

Deep dive

By Franklin O'Donnell

For the Cassini team, it's the beginning of the end—but they're confident it will be spectacular.

After orbiting Saturn for nearly 13 years, on April 22 the spacecraft will sail past the ringed planet's largest moon Titan. That will send Cassini into a unique orbit taking it into the narrow gap between Saturn's innermost ring and the top of its atmosphere.

Following 22 orbital passes through that gap—which promise intriguing new science but heightened danger—on Sept. 15 Cassini finally will plow into Saturn's atmosphere and vaporize, bringing the flagship mission to a close.

The novel flight plan was conceived more than seven years ago, when Cassini managers considered options for the spacecraft's later years. One high priority was preventing any possibility of contaminating Saturn's moon Enceladus, which was found to have warm water and organic compounds underneath an icy shell.

Mission planners discovered that a sequence of carefully selected flybys past Titan could fling the spacecraft into a unique orbit giving it unprecedented views of Saturn's poles, rings and atmosphere. Like Galileo's fiery end at Jupiter, sending Cassini into Saturn's atmosphere solves the issue of contaminating any icy moons.

"Titan is a mission designer's dream,"



A still from the video "Cassini's Grand Finale" shows the spacecraft diving between Saturn and its innermost ring.

said Earl Maize, Cassini's project manager. "It gives you many hundreds of meters-per-second velocity change every time you fly by closely, and you can use it to shape your trajectory and move to almost anywhere you wherever you want the spacecraft to go."

Maize noted that the passes between Saturn's rings and its atmosphere raise risks to the spacecraft, primarily from impacts from small particles. "There's no way we would have taken this risk earlier, when we had the entire mission ahead of us," he said. Normally the Cassini team reduces risk so that probability of mission loss is less than 1%. For the Grand Finale orbits, Maize says the risk is estimated somewhere between 1.2% and 3%.

But even if the spacecraft is disabled,

that would not change its ultimate fate, he added. "After the April 22 Titan flyby, Cassini's fate is pretty much sealed," he added. "Assuming all goes well with the final approach maneuver, we could lose contact with the spacecraft and it would still go into Saturn's atmosphere on Sept. 15. It's all ballistic at that point."

Maize said the finale is especially poignant because, as a major flagship mission, Cassini has touched so many at JPL and elsewhere. About 150 JPL staff currently work at least part-time on the mission, and many hundreds of current employees are Cassini alumni. When external affiliates around the United States and overseas are added, the number of Cassini veterans is in the thousands.

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Cassini: JPL's driving school

By Carl Marziani

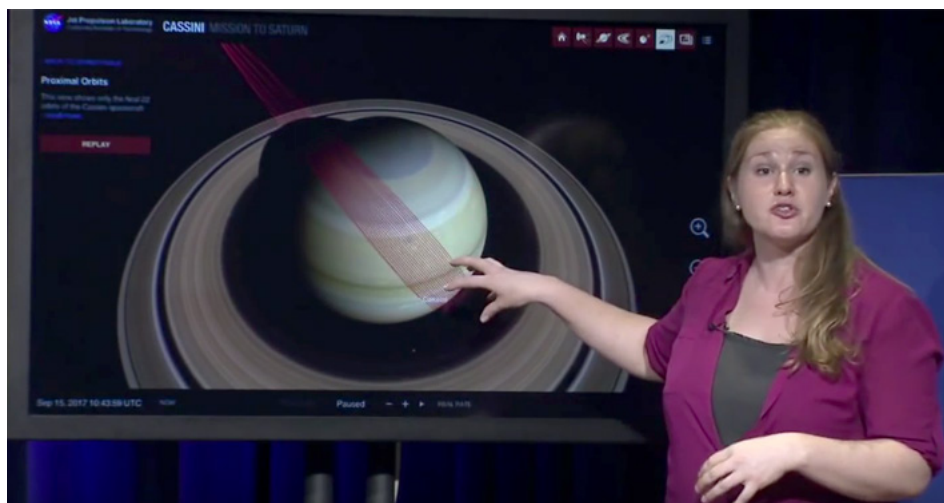
Interplanetary driving school requires a good vehicle, and few have proven as instructive and dependable as Cassini for hundreds of young engineers.

They are the Cassini cohort. Joan Stupik and the mission were born the same year, and she was in high school when Cassini arrived at Saturn. A bachelor's and a master's degree later, as a fresh guidance and control engineer at the Lab, she slipped into whatever non-descript chair in Building 230 passed for the driver's seat of the nearly 20-year-old craft.

After more than three years, Stupik has absorbed valuable lessons from her time at the wheel. Some were expected but still novel, like the nearly three hours of lag between transmission of a command and receipt of an answer from the craft. When the reply did arrive, it had the fast-fading charm of a string of digits unspooling across a monitor.

Watching engineers and scientists argue—that was educational.

“One of the things that never occurred to me until I was actually working here was that there's a very interesting relationship between the engineers who are



Cassini guidance and control engineer Joan Stupik at a recent Cassini news conference.

operating the spacecraft and the scientists who are using the data,” Stupik said. “The scientists want to push the limits of the spacecraft as much as they possibly can, whereas the engineers—we’re in charge of the health of the actual hardware.”

These days the scientists are winning, because when your vehicle is headed to the Saturnine scrap yard in less than six months, you may as well take a hard corner.

Or several. The Grand Finale consists

of repeated dives to explore Saturn's cluttered rings—maneuvers too risky to attempt when the craft was studying the planet and its moons. It was Cassini that discovered liquid water under the icy sheath of Enceladus, upending scientific consensus and raising a new candidate in the search for life.

“All of our hardware is still working really well, so we have relaxed a lot of the constraints that we used to put on the scientists, for how fast they could turn and that kind of thing. At this point everything's going to be fine—engineering-wise,” Stupik qualified with a laugh, because for once the demise of the craft is part of the plan.

Stupik is spending only half her time on Cassini these days. With the other half, she is taking her experience to the design team for her next vehicle: the Europa Clipper.

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During most of its mission, Cassini has collected science data and then relayed it to Earth sometime later. During its final hours in September, however, the spacecraft will be doing the interplanetary equivalent of a Facebook Live event—sending data back in real-time as it descends into Saturn's atmosphere.

“I wouldn't be surprised if some of the discoveries we make might be some of the best of the mission,” said Linda Spilker, Cassini's project scientist.

Said Maize: “It's been a marvelous ride.”

From Campus to Lab, Simons sees the big picture

Caltech professor is named JPL's chief scientist

By Leslie Mullen

Mark Simons has been the JPL chief scientist since February. He arrived here from Caltech (where he is still a professor of geophysics in the Seismological Laboratory), but he actually has a long history of collaboration with JPL dating back to 1990. He came to JPL then as a graduate student, during orbit insertion for the Magellan mission to Venus.

"My Ph.D. was on the tectonics of Venus," he says. "It was right before Magellan went into orbit around Venus, and I had an opportunity to be here when the first images came from Venus—images of the surface that we'd never seen in that kind of detail before. It was a stunning few days, just to be there the first time that you got confirmation that it had all worked and you were seeing images of a place nobody had seen before."

Simons maintained his connection to JPL afterward, working on the relationship between variations in the topography and gravity fields of Venus and later using radar interferometry to measure deformation of Earth's surface, which had been developed at JPL by Richard Goldstein and colleagues.

After being hired as faculty at Caltech, he continued to work closely with JPL using radar to study crustal deformation processes on Earth, such as due to large earthquakes around the globe, landslides along the San Andreas fault and the mechanics of icecaps in Iceland and ice streams in Antarctica. He is a member of the Advanced Rapid Imaging and Analysis (ARIA) project, a collaboration between Caltech and JPL to use space geodesy to better inform emergency response teams for earthquakes and other



natural disasters. Simons says the project allows agencies to receive scientific information much more quickly than before, in hours and days rather than months.

Simons is also on the science definition team for the NASA-ISRO Synthetic Aperture Radar (NISAR) mission that will launch in 2021. NISAR will provide images several hundred kilometers across on every spot "that we care about" on Earth, to look at deformation processes from earthquakes and volcanoes every 12 days. The NISAR mission will be run out of JPL and the Indian Space Agency.

"In some sense, JPL is uniquely positioned to help guide how we explore the universe," Simons says. "This job of chief scientist is trying to make sure that we explore as many of avenues as possible. What could we do? What could we measure? What can we detect? And what questions can we answer?"

Once we understand that, he says, his role at JPL is to try to help shepherd the right technologies and scientific approaches that should be developed to

best answer all the questions we have.

"What's been interesting to me, coming here to the Office of the Chief Scientist from campus, is that it really is not decisions made in a closed room with two or three people. There's continuous reliance on the entire JPL community, and the outside community frequently, to give us input on what to do next."

Even though he has a lot of experience working with JPL over his career, Simons acknowledges that no one person can be an expert in everything. He's in awe of the variety and diversity of projects and missions currently at JPL. "What is truly inspiring is the JPL culture to think big and come up with bold ideas. My hope is that I can help these bold ideas come to fruition as often as possible.

"One of the things I've been impressed by is the number of people you can rely on to go to, and ask dumb questions, and say, 'Great. I really have no idea what you're talking about. Please explain.' I like to learn, and so it's like being a kid in a toy store all over again."

Letters

The Alkalai family wishes to thank the JPL family for their outpouring of love and support received since the passing of our beloved mother and wife Lea Glitman-Alkalai (59). She passed very suddenly and unexpectedly Feb. 14 after a brief battle with metastatic melanoma. Her love for people, her children and family, for music, her smile and her love for life will inspire us all and guide us to live a healthier and happier life and become better people.

Leon Alkalai

I'd like to thank my colleagues for the plant and card following the passing of my 98-year-old father, Earl Eldred, in March. One of the original founding professors of the UCLA medical school, he dedicated his life to teaching students and conducting research in neurobiology. I owe my own career at JPL to his pursuit of things academic, and his strong sense of adventure and athletic fitness have left their marks on everyone who knew him. He will be missed deeply by his family, friends, and acquaintances.

Dan Eldred

I would like to thank my colleagues for their condolences and best wishes to me on the recent passing of my father. It was reassuring to have so many supportive friends. Thanks also to Section 312 for the beautiful plant, and to several colleagues for covering my tasks while I was away in England.

Stephen Unwin



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Universe

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Classifieds

Ads submitted April 1 to 7.

For Sale

DINING SET, IKEA extendable; dining table with 2 pull-out leaves, seats 4, adjustable size, normal wear and tear; the rest support on one of the chairs is a little wobbly, so it's free if you buy all 4 chairs with or without the table; original table price \$149, original 4 chairs price \$156, total price \$305 (\$332 with 9% tax); min. length: 19¾," max. length: 34 5/8," 1 leaf length: 7½," width: 35 3/8," height: 29 1/8;" selling at 50% off the original bought price; table selling price \$75, 4 chairs selling price \$60, total price \$135. 404-405-5687.

FURNITURE, Shermag oak-colored glider rocker w/cream-colored cushions and matching ottoman, made from select hardwoods, smooth gliding motion w/multi-positioning locking system, dimensions: 29.2 x 25.5 x 20.5". katiec033@gmail.com or 818-832-0215, leave a message.

MISC.: Ethan Allen Tribeca (quality name brand) sofa-sleeper and matching ottoman in excellent condition, hardly used, comes from smoke-free and pet-free house. Matching ottoman on wheels with storage space, \$600/obo; very clean and fully functional General Electric refrigerator, \$150; Nordic Ware microwave tender cooker for \$40, 27" KitchenAid microwave KCMS1655BSS with trim kit to install in cabinet, microwave can be used on kitchen counter or can be installed in cabinet (both items for \$175 and will consider selling separately). 818-369-6640.

SOFA: Really comfortable, 3 seat and back cushions, plush brown, with big pillow top arm supported by 4 wooden legs, cushions are not attached to the sofa, cushion covers can be removed for washing, sofa is in great cond., used for 2 years; 8' long, classic 40" deep, 31" high; original MSRP \$700 (\$763 with 9% tax), selling for \$550. 404-405-5687.

Wanted

SPACE INFO/memorabilia from U.S. & other countries, past & present, for personal use (see <http://www.youtube.com/watch?v=S7PvjGp7mCU>). mrayman@alumni.princeton.edu, 818-790-8523, Marc Rayman.

Real Estate for Sale

LEBEC-area mountaintop retreat, spectacular views, 4 br./2 ba., 3,210 sq. ft. custom-built house on 20 acres, surrounded by vast fields of wildflowers in spring, but stunning year-round; only about an hour from JPL north on I-5; includes spacious workshop or artist's studio; see <http://www.tourfactory.com/idxr1308594>; \$549,900. 805-358-1626 or Robert.A.Preston@icloud.com.

For Rent

ALTADENA, short- or longer-term rental; furnished bedrm. in a beautiful 4-bd., 2-bath house; includes desk, dresser, bedding, towels, Wi-Fi, etc.; share common areas w/2 considerate professional women, large kitchen w/ample storage; quiet, safe neighborhood, large, fenced yard with mature fruit and shade trees; easy bike distance to JPL (1 mile); all utilities included; \$825/mo. Louise: 818-653-9600, louise@louiseh.org.

LA CANADA FLINTRIDGE, newly-renovated home for lease, 4 bedrooms, 3 baths, approx 2,800 home sq. ft. & 22,000 lot sq. ft.; great schools, great views & beautiful oak trees; pool, ample storage, two-car garage with additional carport, includes regular pool and yard service; \$5,600 per month, minimum 1 year lease. Call, text or email John: 323-270-4081 or johncmazur@gmail.com.

LA CRESCENTA, front house with high, open beam ceilings; 1 bedroom, 3/4 bath and kitchen, refrigerator, microwave, dishwasher, and washer & dryer included; fenced-in backyard area w/built-in gas grill, beautiful quiet neighborhood next to mountains; includes all utilities and internet; \$2,350/month. tina_t_ml@yahoo.com.

PASADENA, 3-bed, 2.5-bath, 1,438 sq. ft., corner unit townhome in gated community minutes from Rose Bowl/Old Town/JPL; 2-car attached garage, private patio & yard, refinished kitchen, new carpet and paint.; community amenities include pool, spa, sport court, grassy playground area and guest parking; pets OK w/additional deposit; no smoking; \$3,200/mo. 818-949-8103 or 1109Rosewalkway@gmail.com, Evan.

PASADENA, furn. room in a lovely 4-bd./2-bath house, big backyard, hardwood floor, big closet, shared bathroom, kitchen and laundry privileges; 2 miles to JPL, close to public transportation; short- or long-term lease available; must like dogs and be very clean; \$900 + \$900 deposit. 818-960-8654.

Vacation Rentals

MAMMOTH, Snowcreek, 2 bd., 2 ba. + loft, sleeps 6-8, fully equip'd kitchen incl. microwave, D/W, cable TV, VCR, phone, balcony w/mtn. vw., Jacz., sauna, streams, fishponds, close to Mammoth Creek, JPL discount, no pets. 626-798-9222, 626-840-3749 or valeriee@caltech.edu.

MAMMOTH, Snowcreek, beautiful updated condo, 2 bd., 2 ba. + loft (sleeps 6-8), great location by pond/meadow, new appliances, TVs, DVD players, free wireless Internet and washer/dryer, no pets. 818-952-2696 or BigMtnPrettySky@gmail.com.

MAMMOTH, remodeled 2 bed/2 bath + loft, short walk to Canyon Lodge; Courchevel 6 features full kitchen, cable/Internet TV, DVD, Blu-Ray, wireless hi-speed Internet, 2-car garage, Jacuzzis, grill, pool; no pets. <http://Courchevel6.com>.