

"All The v's That's Fit
To Print"

ΦYAST ΦLYER

*The Department of Physics & Astronomy
The University of Oklahoma*

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UNDERGRADS HONORED FOR ACHIEVEMENTS

Awards were given to many of our undergraduate students during award ceremonies held on Thursday, April 22. Chair Ryan Doezema opened the session with his customary greetings and joke.

Awards and recognition were presented by Dr. Sheena Murphy, undergraduate chair, to majors in Physics & Astronomy. *J. Clarence Karcher scholarships* were awarded to John Burns, Emily Day, Nicholas Hall, Devin Harper, Mercy Melakayil, Tuan Dinh Nguyen, Xiao Jing Wang, and Benjamin Williams. Faith Jordan was given the *Karcher Award for Outstanding Scholarship in Physics & Astronomy*, while Dan Stark received the *Fowler Prize*. Recognition for outstanding scholarship was also given to Ryan Biesemeyer, Cedric Brown, Ethan Brown, Blake Burdett, Melanie Carter, Isaac Childres, Jiehae Choi, Erin Cooper, Jeffrey Crawford, James Dizikes, John Exner, Caitlin Finley, Earl Flinn, Juliana Gay, Evan Hamilton, Tyler Hardman, Joshua Harrison, Kimberly Hines, Tiffany Houston, Jeremy Jernigen, William Keller, Kris Kettner, Zachary Kovash, Melissa Long, Brady Longenbaugh, Allison McCoy, Samuel Meek, Mark Miller, John Moore, Jerod Parrent, Timothy Russin, Julie Skinner, Samuel Spence, Daniel Stark, David Stewart, Shi-Hau Tang, Stephanie Tchatchoua, Andrew Thiel, Derrick Toth, Kyle Whipple, Timothy Wofford, and Patrick Zabawa.

The awards in Engineering Physics were presented by Mike Santos. *J. Clarence Karcher Scholarships* went to Gareth Basset, Thomas Easley, Stanton Harwood, Jamie Hereford, David Kelle, Aaron Marshall, Christopher McGuffy, Michael Meier, Robert Nicholas, Joel Ramey, Daniel Wasielewski, Aaron Willard, and Jeffery Woidke. In addition, the *Karcher Award for Outstanding Scholarship in Engineering Physics* was presented to Jeremy Graham. Finally, recognition for *Outstanding Scholarship* was given to Christopher Bares, Shawn Carson, Jer-Min Chong, Butch DeBerry, Alexander Down, Jack Franklin, Douglas Howell, Sarah Lumpkins, Devin McCombs, Timothy Nall, Adam Parry, Brittany Pendleton, David Reeves, Joshua Smart, and Matthew Ulmer.

Congratulations to all of these students for superb work and dedication!

But wait. There's more! Dan Stark, the Fowler Prize winner, will spend the next year on a Humboldt Fellowship in Munich working in biophysics. After that he will move on to Rice University. Faith Jordan, winner of the Karcher Award for Outstanding Scholarship, received an NSF graduate fellowship at Yale and is starting in experimental atomic and molecular physics this fall. And Jeremy Graham, the winner of the Karcher Award for Engineering Physics will attend the University of Virginia in the fall.

FACULTY HONORED

Once again, the Department of Physics & Astronomy fared well in the area of university-wide recognition, when five members of the Department were honored during the faculty awards ceremony on April 13. Deborah Watson was named the Edith Kinney Gaylor Presidential Professor; Ryan Doezema received a Regents' Professorship; Dick Henry became a David Ross Boyd Professor; Eric Abraham received a Regents' Award for Superior Teaching; and Jim Shaffer was granted a Junior Faculty Summer Research Fellowship. Congratulations to these five professors!

COLIN A. PLINT (1926-2004)

A former faculty member of our Department, Dr. Colin Plint, died on April 3, in Fonthill, Ontario. He was 78. Dr. Plint and his wife Florence moved to Norman in 1953, when he began what became a 15 year stay at OU, during which he served as Department chair for four years. An RAF navigator from 1944-1947, Dr. Plint moved to Brock University in St. Catharines, Ontario, in 1968, where he served for seven years as Dean of Arts & Sciences beginning 1969, as well as on the Graduate Council of Ontario, before retiring in 1991. Dr. Plint is survived by his wife, four daughters, two sisters, and one brother. Former students of Dr. Plint are encouraged to write us with any anecdotes about him that they would like to share with other newsletter readers.

OSSM AWARD TO XIFAN LIU

Xifan Liu, a Physics PhD recipient of our Department (1992; Tom Miller, advisor) has been recognized by The Oklahoma School of Science and Mathematics in OKC with the McCasland Foundation Faculty Award. OSSM is a high school for students from all over Oklahoma who excel in particular in the sciences. Xifan has been on the OSSM faculty since 1992. He teaches courses in General Physics, Mechanics, Thermal Physics, Waves & Optics, Electricity & Magnetism, and Modern Physics I & II. In addition to teaching, Xifan enjoys mountain climbing, and has conquered summits around the globe. He also moonlights as a professional photographer for a daily newspaper at OU football and basketball games and as a coach of the OSSM US Physics Olympiad Team, one of which won a gold medal in 1995. Xifan is also a husband and father. Says Xifan, "It is a wonderful experience teaching gifted, motivated students at OSSM. I set high standards and challenge myself in addition to challenging my students." Congratulations to Xifan Liu.

INTERNATIONAL STUDENT LEADERSHIP AWARD

Thushari Jayasekera was awarded the Ronnie Iranie International Student Leadership Scholarship by the University of Oklahoma Educational Abroad and International Student Services in recognition of the leadership demonstrated through initiative, creativity and commitment.

IN DEFENSE

Sharon Kennedy recently defended her PhD dissertation, "Creation and Studies of Laguerre-Gaussian Laser Beams for use in Trapping Ultracold Atoms." Her advisor was Eric Abraham.

ALUMNI NEWS

Eldon Ferguson (PhD 1953 with J.R. Nielsen) gave the Harold Schiff Memorial Lecture at York University in Toronto on March 30, and will be featured speaker at the 8th International Bunsen Discussion Meeting on Chemical Processes of Ions in Marburg, Germany, September 15-17.

Eldon's most recent research (Ferguson et al., Int. J. Mass Spec.) resolves a long standing problem concerning the collisional detachment of NO⁻ by rare gases. The novel mechanism proposed (vibrational excitation followed by autodetachment) is a rare example (unique?) of the application of Ehrenfest Adiabatic Principle to a negative ion and certainly is the only application of the Landau-Teller theory of vibrational energy transfer to a negative ion. In October, 2003, Eldon gave a seminar at JILA entitled "Hindsight in Retrospect," describing five significant discoveries in his lab that could have been predicted but were not. Eldon divides his time between Boulder, Paris and the Brittany Coast of France, indulging his interests in skiing, art, music, travel, and history.

RESEARCH ACTIVITIES

Publications

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C. Matsumoto, K. M. Leighly, H. L. Marshall, "A Chandra HETGS Observation of the Narrow-Line Seyfert 1 Galaxy Arakelian 564," ApJ, 603, 456 (2004)

- D. Grupe, B. J. Wills, K. M. Leighly, H. Meusinger, "A Complete Sample of Soft X-Ray-Selected AGNs. I. The Data," *AJ*, 127, 156 (2004)
- D0 Collaboration, B. Abbott,... P. Gutierrez,... M. Strauss, et.al., "Search for 3- and 4-body decays of the scalar top quark in proton anti-proton collisions at $S^{**}(1/2) = 1.8$ TEV," *Phys.Lett.B581*:147-155,2004
- D0 Collaboration, B. Abbott,... P. Gutierrez,... M. Strauss, et.al., "Observation of diffractively produced W and Z bosons in anti-P P collisions at $S^{**}(1/2) = 1800$ -GEV," *Phys.Lett.B574*:169-179,2004
- G.R. Kalbfleisch, W. Luo, K.A. Milton, E.H. Smith, M.G. Strauss, "Limits on production of magnetic monopoles utilizing samples from the D and CDF detectors at the tevatron," *Phys.Rev.D69*:052002,2004
- Kimball A. Milton, "Anomalies in PT symmetric quantum field theory," *Czech. J. Phys.* 54, 85-91 (2004)
- R. C. Thomas, D. Branch, E. Baron, et al., "On the Geometry of the High-Velocity Ejecta of the Peculiar Type Ia Supernova 2000cx," *Astrophysical Journal*, 601, 1019 (2004)
- Pia Mukherjee, and Yun Wang, "Direct Wavelet Expansion of the Primordial Power Spectrum," *ApJ*, 598, 779 (2003)
- Pia Mukherjee, and Yun Wang, "Model-Independent Reconstruction of the Primordial Power Spectrum from WMAP Data," *ApJ*, 599, 1 (2003)
- Dipak Munshi, Cristiano Porciani, and Yun Wang, "Galaxy Clustering and Dark Energy," *MNRAS*, 349, 281 (2004)
- C. Travaglio, R. Gallino, E. Arnone, J. J. Cowan, F. Jordan and C. Sneden,, "Galactic Evolution of Sr, Y, Zr: a multiplicity of stellar neutron capture components," *Astrophys. J.*, 601, 864 (2004)
- K.-L. Kratz, B. Pfeiffer, J. J. Cowan and C. Sneden,, "R-Process Chronometers," *New Astronomy Reviews*, 48, 105 (2004)
- J. E. Lawler, C. Sneden and J. J. Cowan, "Improved Atomic Data for Ho II and New Holmium Abundances for the Sun and Three Metal-Poor Stars," *Astrophys. J.*, 608, 850 (2004)
- J. J. Cowan, "A Sprinkling of Stardust," *Nature*, 428, 369 (2004)
- K. Zhang, G. A. Parker, D. J. Kouri, D. K. Hoffman, S. S. Iyengar, "Quantum Reactive Scattering in Three Dimensions using Hyperspherical (APH) Coordinates: Periodic Distributed Approximating Functional (PDAF) Method for Surface Functions." *J. Chem. Phys* 118, 569-581 (2003).

F. D. Colavecchia, J. P. Burke, W. Stevens, M. R. Salazar, G. A. Parker and R. T Pack, "The Potential Energy Surface for Spin-Aligned Li_3 and the Potential Energy Curve for Spin-Aligned Li_2 ," J. Chem. Phys. 118, 5484-5495 (2003).

F. D. Colavecchia, F. Mrugala, G. A. Parker and R. T Pack, "Accurate Quantum Calculations on Three-Body Collisions in Recombination and Collision-Induced Dissociation II. An Improved Propagator," J. Chem. Phys., 118 10387-10398 (2003).

D.C. Larrabee, G.A. Khodaparast, F.K. Tittel, J.

Kono, M. Rochat, L. Ajili, H. Willenberg, J. Faist, K. Ueda, Y. Nakajima, M. Nakai, S. Sasa, M. Inoue, S.J. Chung, and M.B. Santos, "Application of Terahertz Quantum Cascade Lasers to Semiconductor Cyclotron Resonance," Optics Letters, 29, 122 (2004).

G.A. Khodaparast, R.C. Meyer, X.H. Zhang, T. Kasturiarachchi, R. E. Doezema, S.J. Chung, N. Goel, and M. B. Santos, and Y.J. Wang, "Spin Effects in InSb Quantum Wells," Physica E20, 386 (2004).

N. Goel, K. Suzuki, S. Miyashita, S.J. Chung, M.B. Santos, and Y. Hirayama, "Ballistic Electron Transport in InSb Quantum Wells at High Temperature," Physica E20, 251 (2004).

T.D. Mishima, J.C. Keay, N. Goel, M.A. Ball, S.J. Chung, M.B. Johnson, and M.B. Santos, "Effect of Structural Defects on InSb/AlInSb Quantum Wells Grown on GaAs (001)," Physica E20, 260 (2004).

N. Goel, K. Suzuki, S. Miyashita, S.J. Chung, M.B. Santos, and Y. Hirayama, "Effect of Temperature on Ballistic Transport in InSb Quantum Wells," Physica E21, 761 (2004).

R.B.C. Henry, K.B. Kwitter, & B. Balick, "Sulfur, Chlorine, and Argon Abundances in Planetary Nebulae. IV. Synthesis and the Sulfur Anomaly," Astron. J., 127, 2284 (2004)

R.B.C. Henry, "Element Yields of Intermediate-mass Stars," invited review in Origin and Evolution of the Elements, from the Carnegie Observatories Centennial Symposia. Published by Cambridge University Press, as part of the Carnegie Observatories Astrophysics Series. Edited by A. McWilliam and M. Rauch, 2004, p. 44.

Meetings Attended

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Larry Maddox attended meeting "X-Ray and Radio Connections," 3 Feb - 6 Feb, 2004, Santa Fe, NM, and the Atlanta meeting of the American Astronomical Society, Jan. 4-8.

Karen Leighly and Chiho Matsumoto attended "Stellar-Mass, Intermediate-Mass, and Supermassive Blackholes, Kyoto, Japan, October 28-31, 2003. Karen was on the scientific organizing committee and gave an invited talk entitled "The Spectral Energy Distribution of Narrow-line Seyfert 1

Galaxies." Chiho had a contributed poster paper entitled "XMM-Newton Observations of Luminous Narrow-line Seyfert 1 Galaxies."

Karen Leighly and John Moore attended the 203rd American Astronomical Society Meeting, Jan 4-9, 2004, Atlanta. John presented a poster paper entitled "Near UV Spectra of Narrow-line Quasars from the SDSS", by J. R. Moore, K. M. Leighly, and D. Casebeer.

Bahman Roostaei attended "Spin in Nanostructures," Jan. 4-10, Aspen.

Jean-Claude Chokomakou attended the 2004 Joint annual Conference of the National Society of Black Physicists and the National Society of Hispanic Physicists, February 18 to February 21, 2004, in Washington, D.C. He also attended the APS March meeting, March 22 to March 26, 2004, Montreal, Canada.

Yun Wang attended the "UCLA Symposium on the Sources and Detection of Dark Matter and Dark Energy," February 2004, Marina Del Ray.

John Cowan attended "Nuclear Astrophysics 12," March 22-26, Ringberg Castle, at Lake Tegernsee, Germany.

Numerous members of the Solid State Group attended the March APS meeting in Montreal, March 22-26. The following presentations were made.

Niti Goel gave a talk entitled "Quantized conductance observed in InSb point contacts." Her coauthors were J. Graham, J.C. Keay, M.B. Santos, K. Suzuki, S. Miyashita, and Y. Hirayama.

Tetsuya Mishima gave a talk entitled "Structural defects in InSb/AlInSb quantum wells grown on GaAs (001) substrates." M.B. Santos was his coauthor.

Jean Claude Chokomakou gave a talk entitled "Density and temperature dependence of quantum Hall ferromagnetic states in InSb-based heterostructures." His coauthors were N. Goel, S.J. Chung, M.B. Santos, M.B. Johnson, and S. Murphy.

Taroshani Kasturiarachchi gave a talk entitled "Spin Resolved Cyclotron Resonance in InSb Quantum Wells." Her coauthors were X.H. Zhang, R.C. Meyer, R.E. Doezema, N. Goel, S.J. Chung, M.B. Santos and Y.J. Wang.

Robert Meyer gave a talk entitled "Inter-subband coupling of Landau levels of opposite spin." His coauthors were X.H. Zhang, T. Kasturiarachchi, N. Goel, R.E. Doezema, S.J. Chung, M.B. Santos, and Y.J. Wang.

Thushari Jayasekera gave a talk entitled "R-Matrix Theory and Device Modelling." Her coauthors were Michael A. Morrison, Kieran Mullen.

Kieran Mullen gave a talk entitled "Polarization Transitions in Quantum Ring Arrays." Bahman Roostaei was his coauthor.

Kevin Hobbs gave a talk entitled "Metallic, Magnetic, and Superconducting Arrays of Nanorings." P. Larson, J. Keay, and M.B. Johnson were his coauthors.

Lloyd Bumm presented a poster entitled "An STM and TEM study of atomically-flat single-crystal gold nanoparticles on indium tin oxide." His coauthors were D. Dahanayaka, S. Hossain, S. Ross, J. Dizikes, and J. Wang.

Dick Henry attended a meeting of the Space Sciences Panel for the NRC Associateship program in March, in Washington.

Colloquia, Seminars, Invited Talks

- Karen Leighly gave an invited talk at "The Spectral Energy Distribution of Narrow-line Seyfert 1 Galaxies". Karen also presented , "The Highs and Lows of Narrow-line Seyfert 1 Galaxies (Alternative title: The Wind Comes Sweeping Down the Plane)," RIKEN, Japan, November 4; ISAS, Japan, November 5.

Bahman Roostaei gave an invited talk entitled "Novel Phenomena in Quantum Ring Arrays," March 24, U. of Arkansas, Fayetteville, in which he discussed his and Kieren Mullen's work.

Jean-Claude Chokomakoua presented "Temperature and density effects on Quantum Hall Ferromagnetic states in InSb based Quantum wells," February 21, 2004 at the NSBP-NSHP meeting in Washington, DC. He gave the same talk at the March APS meeting in Montreal. Other authors on this work are N. Goel, S.J. Chung, M.B. Santos, M.B. Johnson, and S.Q. Murphy. He presented the poster "Fabrication and characterization of reliable Metal-Insulator-Semiconductor(MIS) structures on InSb heterostructures, February 21, 2004, at NSBP-NSHP meeting in Washington, DC. Other authors are N. Goel, S.J. Chung, M.B. Santos, M.B. Johnson, and S.Q. Murphy. A second poster was "Fabrication and characterization of reliable Metal-Insulator-Semiconductor(MIS) structures on InSb heterostructures," March 31, 2004 at Graduate Research and Creative Endeavor Poster Session, The University of Oklahoma, Norman, OK. The other authors were N. Goel, S.J. Chung, M.B. Santos, M.B. Johnson, and S.Q. Murphy. J.C also won honorable mention (second prize) in the Science category.

David Branch presented "FeLoBAL Quasars: Orientation or Evolution?" March, at OU and at Stockholm University.

Yun Wang presented "Model-Independent Reconstruction of Dark Energy Density from Current Observational Data," February 2004, UCLA Symposium on the Sources and Detection of Dark Matter and Dark Energy.

John Cowan presented "Halo Star Abundances and Heavy Element Nucleosynthesis," March 23 at Nuclear Astrophysics 12, Ringberg Castle, Germany

Daminda Dahanayaka and Sohrab Hossain presented a poster at the Nanotechnology Conference held at University of Texas at Dallas from Jan.

22-24, 2004.

Eric Abraham presented "The Coldest Physics: Atoms and Molecules near Absolute Zero," at Texas State University, San Marcos, Nov. 12 and at Grinnell College, Nov. 4. He also presented "Sources and Studies of Ultracold Atoms and Molecules without Laser Cooling," ITAMP, Harvard, Jan 10, 2004

M.B. Santos spoke on "Spin-Related Electronic Properties of InSb Quantum Wells and Mesoscopic Structures" at Ohio University (Physics Colloquium, 10/9/03) and Rice University (Solid State Seminar, 4/12/04). He also spoke on this topic at Hitachi Global Storage Technologies in San Jose CA (1/30/04).

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Research Travel

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Jean Claude Chokomakoua traveled to the National High Magnetic Field Laboratory in Tallahassee, Florida, February 23-27, 2004 and April 5-11, 2004. The purpose of the trip was to search for fractional Quantum Hall Effect in InSb-based two dimensional electronic systems and evaluate quantitatively the effect of carrier density on Quantum Hall Ferromagnetic states by measuring activation energy as a function of electron density.

John Cowan traveled to the Univ. of Texas, February 17-22, to work with Chris Sneden to analyze and reduce HST abundance data and to prepare another joint publication. He also went to Max Planck Institute, Garching bei Munchen, Germany, March 29, to meet with scientists at the Institute and discuss new ideas on heavy element abundances and the synthesis of heavy elements in supernovae.

Visitors Hosted

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Kim Milton hosted Alexander Turbiner (UNAM) February 25-27. They worked on the project involving quasi-exactly solvable models. Luis Urrutia (UNAM) also visited Kim April 6-10, to work on quantum gravity.

Yun Wang hosted Joe Mohr (U. Illinois), Nov. 25, to discuss dark energy observations; and Josh Frieman (Fermilab and U. Chicago), Dec. 11, to discuss their paper on constraining dark energy with future supernova data.

John Cowan hosted Al Cameron, Univ. of Arizona, April 21-23, to discuss new ideas on heavy element nucleosynthesis.

Grants Awarded

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Karen M. Leighly, Chiho Matsumoto, "XMM-Newton Observations of the Second-brightest Quasar, PHL 1811," NASA XMM-Newton AO3, \$35,697

Karen M. Leighly, Chiho Matsumoto, "XMM-Newton Observation of the Extreme NLS1 RX J0439-45," NASA XMM-Newton AO3, \$35,697

Chiho Matsumoto, Karen M. Leighly, "An XMM-Newton Observation of IRAS 17020+4544: A Host of Dusty Warm Absorber," NASA XMM-Newton A03, \$43,648.

Karen M. Leighly, Darrin Casebeer, "Where is the Wind in 1H 0707-495?" NASA FUSE Cycle 5, \$48,100.

Strauss, Abbott, Gutierrez, Kao, Milton, Skubic with OSU (Nandi, Babu), and Langston (Snow), "The Oklahoma Center for High Energy Physics," Department of Energy, \$1.08 million over three years plus \$0.5 million from the state regents, and almost 2 million from university matching funds. This is an awesome new award which will set up an experimental program in High Energy Physics at OSU and develop the resources and ability to do grid computing at OU.

K.A. Milton (PI), C. Kao (Co-PI), "Nonperturbative Quantum Field Theory," Department of Energy, \$95,000.

David Branch and Eddie Baron, "Multi-wavelength Analysis of Spectra of Supernovae and Broad-Absorption-Line Quasars," NASA Long Term Space Astrophysics Program, \$209,000.

Greg Parker received funding from the National Science Foundation (Atomic and Molecular Dynamics Theory) for next three years 6/1/2004-5/31/2004. The proposal title is "Three-Body Recombination and Coherent Control in Ultracold Collisions."

Research Updates

- Bahman Roostaei and Kieran Mullen have found interesting new effects of magnetic fields on singly charged interacting quantum rings where the magnetic field changes electric polarization of rings because of the Aharonov-Bohm Effect.

Kim Milton writes, "This semester I have concentrated on writing a major review article on the Casimir effect, bringing the subject up to date since 2001, when two major reviews of the subject were published, one being my book. There are a number of controversial subjects in the field of manifestations of quantum vacuum energy, even including the Casimir-Polder interaction of a polarizable molecule with a substrate. I am trying to clarify the issues involved, and put my own perspective on the subject." by the end of the summer.

ANTON AND THE HUBBLE ULTRA DEEP FIELD

Sometime during my early years as a zoology major I read about the scientific work of Anton van Leeuwenhoek (1632-1723), the Dutch microscopist, who, like Galileo, didn't invent his instrument of choice but was innovative about how he used it. Perhaps the most famous story about

Anton is his discovery of "wee beasties", the abundant and varied population of microorganisms he discovered in a drop of ordinary pond water, a surprising finding and a lesson in scale which changed our perspective of nature forever.

Recently, while preparing for the extragalactic segment of my General Astronomy class, I downloaded the Hubble Ultra Deep Field image from the HST website and had a close look to determine if it would be useful to show and discuss in front of the class. As I studied my printed copy of the image, I experienced a feeling somewhat like what Anton himself must have felt. And I remarked to myself about the parallels. While Anton viewed the teeming life in a small drop of water with his microscope, I was looking at hundreds of galaxies in an image recorded while HST stared for the equivalent of 11 days at a piece of sky in the Fornax constellation that's smaller than a dime held at arm's length. And while Anton saw organisms of all different types, in the Hubble image you can see galaxies of different shapes, colors, and sizes, corresponding in part to their ages and distances. I don't recall ever getting chills before when looking at an astronomical image, but I did this time. What would the class think about the picture?

So I loaded the image into the computer in the lecture hall and displayed it for my class on the big screen. I told the students that when they look at the image, they're really looking back in time, and that astronomers estimate that some of the smaller galaxies have redshifts which tell us that they formed nearly 13 billion years ago, not long after the Big Bang. Their light is just reaching us now, so we're seeing the objects the way they were then, not now. Next, I began playing with the zoom feature. Moving in more and more revealed the morphology of many of the galaxies which had previously appeared only as small, diffuse blobs of light. I had shown them pictures already of nearby spirals and ellipticals, but now we were looking at this magnified drop of cosmic pond water and seeing the familiar shapes and features that we'd been studying. I even heard honest gasps from an otherwise image-saturated, technologically savvy audience.

One of the true joys of studying science is seeing how certain patterns and phenomena get repeated on different scales. Only the order of magnitude changes. Microbes. Galaxies. Pond water. The deep universe. But I said nothing so sentimental about this to the class. Yet it was only a few days afterwards that a student came into my office to talk and mentioned that when she had seen the UDF image on the screen, it had reminded her of pond water and microscopes. She knew about Anton. And she had gotten my point, the one that I didn't make to the class. The Hubble picture has revealed a universe filled with more galactic beasties than we could have fathomed before. Download the image and see for yourself. Experience your own chills.

Dick Henry

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