

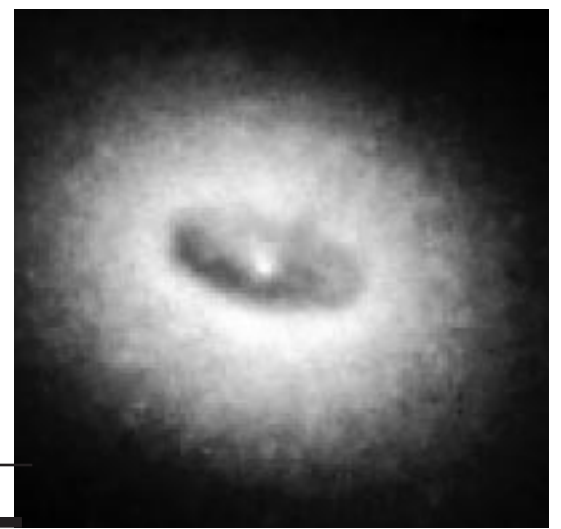
sign of giving it up, he seems to me to be asking for some hard knocks.” And C. P. Snow: “The young scientists know that with an indifferent degree they’ll get a comfortable job, while their contemporaries and counterparts in English or history will be lucky to earn 60 percent as much” (*The Two Cultures*, Cambridge UP, 1983, p. 18). However, the usefulness of physics does not depend on its money-making potential, which is matched or even surpassed by some branches of the humanities—the novel made into film, the lyrics of musical groups, and even the successful textbook in academia. And, of course, the usefulness and value of the academic study of the humanities derives from the topics they deal with.

- Individual identity: All of Shakespeare’s comedies are obsessed with our reality and possible falsifications.
- Collective identity: culture, migration, nationalism, racism, terrorism in the name of some of these notions.
- Communication: All lyric poetry has been and is a yearning for love and satire against injustice.
- The ultimate sense of life: affirmative, nihilistic attitudes, and the in-between—“the tragic sense of human existence” (Unamuno).
- Creativity: As much as a narrative, *Don Quixote* is a workshop on how to build a long fictional narrative that is a “son of the intellect” (search for truth), not of wild imagination.

While science contributes to lengthen human life and make it more comfortable, those who benefit most from scientific progress—affluent societies—have to cope every day with their personal identity, their role in the different groups to which they belong, communication with their intimate family and the world around them, the meaning of their existence, and with the reflection on everything they do: creativity. Cultivating the interdisciplinary does not mean that a professor of literature dares to write about physics. It means that we are anxious (ethical attitude) and able (intellectual preparation) to listen and to learn about nature, society, and culture.

**Ciriaco Morón Arroyo**, a native of Spain, obtained the M.A. in philosophy at the Pontifical University of Salamanca, and the Ph.D. at the University of Munich in 1963. He has been the Emerson Hinchliff Professor of Spanish Literature at Cornell since 1971. He has taught Spanish thought and poetry in the Department of Romance Studies, and European thought in Comparative Literature. His book, *El sistema de Ortega y Gasset* (Alcala, 1968), won him acclaim as the foremost authority on the Spanish thinker. In addition to other books, this year he has published his 100th article, all exploring the ideal reading at the university, the nature of humanistic knowledge, and the practical value of the humanities.

This is a Hubble space telescope image of a 300-light-year-wide spiral shaped disc of dust and gas fuelling a massive black hole at the center of galaxy NGC 4261. Black holes like this will be a prime source of gravitational waves.



## Listening to the Cosmos

by Eanna Flanagan

Normally the air that surrounds us is a passive backdrop for events, a backdrop we do not notice.

However, we know that it can make its presence felt in the form of winds and hurricanes, and also that it is the medium through which sound waves travel and bring us information. Similarly, we used to think of space and time as forming a passive backdrop for the events that take place within it. However, Einstein taught us that this is not so: there can be “hurricanes” in the fabric of spacetime itself in the form of rotating black holes. Moreover, violent events in distant galaxies will produce tiny vibrations in the fabric of spacetime, just like sound waves, called gravitational waves. If these vibrations are ever detected, they will allow us to hear the rumbles and crashes of distant events and open up a new branch of astronomy.

In 1974, astronomers using the Cornell-administered Arecibo radio telescope in Puerto Rico discovered a binary star system of two neutron stars in the direction of the constellation Sagitta, at a distance of about 3,000 light years. The two stars—each about the size of Ithaca, yet as massive as our sun—orbit each other roughly once every eight hours. General relativity predicted that the two stars should give off gravitational waves, and consequently should very gradually spiral in towards one another. In 1993, the Nobel prize in physics was awarded to Joseph Taylor and Russell Hulse of Princeton University for their precise measurement of the gradual in-spiral that agreed with general relativity’s prediction. Thus, today we are confident that gravitational waves exist.

Over the last several decades, physicists and astronomers around the world have worked to open the new window on the universe that gravitational waves constitute. The most promising technology is to monitor the relative displacement of suspended test masses in a vacuum using laser interferometry. Passing gravitational wave bursts will cause the test masses to oscillate back and forth, and this

motion is detected using the laser. Unfortunately the amplitude of oscillation is expected to be smaller than the size of an atomic nucleus, so the instrument needs to be extraordinarily sensitive. In November 1999, the Laser Interferometer Gravitational Wave Observatory (LIGO) was inaugurated; this instrument consists of two separate laser interferometers in two sites in Washington and Louisiana, each 4 kilometers long. LIGO was funded by the National Science Foundation and constructed by a team of physicists and astronomers from around the country, led by Caltech and MIT. The first gravitational wave searches with LIGO are taking place this year. Similar instruments are being constructed in Europe and Japan. There are also plans to operate a space-based detector by bouncing lasers between spacecraft in orbit around the sun. Such a system is being planned for around 2015 as a joint venture by NASA and the European Space Agency.

### The cosmic signals we expect to hear are primarily caused by cataclysmic events involving black holes and neutron stars.

In parallel with this experimental effort, theoretical physicists and astrophysicists are preparing for gravitational wave astronomy. A gravitational wave detector is something like the sonar on a submarine that is used to track other submarines. Sonar operators need to be skilled at distinguishing between screw noises and sounds from fish, whales, and other natural sources of noise. Similarly, gravitational wave astronomers will have to be skilled at separating out the signals we seek from the background cacophony due to various sources of noise in the detector.

Because the signals are so weak, such separation cannot be done by the human ear; it requires sophisticated data analysis algorithms and significant computational power. Theoretical predictions of signal characteristics from various types of sources will be vital for interpreting the signals we detect, as well as for aiding in the detection process. Making these predictions keeps gravitational theorists like me busy.

What cosmic signals do we expect to hear? Primarily cataclysmic events involving black holes and neutron stars. These objects have very strong gravitational fields and can be efficient emitters of gravitational waves. Neutron stars can spin at speeds of up to 60,000 rpm, as fast as a laboratory ultracentrifuge. We hope to hear the high pitched whine coming from several spinning neutron stars in our galaxy. The physicist Freeman Dyson pointed out back in the 1960s that a binary system of two in-spiralling neutron stars (or black holes) will give off a very strong and distinctive gravitational wave signal in the last few minutes of its in-spiral, before the two stars merge. This may well be the first type of signal we detect.

Over the last few years, astronomers have discovered that a majority of galaxies contain enormous black holes at their centers. Every so often, neutron stars (or small black holes) in the central regions of galaxies will get knocked towards the large black hole, will gradually spiral around it, and eventually fall inside. During the last year of in-spiral, the neutron star might orbit the black hole a few hundred thousand times, moving at close to the speed of light. The gravitational waves produced will carry encoded within them a detailed map of the warpage of space and time near the large black hole, something that has never been observed before. Reconstructing this map is one of the holy grails of gravitational wave astronomy.

To reconstruct this map, we need to be able to predict the complicated motions of the neutron star near the black hole. Although in principle this motion is dictated by the theory of general relativity, in practice various complexities prevent theorists from predicting the motion except in special cases due to various complexities. The issue is the computation of the force that acts on the neutron star due to its own gravitational field, which is analogous to the reaction force associated with synchrotron radiation that acts on electrons in Cornell’s electron storage ring. Over the last few years, I have



The LIGO facility in Hanford, Washington, showing the two beam tubes, each four kilometers long.



## Books by Alumni/ae

**Carol Aneshensel**, Ph.D. '76, wrote *Theory-Based Data Analysis for the Social Sciences* (Pine Forge Press, 2002). Aneshensel presents a method for aligning data analysis and statistical technique with social theory. It includes a description of the elaboration model and introduces into it a new cause-and-effect relationship, the "focal relationship." Aneshensel is a researcher in social stress and mental health and a professor at the School of Public Health, University of California, Los Angeles.

**Don Asher** '47 has published considerable fiction beginning in the 1960s and a memoir, *Notes from a Battered Grand* (Harcourt Brace, 1992). *Raise Up Off Me: A Portrait of Hampton Hawes*, by Hampton Hawes with Asher, the jazz pianist's autobiography, was recently republished (Thunder's Mouth Press, 2001).

**Aimée Boutin**, Ph.D. '98, wrote *Maternal Echoes: The Poetry of Marceline Desbordes-Valmore and Alphonse de Lamartine* (University of Delaware Press, 2001). It examines maternal imagery in the poetry of two French Romantic poets: the increasingly popular Desbordes-Valmore and the critically marginalized Lamartine. Boutin is assistant professor of French at Florida State University.

### *Listening to the Cosmos, continued*

been working with a number of other gravitational theorists from around the world to develop the required mathematical and computational tools. Each year we have organized a workshop to review progress and make plans for the coming year. The first of these workshops took place in 1998 at the ranch of movie director Frank Capra (now owned by Caltech) in southern California, so the workshops have been dubbed the "Capra Ranch radiation reaction workshops." Our goal is now almost at hand; we hope within a year or two to have detailed predictions for the gravitational wave signals.

It is now almost four hundred years since Galileo first raised a telescope to the sky and discovered the moons of Jupiter. Today, using gravitational waves, several hundred physicists and astronomers around the world are attempting to open a completely new window onto the universe. My students and I find it tremendously exciting to be part of this effort. No doubt, the gravitational wave signals, when they are finally detected, will bring lots of surprises.

*Eanna Flanagan is an associate professor of physics and astronomy and specializes in theoretical astrophysics and general relativity. He has been the recipient of Fermi, Sloan, and Radcliffe fellowships.*

**Joseph Conte** '82 wrote *Design and Debris: A Chaotics of Postmodern American Fiction* (University of Alabama Press, 2002), which discusses the relationship between order and disorder in the works of John Hawkes, Harry Mathews, John Barth, Gilbert Sorrentino, Robert Coover, Thomas Pynchon, Kathy Acker, and Don DeLillo. Conte is professor and chair of English at the University of Buffalo.

**Adam Engst** '89 wrote *iPhoto 1.1 for Mac OS X: Visual QuickStart Guide* (Peachpit Press, 2002), which helps Macintosh users make the most of Apple's free iPhoto program for managing and sharing digital photos. Engst publishes the online newsletter *TidBITS* and chairs several Internet non-profit organizations.

**Joel Fetzer** '88 wrote *Public Attitudes toward Immigration in the United States, France, and Germany* (Cambridge University Press, 2000). Fetzer is assistant professor of political science at Pepperdine University.

**Nick Fowler** '89 wrote *A Thing (or Two) about Curtis and Camilla* (Pantheon Books, 2002), a comic and poignant "slacker" romance set in Manhattan. Fowler lives in Los Angeles and is working on his next novel.

**Eric Freedman** '71 wrote *How to Transfer to the College of Your Choice* (Ten Speed Press, 2002), a guide for the one out of four students who are so dissatisfied with the college of their freshman year that they do not return. Freedman is a Pulitzer Prize-winning journalist, senior writer for *Community College Week*, and an assistant professor at Michigan State University's School of Journalism.

**Seth Kibel** '96 is instrumentalist, composer, arranger, and producer for the klezmer band The Alexandria Klezmer, which has released its second CD, *Delusions of Klezmer*. Kibel developed his love of klezmer music while part of the Cayuga Klezmer Revival, a favorite of Ithaca audiences in the mid-1990s.

**Hugh E. Kingery** '54 edited the *Colorado Breeding Bird Atlas* (Colorado Bird Atlas Partnership and Colorado Division of Wildlife, 1998). The atlas reports the results of eight years of fieldwork by 1,200 volunteers. This fieldwork followed a protocol developed, in part, at a conference sponsored by the Cornell Laboratory of Ornithology. Kingery worked for 20 years as an attorney for Husky Oil Co. before retiring to his twelve-year stint directing the Colorado Breeding Atlas project.

**Bette H. Kirschstein** '79 edited *Life Writing/Writing Lives* (Krieger Publishing Company, 2001). Kirschstein is an associate professor of English at Pace University.

**Douglas Kleiber** '69 wrote *Leisure Experience and Human Development: A Dialectical Interpretation* (Lives in Context Series, Basic Books, 1999). Kleiber reviews the predictable changes in leisure activities over the life span, which stimulate developmental change less often and less effectively than they might. He then considers the role that leisure experience can play in addressing the problems of socialization, identity formation, and adjustment to life circumstances, including aging. Kleiber is professor and director of the School of Health and Human Performance at the University of

Georgia and past president of the Academy of Leisure Sciences.

**Joan B. Landes** '67 wrote *Visualizing the Nation: Gender, Representation, and Revolution in Eighteenth-Century France* (Cornell University Press, 2001) and *Women and the Public Sphere in the Age of the French Revolution* (Cornell University Press, 1988). Landes is professor of women's studies and history at Pennsylvania State University.

**John J. Macionis** '70 wrote the textbook *Social Problems* (Prentice Hall, 2001). The book applies various theoretical paradigms, including social-conflict, structural-functional and symbolic-interaction, and conservative, liberal, and radical political perspectives. Macionis is professor and Prentice Hall Distinguished Scholar of Sociology at Kenyon College. He recently received the American Sociological Association's Award for Distinguished Contribution to Teaching.

**Scott McDermott** '94 wrote *Charles Carroll of Carrollton: Faithful Revolutionary* (Scepter, 2002). Carroll was the only Catholic signer of the Declaration of Independence, the wealthiest man in America at the time, and the last signer to die. McDermott focuses on Carroll's political thought as part of the natural law tradition.

**Nicholas Paige** '88 wrote *Being Interior: Autobiography and the Contradictions of Modernity in Seventeenth-Century France* (University of Pennsylvania, 2001). The book speaks to scholars and to readers interested in constructions of gender and authorship, the history of private life and reading practices, and the past and future of interiorized subjectivity. Paige is associate professor of French at the University of California, Berkeley.

**Stuart Peterfreund** '66 wrote *Shelley among Others: The Play of the Intertext and the Idea of Language* (Johns Hopkins University Press, 2002). The book lays out Shelley's ideas of language and its relation to the theory of poetry, and demonstrates how those ideas contribute to reading the poems. Peterfreund is professor of English and director of graduate studies at Northeastern University.

**Joshua H. Roth**, Ph.D. '99, wrote *Brokered Homeland: Japanese Brazilian Migrants in Japan* (Cornell University Press, 2002). Since the late 1980s, Japanese firms have hired foreign workers in increasing numbers. Among these foreigners are roughly 250,000 Nikkeijin—overseas Japanese, mostly from Brazil—who were presumed to assimilate more easily into Japanese society. In fact, however, Japanese and Japanese Brazilians distinguish themselves from each other. The interactions between Nikkeijin and natives, says Roth, play a significant role in the emergence of an increasingly multicultural Japan. Roth is assistant professor of anthropology at Mount Holyoke College.

**Martin Rudolph** '61 wrote *EZ-101 Calculus* (Barron's Educational Series, 2002), a study guide/class notes for a first term calculus course. Rudolph teaches mathematics at Oceanside High School in New York. In 1997, he won the Presidential Award for Excellence in Mathematics Teaching and in 1995 the Tandy Technology Scholar Award.

**Jeffrey Ruoff** '85 wrote *An American Family: A Televised Life* (University of Minnesota Press, 2002). The 1973 PBS documentary/cinema verite of the Loud family reached an unprecedentedly large audience. Ruoff's book is a study of this series—influential on both the documentary film and fictional TV American families—and a bridge to ongoing discussions of reality television. Ruoff is a film historian, documentary filmmaker, and assistant professor of film and television studies at Dartmouth College.

**Douglas Rutzen** '87 co-authored (in Macedonian) *Associations and Foundations* (Faculty of Law, Justinian First, 2001). This law school textbook discusses the legal framework underlying the renaissance of civil society in Macedonia and Central/Eastern Europe. It is the first of its kind in the region and the first textbook co-authored by a foreign expert in the 50-year history of the law school in Skopje. Rutzen is senior vice president of the International Center for Not-for-Profit Law in Washington, DC.

**Rawley Silver** '39 created *Three Art Assessments: The Silver Drawing Test, Draw a Story: Screening for Depression and Age or Gender Differences, and Stimulus Drawing* (Brunner-Routledge, 2002). The Silver Drawing Test assesses cognitive skills without using language and is uniquely suited to clients who have difficulty understanding others and making themselves understood. Draw-a-Story focuses on using art to uncover and treat depression in children. Stimulus Drawings assess personal associations and fantasies.

**James Sturz** '87 wrote *SASSO* (Walker & Co., 2002), a literary thriller set in a 1970s cave town in southern Italy, which the *Sunday Telegraph* called "one of the most intriguing and original books I read so far this year." Sturz is a freelance journalist and author based in New York.

**Catherine Taylor** '85 wrote *Giving Birth: A Journey into the World of Mothers and Midwives*. Taylor is a doula (birth attendant) and wrote this guidebook from personal observations of midwives at work; her own two children were born with the assistance of midwives. After many years of teaching creative writing to at-risk populations, Taylor is now assistant professor of English at Drake University.

**Lillian Trager** '69 wrote *Yoruba Hometowns: Community, Identity, and Development in Nigeria* (Lynne Rienner Publishers, 2001). A Nigerian edition has been published (Spectrum Books, Ibadan Nigeria) as well as a companion video, *Yoruba Hometowns and Local Development in Nigeria*. Trager is professor of anthropology at the University of Wisconsin-Parkside.

**Bob Zeidman** '81 wrote *Designing with FPGAs and CPLDs* (CMP Books, 2002), a guide for engineers designing programmable devices and managers planning and scheduling such a design. In addition to describing the technologies and architectures of these devices, the book details a new, concise, reliable system for hardware design called the Universal Design Methodology (UDM). Zeidman is the president of Zeidman Consulting, a contract research and development firm.