

Ideas in the Lab

Rothenberg Innovation Initiative (RI2) 2021 Awards



Researchers in the Van Valen lab use deep learning methods to identify cells in images

A gift from Caltech Trustee James F. Rothenberg and his wife Anne launched the Caltech Innovation Initiative (CI2) in 2009 to provide essential seed funding for early-stage research that addresses pressing problems and could lead to marketable technologies that benefit society. Each RI2 award provides up to two years of support, with up to \$125,000 in funding per year, to help Caltech professors, students, and post-docs mature their research beyond the conceptual stage to the point that the innovations are attractive to outside investors for further development of the technologies. Bolstered by an additional \$15M gift in 2017 and renamed the Rothenberg Innovation Initiative (RI2), the program funded five new projects and four renewal projects in 2021.

- **Medical Polymers that Undergo Remotely Actuated Shape Change for Surgical Applications**
Bob Grubbs, Victor and Elizabeth Atkins Professor of Chemistry, CCE; Mikhail Shapiro, Professor of Chemical Engineering; Investigator, Howard Hughes Medical Institute, CCE
- **Cell Targeting with Synthetic Sense-and-Respond Living Circuits**
Michael Elowitz, Professor of Biology and Bioengineering; Investigator, Howard Hughes Medical Institute, BBE
- **Bioinspired, Self-Organizing Neural Networks for Real-Time Machine Learning** (renewal)
Matt Thomson, Assistant Professor of Computational Biology; Investigator, Heritage Medical Research Institute, BBE
- **Deep Learning-Enabled Optical Barcodes for Imaging Pooled CRISPR Libraries**
David Van Valen, Assistant Professor of Biology and Biological Engineering; Investigator, Heritage Medical Research Institute, BBE
- **Self-Assembling Viral Spike Nanoparticles as a Vaccine Platform Technology Against SARS-CoV-2 Variants and Future Pandemic Coronaviruses**
Pamela Bjorkman, David Baltimore Professor of Biology and Bioengineering; Merkin Institute Professor; Executive Officer for Biology and Biological Engineering, BBE
- **Smart Bandage for Online Monitoring and Treatment of Infected Chronic Wounds** (renewal)
Wei Gao, Assistant Professor of Medical Engineering; Investigator, Heritage Medical Research Institute; Ronald and JoAnne Willens Scholar, EAS
- **LiDAR on a Chip: Sub-Dollar Active Flat Optics Sensors for Human-Machine Interface, Autonomous Vehicles, and Beyond** (renewal)
Ali Hajimiri, Bren Professor of Electrical Engineering and Medical Engineering; Co-Director, Space-Based Solar Power Project, EAS
- **A Wearable Opioid Monitoring System for Personalized Pharmacokinetics** (renewal)
Henry Lester, Professor of Biology, BBE
- **Multi-Spectral Mid Infrared Image Sensors Using Volumetric Meta-Optics**
Andrei Faraon, Professor of Applied Physics and Electrical Engineering, EAS



Caltech Seed Fund

As a part of its continued efforts to strengthen the surrounding entrepreneurial ecosystem, Caltech has launched an internal venture fund (Caltech Seed Fund) to support the commercialization of Caltech technologies. The Fund's purpose is to provide pre-seed and seed capital to help promising new Caltech companies achieve milestones that will allow them to secure follow-on Series A capital within 12–18 months. The Fund intends to deploy \$1.5M to \$2M per year over a five-to-six-year period. The expectation is that the Caltech Seed Fund will invest in four to six companies per year. Using a SAFE investment vehicle, it is designed to provide up to \$1M per company with typical investments between \$250K to \$500K. The Caltech Seed Fund will partner with an externally managed co-investment fund (Wilson Hill Fund) on a significant number of investments to multiply the Fund's impact on pre-seed/seed stage startups based on Caltech/JPL technology.

Caltech's mission is to expand human knowledge and benefit society through research integrated with education. The Caltech Seed Fund will further enable society to benefit from the technological innovations developed at Caltech and JPL by increasing the number and success rate of companies bringing products and services to market that are based on Caltech technology. Commercialization is an important component of Caltech's desire to share its innovation with the world, and the university is rapidly moving in that direction with new centers that are translational in nature. The Caltech Seed Fund complements these existing efforts.

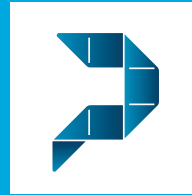
The Caltech Seed Fund invests across all areas of technology from Caltech and JPL. The investments follow research where strong commercialization opportunities exist. Current investments include:



DNATWO

DNATWO is a small molecule targeted oncology drug discovery company founded on technology from the Caltech labs of Judy Campbell, Professor of Chemistry and Biology, and Brian Stoltz,

Professor of Chemistry; Investigator, Heritage Medical Research Institute. They are leveraging key targets in DNA replication and repair such as DNA2, discovered by one of the founders, Judy Campbell, and the concept of synthetic lethality to develop small molecule inhibitors for specific tumor types. Synthetic lethality exploits dependencies of cancer cells on specific components of DNA synthesis and repair pathways that may be redundant in normal cells, thus providing a therapeutic index suitable for clinical development of small molecule inhibitors in oncology. DNATWO launched with CEO Ken Schultz, MD, and seed funding from the Fund@Caltech, Wilson Hill Ventures, and FreeFlow.



Palamedrix

Palamedrix is a DNA nanotechnology company for personalized medicine, founded on technology from the Caltech lab of Paul Rothemund, Research Professor of Bioengineering, Computing

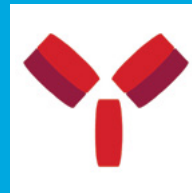
and Mathematical Sciences, and Computation and Neural Systems. Palamedrix utilizes DNA as nucleic acid “staples” that serve as highly sensitive and robust biosensors engineered to capture small molecules from biological samples, and can pinpoint the presence of any analyte with single-molecule accuracy. Organizing these biosensors using proprietary CMOS technologies, the Palamedrix platform is capable of delivering comprehensive data for doctors and patients to get a highly accurate, complete view of an individual’s biochemistry with a single test, allowing the physician to deliver patient-specific data-driven diagnoses and therapeutic interventions. Palamedrix launched with CEO Shane Bowen and seed funding from the Fund@Caltech and Wilson Hill Ventures.



TooFon

TooFon is an autonomous, heavy-lift drone company for “last mile” logistics founded on technology from the Caltech lab of Mory Gharib, Hans W. Liepmann Professor of Aeronautics and Bioinspired

Engineering; Booth-Kresa Leadership Chair, Center for Autonomous Systems and Technologies; Director, Graduate Aerospace Laboratories; Director, Center for Autonomous Systems and Technologies. TooFon’s novel drone hardware architecture and control software will provide autonomous logistics for e-commerce, fire & emergency response, contactless delivery, and other applications. They have created patented drone technology that will allow a drone to carry more than its own weight and scale to over 100 lb. payloads while providing the agility and range needed for commercial operations. Their technology will also reduce the significant costs and greenhouse gas emissions from last-mile logistics. TooFon launched with CEO Amir Emadi and seed funding from the Fund@Caltech, Wilson Hill Ventures, Embark Ventures, and FreeFlow.



ImYoo

ImYoo is a personal immune-profiling company that will provide insights and health intervention tracking to the home user via smartphone application. The company is commercializing

technology from the Caltech lab of Matt Thomson, Assistant Professor of Computational Biology; Investigator, Heritage Medical Research Institute. The technology utilizes single cell profiling of capillary blood, self-collected by the user, for out-of-clinic human immunity studies. The app will provide user-matching based on each user’s unique gene expression profile, to deliver personal biology-driven health interventions by connecting people to others with similar immune system profiles to share their health journeys. ImYoo launched with Caltech alumni CEO Tatyana Dobreva (PhD 2021) and CTO David Brown (PhD 2021) along with seed funding from the Fund@Caltech and the Illumina Accelerator.

Caltech Technology Transfer & Corporate Partnerships

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Innovation. Entrepreneurship. Collaboration.

Our mission is to drive the transfer of scientific and engineering knowledge created by our researchers to maximize societal impact by developing partnerships with industry through the creation of new ventures, collaborations with corporations, and transfer of intellectual property while nurturing an entrepreneurial environment.

FY 2021



128

Invention Disclosures
(campus only)



167

U.S. Patents Issued



8

Startup Companies



2,060

Active U.S. Patents



57

Licenses Granted
(including options)



45

Companies
Sponsoring
Research



55

Companies Giving Gifts



\$46.12M

Corporate Contracts & Gifts

Supporting Innovation Through Corporate Collaboration



Verizon and the Caltech Center for Autonomous Systems and Technologies (CAST) are partnering to explore how 5G, GPU-based computing and artificial intelligence (AI) can improve the way drones sense, respond and adapt to ever-changing environmental conditions in real time. This project has the potential to help accelerate the innovation process and design of Unmanned Aerial Systems (UAS) for the benefit of society.

CAST's researchers are currently designing, studying, and testing ways to enable more real-world applications of aerial robotics. They recreate real-world flying conditions in the CAST

aerodrome using a state-of-the-art fan array wind tunnel formed by an array of over 2500 small fans which can be controlled individually. The tunnel can also tilt between vertical and horizontal orientations allowing for the generation of arbitrary flows that better resemble the real-life conditions drones face when flying to accomplish tasks. Along with one-year of funding, Verizon is providing its 5G Ultra Wideband and edge computing platform, and expertise to CAST's aerodrome in support of this research to enable smart drones. This multi-disciplinary project is performed in collaboration with the groups of Professors Azita Emami and Mory Gharib.

Merkin Institute for Translational Research

The Richard N. Merkin Institute for Translational Research was launched in 2019 to help Caltech scientists accelerate advances in health science and technology. The Merkin Institute's goal is to provide effective and more accessible health care by focusing on propelling discoveries from Caltech labs to the bedside to maximize clinical impact. The Merkin Translational Research Grant program was established to support Caltech research with the potential to prevent and treat diseases and improve delivery of affordable, high-quality health care. The grants target high-risk research projects with the promise to advance the development of therapeutics, vaccines, medical devices, medical diagnostics, and the understanding of health and disease. The program provides selected projects funding support of up to \$400,000 over a two-year period to accelerate the translation of research to the clinic and the commercial sector, for the benefit of society. Projects can be positioned anywhere along the translational path from early-stage discovery to pre-clinical and clinical testing, or early commercialization. In addition to the grant program, the Merkin Institute will also support Caltech professorships, shared instruments and facilities, a Physician-in-Residence, multi-center collaborations and training programs, and educational workshops and short courses. The Richard N. Merkin Institute for Translational Research was established with a gift from Caltech Trustee Richard Merkin, founder and chief executive officer of Heritage Provider Network. Merkin Translational Research Grants were recently awarded for 18 projects.

- **Tsui-Fen Chou, Research Professor of Biology and Biological Engineering**
Targeting the host protein p97/VCP ATPase as antiviral therapy
- **Michael Elowitz, Professor of Biology and Bioengineering; Investigator, Howard Hughes Medical Institute**
Developing methods for accelerated, inexpensive, at home COVID-19 testing
- **Bob Grubbs, Victor and Elizabeth Atkins Professor of Chemistry**
Spray-On Antiviral Coatings
- **Rustem Ismagilov, Ethel Wilson Bowles and Robert Bowles Professor of Chemistry and Chemical Engineering;**
Merkin Institute Professor; Director of the Jacobs Institute for Molecular Engineering for Medicine
A chance to increase global throughput of COVID-19 RNA testing 10 fold
- **Lior Pachter, Bren Professor of Computational Biology and Computing and Mathematical Sciences**
Customizing barcoded hydrogel beads for targeted capture of SARS-CoV-2 viral RNA together with single-cell RNA sequencing
- **Doug Rees, Roscoe Gilkey Dickinson Professor of Chemistry; Investigator, Howard Hughes Medical Institute**
Structural studies of the SARS-CoV-2 integral membrane M protein
- **Shu-ou Shan, Altair Professor of Chemistry; Executive Officer for Biochemistry and Molecular Biophysics**
Define the interactions of the SARS-CoV proteome with Signal Recognition Particle during viral protein localization to the endoplasmic reticulum
- **YC Tai, Anna L. Rosen Professor of Electrical Engineering and Medical Engineering; Andrew and Peggy Cherng Medical Engineering Leadership Chair; Executive Officer for Medical Engineering**
Real-time and Continuous Pulmonary Edema Sensor for Moderate/Severe COVID-19 Monitoring
- **Ralph Adolphs, Bren Professor of Psychology, Neuroscience, and Biology**
Emotional biases, decision-making and the COVID-19 pandemic
- **Pamela Bjorkman, David Baltimore Professor of Biology and Bio-engineering; Merkin Institute Professor; Executive Officer for Biology and Biological Engineering**
Structural characterization of SARS-CoV-2 cell entry and design of universal vaccine strategies to protect against COVID-19 and future coronavirus outbreaks
- **Judy Campbell, Professor of Chemistry and Biology**
High-jacking the innate immune system to reduce SARS-CoV-2 infectivity
- **Wei Gao, Assistant Professor of Medical Engineering; Investigator, Heritage Medical Research Institute; Ronald and JoAnne Willens Scholar**
A Highly Sensitive and Low-Cost Portable Sensing Device for Ultra-Rapid COVID-19 Test
- **Joseph Kirschvink, Nico and Marilyn Van Wingen Professor of Geobiology**
Making Useful Mask Testing for the Caltech (and Other) Masses Possible
- **Dean Mobbs, Professor of Cognitive Neuroscience; Allen V. C. Davis and Lenabelle Davis Leadership Chair, Caltech Brain Imaging Center; Director, Caltech Brain Imaging Center**
A longitudinal study of the impact of psychological stress, social isolation and perceived risk during the COVID-19 pandemic
- **Rob Phillips, Fred and Nancy Morris Professor of Biophysics, Biology, and Physics**
Coronavirus by the Numbers
- **Niles Pierce, Professor of Applied and Computational Mathematics and Bio-engineering; Executive Officer for Biology and Biological Engineering**
Developing a Sensitive, Rapid, Over-the-Counter Test for SARS-CoV-2
- **Axel Scherer, Bernard Neches Professor of Electrical Engineering, Applied Physics and Physics; Merkin Institute Professor**
Rapid Automated qPCR for Point of Care Diagnostics
- **Matt Thomson, Assistant Professor of Computational Biology; Investigator, Heritage Medical Research Institute**
Discovering super-inhibitors of interleukin driven cytokine-storm using high-throughput single-cell mRNA profiling