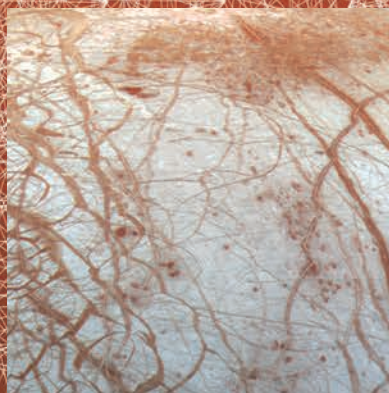




**Caltech**  
2015 Annual Report

**Excellence. Ambition. Perspective.** Three values that define and drive Caltech.

The 2015 annual report highlights these values and their unparalleled returns. This report reflects Caltech today and forms a foundation for the future.

At the Institute, an ambitious faculty and student body conduct their research and studies as members of a community committed to an uncompromising standard of excellence. Caltech's imaginative scholars venture into uncharted territory, taking intellectual risks to revolutionize our understanding of the world around us.

Yet excellence and ambition are not enough. Being able to view a problem from new perspectives, understanding art and history, society and culture, is required to ensure that our scientific and technological discoveries achieve the most profound impact.

It is in this way that the Institute continues to define new areas of science and engineering. We encourage you to read this report and explore how the Caltech community addresses some of the most pressing global problems of our time.



Thomas F. Rosenbaum  
*President, Caltech  
Sonja and William Davidow Presidential Chair  
and Professor of Physics*



David L. Lee  
*Chair, Caltech Board of Trustees*

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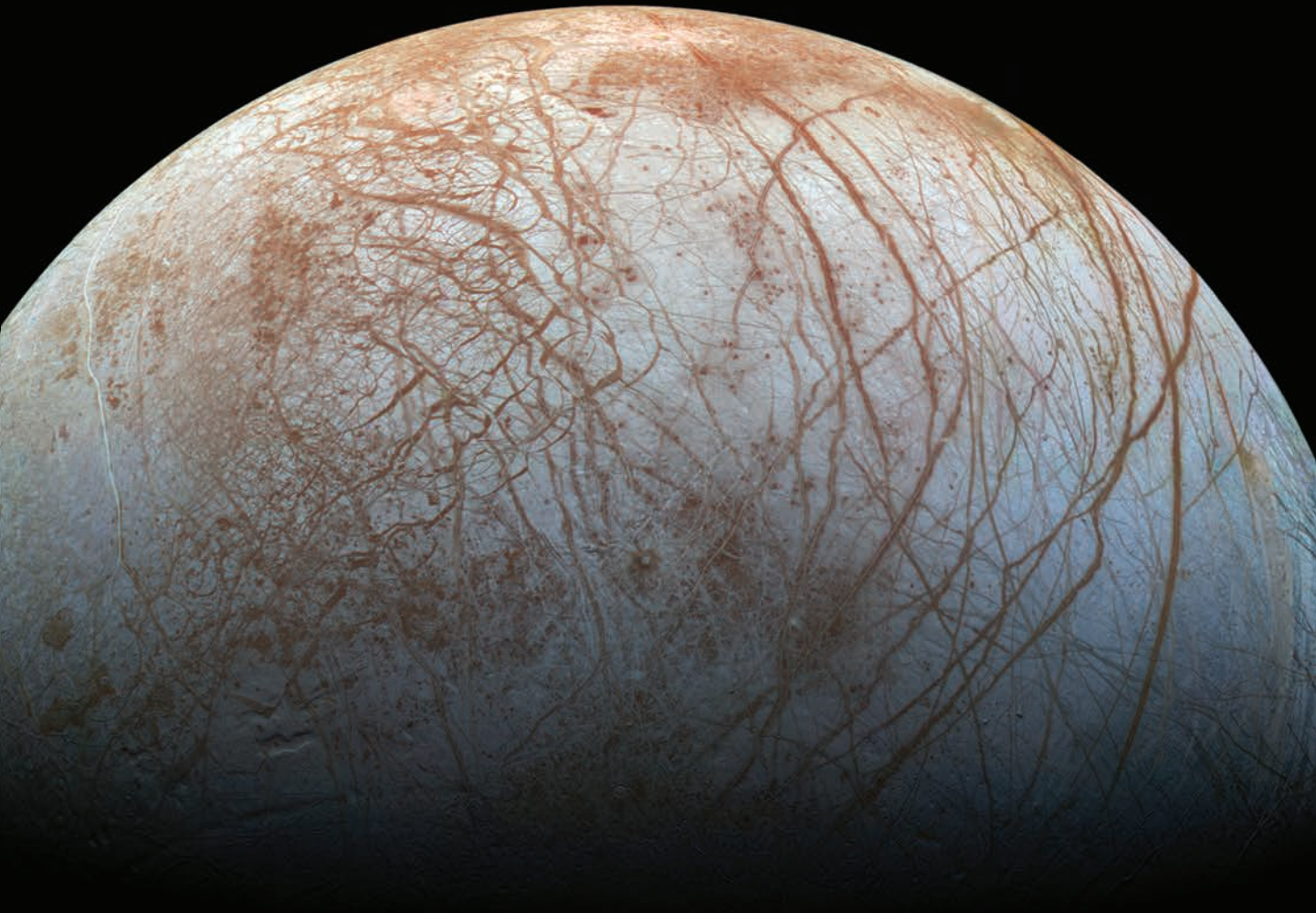
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Surface of Jupiter's icy moon Europa

**Exc**

cellence.



**"The fact that our graduate students are all supported full time creates a very different environment. We're not asking you to work to support yourself. We're going to support you, which gives you an opportunity to explore deeply the subjects you have a passion for; after all, this is the reason you came here."**

**Joe Shepherd**

C. L. Kelly Johnson Professor of Aeronautics and Mechanical Engineering; Vice President for Student Affairs



**"In many ways, we have very few rules. That independence, treating students as joint partners in the discovery of new knowledge, is special to this place. Also, you don't see people resting on their laurels here. They are continually striving to reinvent themselves and take on new challenges."**

**Doug Rees**

Roscoe Gilkey Dickinson Professor of Chemistry;  
Investigator, Howard Hughes Medical Institute;  
Dean of Graduate Studies

**“For such a science-focused place, we really value relationships: the human dimension of what we do, along with the meaning and the connections that are formed in the process of research, teaching, and mentoring. It’s not only the flow of ideas and innovations, but the support and friendship among peers at all levels that distinguishes Caltech.”**

**Cassandra Horii**

Director, Center for Teaching, Learning,  
and Outreach

**What does **excellence**  
mean at Caltech?  
Members of the  
Caltech community  
sat down together  
to discuss and share  
their thoughts.**



**“There’s a powerful culture of collaboration at Caltech that acknowledges on some fundamental level that everyone here is excellent. The bar is set very high, and the expectation is for you to work together and accomplish whatever academic challenges come your way.”**

**Cindy Weinstein**

Professor of English; Vice Provost;  
Chief Diversity Officer

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# 150

Number of grams of a valuable organosilane synthesized by the Caltech team, the largest amount of this chemical product produced by a single catalytic reaction using potassium tert-butoxide

**“We now have a completely new suite of tools to do things we never before thought imaginable.”**

**Brian Stoltz**

Professor of Chemistry

A new technique developed by Caltech chemists uses a cheap, abundant chemical, potassium tert-butoxide, as a catalyst to help create a host of potential products ranging from new medicines to advanced materials. An exceptional team, including Dow-Resnick Fellow **Anton Toutov**, a graduate student working in the laboratory of Nobel Laureate Bob Grubbs, along with Professor of Chemistry Brian Stoltz, reported in February 2015 on how they had replaced the use of expensive precious metal catalysts with an approach that is sustainable and more efficient, but is also thousands of times less expensive than current methods.

“This was a moonshot project that I had in mind for many years, something that I happily dedicated all of my efforts to,” says Toutov. “Not only did it finally work, but it is leading to additional cool and unexpected new findings.”



(L-R) Project lead Anton Toutov, graduate student David Schuman, and staff researcher Kerry Betz (BS '15)

**A**

mbition.

**Members of the Caltech community sat down together to discuss **ambition** at Caltech and how the Institute helps them realize big dreams.**

**“Because Caltech is relatively small, it runs very differently than most major universities. It allows you to pursue what you can’t in other places. It’s more than intellectual freedom; you have the support of the whole institution.”**

**Dave Reitze**

Research Professor of LIGO;  
Executive Director of the LIGO Project



**“I’m a big believer that if you can bring together disciplines or different ideas, that’s a great way to facilitate discovery. That is part of the culture here. Caltech is the right place to build a community of people who share those interests, and all bring different parts of the answers.”**

**John Preskill**

Richard P. Feynman Professor of Theoretical Physics

**“At Caltech, we start with, ‘What’s a great problem that we might be able to really make some progress on?’ And then we’ll do whatever it takes. Sometimes it takes a little longer that way, but the researchers and students get to explore something very fundamental.”**

**Tom Heaton**

Professor of Engineering Seismology



**“It’s not just because Caltech is small; it’s because there are no barriers. The atmosphere enables this fluidity and allows for cross-disciplinary research. We can walk across the hall, or go to coffee and discuss the latest findings.”**

**Jennifer Jackson**

Professor of Mineral Physics

---

1.3 billion

Distance, in light-years, of the merging black holes that produced the GW150914 signal, which marked the first-ever detection of gravitational waves

**“With this discovery, we humans are embarking on a marvelous new quest: to explore the warped side of the universe, objects and phenomena that are made from warped spacetime. Colliding black holes and gravitational waves are our first beautiful examples.”**

**Kip Thorne**

Richard P. Feynman  
Professor of Theoretical  
Physics, Emeritus

On September 14, 2015, the twin **Laser Interferometer Gravitational-wave Observatory (LIGO)** detectors in Hanford, Washington, and Livingston, Louisiana, picked up a signal that would ultimately be recognized as that of two black holes merging and releasing gravitational waves, marking the first time such waves had been directly detected. The observations confirmed the last major unproven prediction of Albert Einstein’s general theory of relativity 100 years after he had published it and 36 years after the idea to build LIGO had been born at Caltech and MIT.

“Our knowledge of how the universe really works comes to us when we as a people take a bold step by measuring something about nature much better than ever before,” says Rana Adhikari, professor of physics. “For the first time, humanity is able to receive signals made entirely by gravity from across the universe.”



Some of the Caltech members of the LIGO Laboratory

Pers

spective.



**“At Caltech, you can do all sorts of things you never knew you could do. Nobody ever told you that you could become an astrobiologist or you could become a geologist who understands microbes. These wonderful mixtures of fields become possible here because there’s no well-trodden route to follow.”**

**Frances Arnold**

Dick and Barbara Dickinson Professor of Chemical Engineering, Bioengineering and Biochemistry; Director, Donna and Benjamin M. Rosen Bioengineering Center



**“This symbiotic relationship between going after the biggest questions of science and developing technologies that allow us to actually unlock these questions is key to Caltech.”**

**Fred Farina (MS '92)**

Chief Innovation and Corporate Partnerships Officer

**Members of the  
Caltech community  
sat down to discuss  
their thoughts on the  
role of **perspective**  
in their work.**

**“Our students are intensely curious. In teaching, I aim to have them see something new or see something differently. But just as often I come out of the classroom with new perspectives.”**

**Kevin Gilmartin**  
Professor of English



**“Caltech is unusual in the sense that, oftentimes, really good students pick pieces of different things that then come together to become something very original. It’s through this ability to integrate seamlessly that our interdisciplinary approach and the lack of walls allow us to do something special.”**

**Jean-Laurent Rosenthal**  
Rea A. and Lela G. Axline Professor of  
Business Economics; Ronald and Maxine  
Linde Leadership Chair, Division of the  
Humanities and Social Sciences

**“The most interesting aspects of the Caltech culture are also extremely contagious. When people come here, suddenly they change. More specifically, they evolve.”**

**Mory Gharib (PhD ’83)**  
Hans W. Liepmann Professor  
of Aeronautics and Bioinspired  
Engineering; Director, Graduate  
Aerospace Laboratories; Vice Provost

Coordinated, deliberate movement was once an impossibility for Erik Sorto, a patient with quadriplegia. That is, until **Richard Andersen** and colleagues here at Caltech and at USC and the Rancho Los Amigos Rehabilitation Center implanted electrodes connected to a robotic arm into Sorto's posterior parietal cortex, the area of the brain that controls the intent to move. This advancement allowed him to simply think, "I want to shake your hand," and have the robotic arm he was controlling make a fluid hand-shaking gesture.

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# 192

Number of active electrodes in the arrays implanted into a patient's posterior parietal cortex; each electrode is capable of recording the activity of a single neuron

"He had been paralyzed for over 10 years, and this was the first time since his injury that he could move a limb and reach out to someone. It was a thrilling moment for all of us," says Andersen, the James G. Boswell Professor of Neuroscience.

**"I remember just having the out-of-body experience, and I wanted to just run around and high-five everybody."**

**Erik G. Sorto**

Quadriplegic patient who participated in the clinical trial of Andersen's neuroprosthesis research



(L-R) Postdoctoral scholars in the Andersen Lab—Michelle Armenta Salas, Tyson Affalo, Spencer Kellis, and Sofia Sakellaridi—and Richard Andersen 19

## National Awards and Honors

---

### Packard Fellowship

**Andrew Thompson**, *Assistant Professor of Environmental Science and Engineering*

### National Academy of Inventors,

Members:

**Frances Arnold**, *Dick and Barbara Dickinson Professor of Chemical Engineering, Bioengineering and Biochemistry; Director, Donna and Benjamin M. Rosen Bioengineering Center*

**David Baltimore**, *President*

*Emeritus; Robert Andrews Millikan Professor of Biology*

**Carver Mead (BS '56, MS '57, PhD '60)**, *Gordon and Betty Moore Professor of Engineering and Applied Science, Emeritus*

**Axel Scherer**, *Bernard Neches Professor of Electrical Engineering, Applied Physics and Physics*

### Warner T. Koiter Medal from the American Society of Mechanical Engineers

**Guruswami (Ravi) Ravichandran**, *John E. Goode, Jr., Professor of Aerospace and Mechanical Engineering; Otis Booth Leadership Chair, Division of Engineering and Applied Science*

**Newton Lacy Pierce Prize of the American Astronomical Society**  
**Heather Knutson**, *Assistant Professor of Planetary Science*

### National Academy of Engineering, Members:

**Harry Atwater**, *Howard Hughes Professor of Applied Physics and Materials Science; Director, Joint Center for Artificial Photosynthesis*

**Mory Gharib (PhD '83)**, *Hans W. Liepmann Professor of Aeronautics and Bioinspired Engineering; Director, Graduate Aerospace Laboratories; Vice Provost*

**Robert Grubbs**, *Victor and Elizabeth Atkins Professor of Chemistry*

**Guruswami (Ravi) Ravichandran**, *John E. Goode, Jr., Professor of Aerospace and Mechanical Engineering; Otis Booth Leadership Chair, Division of Engineering and Applied Science*

**Dan M. Goebel**, *Senior Research Scientist, Jet Propulsion Laboratory*

**Graeme L. Stephens**, *Director of the Center for Climate Sciences, Jet Propulsion Laboratory*

### Air Force's Young Investigator Research Program, Grant

Recipient:

**Andrei Faraon (BS '04)**, *Assistant Professor of Applied Physics and Materials Science*

**Camille and Henry Dreyfus Foundation's Postdoctoral Program in Environmental Chemistry**, Grant Recipient:  
**Brian Stoltz**, *Professor of Chemistry*

### Alfred P. Sloan Foundation, 2015 Fellows:

**Viviana Gradinaru**, *Assistant Professor of Biology and Biological Engineering*

**Mitchell Guttman**, *Assistant Professor of Biology*

**Xinwen Zhu**, *Associate Professor of Mathematics*

**Heather Knutson**, *Assistant Professor of Planetary Science*

**Gregg Hallinan**, *Assistant Professor of Astronomy*

**American Academy of Microbiology**, Fellow:  
**Victoria Orphan**, *James Irvine Professor of Environmental Science and Geobiology*

**2015 Searle Scholar**  
**Yuki Oka**, *Assistant Professor of Biology*

### American Academy of Arts and Sciences, Fellows:

**Michael B. Elowitz**, *Professor of Biology and Bioengineering; Investigator, Howard Hughes Medical Institute; Executive Officer for Biological Engineering*

**Mory Gharib (PhD '83)**, *Hans W. Liepmann Professor of Aeronautics and Bioinspired Engineering; Director, Graduate Aerospace Laboratories; Vice Provost*

**Linda C. Hsieh-Wilson**, *Professor of Chemistry*

**James Rothenberg**, *Trustee*

**Maria Hummer-Tuttle**, *Trustee*

### National Academy of Sciences, Member:

**Marianne Bronner**, *Albert Billings Ruddock Professor of Biology; Executive Officer for Neurobiology*

### Gold Medal of the American Institute of Chemists

**Jacqueline Barton**, *Arthur and Marian Hanisch Memorial Professor of Chemistry; Norman Davidson Leadership Chair, Division of Chemistry and Chemical Engineering*

### Howard Hughes Medical

**Institute**, Investigator:

**Doris Tsao (BS '96)**, *Professor of Biology; Investigator, Howard Hughes Medical Institute*

### Pew Charitable Trusts and the Alexander and Margaret Stewart Trust Scholar

**Mitchell Guttman**, *Assistant Professor of Biology*

### Simons Foundation, 2015

Investigators:

**Alexei Kitaev**, *Ronald and Maxine Linde Professor of Theoretical Physics and Mathematics*

**Christopher Umans**, *Professor of Computer Science*

## Awards and Honors from Professional Societies

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**2015 Rossi Prize of the American Astronomical Society's High Energy Astrophysics Division**  
**Fiona Harrison**, *Benjamin M. Rosen Professor of Physics; Kent and Joyce Kresa Leadership Chair, Division of Physics, Mathematics and Astronomy*

**American Association for the Advancement of Science 2014, Fellow:**  
**George Djorgovski**, *Professor of Astronomy; Director, Center for Data-Driven Discovery*

**Theodore William Richards Medal, American Chemical Society, Northeastern Section**  
**Harry Gray**, *Arnold O. Beckman Professor of Chemistry; Founding Director, Beckman Institute*

**American Physical Society, Fellow:**  
**Maria Spiropulu**, *Professor of Physics*

**2015 Gerard P. Kuiper Prize, American Astronomical Society's Division for Planetary Sciences**  
**Yuk Yung**, *Smits Family Professor of Planetary Science; Jet Propulsion Laboratory Senior Research Scientist*

## International Awards

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**2015 Mukaiyama Award from the Society of Synthetic Organic Chemistry**  
**Brian Stoltz**, *Professor of Chemistry*

**Sacred Treasure Gold and Silver Star, Japan**  
**Hiroo Kanamori**, *John E. and Hazel S. Smits Professor of Geophysics, Emeritus*

**Academia Europaea in the Section of Physics and Engineering Sciences, Member:**  
**Ares J. Rosakis**, *Theodore von Kármán Professor of Aeronautics and Mechanical Engineering*

**2015 Onassis Prize in Finance**  
**Richard Roll**, *Linde Institute Professor of Finance*

**2015 János Bolyai Prize of Mathematics, Hungarian Academy of Sciences**  
**Barry Simon**, *International Business Machines Professor of Mathematics and Theoretical Physics*

## Institute Honors

---

**Endowed Professorships and Chairs:**  
**Markus Meister**, *Anne P. and Benjamin F. Biaggini Professor of Biological Sciences*

**Zhen-Gang Wang**, *Lawrence A. Hanson, Jr. Professor of Chemical Engineering*

**Nicholas Scoville**, *Francis L. Moseley Professor of Astronomy*

**B. Thomas Soifer**, *Harold Brown Professor of Physics*

**Fiona A. Harrison**, *Kent and Joyce Kresa Leadership Chair, Division of Physics, Mathematics and Astronomy*

**Pamela Bjorkman**, *Centennial Professor of Biology*

**Guruswami (Ravi) Ravichandran**, *Otis Booth Leadership Chair, Division of Engineering and Applied Science*

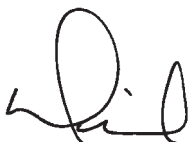
**Richard P. Feynman Prize for Excellence in Teaching**, Recipient:  
**Kevin M. Gilmartin**, *Professor of English*

## Financial Summary

*For the fiscal years ending on  
September 30, 2015 and 2014  
(in thousands)*

### Letter from Dean Currie, Vice President for Business and Finance

I am pleased to report that Fiscal Year 2015 was another positive year for Caltech. The Institute continues to maintain its strong financial performance while building for the future. Campus operating revenues in FY2015 remained steady, operating (current) gifts exceeded \$50 million, and combined federal and nonfederal research revenue was nearly unchanged from the prior year. This all reflects the excellence of our faculty and its groundbreaking research. JPL revenue increased approximately 11 percent, reflecting its strong portfolio of missions and its continuing leadership in deep-space exploration. Total gifts in FY2015 exceeded \$225 million—reflecting strong giving to the endowment and evidence of our donors' belief in Caltech for the long term. These gifts and further commitments made in FY2015 will provide crucial support for graduate fellows, chaired faculty, and innovative research in the years to come. In May 2015, Caltech took advantage of its financial strength and historically low interest rates, and issued \$400 million in 30-year taxable bonds. The bond proceeds will provide critical funding for the construction and revitalization of the cutting-edge facilities required for Caltech's continuing scientific and technological leadership.



| <b>Operating Revenues</b> (excluding JPL) | <b>2015</b>       | <b>2014</b>       |
|-------------------------------------------|-------------------|-------------------|
| Tuition and fees, net                     | \$ 38,065         | \$ 36,307         |
| Endowment payout                          | 113,492           | 108,086           |
| Gifts and pledges                         | 50,204            | 49,523            |
| Grants and contracts                      | 322,575           | 327,744           |
| Other                                     | 67,166            | 72,022            |
| <b>Operating revenues</b>                 | <b>\$ 591,502</b> | <b>\$ 593,682</b> |

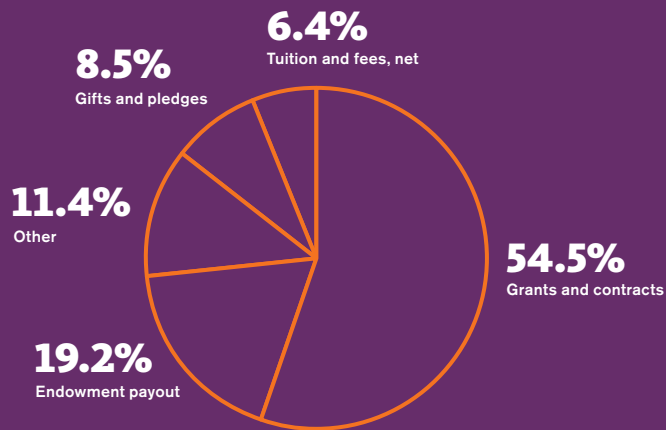
| <b>Operating Expenses</b> (excluding JPL)  |                   |                   |
|--------------------------------------------|-------------------|-------------------|
| Compensation and benefits                  | \$ 355,953        | \$ 351,490        |
| Supplies and services                      | 128,262           | 122,759           |
| Subcontracts                               | 38,107            | 38,355            |
| Graduate fellowships                       | 18,104            | 17,202            |
| Depreciation, accretion,<br>& amortization | 65,794            | 67,170            |
| Utilities                                  | 16,233            | 18,040            |
| Interest                                   | 19,095            | 16,788            |
| <b>Operating expenses</b>                  | <b>\$ 641,548</b> | <b>\$ 631,804</b> |

### Asset, Liability, and Net Assets Summary

|                                               |                     |                     |
|-----------------------------------------------|---------------------|---------------------|
| Cash and cash equivalents                     | \$ 5,257            | \$ 10,092           |
| Accounts receivable, net                      | 272,483             | 239,130             |
| Investments                                   | 2,834,504           | 2,501,865           |
| Other assets                                  | 277,722             | 202,451             |
| Deferred United States<br>government billings | 349,940             | 346,160             |
| Property, plant, and equipment, net           | 865,023             | 866,706             |
| <b>Total assets</b>                           | <b>\$ 4,604,929</b> | <b>\$ 4,166,404</b> |

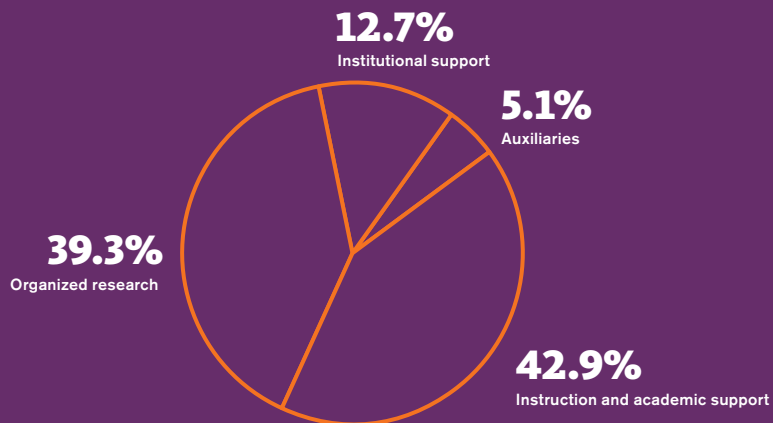
|                                                  |                     |                     |
|--------------------------------------------------|---------------------|---------------------|
| Accounts payable and<br>accrued expenses         | \$ 487,105          | \$ 462,540          |
| Other liabilities                                | 136,516             | 134,876             |
| Bonds and notes payable                          | 1,176,942           | 682,362             |
| Accumulated postretirement<br>benefit obligation | 379,752             | 369,244             |
| <b>Total net assets</b>                          | <b>2,424,614</b>    | <b>2,517,382</b>    |
| <b>Total liabilities and net assets</b>          | <b>\$ 4,604,929</b> | <b>\$ 4,166,404</b> |
| <b>(Decrease)/Increase in net assets</b>         | <b>\$ (92,768)</b>  | <b>\$ 154,818</b>   |

**Note:** The figures that appear in the financial summary shown are derived from the financial statements for the years ended September 30, 2015 and 2014 that have been audited and have received an unmodified opinion. The complete audited financial statements for the Institute can be seen at [www.businessandfinance.caltech.edu](http://www.businessandfinance.caltech.edu).



**2015 Operating Revenues** (excluding JPL)

|                           |                   |                |
|---------------------------|-------------------|----------------|
| Grants and contracts      | \$ 322,575        | % 54.5         |
| Endowment payout          | 113,492           | 19.2           |
| Other                     | 67,166            | 11.4           |
| Gifts and pledges         | 50,204            | 8.5            |
| Tuition and fees, net     | 38,065            | 6.4            |
| <b>Operating revenues</b> | <b>\$ 591,502</b> | <b>% 100.0</b> |



**2015 Operating Expenses** (excluding JPL)

|                                  |                   |                |
|----------------------------------|-------------------|----------------|
| Instruction and academic support | \$ 274,934        | % 42.9         |
| Organized research               | 252,677           | 39.3           |
| Institutional support            | 81,225            | 12.7           |
| Auxiliaries                      | 32,712            | 5.1            |
| <b>Operating expenses</b>        | <b>\$ 641,548</b> | <b>% 100.0</b> |

## Academic Leadership

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