a NATO Collaborative Research Grant.

John Cowan spent two weeks (in July) working with Friedel Thielemann, mostly in Basel, Switzerland, on a project to estimate the ages of the oldest Galactic stars. They also spent several days in Germany (Mainz and Darmstadt) collaborating with several nuclear physicists there. This project will lead to a new publication. In addition, John spent 3 weeks (in August) at the Institute for Theoretical Physics at UCSB on a workshop on supernovae.

Mike Strauss took a couple of 4 day trips to Fermilab (Batavia, IL) over the summer to work with the D0 collaboration.

Phil Gutierrez took numerous trips to Fermilab Approx this summer to participate in D-Zero meetings, work with OU graduate students (Eric Smith & Georg Steinbreuck), work with other D-Zero collaborators He also traveled to Indiana Univ for D-Zero collaboration meeting to discuss upgrade of D-Zero detector as well as to Micron Semiconductor Lancing Sussex England, discuss progress on design and production of silicon microstrip detectors to be used in the D-Zero detector upgrade

RESEARCH DEVELOPMENTS

From Ed Baron, "We [the SN group] worked with 6 REU students this summer. They worked on projects that involved digitizing and categorizing unpublished spectra of supernovae taken at Lick in the 70s and at Palomar in the 50s-60s, running simple synthetic spectra of SN 1994I, porting the PHOENIX code to run on the Hitachi supercomputer in meteorology, and the R-process in a low entropy neutrino wind." Adds John Cowan, "I worked closely with Ed Baron and two of the REU students (Tami Rogers and Kris Gutierrez) on a project to understand the formation of the r-process elements. We found some interesting results and this work will lead shortly to another publication."

From Kim Milton, "Several more papers on analytic perturbation theory are in process with the Solovtsovs. We argue that it is essential to use causality (=analyticity) and not disregard it when analyzing, for example, the decay of the tau lepton. Doing so makes a substantial effect on the numbers extracted from experiment. I'm working with Carl Bender on applying our new variant of the delta

expansion to supersymmetry. We believe, in two dimensions, it is possible to have dynamical supersymmetry breaking. The issue will be decided this month! The scientific biography of Julian Schwinger is now nearly 1/4 completed. That is, we have 4 of 17 chapters through second revision; I'm now working on the chapter on "fundamental interactions" wherein it is demonstrated that Schwinger anticipated V-A (not another contender!) and proposed most of the features of the electroweak synthesis in 1957. It's very fascinating research".

And from Mark Keil, "Strong indications that the initial rotational state of H₂ significantly affects the angular distribution for HF produced in $v'=1$, only, in the $F+H_2 \rightarrow HF+H$ reaction. Work in progress to measure the scattering for H₂ purely in $j=0$ before the collision, and compare to H₂ mostly in $j=1$. Also gearing up for experiments using HD in place of H₂".

TEACHING NEWS

Kim Milton's electrodynamics book is nearly completed. 'I'm writing the one remaining chapter in my program, on waveguides (plus some scattering). The plan is to send the typescript to the publisher soon. However, I unearthed some new material ("the lost chapters") in the Schwinger archive at UCLA, so, it's possible that the project may be delayed a bit to incorporate this. 'I'm trying to teach graduate electrodynamics a bit differently this time, with more 'active learning.' That is, since the book is `done,' I'm having the students cover more of it on their own, and I will, in due course, require presentations on the part of the students. However, the most important part of active learning, in my opinion, is doing homework, and that still remains central."

From Mike Strauss, "I was asked to co-lead a session at the all-university T.A. workshop on "Active Learning" with Jane Bowerman, an assistant professor in the College of Liberal Studies. We led two sessions and taught about 80 new T.A.'s some teaching methods which involve interactive learning techniques. 'I am using more interactive learning techniques in my classroom including students working in small groups and expanded use of interactive questions in class (a la Mazur's Peer_Instruction).

"Many thanks to Dr. Sheena Murphy! As a faculty senate member last spring, she helped graduate students' request for a health insurance subsidy become a reality this fall. Thanks to all of the graduate students and faculty in physics for your input and support last year!" Heidi Morris (retired GSS External Affairs Chair)

Says Mark Keil, "Wonderful work with REU student Kyle Peterson, who significantly improved our laser (he solved a problem that had vexed us for several years!) and who produced a wonderful simulation, on video, of our experimental techniques. Very helpful for visualization. He also built so very useful detectors for the lab. Good luck, Kyle!"

Dick Henry taught "Down-To-Earth Astronomy" in Santa Fe in August to an eclectic group of students.

VISITORS

August Romeo from Barcelona visited Kim Milton for three weeks in July, discussed Casimir effect and related phenomena

Chris Sneden (UT Austin) spent a week here (in July) visiting John Cowan as part of his Big XII faculty fellowship, working with John on a project involving the abundances of heavy elements in stars. This work was also in collaboration with Debra Burris. Debra is writing up the results now as part of her thesis.

AND THIS

Tim Kwiatkowski, graduate student, has accepted the position of managing the ECAS Cray J90 here at OU. Tim's title will be: Manager, Technical Projects. Congratulations, Tim!

SCRATCH PAD

The question for open discussion was simple enough: "Is scientific truth absolute or subjective?" The Engineering and physical science students in

this interdisciplinary class of Honors students have been steeped for years in scientific facts, solving equations which implicitly tell them that, yes, the universe is deterministic and that, forgetting about the lessons of quantum mechanics for a moment, we could in time predict every movement and thought under the sun. On the other hand, the Letters majors are not quite so sure. After all, they've been introduced to relativism and deconstructionism, ways of thinking which have a tendency to turn any focused point into an astigmatic vision. Well, timidly at first, they go at it. But then, "There can only be one radius for the earth," says the science student, fist hitting the desk. "True, but clearly a model of how a system works is subjective," claims someone from the literary crowd. "Would a scientific team of women from Zaire (now the Congo, again) think of gravity in the same way as Newton, and later Einstein?" asks a classicist? And on they go, back and forth, trying to discern the true nature of scientific knowledge, all the time knowing that the question probably can't be answered adequately, but nevertheless enjoying the opportunity to voice what they believe.

And, then, as if to confuse them even more, when these same students visit science faculty around the campus and ask the same question of them about the nature of scientific truth, the responses range from "clearly absolute" from the physicists to "clearly subjective" from the psychologists, with the biologists somewhere in between. (Why did I know the outcome of that one in advance?) So, alas there is no consensus from the people who are supposed to know.

Now, what bothers me is this: if scientific knowledge is subjective, what are we doing research for, because there's no distinct goal. But if it's absolute, how will we ever know when we've reached the truth?

There must be some logical way to go over these questions and divine the answers rationally. That's assuming, of course, that there's just one universal system of logic.

Dick Henry