U.S. DEPARTMENT OF ENERGY
Office of Science

COMMUNIQUE

7 January 2019

*Comm*unique provides a biweekly review of recent Office of Science Communications and Public Affairs work, including feature stories, science highlights, social media posts, and more. This edition is a review of our work in 2018 promoting the research done at universities, national labs, and user facilities throughout the country.
Please note that some links may expire after time.

Quantum Computing: Learning to Speak a Whole New Technology

In 2018, OCPA posted a feature on how scientists create the foundations for their computer languages in order to use quantum computers for scientific discovery.

Imagine trying to use a computer that looks and acts like no computer you've ever seen. There is no keyboard. There is no screen. Code designed for a normal computer is useless. The components don't even follow the laws of classical physics. This is the kind of conundrum scientists are facing as they develop quantum computers for scientific research. Quantum computing would be radically new and fundamentally different from the classical computers we're used to.
Harnessing the phenomena associated with quantum physics may give scientists a tool to solve certain complex problems that are beyond even the future capabilities of classical computers. For this specific set of problems, experts estimate that a single quantum computer just twice the size of the very early-

stage ones today could provide advantages beyond those of every current supercomputer in the world combined.

But fulfilling quantum computers' potential will be a major challenge. The strange nature of quantum particles conflicts with almost everything we know about computers. Scientists need to rewrite the foundations that underlie all existing computer languages. To harness quantum computers' power, the Office of Science's Advanced Scientific Computing Research program is supporting research to develop the basics for quantum software.

Click here to read more about how DOE national laboratories are tackling this challenge.

NEWS CENTER

The Office of Science posted 1,337 news pieces in 2018, including 617 university articles and 657 pieces from the labs and user facilities.

In February, a team of scientists from Brookhaven National Laboratory detected a hidden state of electronic order in a layered material containing lanthanum, barium, copper, and oxygen (LBCO). When cooled to a certain temperature and with certain concentrations of barium, LBCO is known to conduct electricity without resistance, but now there is evidence that a superconducting state actually occurs above this temperature too. This research provides a new technique to probe different types of electronic orders in high-temperature superconductors, and the new understanding may be helpful in explaining other strange behaviors in LBCO and similar compounds.

In January, scientists at UC San Diego used ultrafast lasers and supercomputers to develop a new method to probe electron charge transfer at the interface between organic semiconductors and metal surfaces. This research marks the first time that this charge transfer mechanism was measured in energy systems like solar cells. These energy systems are material sources of "new energy"—naturally replenished resources such as sunlight, wind, rain, waves, geothermal heat—that involve the conversion of light into electricity. This method opens up new possibilities for developing efficient light-harvesting materials and new near-infrared sensors for medical applications.

In May, nuclear physicists from Jefferson Laboratory made the first measurement of a mechanical property of subatomic particles, finding that inside every proton in every atom in the universe is a pressure cooker environment that surpasses the atom-crushing heart of a neutron star. These results shed light on the distribution of the strong force inside the proton, visualizing the magnitude and placement of the force. Once thought impossible to obtain, this measurement is the result of a clever pairing of two theoretical frameworks with existing data.

In August, a team led by physicists from Princeton University announced the detection of the Higgs particle via its decay into two particles called bottom quarks. Tracing this fifth and most prominent way that the particle decays, this research gives scientists a new pathway by which to study the physical laws that govern the universe.

In December, a new study by Lawrence Berkeley National Laboratory analyzed the headwater regions of California's 10 major reservoirs—representing nearly half of the state's surface storage— and found they could see on average a 79 percent drop in peak snowpack water volume by 2100. The study found that a future warmer world will almost certainly feature a decline in fresh water from the Sierra Nevada mountain snowpack, and that snow will melt earlier, thus increasing the time lag between when water is available and when it is most in demand.

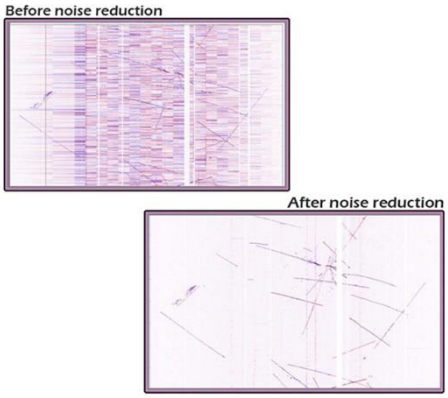
In November, scientists from Stony Brook University discovered a single-site, visible-light-activated catalyst that converts carbon dioxide into "building block" molecules that could be used for creating useful chemicals. The discovery opens the possibility of using sunlight to turn a greenhouse gas into hydrocarbon fuels.

SCIENCE HIGHLIGHTS

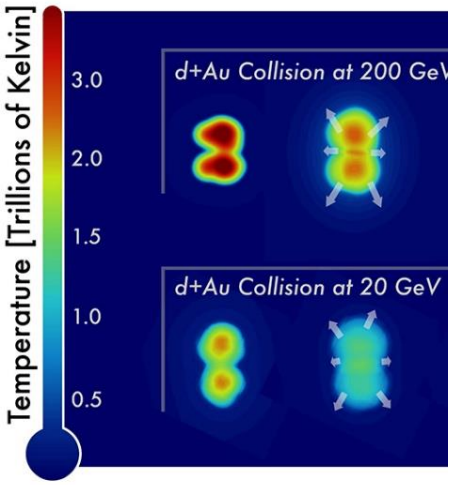
The Office of Science posted 158 highlights in 2018 spotlighting science from all 6 Office of Science programs: ASCR, BES, BER, FES, HEP, and NP.

In August, ASCR highlighted the work of researchers from the National Energy Research Scientific Computing Center (NERSC), Stanford University, and Intel. This team developed the first 15-petaflop deep-learning software and demonstrated its ability to handle large data sets via test runs on the Cori supercomputer at NERSC. This new software could make the world's largest supercomputers able to fit large, complex data sets into deep learning uses, resulting in insights that could benefit Earth systems modeling, fusion energy, and astrophysics.

In May, HEP highlighted the work of researchers who used data from the MicroBooNE neutrino experiment to identify and filter background noise sources, clearing the way for signals made by the neutrinos. The analysis team developed an offline noise filter that eliminates most of the excess noise while achieving excellent neutrino signal preservation. This experience is already informing the design of future liquid-argon detectors.



In September, NP highlighted the work of scientists who observed particle flow patterns, finding that even small-scale collisions of particles with large heavy nuclei created drops of early universe quark-gluon plasma. The team



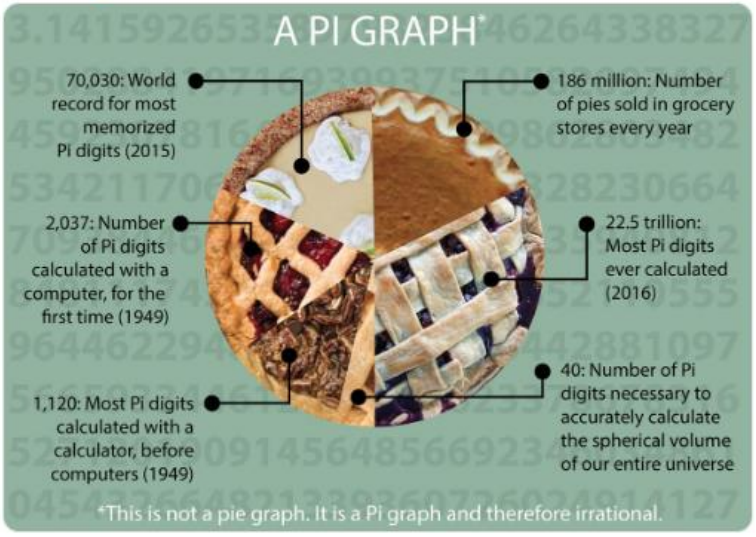
found that the particles exhibit behavior associated with the formation of the building blocks of nearly all visible matter, suggesting that these small-scale collisions might be producing tiny, short-lived specks of matter that mimic the early universe. The specks offer insights into matter that formed nearly 14 billion years ago, just after the Big Bang.

TOP TWEETS

The Office of Science sent out 1,124 tweets in 2018. This year we surpassed 15,000 followers and our audience continues to grow. Here were the three top-performing tweets of 2018.

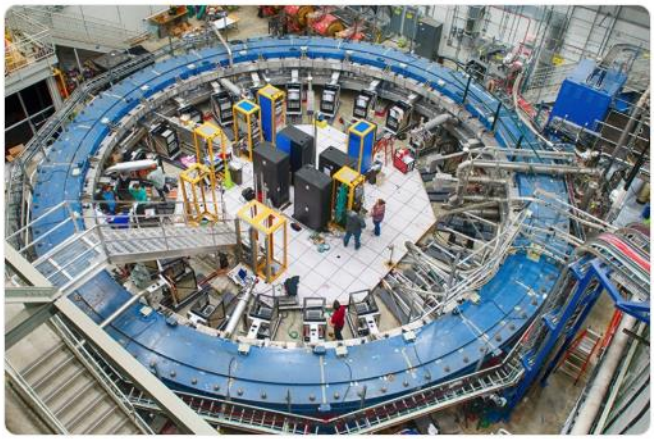
DOE Science
@doescience

Share this irrational Pi graph with your favorite mathematician! @amermathsoc #PiDay



DOE Science
@doescience

Scientists at U.S. Department of Energy (DOE) national laboratories are collaborating to test a magnetic property of the muon bit.ly/2JeY5Cz @argonne @Fermilab



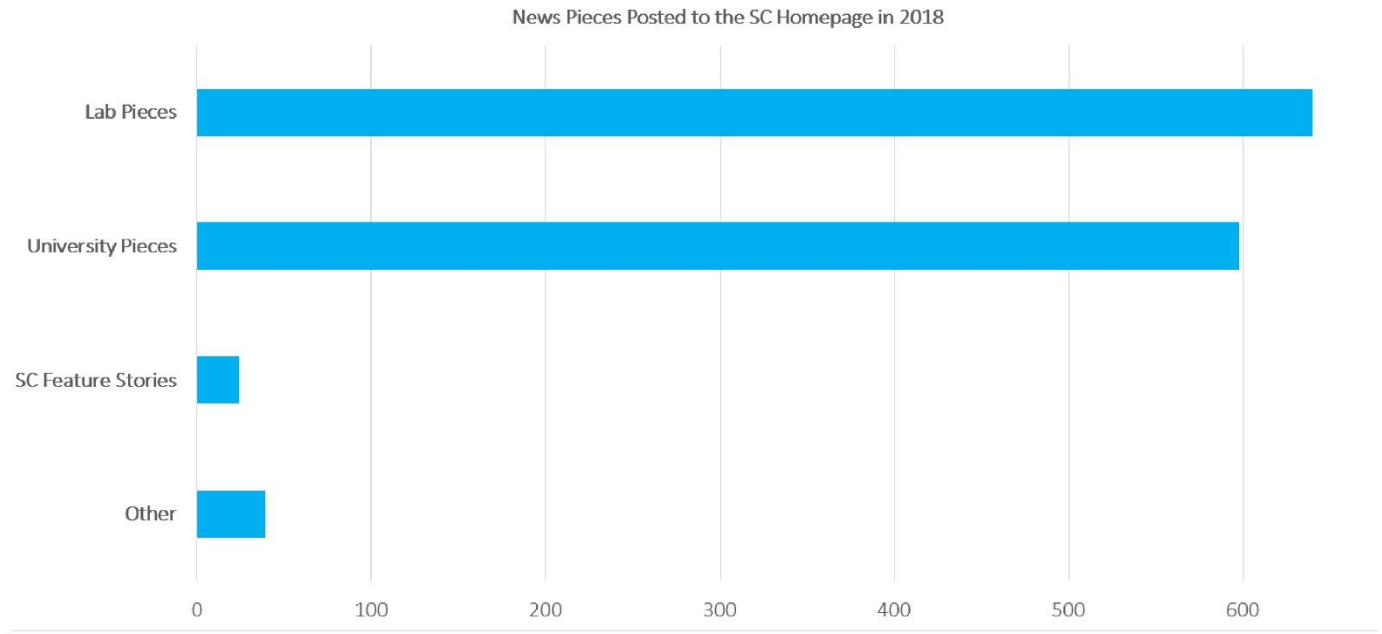
DOE Science
@doescience

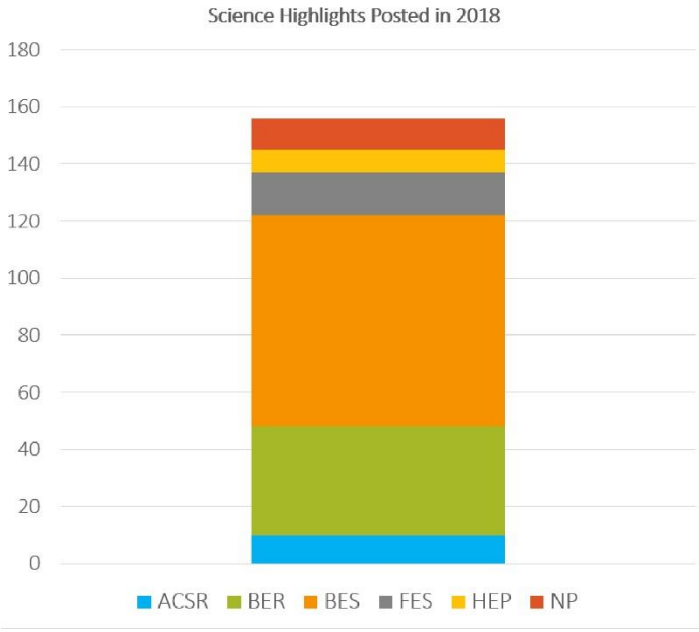
Happy 100th #Birthday, Katherine Johnson - #mathematician who calculated trajectories, launch windows, rendezvous paths, etc for @NASA Projects Mercury, Apollo and beyond go.nasa.gov/2B1HR0y #WomenInSTEM @AAUW @amermathsoc @katherineJNASA

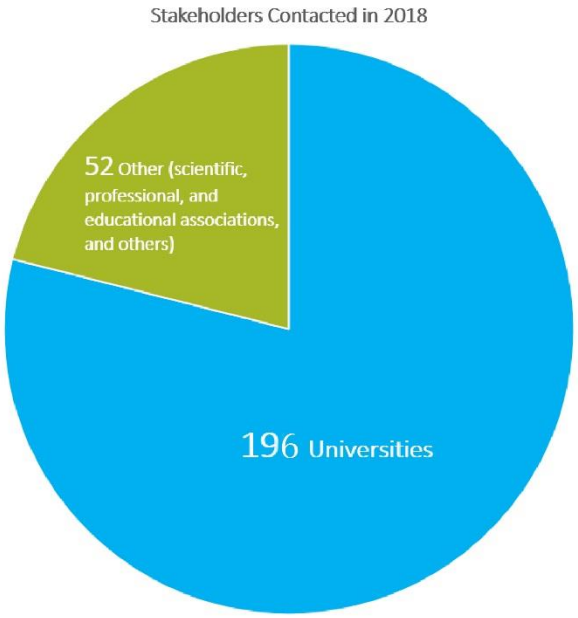
STATISTICS

The Office of Science by the numbers.

2018 in Numbers







In 2018, 1,337 pieces were posted to the SC homepage, spotlighting SC-funded research from the national laboratories and universities, and 158 science highlights were published, summarizing research from all six of the SC programs. 248 universities and scientific, professional, and educational associations were contacted to provide timely information about grants awards and efforts to amplify their institution's research. Almost all of these institutions were contacted multiple times this year and many of them were contacted multiple times each month.

END NOTES

The Office of Science in 2019

The International Year of the Periodic Table

A Common Language for Science

2019 NSB®

NATIONAL SCIENCE BOWL®

a competition like no other . . .

International Day of Light

SCIENCE TRANSCENDING BOUNDARIES

AAAS ANNUAL MEETING

Washington, DC Feb. 14–18, 2019

We at the Office of Communications and Public Affairs are excited about 2019! Here are just a few of the things we're looking forward to this year:

International Year of the Periodic Table

January 18th-20th: Conferences for Undergraduate Women in Physics

February 14th-18th: AAAS Annual Meeting

February 17th-23rd: National Engineers Week

April 25th-29th: National Science Bowl 2019
May 4th: National Math Festival
May 16th: International Day of Light
October 31st: Dark Matter Day

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