universe

JPL

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Featured Stories

A Look Ahead to 2023

By Carl Marziali

Look overhead for the Lab's latest contribution to human knowledge. Then keep going to the ends of the universe.

Coming in 2023 and beyond: discoveries from an orbiting map maker for Earth's waters, a mid-infrared instrument unveiling the early cosmos, and the many JPL inventions exploring the space between.

The **Astronomy & Physics Directorate** expects ongoing dividends in 2023 from the Mid-Infrared Instrument, the most powerful tool for studying early universe galaxies, on the most powerful observatory in history: the James Webb Space Telescope. The Coronagraph Instrument for direct imaging of exoplanets on the next observatory, the Roman Space Telescope, will complete its integration and begin performance characterization.

The SPHEREx mission will undergo its systems integration review, and the directorate will deliver the Microwave Electrojet Magnetometer instrument for EZIE, the Electrojet Zeeman Imaging Explorer heliophysics mission managed by the Johns Hopkins Applied Physics Laboratory.

The **Earth Science & Technology Directorate** looks forward to Surface Water and Ocean Topography mission's datasets, which are expected to provide the first full picture of the extent of the world's freshwaters as well as new insights into dynamics and energy transport in the oceans. EMIT, the Earth Surface Mineral Dust Source Investigation, is expected to resume where it left off in 2022 after a power outage on the International Space Station. The mission has already returned stunning images of Earth's surface minerals and provided high-resolution images of fugitive methane emissions, which contribute strongly to global warming. The PREFIRE (Polar Radiant Energy in the Far-InfraRed Experiment) twin cubesats, for which JPL delivered key infrared spectrometers to constrain projections of Arctic warming, are scheduled to launch in 2023.

OPERA, the Observational Products for End-Users from Remote Sensing Analysis project, will supply critical data and information to federal decision-making agencies, while a new California Information System effort will offer analogous support to state policymakers. A third initiative will build a new bridge between climate science and policy. JPL supplied the main instrument for a satellite launching this year that will pinpoint large carbon and methane emissions. The mission sponsor: not NASA or another space agency, but a consortium led by the non-profit group Carbon Mapper.

The **Interplanetary Network Directorat**e and its Deep Space Network form the conduit to Earth for the James Webb Space Telescope's images of the early universe, and for the data from dozens of other missions exploring our solar system, galaxy, and universe. The conduit needs to expand as spacecraft instruments leap ahead in bandwidth. The DSN is building another 34-meter antenna at the Goldstone site in California's Mojave Desert, with assembly scheduled to start this year and commissioning to be complete in late 2025. Site selection for the last of six new antennas is underway at the DSN's Canberra site in Australia.

The next generation of deep space communication, based on lasers instead of radio waves, will take flight as a demonstration technology on the Psyche mission to the eponymous metal asteroid. The Deep Space Optical Communications experiment is expected to lead to eventual improvements of one to two orders of magnitude over current transmission bandwidths.

The **Planetary Science Directorate** will continue to follow the progress of the Perseverance rover, as it deposits sample tubes on the surface of Mars for future retrieval and return to Earth. The Psyche mission to explore a metal world and Lunar Trailblazer expedition to probe for water on the moon are scheduled to launch this year. Europa Clipper is taking shape in the high bay. JPL also delivered a radar instrument for the European Space Agency's JUICE (Jupiter Icy Moons Explorer) mission, both expected to launch this year.

Nearer to Earth, JPL is developing a fleet of small autonomous rovers for mapping the lunar subsurface. The Farside Seismic Suite is also being developed with four seismometers and lunar overnight survival technology to determine the deep structure of the moon.

Mars Sample Return, potentially the most challenging and complex mission of this decade, will hold preliminary design reviews in 2023 for the sample retrieval lander and capture containment system.

From Earth to deep space, the coming 12 months of JPL explorations promise to rewrite human knowledge for all generations — again.

Water's Cartographer Launches

By Taylor Hill

JPL's newest mission will survey nearly all of Earth's water for the first time in history.

Surface Water Ocean Topography (SWOT), a collaboration of U.S. and French oceanographers and hydrologists, launched Dec. 16 and promises both incremental and fundamental advances in Earth science.

The mission will use spatial resolution radar to measure water levels and flows in Earth's seas in greater detail than ever. That's the incremental part—but one with significant impacts for climate studies. Earth missions often traffic in increments. Over years or decades, these gradual improvements can help clarify our process understanding of how the Earth's climate is established and how changes in the climate can impact storm severity and frequency, heatwaves and wildfires, floods, droughts, and more.

"[Those measurements are] our bread and butter. It's what's made JPL a world leader in the Earth science community," said Earth Science and Technology Director Jim Graf. "But once in a blue moon, we make a brand-new measurement technique, and that's what I think we have here with SWOT."

SWOT will be the first mission designed for measuring the surface topography of the world's freshwater, observing in three dimensions rivers wider than 330 feet, and lakes larger than 15 acres, across 95 percent of the planet's surface.

The data promises to transform how researchers, agencies and policy makers monitor the Earth's water cycle, gauge drought conditions, improve flood forecasts for rivers, manage water supplies, prepare for disasters, and track water locally.

“It has never been done before. It will enable critical Earth science measurements to support hydrology scientist’s efforts to close the water cycle budget and track changes in the level of fresh water around the globe,” Graf said. “There are a number of other space agencies watching this demonstration, ready to pursue the measurement technique once it is established. JPL is again pioneering new ways of looking at the Earth.”

Among those waiting is the European Space Agency, which will be relying on SWOT’s measurements as a baseline for future missions in the Copernicus program.

“They’re counting on us coming forward and showing that we can in fact make the measurement with the accuracies that we’re talking about,” Graf said. “Once we do, then the community will get familiar with the data and start using it, and counting on it.”

SWOT Project Manager Parag Vaze believes the Lab is uniquely positioned for these types of missions.

“We talk about one measurement, but it’s enabled by multiple technologies employed together to make that happen,” Vaze said. “And those technologies—of which there are probably seven or eight major ones incorporated in this mission—are developed here.”

Vaze sees JPL’s mix of skills and talent as an integral combo for a mission such as SWOT. The Lab comprises researchers with a fundamental understanding of the science and science problems; a workforce that doesn’t just manufacture technologies, they actually invent those technologies; and engineers capable of implementing the new designs.

“The result is having the capability to actually take what we built, process the data, and turn it back around to scientists for use in potential applications,” Vaze said. “That’s a capability that I haven’t seen in other places.”

A History of Foundational Missions

Looking back over the decades of JPL Earth science missions, Graf remembers some of the key breakthroughs. Seasat—one of the earliest Earth-observing satellites—launched into orbit in 1978 equipped with experimental sensors including a synthetic aperture radar, a scatterometer, a radar altimeter, and an ocean radiometer—all instruments used on satellites today.

“The mission that launched thousands of careers,” Graf quipped. “Nearly every component of Seasat spawned its own follow-up development, and created brand-new measurements.”

Graf also recalls the measurements gleaned from GRACE starting in 2002, and still coming back from GRACE Follow-On, which allow scientists to track the movement and accumulation of water and ice through their gravitational pull.

“With GRACE, we initially didn’t know how much we could really measure,” Graf said. “We didn’t know how long or what the benefits would really be, or how we’d utilize it. But… people started getting familiar with the data, and started using it in fashions that they hadn’t envisioned when they first started looking at it.”

With its global view of salt and freshwater, SWOT is following in these spacecrafts’ paths.

“The idea of doing interferometry from the space spacecraft with this frequency to make these measurements is just as compelling, and just as new as these other missions that have been game changers in Earth science,” Graf said.

And just as with GRACE, Graf believes the true value of SWOT will increase as time goes on.

“I wouldn’t just look at what the value is in the first year, I think you’d want to look at what the value is going to look like in its third or fourth year,” Graf said, adding that’s when the data series should start revealing the hydrology cycle accurately, and researchers could start understanding the dynamics associated with that.

“It’s not a one-off data point, or an ‘aha’ moment,” Graf said. “We’re in this for the long haul, where we’re starting to look at these parameters over a long time, and seeing what’s happening. That’s where the value of SWOT will shine.”

For Vaze, SWOT’s potential is reminiscent of the TOPEX/Poseidon mission in its early days, specifically in its measurements of global sea levels during the El Niño and La Niña events of the early 1990s.

At the time, Vaze remembers the tremendous amount of news around El Niño, and how the data from TOPEX/Poseidon helped make a connection, not just with scientists and users, but with the public.

“SWOT can be even more impactful,” Vaze said. “Clearly understanding how the oceans and in particular how the coasts behave is something that people easily relate to, and freshwater supply is something people know exactly what it means—from turning on your tap. Making a connection between SWOT’s measurement, and the benefits of the measurement is, I think, going to be straightforward.”

More information on SWOT

SWOT is a joint mission developed by NASA and the French space agency CNES, with contributions from the Canadian Space Agency and the UK Space Agency.

- Mission Website: https://swot.jpl.nasa.gov/
- 5 Things to Know About How SWOT Will Look at the World's Water: https://swot.jpl.nasa.gov/news/74/5-things-to-know-about-how-swot-will-look-at-the-worlds-water/
- Press kit: https://swot.jpl.nasa.gov/resources/press-kit/

Back in Gear: JPL Car Show Returns

JPL's annual Transportation and Fleet Management Annual Car Show revved up for its stylish return to Lab on Dec. 15, with a showcase of over 25 classic and modern cars. The event drew crowds all along Explorer Road as visitors stopped to check out a variety of vehicles on display, from Detroit muscle and foreign classics, to vintage Hondas and modern sports cars. With live tunes from Shop 300 setting the vibe, JPLers peeked under hoods and chatted with car owners about the history, special features, and maintenance of their prized rides.


NOTICE
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Oakwood High School Sweeps the JPL Invention Challenge

By Vince Robbins

The 23rd annual JPL Invention Challenge returned in lively fashion on the Mall on Friday, Dec. 9 — after a two-year hiatus during the pandemic — with 21 student teams and five JPL teams competing side by side in separate divisions. Contestants had one objective: build a device that could launch five colored rubber balls at five different targets in less than 60 seconds, a competition dubbed the “Sticky Wicket.”

In person, the event looked something like a scientific reimagining of croquet. The contraptions employed an array of propulsion methods — from hammer swings to hydraulic batter rams — and a wide range of materials such as wood, polyvinyl chloride pipe, 50-pound dumbbells, duct tape, laser pointers, and even an iPhone.

As each team stepped into the launch zone at the center of JPL’s Mall — tensions high and the sun shining down on them — they fired their rubber balls at the targets while precious seconds on the clock ticked by.

All of the teams put on impressive performances, but Oakwood High School stunned the competition with a clean sweep of first, second, and third place. The “Stingray” contraption carried the school’s Team Rose to victory with a perfect 190-point score in under 30 seconds. Not far behind, Oakwood’s Team Cobalt and Team Emerald came in second and third place, respectively, with similar perfect scores, albeit slightly slower times.

Oakwood High School's Team Rose won first place with their 'Stingray' contraption.

The secret to their success?

“Just a lot of practice,” said Oakwood senior Avalon Bookstaver, who described the winning device as a “slingshot-crossbow type thing.” Prior to the competition, Oakwood’s teams spent 15 hours practicing every week beginning in August, testing multiple approaches before arriving at the winning model, according to their coach, Oakwood STEAM department chair Marcos Arias.

But with three winning teams from the same school, Bookstaver was quick to quash any suggestion of rivalry between fellow classmates. “Everyone is so excited for each other and we’re just proud that [our devices] worked...It was really great to see it all come together.”

On the JPL side, one of the teams was a family affair. EBIS Systems Engineer Gouri Butani has been competing in the Invention Challenge with her husband Sandeep Dawar and daughters Reema and Ria since 2016.

EBIS Systems Engineer Gouri Butani (right) with her husband Sandeep Dawar and daughter Reema.

“It’s really nice for me because we started participating in [the challenge] when I was in elementary school, so I’ve grown up with it,” Reema, a senior at Whitney High School, said.

Behind the Competition

Started in 1998 by Mechanical Systems Engineer Paul Macneal, the Invention Challenge is a STEAM-based contest that provides a fun and challenging opportunity for teams of middle and high school students to put their engineering skills to the test alongside JPL’s finest. Thanks to a unique engineering challenge presented each year, the contest has provided a competitive but supportive environment for upwards of 10,000 students over the past two decades to hone and test their skills in creativity, brain-storming, and solving complex engineering problems.

Over the course of three months leading up to the event, all of the teams design, fabricate, test, and analyze devices that will — hopefully — accomplish the goal of that year’s competition. After a regional qualifying round, the top 20 or so teams are invited to JPL to compete in the final round: an action-packed day that puts the student teams on equal footing with JPL engineers.

“It’s one of the only contests I’ve ever seen where you’ve got professionals competing side-by-side with student teams,” founder Macneal said. “I think [it’s] very valuable to allow the students to see that the engineers are having fun. That’s the whole reason I do the contest.”

Ultimately, Macneal says, it’s all about teamwork for the students.

“They learn team dynamics and team dynamics are so important at JPL,” Macneal said. “[Being] super brilliant is nice, but you also have to be able to work with people.”

Although the competition is primarily centered around Southern California schools, more than a dozen international teams have competed in the Invention Challenge over the years, traveling at their own expense from as far as Ethiopia, Tanzania, and Germany, as well as remote participation from a school in Istanbul, Turkey.

Macneal doesn’t keep specific statistics, but he estimates that over two-thirds of the students are from underrepresented communities, and that over half are female. And while other similar engineering competitions on the local and national level have high participation fees or are predicated on building elaborate — and expensive — devices, Macneal is proud that the Invention Challenge is free to enter and requires about $50 to build a device.

“Everybody is equal,” he said. “Everybody starts with a blank sheet of paper.”

And while the challenge is a great opportunity for students to get a sneak peek into JPL’s universe, it’s also a chance for JPLers to glimpse the next generation of engineers.

“The students are engineers, they just don’t know it,” Macneal said. “When they’re getting ready for the contest and they’re building their devices, and they’re testing them, and redesigning them, and re-testing them — they are engineers.”

Events

Von Karman Lecture: How Do Missions Get Formed?

Thursday, Jan. 19
7 to 8 p.m.

Watch on YouTube

Robotics Engineer Paulo Younse will talk about project formulation and demonstration, looking at the process of generating ideas — from napkin sketch to prototype to development and testing. He'll also look at how they figure out the right questions to ask in order to understand what technologies are needed to get the job done using real life experiences and stories about the Mars Rovers and Mars Sample Return Mission.

Speaker: Paulo Younse, Robotics Engineer, NASA/JPL

Host: Brian White, Office of Communications and Education, NASA/JPL

Co-host: Lindsay McLaurin, Mars Public Engagement, NASA/JPL

JPL Family News

Retirees

The following JPL employees recently announced their retirements:

40+ Years:
Antonio Fonseca, Section 357E, 44 years
Leslie J. Deutsch, Section 9000, 42 years

30+ Years:
Reba J. Craig, Section 3418, 39 years
Donna L. Markley, Section 5122, 38 years

20+ Years:
Sandra Capaldi, Section 3023, 25 years
Nancy Vandermey, Section 397D, 25 years
John Ho, Section 398N, 20 years

Awards & Honors

JPLers often Dare Mighty Things, and nearly as often earn awards or professional designations. JPL Space will periodically feature a roundup of recent honorees. Please join us in congratulating your accomplished colleagues:

Michael Greene
International Academy of Astronautics (IAA)
Elected a Corresponding Member for Section 4 on Social Sciences of the International Academy of Astronautics.

Full story

Blaine Baggett
International Academy of Astronautics (IAA)
Elected a Full Member for Section 4 on Social Sciences of the International Academy of Astronautics.

Full story

Otfrid Liepack
International Academy of Astronautics (IAA) - Social Sciences Award
“For a lifetime of achievements on integration, test and deployment of major international cooperative planetary missions such as Galileo, Cassini and Phoenix."

Full story

NASA's Ingenuity Mars Helicopter team
Royal Aeronautical Society - Team Gold Medal
"Awarded the Society's Gold Medal for the advancement of aerodynamics and aerial robots for planetary science through the design, development, and fabrication of the Ingenuity Mars Helicopter Technology Demonstrator."

Full story

Julie Castillo-Rogez
2022 Farinella Prize
"Awarded for outstanding contributions to the field of 'Asteroids: Physics, Dynamics, Modelling and Observations'."

Full story

Goutam Chattopadhyay
Institution of Electronics and Telecommunication Engineers (IETE) Biman Behari Sen Memorial Award 2022
"Outstanding contribution in the the Emerging areas of Electronics and Telecommunications with emphasis on R&D and industrial development."

Full story

Shailen Desai
AIAA Associate Fellow
"For exceptional contributions to NASA ocean altimetry missions, including mission-critical calibration and validation of their measurements and enhancing their science return."

Full story

Laurie Barge
Scialog "Signatures of Life in the Universe" Award
Research Corporation for Science Advancement, the Heising-Simons Foundation, The Kavli Foundation and NASA are announcing awards totaling $1,045,000 to eight multidisciplinary teams of researchers from institutions across the United States and Canada in the second year of Scialog: Signatures of Life in the Universe. Each of the 19 individual awards is $55,000.

Full story

The VITAL Design Team
Fast Company Innovation by Design Awards
Finalist in the Pandemic Response category and Honorable Mention in the Rapid Response category.

Full story