Mapmakers Chart Distribution of Dark Matter

By Michael Lucibella

APS April Meeting 2015, Baltimore — Scientists working on the Dark Energy Survey (DES) released a map of a section of the southern sky charting the location of matter based on its lensing effects on light from distant galaxies. The map, presented at the April Meeting, is the first preliminary analysis of results from the survey, and the first detailed picture of the distribution of matter in the universe out to about seven billion light years.

New information about the distribution of dark matter complements the findings of existing surveys of luminous matter. “It ... [includes] not only the galaxy and stars we know and love, but also the dark matter,” said Chihway Chang of the Swiss Federal Institute of Technology.

**Particles Particle Physicists Gather to Plan Next Accelerator**

By Michael Lucibella

As news broke that the restart of the Large Hadron Collider (LHC) would be delayed, more than 300 physicists, including many of CERN’s top scientists and administrators, gathered in Washington, D.C. in March 2015 to plan for the machine’s successor — the Future Circular Collider (FCC), to be built at CERN. This meeting was the second annual design conference for the FCC, and the first held in the United States.

The FCC would surpass the LHC in both size and energy. Though early in the design process, the FCC is envisioned as a 100 TeV circular collider between 80 and 100 km in circumference, compared to the LHC’s 27 km ring and 13 TeV energy (after the current upgrade is complete). Such a gargantuan project faces a variety of technical, economic, and political challenges, some likely easily surmountable, others less so.

“I think for the next collider, we should go to the Moon,” said Bruce Strauss, a physicist in the U.S. Department of Energy (DOE), using an Apollo-era metaphor. “There are some challenges ahead, but I think we should go.”

The current plan is to run the LHC through about 2022. Then a major upgrade, completed by 2025, would turn it into a high-luminosity machine, the HL-LHC, which would support a ten-year science program. FCC would start construction shortly after this program ended.

Participants in the meeting, which was organized by IEEE in conjunction with the DOE and CERN, hope to complete the FCC’s technical report by about 2018, in time for the next update to the European Strategy for Particle Physics (ESPP) in 2019 or 2020.

“The LHC is the main machine, and now we have people looking at what else can be [built],” said Frederick Bordry, the director for accelerators and technology at CERN.

The final design for the FCC is up against a parallel effort to design the Compact Linear Collider (CLIC). The envisioned 42-kilometer long, 3 TeV electron-positron linear collider would also be located at CERN. Once both designs are completed, CERN administrators will recommend one of the two options when it is time to update the ESPP.

Though the FCC planners at the **ACCELERATOR** continued on page 6

**Nuclear Needles in Cargo Haystacks**

By Shannon Palus

APS April Meeting 2015, Baltimore — Every day, some 60,000 ship-board cargo containers pull into United States ports. Each metal box is about 2.4 m by 2.4 m by 12 m, which is plenty of space to hide a nuclear bomb, says Argen Danagoulian, a nuclear scientist at MIT. In fact, there are bombs that could blow up several city blocks, and could fit in a backpack. Danagoulian asks: “How do we detect something so small?”

At the April Meeting, Danagoulian presented data from a proof-of-concept demonstration that peers into cargo with beams of gamma rays. Within the decade, he hopes, the method will be used at ports to accurately scan cargo at a rate of about two minutes per container. His is just one of the technologies that physicists are developing to prevent the proliferation of nuclear materials, whether through terrorism or war.

It’s been decades since school children were advised to “duck and cover” to shield themselves from Cold War atomic bombs. According to the National Academy of Engineering (NAE), preventing nuclear terror is still an important goal, and the NAE put it on the list of 14 Grand Challenges of Engineering to be solved in this century.

“Peaceful energy programs could mutate into weapons programs,” says Danagoulian. “You could use a reactor for synthesizing plutonium, and [make] a weapon out of that.” Also, weapons can be stolen from existing stockpiles; there are 17,000 warheads in the arsenals of Russia and the U.S.

Today, port inspectors use passive methods to detect nuclear contraband, like looking for radiation coming from a container. That is easy to block with lead if NEEDLES continued on page 6

**PhysTEC Selects Four New Sites to Share $1.2 Million**

By Bushraa Khatib

The Physics Teacher Education Coalition (PhysTEC) project has added four newly-funded comprehensive PhysTEC sites and nine sites that received smaller recruiting grants. Since the project began in 2001, it has funded a total of 46 sites (including the newly-funded sites) to build model physics teacher education programs. Collectively, these institutions have doubled the number of high school physics teachers graduating from their programs.

The four new comprehensive sites selected to develop their physics teacher education programs into national models are Rowan University, Texas State University, West Virginia University, and a joint University of Northern Colorado/Colorado School of Mines project. Funding for the new sites, up to $300,000 per site over three years, will begin in fall 2015.

PhysTEC, the flagship APS education program, aims to improve the education of future physics teachers by creating successful models for physics teacher education programs and disseminating best practices. The PhysTEC program is led by APS, in partnership with the American Association of Physics Teachers, with support from the National Science Foundation and APS donors.

Monica Plitch, Director of PhysTEC and APS Associate Director of Education and Diversity, said, “We were pleased to have received such strong proposals that promise to develop new models for physics teacher education.” The nationwide need for physics teachers is acute; only one third of physics teachers have a degree in the field.

In one of first partnerships of its kind, the University of Northern Colorado (UNC), one of the top producers of science educators in Colorado, has teamed up with the Colorado School of Mines (CSM), one of the largest physics undergraduate programs in the country.

Wendy Adams, director of Science Education Programs at UNC, said the PhysTEC grant has already helped leverage institutional support, including a six-year commitment for a full-time Teacher-in-Residence (TIR), one of the key components of successful PhysTEC sites.

Vincent Kuo, director of the Center for Engineering Education at CSM, and a champion for PhysTEC, said that as a science and engineering school, CSM has historically not been involved with producing educators. With this collaboration, the school is uniquely positioned to fill the licensure pool with exceptionally qualified undergraduates.

Texas State University is the first PhysTEC site in Texas and an institution serving Hispanic students. The program aims to produce five physics teachers per

**PHYSTEC continued on page 4**

**Map of total (luminous and dark matter) mass distribution produced by the Dark Energy Survey team based on gravitational lensing of light from distant galaxies. Red indicates higher mass densities and blue the lower mass density regions. Size of moon is shown in upper left for comparison.**

**NEEDLES continued on page 6**

**Jura**

**Prelaps**

**Aravis**

**Mandala**

**Schematic of an 80 - 100 km long tunnel**

**LHC and one possible successor (dotted line)**

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www.aps.org/publications/apsnews

See pp. 3 and 4
This Month in Physics History


Much of the outdoor footage for the 1997 film Contact was shot on-site at the Very Large Array observatory in New Mexico. Far more people have heard of the film than of the man for whom that observatory is named: Karl Guteh Jansky, known among astronomers as the father of radio astronomy.

Born in 1905, Jansky was one of six children. His father, Cyril, an electrical engineering professor at the University of Wisconsin, instilled a strong love of physics in Karl’s older brother, Cyril Jnr., insisted that his younger sibling “was no bookworm,” citing his skill at tennis and hockey, and later Stanford University’s Table tennis champion in New Jersey, as evidence.

Karl Jansky earned his degree in physics from the University of Wisconsin, and spent an extra year as a graduate student, although he never completed his thesis. Instead, he joined the research staff of Bell Telephone Laboratories in 1926. He had been diagnosed with chronic kidney disease in college, so Bell Labs was initially rather leery of him, but retained Jansky when big brother Cyril — an electrical engineer, like his father, and a former Bell Labs staff member who helped build some of the earliest radio transmitters in the U.S. — intervened on his behalf.

Jansky’s first assignment was to study intermittent static noise that might be interfering with radio waves used for transatlantic telephone transmissions. It was a challenging assignment; Jansky had to design and build special instruments for that purpose, most notably a large directional antenna system mounted on a motor-driven turntable that rotated through 360° about a central vertical axis, riding on a circular track on the wheels of a Model-T Ford. It was dubbed “Jansky’s merry-go-round.”

Once he analyzed all that data — collected over many tedious months — Jansky identified three basic types of static: local thunderstorms, distant thunderstorms, and a third he described as being “composed of very steady hiss static the origin of which is not yet known.” His careful wording came at the advice of his supervisor, who cautioned him against making over-bold claims, lest his finding not hold up to further investigation. But Jansky suspected that something originated in the center of the Milky Way galaxy, making it the first known detection of extraterrestrial radio signals.

His reasoning was simple. He studied that third type of static for over a year, and noted that it rose and fell once a day. At first, Jansky thought this meant it was radiation from the sun. But a few months later the brightest point of the signal moved away from the sun’s position. Furthermore, the rise and fall did not repeat exactly every 24 hours, but every 23 hours and 56 minutes — a property of fixed stars and other celestial objects beyond our solar system. The most likely source of the radiation, he concluded, was the center of the Milky Way, where the signal was strongest, in the constellation of Sagittarius.

As Cyril Jansky called his scientist’s problem to be one that is recognized to basic facts even though they are obscured by a wealth of extraneous material, and then to apply creative imagination in their interpretation. That Karl Jansky did.

The result was not one, but three published papers, including “Electrical disturbances apparently of extraterrestrial origin,” which he presented at a meeting of the International Scientific Radio Union in April 1933. This, in turn, led to a high-profile news story in The New York Times on May 5, 1933, trumpeting his discovery, and the University of Wisconsin finally awarded him his master’s degree based on the three papers.

Jansky was keen to continue investigating these mysterious cosmic signals and wanted to build a 30-meter dish antenna for that purpose. He tried to get his work supported by interested in applied research at the time — the height of the Great Depression. Since Jansky’s work showed the hissing static must not be problematic for transatlantic communications, they judged the project complete. Jansky was assigned to other projects. He remained at Bell Labs for the rest of his life, testing in relative obscurity despite pioneering a new field of science, although he was elected as a fellow of the Institute of Radio Engineers in 1948.

That new field, radio astronomy, didn’t emerge overnight. The dire economy and Jansky’s lack of professional standing as an astronomer dissuaded various investors from finding in research. One key early figure was Grote Reber, who heard of Jansky’s discovery and built a radio telescope in his own backyard in 1937, using it to conduct the first systematic survey of cosmic radio waves.

The development of radar during World War II provided a boost to radio astronomy, such that after the war ended, another astronomer named John Kraus was able to start a radio observatory at Ohio State University. Kraus eventually wrote a textbook that became a bible for radio astronomers. By 1964, it was said that the year Arno Penzias and Robert Wilson used a giant horn antenna to discover the cosmic microwave background radiation.

Jansky died in 1950 at the age of 44, the result of a massive stroke stemming from his kidney disease. When that first 1933 paper was reprinted in Proceedings of the IEEE in 1964, the editors noted that Jansky’s work would mostly likely have won a Nobel prize, had the scientist not died so young.

COSMIC RADIO WAVES continued on page 7
Environmental Physics at the April Meeting

By Michael Lucchella

APS April Meeting 2015, Baltimore — Presenters at the April Meeting highlighted the role that physicists can play in combating climate change. Researchers shared ways to reduce carbon emissions in the developing world, innovate new techniques to harness the sun’s energy, and even extract carbon dioxide from the air.

The APS Forum on Physics and Society honored Berkeley physicist Ashok Gadgil for his work improving global health and the environment. One of the projects he spearheaded was the Darfur Stove, a cheap and efficient wood stove first distributed to refugees in camps in Sudan.

He designed the stoves to maximize their energy efficiency, conserving the wood fuel, a scarce resource that is dangerous for people to collect in arid northern Africa. At Lawrence Berkeley National Laboratory, Gadgil and his team designed and tested a $20 sheet-metal stove that could be inexpensively shipped all over the world.

Estimates cooking with the stoves saves two tons of carbon per stove per year compared to the traditional method of heating a pot raised on three stones over a small fire. So far, the nonprofit that manufactures and distributes the stoves, Potential Energy, has dispensed more than 46,000 of them throughout the region and plans to send another 5,000 by the end of the year.

As an officer with the University of Arizona Police Department (UAPD), Andrew Lincowski spends most of his days ensuring safety by patrolling the streets, responding to calls, and visiting schools to talk about the importance of maintaining personal safety between shifts, he pursues another passion — he is an undergraduate in physics and astronomy and plans to go to graduate school and become a theoretical astrophysicist.

Lincowski traces his love of science back only a few years. “I’m an advanced student in physics who has a lot of curiosity,” he says. “And so, ‘my science path was initially diverted.’” He graduated in 2006 with a bachelor’s in accounting and immediately started working in the housing market. But when the economic crisis hit, he shifted towards law enforcement, eventually becoming a cop with the Tucson Police Department (TPD). “My goal was to become a detective as quickly as possible,” he says, with an eye towards a federal agency such as the IRS, where he could use his accounting skills to investigate financial crimes.

Never a gambling man, as he prepared for the detectives exam, Lincowski also applied to UA as a physics student. The move paid off: “I didn’t make detective eligibility, so I went back to school,” he says, and he was happier because of it. He stayed with TPD for 4 years before transferring to UAPD.

Now a senior, Lincowski is set to graduate in May 2015. He has done quite a bit as a physics student, including completing an internship at NASA’s Goddard Space Flight Center, where he contributed to the Haystacks Project, which supports the search for habitable exoplanets by simulating telescopic planetary system images across a wide range of wavelengths. Ultimately, his efforts will improve the development of future telescopes in the search for exoplanets. He also was one of only 16 nationwide recipients of the prestigious Computational Science Nobel Scholarship, offered by the National Space Grant Foundation.

Derrick Brown, a firefighter with the city of Savannah, GA, has taken his studies, he was taking a mechanics class where the instructor was discussing collisions between moving vehicles. Soon, Lincowski was called to testify in a lawsuit pertaining to a car accident. When he sat up in the witness stand, “I used my physics knowledge to show that the guy had been going over 50 miles per hour in a 55 mph zone,” he says. “The lawyer said I had no knowledge of this, but I was able to refute this … The attorney got flustered, because they were trying to throw that information out. But I had proof and showed them the math. Most police officers can’t do that.”

The experiences of Lincowski and Brown as first responders who use physics have also greatly helped them as physics students. Lincowski reports that he has improved his time management and ability to deal with stressful situations and conflict. “I don’t tend to be affected as much by stress,” he says. “It’s hard to be stressed about deadlines, presentations, or tests when you’ve been on the street with people who want to kill you.”

Lincowski also has honed the skill to focus on facts and ignore preconceptions. “As a police officer, you have to weigh your experience with certain people to know how they’ll react,” he says. “This extra sense of awareness has helped me as a scientist, although he also adds that he has learned not to ‘judge things too quickly, because they can change very quickly.’”

On the other hand, his physics education has also helped him on the force. For example, he has a greater appreciation of technology used by law enforcement, such as TASERs, and he has leveraged his physics knowledge to bolster his ability to solve cases.

First responders: Getting the bad guys and fighting fires … as physicists

By Aliaina G. Levine

Andrew Lincowski

Environmental Physics at the April Meeting

As first responders, their flexible schedules have definitely made it easier to pursue physics. Lincowski typically works four 18-hour shifts each week, which leaves him plenty of time to attend courses and research. “During my shifts, I’m on duty, his focus is completely on law enforcement. ‘I can’t do homework in the car,’ he jokes. And although his physics education is still a work in progress, the discipline is part of many aspects of his job, “I try not to be ‘that guy,’ who has a story for everything in class.”

Brown, who works 24-hour shifts and then has 48 hours off, can...
Nuclear Wafers and Neutron Waffles

APS April Meeting 2015, Baltimore — Neutron stars contain some of the densest matter in the universe, second only to black holes. Astrophysicists say that these compact, Manhattan-sized remnants of stars have a thin, 100-meter crust whose structure resembles different kinds of noodles: strings of protons and neutrons, smushed together like floor and eggs in a pasta press. At the April Meeting, graduate student Matt Caplan gave an update on the research conducted in a group led by Charles Horowitz at Indiana University. This team of theoretical physicists uses supercomputer simulations of very dense nuclear “pasta” — the region where things get weird,” as Caplan puts it. Even in black holes, something can be better than nothing. Clearly, Caplan showed off another food-like substance hidden in the neutron star: waffles (see left side of figure), named for their similarity to the waffle pattern on the computer simulations of the densest matter in the universe.

The middle child

There are black holes that are a million, or even a billion times more massive than our sun. There are the comparably small black holes, at a few solar masses. University of Maryland physicist Dheeraj Pasham showed off data from a rare middle-sized black hole that officially clocks in at 480 solar masses. He called it Schnittman, after a species of orchid — Jeremy Schnittman showed that in some cases, critical particles that just barely fall into the black hole, so they collide with the maximum possible energy, he explains.

The energies in these so-called Penrose collisions “are not quite as impressive,” says Schnittman. But they are greater in terms of effect. In a way of explanation, Schnittman offers the classic tortoise and the hare morality: “sometimes second best wins!”

PHYSTEC continued from page 1

year by the end of the funding period, and plans to engage a TIER to focus on course improvement and community-building activities. The physics department at Texas State University has committed to physics education as a core activity, and recently hired two faculty members who specialize in this area.

John and Gay Stewart, who developed an exemplary PHYS -TEC site at the University of Arkansas, plan to use the lessons they have learned there to remove institutional barriers to teaching at West Virginia University (WVU). “Our model at the University of Arkansas was always departamental transformation leading to the growth of the undergraduate major, with increased graduation of students and teachers, a natural outcome of that growth,” said John Stewart, site leader of the WVU PHYS-TEC project. The project will partner with WVU/Teach, a brand new UTeach replication effort that has already shortened the licensure path of physics students from six years to four.

Rowan University in New Jersey has a thriving undergraduate physics program, within a multi-institution site involving four institutions in New Jersey. “Our model at the University of Arkansas was always departamental transformation leading to the growth of the undergraduate major, with increased graduation of students and teachers, a natural outcome of that growth,” said John Stewart, site leader of the WVU PHYS-TEC project. The project will partner with WVU/Teach, a brand new UTeach replication effort that has already shortened the licensure path of physics students from six years to four.

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References


Horowitz Group/Indiana University

PhysTEC also selected nine sites to receive recruiting grants (up to $50,000 over three years) in order to explore new approaches for increasing the number of high school physics teachers and engage bachelor’s-granting physics departments, which collectively educate over half of all physics teachers in the U.S. While comprehensive sites deal with all aspects of physics teacher preparation, these smaller sites focus on recruiting more future high school physics teachers.

The sites selected for funding beginning in September 2014 include Boise State University; Bowdoin College; East Tennessee State University; Indiana University South Bend; Northwestern Oklahoma State University (a multi-institution site involving four universities in Oklahoma); Salisbury University; Sonoma State University; University of Massachusetts Dartmouth; and University of Wyoming.

These sites will use PHYS-TEC grants to boost marketing efforts, improve advising, create streamlined pathways to the physics degree/certification, provide financial support, develop early teaching experiences, and fund a part-time TIER.

The author was formerly APS Bridge Program Coordinator. She is now at the Drexel University Autism Bridge Program. For more information on PHYS-TEC and other physics education initiatives, visit www.aps.org/phys-tec.
New APS Ad Hoc Committee on LGBT Issues Gaining Ground

The new APS ad hoc Committee on LGBT Issues (C-LGBT) is charged with making recommendations to the APS on how to make physics more inclusive for LGBT individuals, and the committee will make a report in early 2016. For a Physics Today piece on C-LGBT, go to: scitation.aip.org/content/aip/magazine/physicstoday/article/68/3/10.1063/PT.3.2716.

Also, profiles of LGBT physicists are available online at the following URL: scitation.aip.org/content/aip/magazine/physics today/news/10.1063/PT.5.9034.

M. Hilddred Blewett Fellowship: Applications due June 1

APS is now accepting applications for the M. Hilddred Blewett Fellowship. This award is intended to enable women to resume physics research careers after an interruption. The deadline to apply is June 1, 2015. For more information and/or to apply, please visit: www.aps.org/programs/women/scholarships/blewett/.

Follow Physics Diversity on Twitter

Curious to hear the latest happenings in physics and diversity? Follow @APSdiversity on Twitter.

Sign up to receive the COM/CSWP Gazette

The Gazette is the newsletter of the APS Committee on the Status of Women in Physics (CSWP) and the Committee on Minorities (COM). It features updates on CSWP and COM activities and programs, book reviews, statistical reports, and articles on programs designed to increase the participation of women and minorities in science. The Gazette is distributed free of charge. To add your name to the Gazette mailing list, email women@aps.org and include your postal mailing address.

Accepting Nominations for the CSWP Woman Physicist of the Month

The APS Committee on the Status of Women in Physics (CSWP) Woman Physicist of the Month award recognizes female physicists who have an impact on an APS member’s life or career, both past and present, and/or who are worthy of recognition. Each CSWP Woman Physicist of the Month is featured on the APS Women in Physics website (www.WomenInPhysics.org), announced in the Gazette, and recognized at a reception at an APS national meeting.

Nomination is easy: Email a three-paragraph statement explaining why the physicist you are nominating is worthy to women@aps.org.

2015 APS General Election

Candidates for Vice President

Roger Falcone
University of California, Berkeley
Lyman Page
Princeton University

Candidates for Treasurer

Thomas Haiky
ExxonMobil
James Hollenhorst
Aglion

Candidates for Chair-Elect Nominating Committee

Deborah Jin
University of Colorado
Robert McKeown
Jefferson Laboratory

Candidates for General Councilor

Bonnie Fleming
Yale University

Candidates for International Councilor

Johanna Stachel
University of Heidelberg, Germany
Joachim Ullrich
Max Planck Institute

Candidates for General Councilor

Brad Marston
Brown University

The 2015 APS Nominating Committee is pleased to present an outstanding slate of candidates for this year’s annual election. Voting will be open from May 15 through June 30. Those who are elected will begin their terms on January 1, 2016. Information on voting, and the candidates’ statements and biographical information, are available at go.aps.org/aps-votes-2015.
the smogger has any competence, says Danagoulian. Inspectors also use handheld x-ray optimized for spe-
ific wavelengths ranges. He said that this technique might boost a solar cell’s efficiency from around 5 percent to 50 percent.

Other teams are taking the idea one step farther. For example, after the sun’s visible light is absorbed, the remaining infrared radiation is directed at a thermoelectric. “There’s lots of advanced optics going on at ARPA-E,” Braun said. “We need the advances for build-
ings, solar power, drying clean, all kinds of things.”

For other researchers, generat-
ing electricity without producing any carbon dioxide isn’t enough. Con-
ing uses a truss-like structure to keep up with the needs of the

But his system alone isn’t enough to conclusively determine what’s inside the container. “If you start mixing materials, you’re going to measure the effective Z,” says Danagoulian. Adding low-Z materials to a container with plu-
tonium could throw off the system. One method that might com-
plement gamma-ray inspection is neutron radiography. “Neutron radiography is good at analyzing materials with low Z,” says Dana-
goulian. That includes plastics and organic material. “I see it as a way of augmenting the range of Z recon-
struction,” he explains.

When it comes to capturing a warhead, or the material for one, “There is no silver bullet,” says Danagoulian. Ultimately, he envi-
sions a combination of methods employed at ports, the data from each utilized in a decision-making algorithm. And the methods work for catching more banal contraband, too. Coffee washed out in ordinary water for tax evasion. “I see it as not being as threatening of a scenario, but it’s one customs agents are more likely to see on a regular basis.”

ENVIRONMENT continued from page 3

mirrors to split white light into its constituent wavelength in order to

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ACCCELERATOR continued from page 3

enabling chicken wire in order to maximize its surface area. He

The role of the U.S. in the proj-

Central for Negative Carbon Emis-
sions at Arizona State University, where he and his team have been

work do homework at the stationhouse in between fires, but the climate pressure makes it a challenge. “It’s like a fra-
house,” he admits with a chuckle. “I have to hide in the bathtub to do my homework.”

In Danagoulian’s cargo inter-
rogation method — 10 times as efficient as the broadband method — two monochromatic gamma-ray beams, one at 15.1 MeV, pass through a container to a detector on the other side. The flux of the 4.4 MeV beam through the container reduces the number of photons that go through the container decreases.

ACCELERATOR continued from page 3

Getting different career options. He was

The present cost of niobium-3 in a . . . [dealer-breaker],” said Ezeo

However, the challenge of scrub-
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Resolution that would determine overall spending, it became clear that the work-around would carry the day. The instrument they settled on was an account called Overseas Contingency Operations (OCO), which is not subject to BCA caps. Using that mechanism, both chambers added about the same amount of new money for defense the president had called for in his February budget request. And with military needs taken care of, congressional Republicans refused to give the president half a loaf to rolls forward, Congress is poised to begin defense discretionary programs. By so doing, he eventually might be able to arrive at the spending balance he asserted was right for the country. I respect Barack Obama’s intellect, integrity, and sincerity, but his own copybook world of today’s Washington requires far more. Politics is the art of recognizing what is possible and then using effective bargaining skills to achieve the end you want. Starting at the end and trying to convince people you’re right and they’re wrong is usually a losing strategy — even when you are right and they are wrong. Logic and evidence might carry the day in science and law, but in politics persuasive argument, alone, will not suffice. Compromise, horse-trading, and an occasional threat of retribution are additional essential ingredients for success. The president’s budget bungle is a fait accompli, and all the ketchting in the world can’t change it. We’ll just have to live with the consequences: increased military spending and, in all likelihood, a series of continuing resolutions (CR) for almost everything else. Of course before we get to the CRs we’ll have to weather threats of veto, actual vetoes, threats of government shutdowns, and more likely, a series of lesser furloughs, but hey, this is Washington. Now by us should be used to it. A decade ago, sausage-making was an apt though distasteful metaphor for what material is falling onto medium black holes. In these cases from mergers of stars in a dense star cluster, says Pasham. A mega star could quickly collapse into a black hole, so further study of the rare middle-aged object could solve that mystery. Two to Tango Short gamma ray bursts — less than two seconds — are thought to come from a spinning black hole in a magnetized gaseous disk, with twin jets of matter emanating from its sides. In the outer regions of the cloud, gamma rays and electromagnetic radiation become X-rays, visible light, radio waves — are born. In the shrinking clouds these jets are created from the magnetic field that arises from a neutron star orbiting a black hole, eventually being sucked in and swallowed up. But, “no computer simulations based on the laws of general relativity and magnetohydrodynamics have been able to form a jet [after the neutron star merger with the black hole],” says Stuart Shapiro from the University of Illinois.

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In nature one can associate to each particle an antiparticle with equal mass and opposite charge: to the electron there is the positron, to the neutrino there is the antineutrino. Although they have been theoretically predicted to exist, they are recondite and only recently confirmed to be found of their antiparticles. In Colloquium the nature of Majorana fermions and their presence in several different branches of physics is discussed from nuclear to condensed matter. DOI: dx.doi.org/10.1103/RevModPhys.87.137

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I t was my first APS March Meeting and I was invited to join a group of soft matter physicists from the University of Chicago for dinner. At the restaurant, I ended up in the last open seat and while waiting to order, chatted with some friends from the previous summer’s soft matter workshop hosted by the University of Massachusetts Amherst physics department. Working my way through the conversations, I eventually turned to my right and saw an unfamiliar face. He was older, greying, sporting coke-bottle glasses, and seemed to have an open air about him. Smiling, I introduced myself with,

Hi, I’m Jesse Silverberg. I’m a second-year graduate student in Itai Cohen’s lab at Cornell. Who are you?

His smile turned to a look of amused stoicism as my question sank in. He responded in voice loud enough to be heard from across the table and stern enough to attract attention from those nearby.

You don’t KNOW who I am? Either I wasn’t thinking straight, or just felt goaded on by the question. Regardless, I gave an overly honest response:

No, SHOULD I?
The older gentleman grinned at my complete failure of diplomacy and through a full-bellied laugh, managed to get out:

Oh boy, another WISEABLE!!

We were both laughing at this point, and the conversation continued from there. This is how I met Heinrich Jaeger, long-time professor at the University of Chicago’s James Franck Institute, leader in the field of granular physics, and, as it turned out, the person who bought dinner for everyone that night.

This story illustrates two points. First, the field of soft matter physics is full of fun, animated, and quirky personalities, a definite plus for anyone who enjoys such company. Second — and from anecdotal evidence, I think this applies broadly to our field — I didn’t know I wanted to be a soft matter physicist until I was already a soft matter physicist. After all, if I had known anything about the field before joining, I wouldn’t have asked such an ignorant question! Now that APS is home to GSOFT (aps.org/units/gsoft), the topical group on soft matter physics, I think this second point deserves a bit more attention. Why? Well, I noticed over the course of my Ph.D. and into my postdoc that despite being an intellectually rich field of research, many physicists don’t actually know what soft matter is, what it isn’t, and how it relates to the established branches of physics. Though I found my way into the field by a combination of coincidence and luck, a broader awareness has to be raised so that the generation of bright and talented physics students can find their way too.

With this idealistic vision in mind, I’ll confess that in preparing this article, I was warned that any attempt to concretely define soft matter would likely be met with failure. The boundaries are nebulous, topics diverse, and the practitioners widely distributed across academic departments. All of this is true, but nevertheless, there is a clear community with a common language. Because of this reality, I’ve come to view soft matter as less of a walled city built around specific questions, and more of a big tent that encompasses diverse views and paths of inquiry. Along these lines, I’ve heard stories of young soft matter physicists introducing themselves to colleagues in high energy physics, cosmology, and even hard condensed matter, where a typical conversation often goes something like this:

Oh, you’re in soft matter? Isn’t that just biophysics?

Or, Oh, you’re in soft matter? Isn’t that just polymer physics?

Soft matter is neither biophysics nor polymer physics, though these research topics can and do come under “the tent.” A list describing this scientific coalition based on several leading conferences identifies some major hubs of activity:

• Active and driven matter explores systems that are more than just passive recipients of the environment. This is a valuable test bed for studying collective dynamics in nonequilibrium systems ranging from vibrated grains of sand to motile bacteria and animal flocks. Biologists also find the principles of hierarchically organized biological materials from cyskotoseletal networks to entire organs. Coarse grain across length-scales is extremely useful as it offers insights for structured and functional materials.

• Colloids are a mainstay of the soft matter community. The ability to image and track these micron-sized particles in experiments enables direct tests of fundamental thermodynamics, phase transitions, self-assembly, and suspension rheology. Moreover, they have numerous real-world applications including flexible electronics and drug delivery.

• Dynamics of structured and complex fluids is a subject similar at the roots of the soft matter. These solid-liquid, solid-gas, liquid-gas, and liquid-liquid suspensions, to name just a few, exhibit unusual flow behavior that can be attributed to microscopic internal structure.

• Fracture and failure have become topics of broader interest for their role in phenomenology beyond linearized continuum theories. For example, fracture depends critically on the concentration of energy in materials, and hence non-equilibrium microscopic dynamics. Failure, on the other hand, has more to do with mechanical instabilities — buckling, wrinkling, and snapping — that are widely utilized in biological pattern formation.

• Membranes, vesicles, and droplets are relevant to problems in biophysics where regulated flows of molecules between membrane and internal cellular machinery are critical for survival. More broadly, understanding both how confined fluids fluctuate, deform, and pinch, as well as the consequences of these structural changes, still holds unsolved questions.

• Packing, geometry, and topology covers not a specific material system, but a broad set of organizational principles. Jamming in granular systems, arrangement of colloids on spheres, topological defects in liquid crystals, and finite deformations of linkage structures are just some of the problems that benefit from these deeper mathematical ideas.

• Polymers, like colloids, are at the heart of soft matter. Recognized with the 1991 Nobel Prize in Physics awarded to Pierre-Gilles de Gennes, this topic builds on an understanding of statistical mechanics and chemistry to explain mechanical properties. Remarkably, even Feynman diagrams have been introduced to polymer theory to help understand the multitude of applications governing these systems.

The field of soft matter is full of fun, animated, and quirky personalities.