Philanthropy plays a growing role in funding US physical sciences

To buy equipment, build infrastructure, foster collaborations, and more, scientists are benefitting from—and relying on—private money.

A few years ago, Jonathan Feng was spreading the word about his idea for searching for light and weakly interacting elementary particles. One day after he gave a talk, a stranger approached him. It was Jochen Marschall, a science program officer at the California-based Heising-Simons Foundation. The foundation funded Feng's idea, and the Forward Search Experiment (FASER) was installed in a custom-excavated trench at the Large Hadron Collider in Geneva. It happened quickly—before the collider was turned back on in spring 2022—and FASER is now collecting data. At first, says Feng, a theoretical physicist at the University of California, Irvine, "it seemed like the money fell from the sky." But he came to find out that Marschall had heard him talk multiple times and researched the proposed experiment before they spoke.

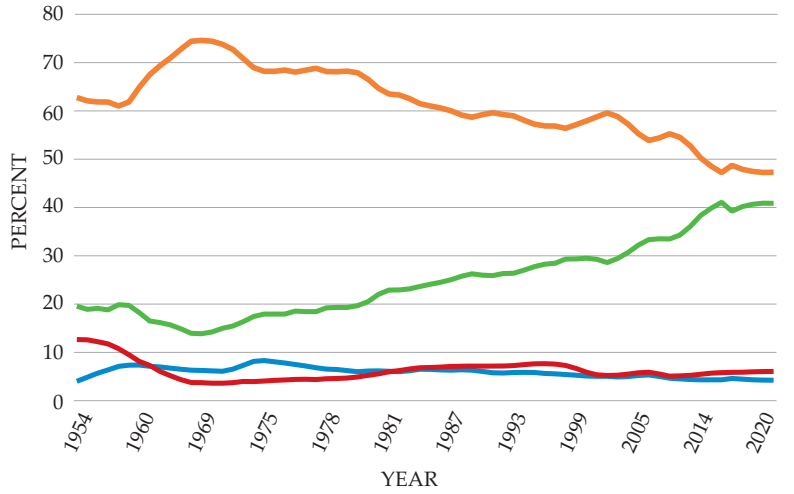
Another example of private money for basic physical sciences research is the Mani L. Bhaumik Institute for Theoretical Physics at UCLA. In 2014 Mani Bhaumik funded a postdoc in Zvi Bern's group at the university. Two years later he expanded his gift to set up the institute; the endowment has grown to $20 million. Says Bern, who directs the institute, "We can hire about seven postdocs a year. We also fund graduate students, workshops, and lectures."

Without private money, says Bern, the US physics community "would be completely screwed. There is no way we could be as competitive in science as we are."

In the late 19th and early 20th centuries, private money was a mainstay for US science: Think of universities founded by the likes of John D. Rockefeller and Andrew Carnegie; telescopes, too, have a long history of private funding. After World War II, as the US government stepped up funding for science, private foundations took their money elsewhere. Government funding for science spiked after the Soviet Union launched *Sputnik 1* in 1957, but since the mid 1960s it's been decreasing as a share of research funding. (See the plot on page 25. See also Physics Today, June 2018, page 26.)

The biggest source of private money in the US is from universities, largely in the form of startup funds, says Marc Kastner, a physicist and former dean of sciences at MIT. The numbers of foundations and ultra-wealthy individuals who

THE FORWARD SEARCH EXPERIMENT (FASER) at the Large Hadron Collider got off the ground in 2018. It has received several million dollars from the Heising-Simons Foundation and additional support from the Simons Foundation, CERN, and NSF. The experiment is designed to detect high-energy (TeV) neutrinos and other weakly interacting particles that are produced parallel to the beamline and that escape other detectors.



PHILANTHROPY'S INCREASING ROLE in funding US basic science. In 2020, higher education and nonprofit funding sources (green line) totaled $25.1 billion, or 42% of the total for basic research performed in universities and nonprofit research institutes. Gifts from private individuals are harder to track and are not included here. The importance of philanthropic investment has grown as the relative contribution by the federal government (orange line; $29 billion in 2020) has declined, according to the Science Philanthropy Alliance. (Courtesy of the Science Philanthropy Alliance, based on data from NSF.)

want to fund science is growing, with the bulk of philanthropy going to biomedicine. Kastner was the first president of the Science Philanthropy Alliance, which got started in 2013 with 6 member foundations and as of September had 37. The alliance guides philanthropists on best practices, helps them determine where to put their money, and encourages networking among them.

Traditions for science philanthropy vary by country, but most are weaker than in the US. Still, it's picking up in Europe too. An example is the CNRS Foundation, launched three years ago by its namesake; so far it is funded mostly through legacy giving by former CNRS employees.

Although philosophies and modes of operating vary, foundations generally share the aim of having impact by putting money where the government isn't, says France Córdova, former NSF director and the alliance's current president.

Filling the gaps

Foundations and individuals occasionally make enormous gifts to the physical sciences. Two notable examples are the $13 million raised by Jim Simons to rescue experiments at Brookhaven National Laboratory's Relativistic Heavy Ion Collider and T. Denny Sanford's $70 million gift to the underground lab named for him in South Dakota (see Physics Today, March 2006, page 26, and February 2013, page 19). But for the most part, private money cannot fund major facilities. More often it focuses on funding people.

The Simons Foundation gave nearly $122 million to math and physical sciences in 2021, up almost threefold from a decade earlier. It has programs to fund institutions, individual investigators, collaborations, meetings, and conferences. It also funds projects, such as the arXiv preprint server, for which it covers half the budget, and the Simons Observatory in Chile, for which it's ponying up the bulk of the $108.5 million tab for construction.

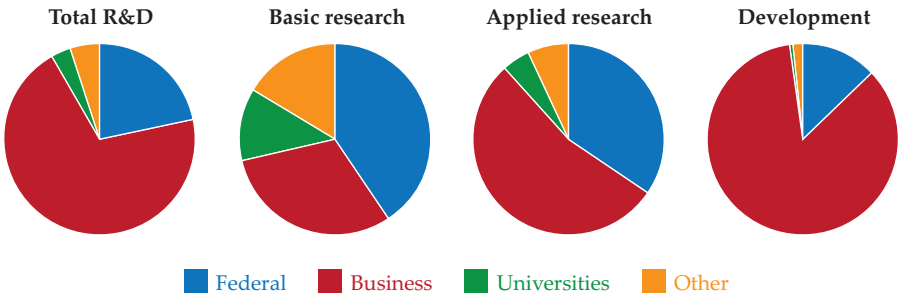
One Simons program provides grants for scientists to extend sabbatical leave. Another gives five-year awards annually to 140 mathematicians and physical scientists who do not have federal support.

A new program funds mid-career scientists who want to change research directions because, as Simons president David Spergel says, "it's difficult to get funding in a field without a track record." Yuri Tschinkel, director of math and physical sciences at the foundation, says, "We always aim at not replicating existing programs. And we don't want to compete with federal agencies. We want to collaborate with them."

The Gordon and Betty Moore Foundation plans to give about $420 million this year, of which $150 million will go to the sciences. Among its initiatives are calls for proposals in specific areas, such as tabletop experimental physics and emergent phenomena in quantum systems.

The Moore Foundation also funds standalone projects in areas it seeks out. Science program officer Gary Greenburg has funded projects from less than $100 000 up to $20 million. "I talk to experts and read broadly. My sweet spot is high-risk, high-reward projects," he says. One project was inspired by a *Physical Review A* paper that suggested that interaction-free quantum measurements could eliminate sample damage in electron microscopy. In another, an international collaboration has developed a dielectric laser accelerator that can drive electrons on a silicon chip at higher gradients than conventional accelerators.

The Research Corporation for Science Advancement holds "Scialog" workshops, often jointly with other foundations, in which early-career scientists from an array of disciplines are invited to brainstorm on a specified theme. Over the course of a couple of days, teams put together short proposals. A few get funded for a year at $56 500 per investigator. Recent topics include mitigation of zoonotic threats and negative emissions science. "The goals are to share ideas and enthusiasm, to get people to think more broadly, and to network," says Research Corp president Daniel Linzer. "Science has become ultracompetitive, and people



SUPPORT FOR RESEARCH in the US is presented by investment sector for 2018–19. The pie charts show the reliance of basic research on philanthropy, which is included in the categories "universities"—through institutional funds derived from endowments—and "other." These data include research performed by all sectors, including the business sector. (Courtesy of the Congressional Research Service, based on NSF data.)

do not play as nicely in the sandbox as they used to. Science should be fun."

A funding ecosystem

The foundations and individuals who fund science generally tout their nimbleness, flexibility, and risk-taking ability and contrast them with federal funding agencies, which are bound by procedures and accountable to taxpayers. "We can react quickly to changes," says Tschinkel. For example, early in the COVID-19 pandemic when many US universities froze hiring, the Simons Foundation stepped in to pay for 50 postdoc positions across the country. Heising-Simons's funding of the FASER experiment is another example of swift action.

Recipients of philanthropic gifts can typically redirect spending from, say, people to equipment. And if there is an abundance of outstanding postdoc applicants in a given year, says Hirosi Ooguri, director of Caltech's Walter Burke Institute for Theoretical Physics, "we can hire more that year. With federal funding, we wouldn't have that flexibility." It's also easier for a researcher with private money to pivot directions mid-grant. And private money can fund researchers in multiple countries.

Another advantage of private money is the freedom to fund unproven ideas or researchers. "Private philanthropy can take risks," says Adam Falk, president of the Alfred P. Sloan Foundation. "That means failing sometimes." The Sloan Foundation gives $90 million a year across programs, of which about $25 million goes to the physical sciences. As an example of a failure, Falk points to a project in the social sciences: "We funded a partnership between academic researchers and Facebook to study misinformation," he says. "The project didn't live up to its promise—the technical and legal problems were harder than we anticipated."

"Risk is a complicated topic," says Dusan Pejakovic, a science program officer at the Moore Foundation. Risk can come from outside, such as the travel and supply-chain difficulties that the pandemic wrought. Inherent research risk can be managed, in part, through diversification, notes Pejakovic. "If I have 20 or 30 investigators working on a topic, important discoveries will be made. The risk to the funders is minimal." If researchers have substantial funds and freedom, he says, "they almost always stumble on something exciting. The impact can be high even if the output is not what was expected."

One concern about private money that some researchers voice is that the review process can be opaque. Tschinkel notes that his division at the Simons Foundation gives proposals a thumbs up or down, but no reviews.

Thirty years ago, says UCLA's Bern, a US Department of Energy grant shared by three professors in elementary particle theory was sufficient to fund two postdocs and several students. "You need that type of funding to be a world leader in the field." On government grants nowadays, he says, "we can't even dream of funding students at anywhere close to the level we could 30 years ago." With researchers forced to look elsewhere for money, he adds, "private foundations have a huge influence on the direction of science. That makes transparency in their peer review important."

"It's an ecosystem, and there is room for both styles of funding," says Falk. In the federal system, the role of the wider scientific community "is critical and positive," he adds. "But it's nice to have that complemented by the philanthropic sector that has more freedom."

The philanthropists Bill Gates and Charles Simonyi contributed a total of $30 million for fabricating a new type of mirror for the Vera C. Rubin Observatory in Chile. After the technology was proven, NSF and DOE jumped in, says Kastner. "If it had been left up to the government, the observatory may never have happened." Likewise, Peter Graham, a Stanford University theorist, says that when he and colleagues wanted to build a low-frequency gravity-wave detector based on interfering atoms, they "needed someone to take a risk" on their idea. The Moore Foundation paid for tabletop proof-of-concept research and is covering the bulk of a scaled-up $15 million 100-meter vertical drop experiment under construction at Fermilab. The project also now has funding from DOE.

Moving from private to public money is a pattern, says Graham. "We build the first round thanks to private foundations. When it works like a dream, the government agencies step in."

Relationships

"Who gets to ask for private money?" says Lars Bildsten, director of the Kavli Institute for Theoretical Physics at the University of California, Santa Barbara. "The access question is important." Private philanthropy can be specific to an institution and rely on relationships, he notes, pointing to the $65 million that Charles Munger gave the institute for a building to house visiting scientists (see Physics Today, April 2017, page 32).

Relationships between several billionaire businessmen and some physicists are growing into the Quantum Gravity Institute in Vancouver, British Columbia, Canada. The form the institute will take is still in flux, with plans under discussion for fostering international collaborations, holding conferences, and having a physical space. "They are still feeling their way," says James Peebles, a Princeton University physicist who was among several Nobel laureates who attended the institute's launch conference in August. "But this institute will be prepared for a breakthrough in any direction." Terry Hui, one of the philanthropists behind the institute, earned his bachelor's degree in physics. "Contribu-

ABIGAIL VIEREGG (left) and Jessica Zebrowski, formerly an undergraduate in Vieregg's group, dig out the Askaryan Radio Array at the South Pole in 2018. Vieregg, a professor at the University of Chicago who develops instruments to detect ultra-high-energy neutrinos, is one of 16 inaugural awardees in the Gordon and Betty Moore Foundation's new Experimental Physics Investigators Initiative; they will each receive $250 000 a year for five years.

tions to physics are underrated," he says. "People don't see how basic research will help humanity. From my perspective, I think the impact is huge."

Bhaumik's gift to UCLA was also based on relationships: He was a postdoc at the university in 1959, and more recently he got to know Bern. During his career at Northrop Grumman, Bhaumik was involved in the development of the excimer laser, for which he received company shares that eventually grew into his fortune. "In India I worked with [Satyendra Nath] Bose. I had wanted to be a theoretical physicist," Bhaumik says. Having "suffered the agony of not really fulfilling that desire," he continues, seeding the UCLA institute has brought satisfaction and been "beneficial for me to understand the nitty-gritty of quantum field theory and meeting accomplished physicists from around the world."

Aligning goals

David Eisenbud was director of the Mathematical Sciences Research Institute in Berkeley, California, for nearly two decades. "You don't always get money for your top priority, but you don't take money for nonpriorities," he says. Among the traps to avoid, Eisenbud says, are money that is too restrictive, donors who want too much recognition, or situations where the donor feels they have the right to call the shots—such as the right to fire and hire or to select fellowship recipients.

As director of the Institute of Advanced Scientific Studies (IHES) on the outskirts of Paris, Jean-Pierre Bourguignon set to work in 1998 raising an endowment. For France, it was unusual to raise private money for science, he says, "and some in the science community disapproved." Still, he was successful, and the IHES now has an endowment of nearly €50 million ($49 million), of which about half is from donors in France. Contributions from individuals and companies in Japan and China, he says, are used to bring in mathematicians and physicists from those countries. Those type of strings are okay, he says. Also acceptable, he continues, is naming fellowships for companies that have made gifts. At IHES, for example, fellowships are named for Huawei and Schlumberger, but the companies have no say in who is invited to fill them.

The goals and expectations of the donor and recipient need to align. "If someone comes with money," says Caltech's Ooguri, "there may be a temptation to tweak the mission to match the money. That's a slippery slope."

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