



Vol. 65, No. 9 – September 2017

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**\*\*\* ONE-TIME VENUE CHANGE: SEPTEMBER 19<sup>th</sup> LECTURE ONLY \*\*\***

The September Astronomy lecture on 9/19/17 must be re-located from the Officers Club to the Observation Post (Our previous meeting locations). The Presidio team is helping to spread the word about the venue change through their media channels. There will be someone at the Front Desk of the Officers Club on 9/19, who will personally advise and re-direct any guests who are looking for the lecture. The Observation Post is located at: 211 Lincoln Blvd, next to the Transit Center.

# 01.

## SFAA PRESIDENT'S NOTE | A GLORIOUS END TO A SIGNIFICANT ACCOMPLISHMENT

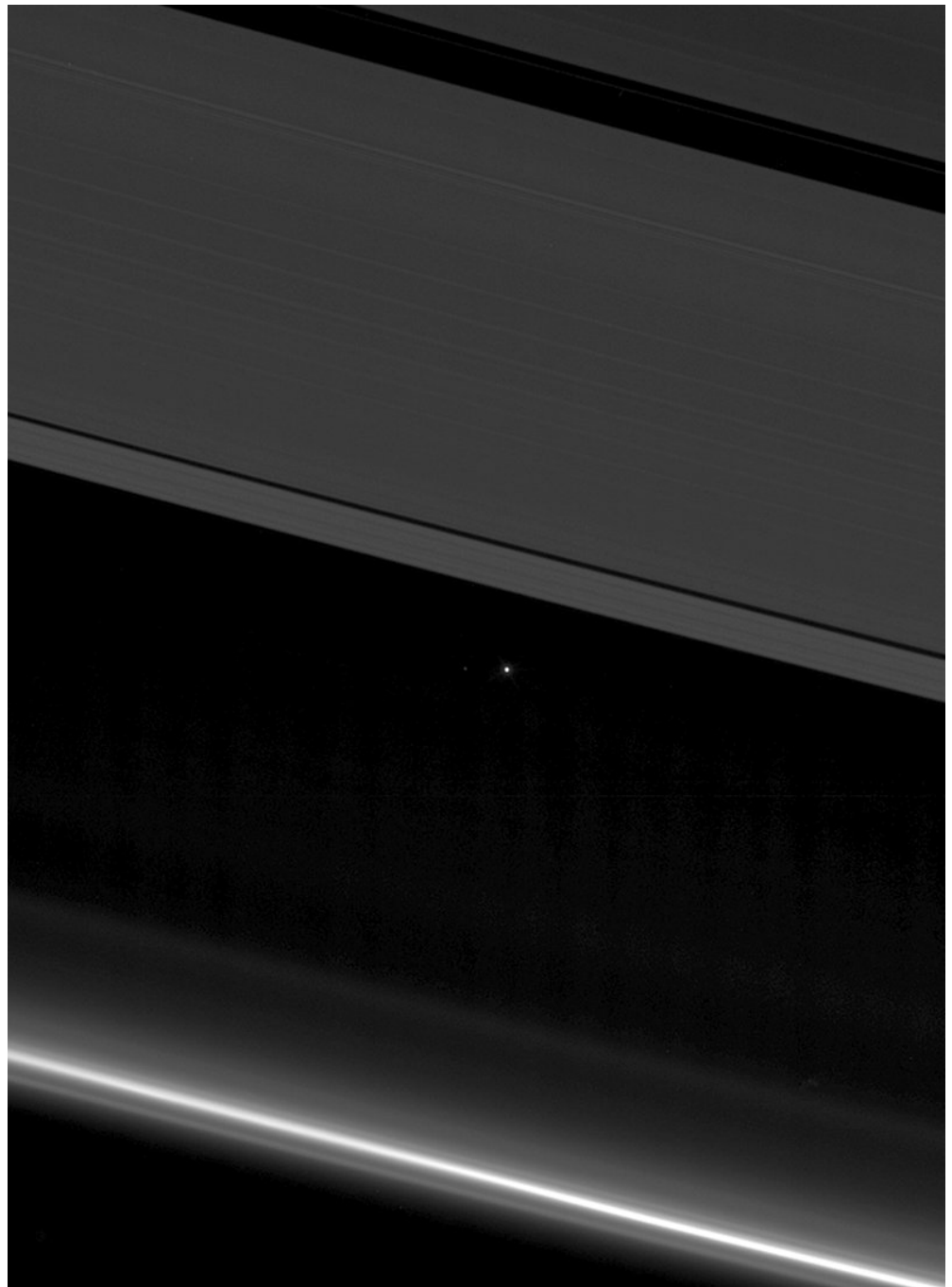
As I write this on 14 September spacecraft Cassini has less than 24 hours before it plunges into Saturn's atmosphere, gathering and sending back data until it can no longer do so. Launched back in 1997 (!), orbiting and collecting data on Saturn and its moons since 2004, Cassini-Huygens is one of the most successful and accomplished missions done to date by humankind. In addition to the orbits of Saturn and moons spacecraft Huygens was the first human craft to land on another planet's moon – Titan, giving more data to consider this moon as potentially harboring life (that is, life as we do not know it since the atmosphere is hydrocarbons and has liquid methane oceans). Enceladus, another of the 53 recognized moons of Saturn (with 9 provisional moons), is a frozen world on the surface with liquid water underneath and at its south pole ejecting some H<sub>2</sub>O into space (contributing somewhat to a ring) – another candidate for life in our solar system.

*Earth as seen through Saturn's rings. Photo credit: NASA/JPL*

Cassini has flown through Saturn's beautiful rings giving us magnificent close-ups, my favorite being this image showing distant Earth (8.5 AU away) between two rings (APOD 22 April 2017 – Between the Rings).

A list of Cassini's accomplishments would be quite long but one of the more important is that this was a joint effort between NASA and ESA, the European Space Agency (with some help from the Italian Space Agency). With our seemingly endlessly fracturing world (at least it seems that way on 24/7 news outlets), it is reassuring and comforting that we can all unite behind science and engineering for the exploration of our universe and knowledge acquisition.

The image from Saturn's Rings of Earth (and a small moon) is quite a "selfie" and at once reassuring of our capabilities while also demonstrating the stark reality of the only world we are aware of that contains life - floating in a dark vastness.



## SFAA PRESIDENT'S NOTE (cont.)

Let's work (and hope) that such cooperation that produced Cassini (and many others) will extend to the rest of humankind's relations. In the meantime we can all sense the wonder and accomplishments of Cassini and give it a heartfelt salute to the work it has done.

For additional information on the Cassini mission, please visit these sites:

APOD – Between the Rings

<https://apod.nasa.gov/apod/ap170422.html>

Cassini

[https://www.nasa.gov/mission\\_pages/cassini/main/index.html](https://www.nasa.gov/mission_pages/cassini/main/index.html)

Dark, clear and stable skies,

**Michael Patrick**  
President, SFAA

### **SFAA Board Officers and Directors:**

President	Michael Patrick	<a href="mailto:president@sfaa-astronomy.org">president@sfaa-astronomy.org</a>
Vice President	Liz Triggs	<a href="mailto:vice-president@sfaa-astronomy.org">vice-president@sfaa-astronomy.org</a>
Treasurer	Michael Patrick	<a href="mailto:treasurer@sfaa-astronomy.org">treasurer@sfaa-astronomy.org</a>
Secretary	Anthony Barreiro	<a href="mailto:secretary@sfaa-astronomy.org">secretary@sfaa-astronomy.org</a>
Directors:	PJ Cabrera, Anil Chopra, Brian Kruse, Matthew Jones, Jessica Miller, Scott Miller, Douglas Smith, Paul Salazar	

### **\*\*\* Mark Your Calendars \*\*\***

**Quarterly in-person SFAA Board Meetings – all SFAA members are welcome to attend:**

**Tuesday November 14, 7:00 pm – 8:45 pm**

SF Public Library: Presidio Branch Meeting Room / 3150 Sacramento Street, San Francisco

Come join us to learn what's going on with upcoming club events such as: public outreach, star viewing trips, scientific lectures, telescope making, members-only dark sky viewing nights, opportunities to participate in Astronomy, and much more.

### **\*\*\* Call For Design Submissions \*\*\***

**Calling all Designers! The SFAA Board is excited to announce that we are looking to create SFAA Hoodies; the exact item that all well-dressed night sky watchers need!**

**Three simple steps:**

- 1. Think up a great design idea**
- 2. Draw it**
- 3. Submit it to [president@sfaa-astronomy.org](mailto:president@sfaa-astronomy.org)**

**Got more than 1 idea? Fantastic! Repeat steps 1 – 3.**

**Your design might be the winner. What are you waiting for? The sky's the limit!**

## 02. ASTRONOMY EVENTS



### SAN FRANCISCO AMATEUR ASTRONOMERS EVENTS SEPTEMBER 16, 2017 – NOVEMBER 18, 2017

Details at: <http://www.sfaa-astronomy.org>

**Saturday, September 16, 6:30 pm – 2:00 am**  
Mt. Tam Members Night

**Tuesday, September 19, 7:30 pm – 9:15 pm**  
Meeting and Lecture,

**\*\* Please note venue change for this date only: OBSERVATION POST \*\***

**Saturday, September 23, 6:30 pm – 11:00 pm**  
Mt. Tam Public Astronomy Night: Lecture and Star Party  
Mountain Theater and Rock Springs Parking Lot

**Thursday, September 28, 8:00 pm – 11:00 pm**  
City Star Party, Presidio Main Parade Ground

**Tuesday, October 17, 7:30 pm – 9:15 pm**  
Meeting and Lecture, Presidio Officers Club

**Saturday, October 21, 6:00 pm – 2:00 am**  
Mt. Tam Members Night

**Saturday, October 28, 6:30 pm – 11:00 pm**  
Mt. Tam Public Astronomy Night: Lecture and Star Party  
Mountain Theater and Rock Springs Parking Lot

**Sunday, October 29, 7:00 pm – 10:00 pm**  
City Star Party, Pier 17, Adjacent to Exploratorium

**Saturday, November 11, 7:30 pm – 10:30 pm**  
City Star Party, Presidio Main Parade Ground

**Tuesday, November 14, 7:00 pm – 8:45 pm**  
SF Public Library: Presidio Branch Meeting Room / 3150 Sacramento Street, San Francisco  
Quarterly in-person SFAA Board Meeting – All SFAA Members are welcome to attend

**Saturday, November 18, 5:00 pm – 2:00 am**  
Mt. Tam Members Night

\* \* \* \* \*  
**GET REAL, LIVE HELP  
WITH YOUR TELESCOPE!**  
\* \* \* \* \*

Are you a new telescope owner?  
Or perhaps you could use some  
help with alignment, collimation  
or other adjustments?  
Collimating a reflector, like  
playing guitar or dancing the  
tango, can, with great effort, be  
learned from reading, but it is  
much easier and more enjoyable  
to learn hands-on from  
somebody who already knows  
how to do it.

Bring your telescope to a Star  
Party – we'll be happy to help!

### BAY AREA ASTRONOMY EVENTS

Each month, long-time SFAA member Kenneth Lum assembles and sends out a list of Bay Area Astronomy events.

As each month unfolds, check the following link for information regarding additional events:

<http://tech.groups.yahoo.com/group/bayastro/?v=1&t=directory&ch=web&pub=groups&sec=dir&slk=94>

# 03.

## **SFAA NEEDS YOU: VOLUNTEER OPPORTUNITIES | ANTHONY BARREIRO**

### **Volunteers Needed for SFAA Star Parties**

Throughout the year SFAA provides two or three star parties a month. Every month of the year we do a City Star Party at various locations in San Francisco and a members night on Mount Tamalpais. From April through October, in collaboration with Mt. Tam State Park, the Friends of Mt. Tam, and Wonderfest, SFAA provides telescope observing as part of the monthly public astronomy program. That's a total of 31 star parties a year! We need a couple of experienced SFAA members to serve as contact people for each of these events. If you've been to at least a few star parties, you're familiar with the procedures, and you're able to commit to attending a specific star party, we need your help.

Star party contact persons check the weather forecast during the days before a star party, keep in touch with the other contact person, and make a decision whether or not to cancel the event because of rain, or because of high fire danger on Mt. Tam. On the day of the star party, contact people arrive early, welcome and orient members, and hold a brief huddle for all the telescope operators to review procedures and answer questions. On Mount Tamalpais contact people make sure that every vehicle belongs to an SFAA member and has a parking pass. For the Mt. Tam public astronomy program, SFAA contact people coordinate with the Friends of Mount Tam volunteers who manage the visitor parking area. Contact people always have plenty of time to set up and use their own equipment and to enjoy the star party. At the end of the night on Mt. Tam, the contact persons need to make sure members know to lock the gate behind them on the way out.

A small number of SFAA members have been serving as contact people for all our star parties. It would be great to have a larger pool of volunteers, so that we could all take turns. If you sign up you will receive one email a month asking people to volunteer for upcoming star parties.

If you're willing to help out, or if you have questions, please contact Anthony Barreiro at [secretary@sfaa-astronomy.org](mailto:secretary@sfaa-astronomy.org).

### **Snack Volunteers Needed**

SFAA also needs members to volunteer to bring **light refreshments** to our monthly **meetings and lectures** at the Presidio Officers Club, on the **Third Tuesday of Each Month**. Refreshments help to create a welcoming, sociable atmosphere for members and guests. If a few members each bring something, there's less burden on any one member, and we'll have a good variety of snacks and beverages. You may donate snack items or simply provide receipts to be reimbursed for your expenses, and your fellow members will be grateful to you! If you can bring refreshments, please send an email to Linda Mahan, [speakerchair@sfaa-astronomy.org](mailto:speakerchair@sfaa-astronomy.org)

Let Linda know which month or months you can help with, and what you would like to bring.

### **Ongoing Opportunities to Participate in our SFAA Club**

SFAA is also looking for volunteers to help in these areas:

- **Star Parties** – both on Mt. Tam and for City Star Parties
- **Marketing** – we can use help posting SFAA event updates to SFGate, SF FunCheap, Eventful, Bay Area Science, etc.
- **Above The Fog** – submit an occasional article, astrophoto and/or serve as a member of the editorial team.

Please send an email to Michael Patrick at [president@sfaa-astronomy.org](mailto:president@sfaa-astronomy.org) if you're interested.

**On behalf of the board of directors and your fellow SFAA members, thank you for your willingness to help out!**

# 04.

## SFAA EXPEDITION 2017: TOTAL SOLAR ECLIPSE TRIP SUMMARY | PAUL SALAZAR

A group of about 35 SFAA members and family and friends traveled to Jackson Hole, Wyoming to view the August 21st total solar eclipse. The group stayed in Teton Village at the base of the Jackson Hole ski area and traveled by tram with 800 spectators on eclipse morning to the top of Rendezvous Mountain at 10,450 feet elevation. The conditions were crystal clear and the high altitude removed about 20% of the atmosphere so viewing was at its best.

The warm morning was broken by first contact of the lunar disk and over the course of an hour and fifteen minutes the temperature dropped dramatically and the approaching darkness swept in like a curtain, enveloping the Teton Mountains, Jackson Valley, and everything we could see for many miles. Venus appeared shortly before totality and when the first diamond ring appeared, a cheer sounded across the mountaintop followed by oohs and aahs from the many who witnessed this spectacle from such a magnificent perch.

Totality was marked by a very fine grained and broad corona and significant prominences, particularly on the western limb of the sun. Regulus was visible in the outer wisps of the corona and although it was challenging to see any shadow bands on the uneven surface of the mountain ridge, many who were below in Jackson Hole reported clear visibility of the bands. The 2 minutes and 21 seconds were gone in an instant and the second diamond ring welcomed back, all too soon, the warm sun and the comfortable afternoon that followed.

While in Teton Village we held one star party and had an afternoon of lectures including a guest appearance by author David Baron who wrote *The American Eclipse* and spoke about the last eclipse to cross over Wyoming in 1878, a fascinating talk. We got to know Amy from the east bay who was capturing the event to be part of the Google Megamovie. The SFAA members made some new friends and had a very nice time exploring the region and enjoying the incredible time in totality.

The group shared photos on a Slack Group channel and several are included here for your enjoyment.



*Photo credits: Michael Patrick, Allison Broennimann*

*Left: The Grand Tetons prior to the eclipse. Note the smoke from wild fires in the upper left sky. Michael Patrick  
Right: Group shot, Allison Broennimann*

## TOTAL SOLAR ECLIPSE TRIP PHOTOS (cont.)



*Photo credits: Paul Salazar*

*Left: View from the top of the tram—note the temperature!*

*Middle left: View to the South from the top of the tram  
Middle right: View to the West from the top of the tram*

*Photo credits: Allison Broennimann*

*Bottom left: Time for the SFAA tram up the mountain. There were so many people there and the trams were sold out for a year, so they had waiting areas for trams going up the mountain. All Aboard!*

*Bottom right: Getting set up*



## TOTAL SOLAR ECLIPSE TRIP PHOTOS (cont.)

Photo credits: Sandra Evans

Left: Eclipse day group getting ready!

Right: Bob and Clarissa eclipse day



Photo credits: Agnes Pyrchla

Left: Looking for Venus

Right: Paul at the telescope





## TOTAL SOLAR ECLIPSE TRIP PHOTOS (cont.)

Photo credits: Agnes Pырchla

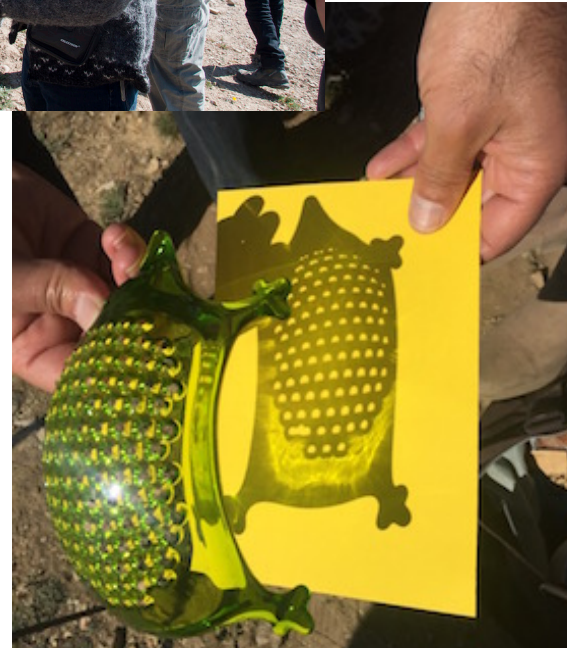
Top left: Celebration!

Top right: Margo at the Sunspotter.

Middle: Anthony with a pinhole viewer.

Bottom left: Anthony with a pinhole view of the partial eclipse

Bottom right: Cheese grater eclipses during the partial eclipse



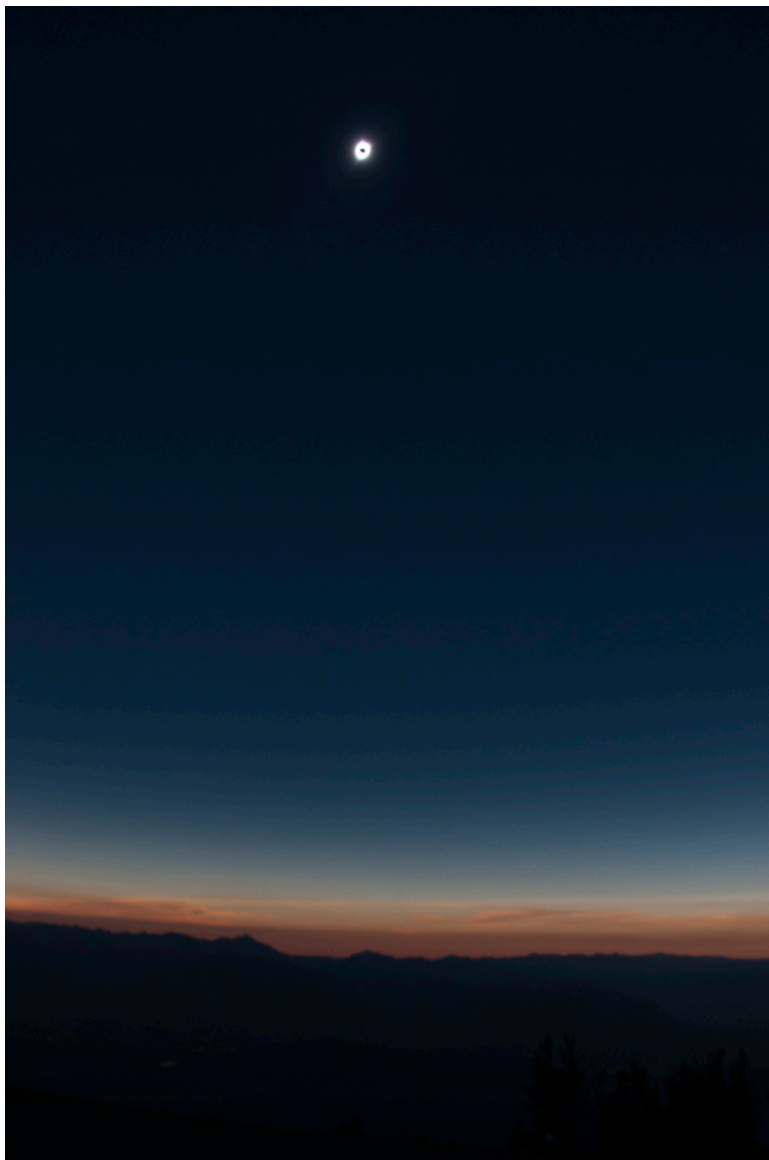
## TOTAL SOLAR ECLIPSE TRIP PHOTOS (cont.)

Photo credits: Agnes Pyrchla

Top left: Eclipse 2017 Astronomers

Top right: Eclipse 2017: Astronomers stake out a good viewing spot early and wait for the Totality

Bottom: Eclipse 2017 Totality!



\* \* \* \* \*

### SFAA SHOUT OUT TO PAUL SALAZAR

\* \* \* \* \*

Dedicated eclipse-chaser and SFAA Board Member Paul Salazar began planning SFAA's Wyoming eclipse trip over two years ago.

Paul arranged for a block of rooms at the lovely Alpenhof Lodge in Teton Village far enough in advance to get us a group discount.

Paul made an advance reconnaissance trip to Jackson Hole at his own expense, during which he talked the aerial tram operator into scheduling early runs to the summit on eclipse day, so that our party and other umbraphiles could get to the summit well before the beginning of the eclipse.

Before, during, and after the trip Paul actively communicated with everyone involved, coordinated and fine-tuned our plans, and solved problems large and small.

Thanks Paul!

## TOTAL SOLAR ECLIPSE TRIP PHOTOS (cont.)

*Photo credits: Moshen  
Chan*

*Top: Eclipse 2017 Totality*

*Bottom: Eclipse 2017  
Totality with great view of  
the prominences*



# 05.

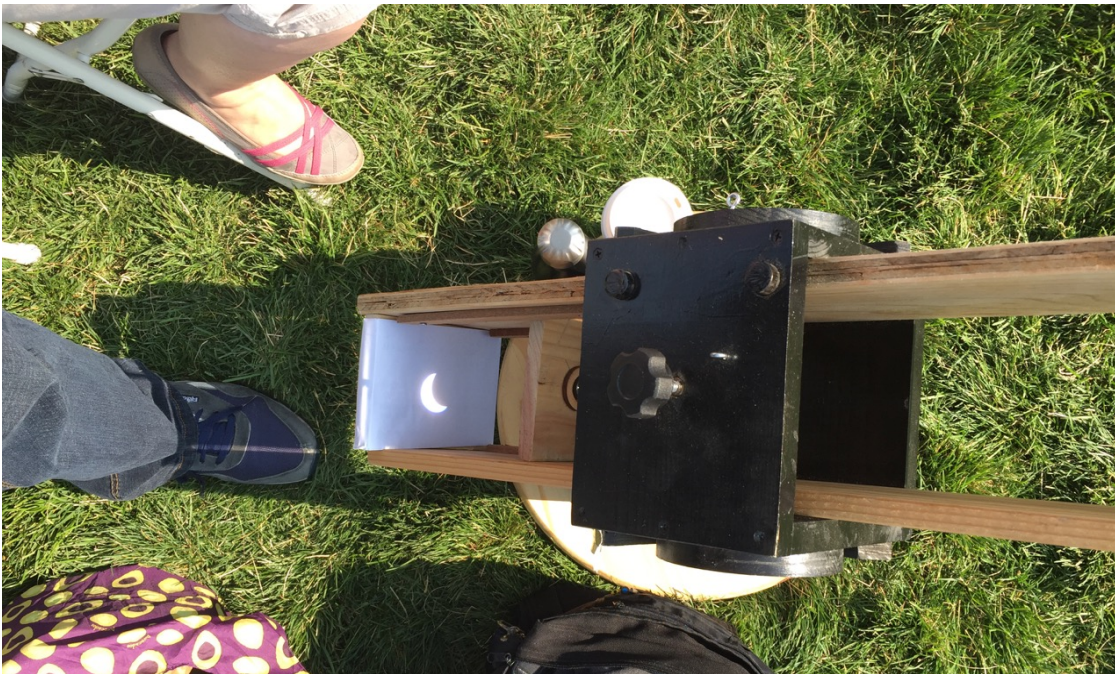
## TOTAL SOLAR ECLIPSE 2017: THE VIEW FROM OREGON | MITCHELL SCHOENBRUN

Here are two pictures from Oregon, a “selfie” with my wife and two friends, and a shot of my projection scope during partial.



*Photo credits:  
Mitchell  
Schoenbrun*

*Top: Eclipse  
2017 group  
“selfie”.  
Pictured left to  
right: my two  
college friends  
Syliva Mahaffey,  
Janet Hoffman,  
and then my  
wife Elva Granat  
followed by me.*



*Bottom:  
Projection  
scope image  
during partial.  
Look at that  
image clarity!*

I also put a video on YouTube here: <https://youtu.be/-DU4qMGKCsI>

*(Editor’s Note: The video is great – it’s awesome to hear the crowd and Mitchell’s reaction, too. I watched it twice – watch for the great view of Venus. Enjoy!)*

# 06.

## TOTAL SOLAR ECLIPSE 2017: THE VIEW FROM MARIN | MICHAEL PATRICK

Here are a few pictures from the San Rafael Public Library in Marin and part of the 300+ people who showed up to see the partial eclipse,



*Photo credits: Michael Patrick*

*Top: Eclipse 2017 at the San Rafael Public Library. People are waiting in line for Eclipse Glasses.*

*Bottom photos: Partial eclipse through slightly overcast skies.*



# 07.

## WHAT TO DO WITH THOSE ECLIPSE GLASSES | P.J. CABRERA

Give your eclipse glasses a second chance! Astronomers Without Borders (AWB) and Explore Scientific are collecting glasses to be sent to schools in South America and Asia when eclipses cross those continents in 2019.

If you have glasses you want to donate, please send them to the Explore Scientific address below. Explore Scientific, AWB's corporate partner in this program, is making this possible by receiving, processing, and storing them. Astronomers Without Borders will then distribute them to schools in the months prior to the 2019 partial, annular and total eclipses.

Please send eclipse glasses to:

**AWB Eclipse Glasses Donation Program**  
Explore Scientific  
1010 S. 48th Street  
Springdale, AR 72762



Cartoon re-printed with permission of Dan Pegoda. Thanks, Dan!

08.

\* \* \* \* \*  
**MEETING VENUE CHANGE: SEPTEMBER 19<sup>th</sup> ONLY!**

\* \* \* \* \*  
The September 19<sup>th</sup> lecture will be held at our previous location, at the OBSERVATION POST, 211 Lincoln Blvd in the Presidio.  
Doors open at 7:00 pm; Meeting starts at 7:30 pm. See you there!

**SEPTEMBER 19<sup>TH</sup> LECTURE | NATALIE BATALHA, PH.D.  
SPACE SCIENCES, NASA**

**\*\* SEPTEMBER 19th ONLY \*\*: PRESIDIO OBSERVATION POST, BUILDING 211 \*\***  
211 Lincoln Blvd, San Francisco  
7:00 pm Doors Open & Light Refreshments | 7:30 pm Club Announcements | 7:45 pm Speaker  
SFAA'S GENERAL MEETINGS OCCUR ON THE 3<sup>RD</sup> TUESDAY OF EACH MONTH (EXCEPT JANUARY)



**“A PLANET FOR GOLDILOCKS:  
NASA'S SEARCH FOR LIFE  
BEYOND THE SOLAR SYSTEM”**

**NATALIE BATALHA, PH. D.  
NASA AMES RESEARCH CENTER**

"Not too hot, not too cold" reads the prescription for a world that's just right for life as we know it. Finding evidence of life beyond Earth is one of the primary goals of science agencies in the United States and abroad. The goal looms closer as a result of discoveries made by NASA's Kepler Mission. Launched in March 2009, Kepler is exploring the diversity of planets and planetary systems orbiting other stars in the galaxy. Finding inhabited environments is a path of exploration that stretches decades into the future. It begins by determining if Goldilocks planets abound. Dr. Batalha will describe the latest discoveries of NASA's Kepler Mission and the possibilities for finding inhabited environments in the not-so-distant future.

**Brief Bio**

*Dr Natalie Batalha is a world-renowned research astronomer in the Space Sciences Division of NASA Ames Research Center and as a Kepler Mission Scientist. She has been involved since the Kepler proposal stage and has contributed to its many different scientific aspects, from studying the stars themselves to detecting and understanding the planets they harbor.*

*Dr. Batalha started her career as a stellar spectroscopist studying young, sun-like stars. She holds a doctorate in Astrophysics from UC Santa Cruz, and completed a post-doctoral fellowship in Rio de Janeiro, Brazil.*

# 09.

## UPCOMING SFAA LECTURES 2017

**THE PRESIDIO . PRESIDIO OFFICERS' CLUB, BUILDING 50 . MORAGA HALL**

50 Moraga Avenue, San Francisco

7:00 pm Doors Open & Light Refreshments | 7:30 pm Club Announcements | 7:45 pm Speaker

SFAA'S GENERAL MEETINGS OCCUR ON THE 3<sup>RD</sup> TUESDAY OF EACH MONTH (EXCEPT JANUARY)

**OCTOBER 17TH | TOM ABEL, KAVLI INSTITUTE. DIRECTOR OF KIPAC, STANFORD**



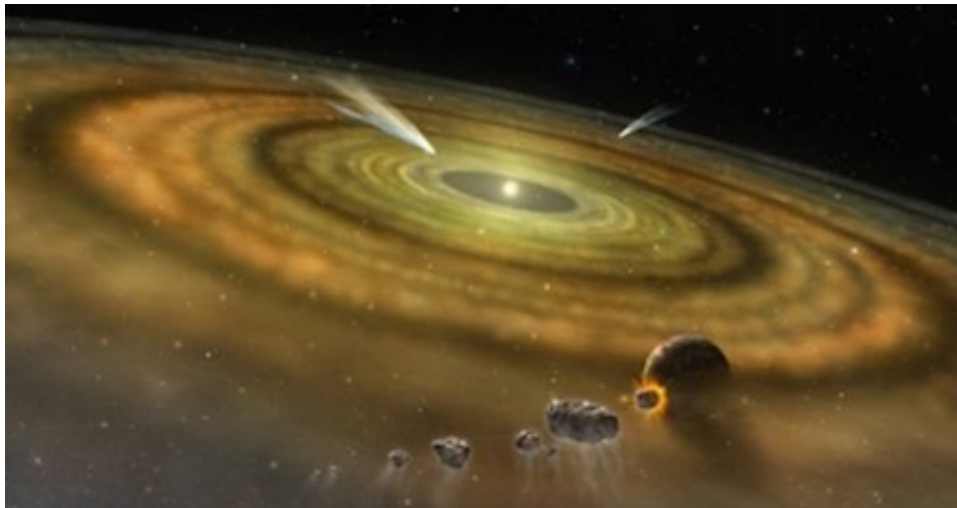
### "HOW THE FIRST THINGS IN THE UNIVERSE CAME ABOUT, AND HOW THEY ENDED UP WITHIN US"

Join us for a fascinating journey through the early universe using the latest computer animations of early star formation, supernova explosions and the build-up of the first galaxies. Dr. Abel's work has shown that the first luminous objects in the universe were very massive stars shining one million times as brightly as our Sun. They died quickly and seeded the cosmos with the chemical elements necessary for life.

One star at a time, galaxies started to assemble just one hundred million years after the Big Bang, and they are still growing now. Computer simulations of these events use the physics of dark matter, of ordinary atoms and molecules, and of expanding space to deliver remarkable insights into the early history of the cosmos.

**NOTE: NOVEMBER LECTURE DATE IS CANCELLED DUE TO THANKSGIVING HOLIDAY**

**DECEMBER 19TH | BARRY WELSH, UC BERKELEY SSL**



### "EXOCOMETES: NOW YOU SEE THEM, NOW YOU DON'T"

Using high-resolution spectrographs mounted on large aperture ground based telescopes, we have discovered 15 young stars that harbor swarms of exocomets. This lecture will describe attributes of comets in our solar system, and observing techniques to detect evaporating exocomets around young stars. The relevance of Kepler's discovery of "Tabby's Star" will also be discussed.



## CASSINI SPACECRAFT MAKES ITS FINAL APPROACH TO SATURN



*This illustration shows Cassini above Saturn's northern hemisphere prior to making one of its Grand Finale dives.*

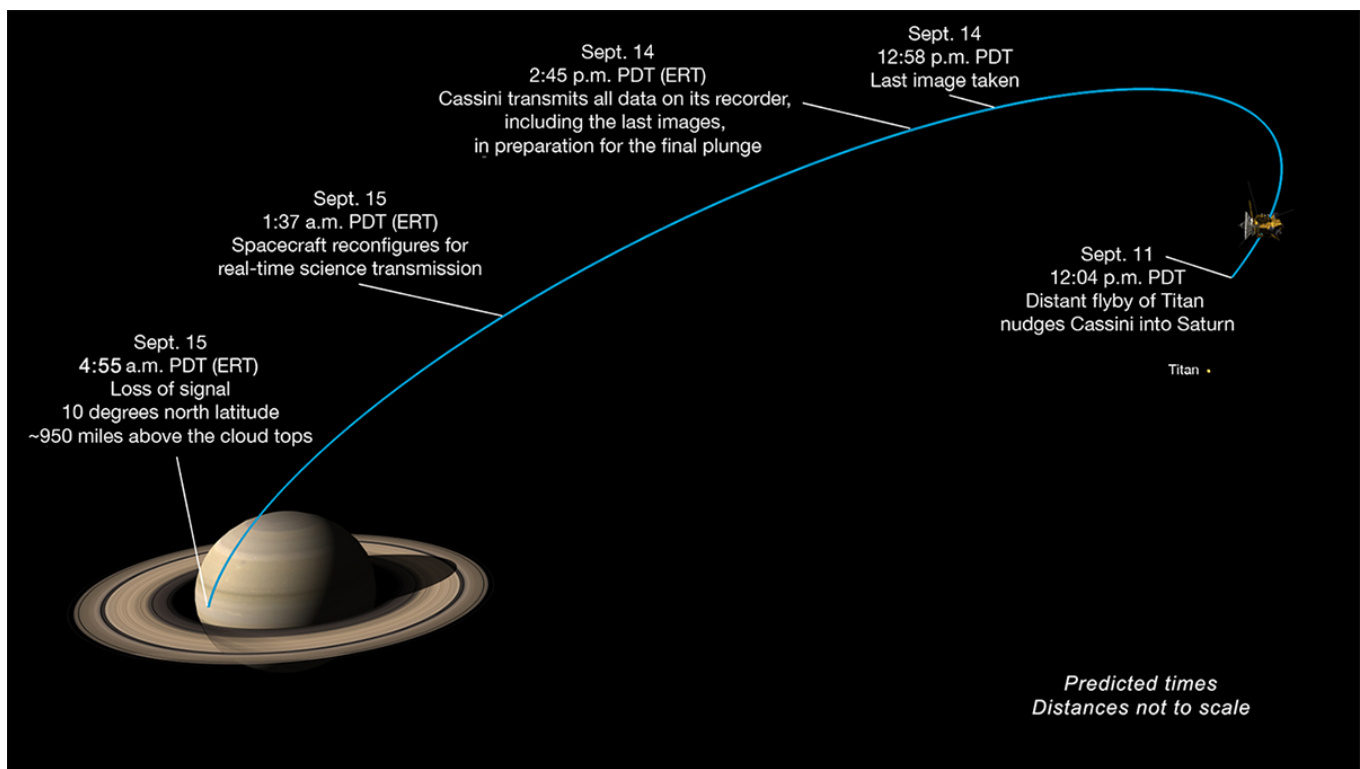
*During Cassini's Grand Finale, the spacecraft will make 22 orbits around Saturn that carry the spacecraft over the planet's north before diving between Saturn and its rings. At the conclusion of this final set of daring orbits, the spacecraft will plunge into Saturn's atmosphere, ending its mission on Sept. 15, 2017.*

*The Cassini mission is a cooperative project of NASA, ESA (the European Space Agency) and the Italian Space Agency. The Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena, manages the mission for NASA's Science Mission Directorate, Washington. [Image Credit: NASA/JPL](#)*

NASA's Cassini spacecraft is on final approach to Saturn, following confirmation by mission navigators that it is on course to dive into the planet's atmosphere on Friday, Sept. 15.

Cassini is ending its 13-year tour of the Saturn system with an intentional plunge into the planet to ensure Saturn's moons - in particular Enceladus, with its subsurface ocean and signs of hydrothermal activity - remain pristine for future exploration. The spacecraft's fateful dive is the final beat in the mission's Grand Finale, 22 weekly dives, which began in late April, through the gap between Saturn and its rings. No spacecraft has ever ventured so close to the planet before.

The mission's final calculations predict loss of contact with the Cassini spacecraft will take place on Sept. 15 at 7:55 a.m. EDT (4:55 a.m. PDT). Cassini will enter Saturn's atmosphere approximately one minute earlier, at an altitude of about 1,190 miles (1,915 kilometers) above the planet's estimated cloud tops (the altitude where the air pressure is 1-bar, equivalent to sea level on Earth). During its dive into the atmosphere, the spacecraft's speed will be approximately 70,000 miles (113,000 kilometers) per hour. The final plunge will take place on the day side of Saturn, near local noon, with the spacecraft entering the atmosphere around 10 degrees north latitude.



*Milestones in Cassini's final dive toward Saturn. Image Credit: NASA/JPL-Caltech*

When Cassini first begins to encounter Saturn's atmosphere, the spacecraft's attitude control thrusters will begin firing in short bursts to work against the thin gas and keep Cassini's saucer-shaped high-gain antenna pointed at Earth to relay the mission's precious final data. As the atmosphere thickens, the thrusters will be forced to ramp up their activity, going from 10 percent of their capacity to 100 percent in the span of about a minute. Once they are firing at full capacity, the thrusters can do no more to keep Cassini stably pointed, and the spacecraft will begin to tumble.

When the antenna points just a few fractions of a degree away from Earth, communications will be severed permanently. The predicted altitude for loss of signal is approximately 930 miles (1,500 kilometers) above Saturn's cloud tops. From that point, the spacecraft will begin to burn up like a meteor. Within about 30 seconds following loss of signal, the spacecraft will begin to come apart; within a couple of minutes, all remnants of the spacecraft are expected to be completely consumed in the atmosphere of Saturn.

Due to the travel time for radio signals from Saturn, which changes as both Earth and the ringed planet travel around the Sun, events currently take place there 83 minutes before they are observed on Earth. This means that, although the spacecraft will begin to tumble and go out of communication at 6:31 a.m. EDT (3:31 a.m. PDT) at Saturn, the signal from that event will not be received at Earth until 83 minutes later.

"The spacecraft's final signal will be like an echo. It will radiate across the solar system for nearly an hour and a half after Cassini itself has gone," said Earl Maize, Cassini project manager at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California. "Even though we'll know that, at Saturn, Cassini has already met its fate, its mission isn't truly over for us on Earth as long as we're still receiving its signal."

Cassini's last transmissions will be received by antennas at NASA's Deep Space Network complex in Canberra, Australia.

Cassini is set to make groundbreaking scientific observations of Saturn, using eight of its 12 science instruments. All of the mission's magnetosphere and plasma science instruments, plus the

spacecraft's radio science system, and its infrared and ultraviolet spectrometers will collect data during the final plunge.

Chief among the observations being made as Cassini dives into Saturn are those of the Ion and Neutral Mass Spectrometer (INMS). The instrument will directly sample the composition and structure of the atmosphere, which cannot be done from orbit. The spacecraft will be oriented so that INMS is pointed in the direction of motion, to allow it the best possible access to oncoming atmospheric gases.

For the next couple of days, as Saturn looms ever larger, Cassini expects to take a last look around the Saturn system, snapping a few final images of the planet, features in its rings, and the moons Enceladus and Titan. The final set of views from Cassini's imaging cameras is scheduled to be taken and transmitted to Earth on Thursday, Sept. 14. If all goes as planned, images will be posted to the Cassini mission website beginning around 11 p.m. EDT (8 p.m. PDT). The unprocessed images will be available at: <https://saturn.jpl.nasa.gov/galleries/raw-images>

Live mission commentary and video from JPL Mission Control will air on NASA Television from 7 to 8:30 a.m. EDT (4 a.m. to 5:30 a.m. PDT) on Sept. 15. A post-mission news briefing from JPL is currently scheduled for 9:30 a.m. EDT (6:30 a.m. PDT), also on NASA TV.

NASA TV is available online at: <https://www.nasa.gov/live>

A new NASA e-book, The Saturn System Through the Eyes of Cassini, showcasing compelling images and key science discoveries from the mission, is available for free download in multiple formats at: <https://www.nasa.gov/ebooks>

An online toolkit of information and resources about Cassini's Grand Finale and final plunge into Saturn is available at: <https://saturn.jpl.nasa.gov/grandfinale>

Follow the Cassini spacecraft's plunge on social media using #GrandFinale, or visit:

<https://twitter.com/CassiniSaturn>

<https://www.facebook.com/NASACassini>

The Cassini-Huygens mission is a cooperative project of NASA, ESA (European Space Agency) and the Italian Space Agency. JPL, a division of Caltech in Pasadena, manages the mission for NASA's Science Mission Directorate, Washington. JPL designed, developed and assembled the Cassini orbiter.

More information about Cassini:

<https://www.nasa.gov/cassini>

<https://saturn.jpl.nasa.gov>

Updated at 1:30 p.m. PDT on Sept. 13, 2017 to correct travel time for a signal from Cassini to Earth from 86 minutes to 83 minutes.

#### **News Media Contact**

Dwayne Brown / Laurie Cantillo

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# Cassini — The Grand Finale

With help from the public, members of NASA's Cassini mission to Saturn have chosen to call the spacecraft's final orbits the *Grand Finale*.

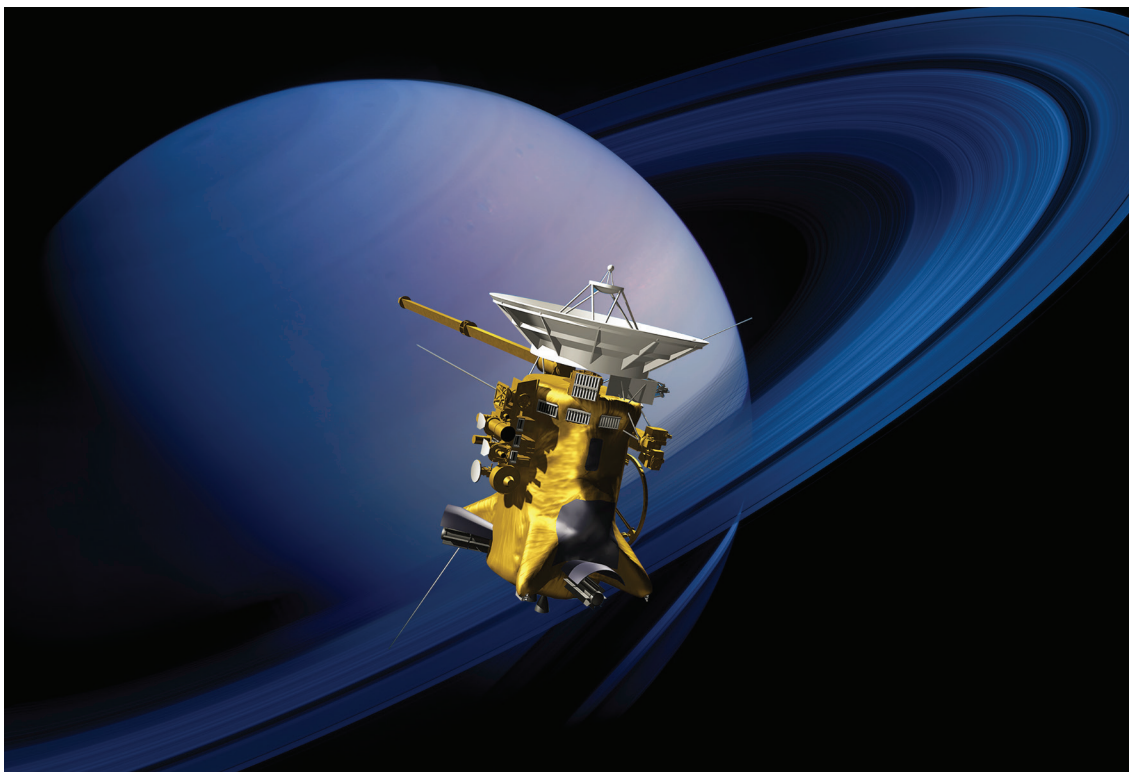
In late 2016, the Cassini spacecraft will begin a daring set of orbits that is, in some ways, like a whole new mission. The spacecraft will repeatedly climb high above Saturn's poles, flying just outside its narrow F ring. Cassini will probe the water-rich plume of the active geysers on the planet's intriguing moon Enceladus, and then will hop the rings and dive between the planet and its innermost ring 22 times.

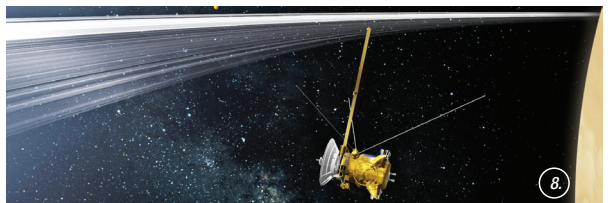
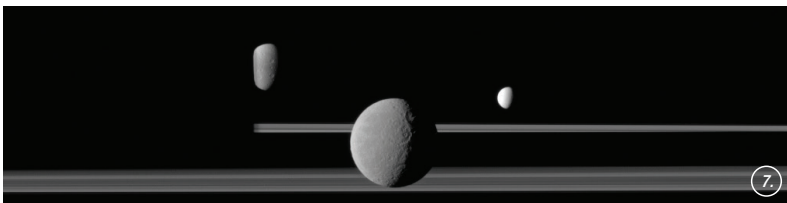
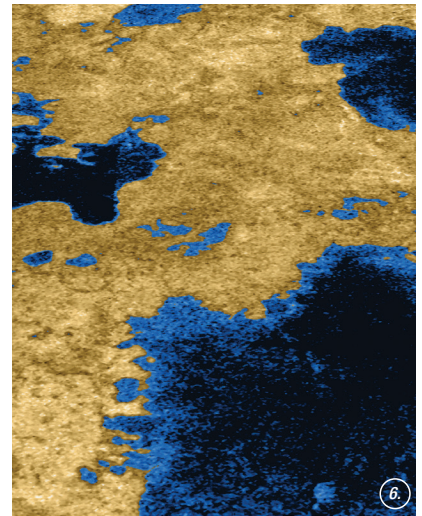
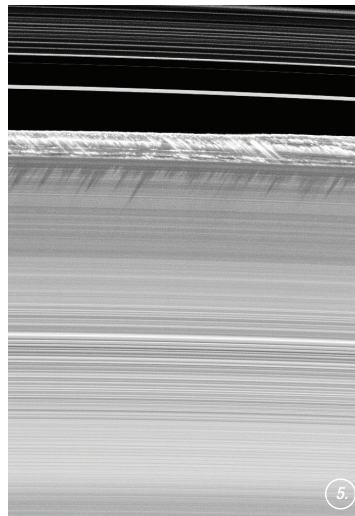
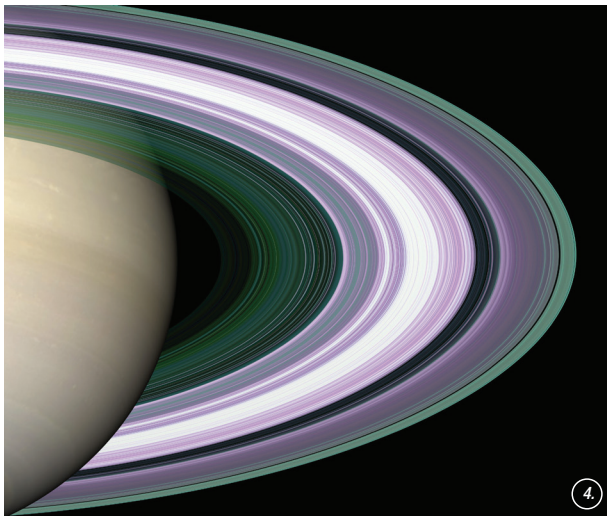
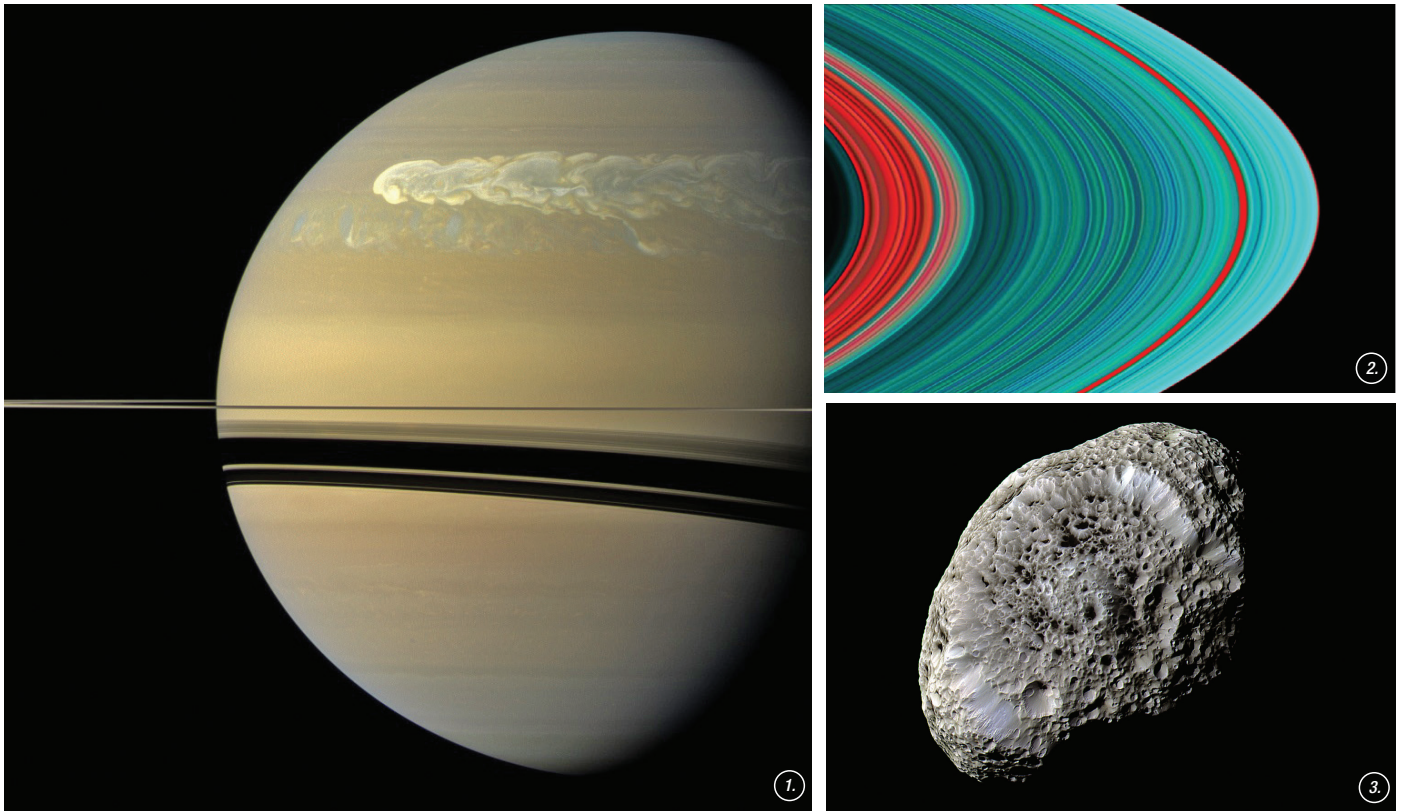
As Cassini plunges past Saturn, the spacecraft will collect some incredibly rich and valuable information that the mission's original planners might never have imagined. The spacecraft will make detailed maps of Saturn's gravity and magnetic fields, revealing how the planet is composed on the inside, and possibly helping to solve the irksome mystery of just how fast

the interior is rotating. It will vastly improve our knowledge of how much material is in the rings, bringing us closer to understanding their origins. Cassini's particle detectors will sample icy ring particles being funneled into the atmosphere by Saturn's magnetic field. And its cameras will take amazing, ultra-close images of Saturn's rings and clouds.

No other mission has explored this unique region so close to the planet. What we learn from these activities will help to improve our understanding of how giant planets — and families of planets everywhere — form and evolve. At the end of its final orbit, as Cassini falls into Saturn's atmosphere, it completes its 20-year mission by ensuring that the biologically interesting worlds Enceladus and Titan could never be contaminated by hardy microbes that might have stowed away and survived the journey intact. It's inspiring, adventurous and romantic — a fitting end to this thrilling story of discovery.

**NASAfacts**





1. This huge northern hemisphere storm wrapped around the entire planet.

2. This view of Saturn's rings in the ultraviolet indicates there is more ice toward the outer part of the rings.

3. Cassini captured this false-color view of the tiny moon Hyperion in 2005. The color differences may indicate differences in surface material composition.

4. Color was used in this simulated image to represent information about ring particle sizes based on measurements of three radio signals sent to Earth by Cassini.

5. Vertical structures rise from the edge of the B ring, perhaps formed as moonlets disturb the ring particles streaming nearby.

6. Radar imaging data from Cassini indicate the presence of large bodies of liquid on Titan's surface.

7. Three of Saturn's moons are seen against the darkened nightside of the planet. Dione (at left) is partly obscured by Saturn.

8. The final part of Cassini's mission — the Grand Finale — will take the spacecraft to previously unexplored regions of the Saturn system.

## Mission Science Objectives

**Saturn** — cloud properties and atmospheric composition; winds and temperatures; internal structure and rotation; ionosphere; origin and evolution

**Rings** — Structure and composition; dynamical processes; interrelation of rings and satellites; dust and micrometeoroid environment

**Titan** — Atmospheric constituent abundances; distribution of trace gases and aerosols; winds and temperatures; surface state and composition; upper atmosphere

**Icy Satellites** — Characteristics and geological histories; mechanisms of surface modification; surface composition and distribution; bulk composition and internal structure; interaction with magnetosphere

**Magnetosphere** — Configuration and current systems; particle composition, sources and sinks; dynamics of the magnetosphere; interaction with solar wind, satellites and rings; Titan's interaction with solar wind and magnetosphere

## A Decade of Discoveries

As of its 10th anniversary in Saturn orbit, July 2014, the stalwart spacecraft has beamed back to Earth more than 500 gigabytes of scientific data through NASA's Deep Space Network, enabling the publication of more than 3,000 scientific papers. Cassini has completed more than 200 orbits of Saturn, carried out 132 close flybys of Saturn's moons and discovered seven new moons.

Representing just a sampling, 10 of Cassini's top accomplishments and discoveries are:

- The European Space Agency's Huygens probe, carried to the Saturn system aboard the Cassini orbiter, parachutes to Titan, making the first landing on a moon in the outer solar system.
- Cassini discovers active, icy plumes spraying from "tiger stripe" fractures on Saturn's moon Enceladus.
- Saturn's rings are found to be active and dynamic — a laboratory for how planets or moons form.
- Titan, Saturn's largest moon, is revealed to have rain, rivers, lakes and seas; it is shrouded in a thick, nitrogen-rich atmosphere that might be similar to what Earth's was like long ago.

## Mission Timeline

1997

The orbiter, the largest interplanetary spacecraft ever constructed by NASA, launches on October 15 (EDT) from Cape Canaveral Air Force Station in Florida, with the European Space Agency's Huygens probe aboard.

1997 – 2004

Seven-year cruise to Saturn on a gravity-assist trajectory: two swingbys of Venus, one of Earth and one of Jupiter to give the spacecraft the boost needed to reach Saturn.

2004

Arrival and orbit insertion on June 30 (PDT). Cassini passes between the F and G rings and allows itself to be captured as a satellite of Saturn.

2005

Released on December 24, 2004, the Huygens probe descends through Titan's atmosphere, lands on Titan and relays data to Earth on January 14, 2005.

2004 – 2008

Cassini's four-year prime mission orbital tour consists of 45 Titan encounters, 10 icy satellite encounters and 76 orbits of Saturn.

2008 – 2010

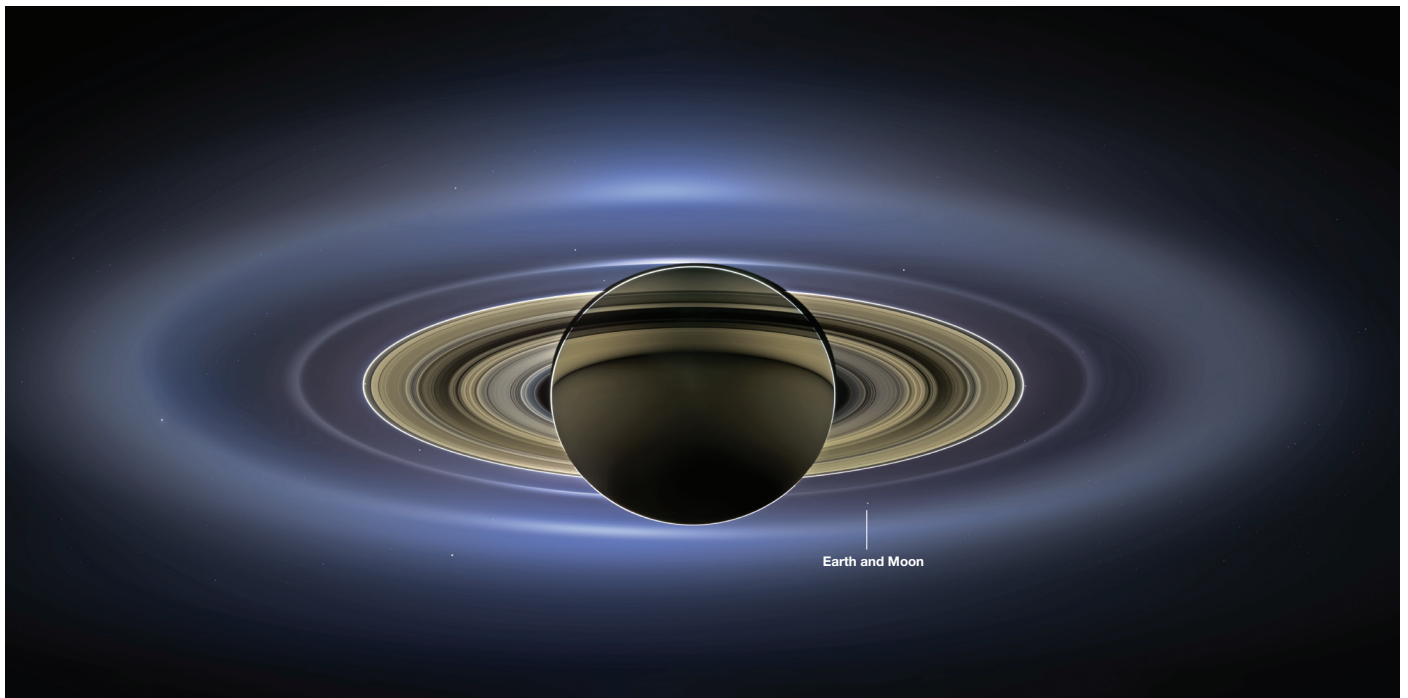
Equinox Mission: two-year mission extension, 64 orbits, 28 Titan encounters, 8 Enceladus encounters, 3 with other smaller icy satellites; equinox crossing in August 2009.

2010 – 2017

Solstice Mission: seven-year mission extension consisting of 155 orbits, 54 Titan encounters, 11 Enceladus encounters, 5 other icy moon encounters; opportunity to observe spring-early summer in northern hemisphere.

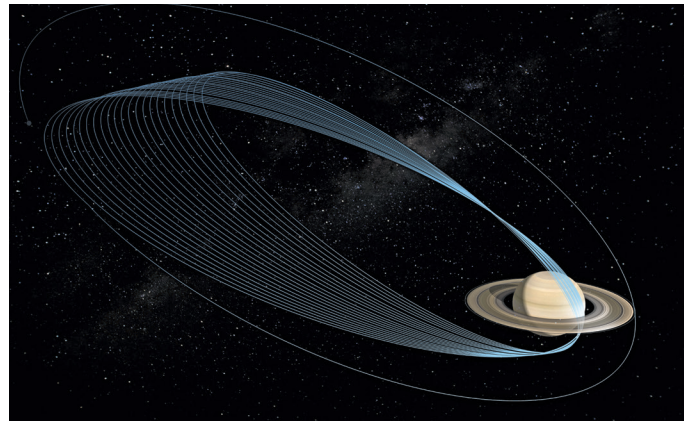
2017

Grand Finale: at the spacecraft's final orbit, it falls into Saturn's atmosphere, ending its extraordinary 20-year mission of discovery.



*With Saturn sheltering Cassini from the sun's glare, the spacecraft captured 141 images to create a panoramic mosaic. Some of Saturn's moons can be discerned in this contrast-enhanced image, as well as the tiny dots of our own planet and its moon.*

- Saturn's great northern storm of 2010–2011, which eventually encircled the entire planet for months, is imaged and characterized.
- Studies reveal radio-wave patterns are not tied to Saturn's interior rotation, as previously thought.
- Vertical structures in the rings are imaged for the first time; they appear to be made up of particles piled up in bumps or ridges more than 2 miles (3 km) high.
- Titan's prebiotic chemistry is studied.
- The mystery of the dual, bright–dark surface of the moon Iapetus is solved — it is thought that one side of the moon's topmost ice layer has sublimated (vaporized), leaving a dark, carbon-rich coating on that side while the ice condensed on the other side, making it appear brighter.
- Cassini captures the first complete view of the north polar hexagon and discovers giant hurricanes at both of Saturn's poles.



*Cassini will end its historic mission with 22 daring loops passing through the gap between Saturn and the innermost ring.*

The Jet Propulsion Laboratory, a division of the California Institute of Technology, manages the Cassini mission for the National Aeronautics and Space Administration (NASA). Cassini is a cooperative mission of NASA, the European Space Agency and the Italian Space Agency, with participation by hundreds of scientists and engineers from Europe and the U.S.

National Aeronautics and Space Administration

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[www.nasa.gov](http://www.nasa.gov)

For more information and images, visit:

[saturn.jpl.nasa.gov](http://saturn.jpl.nasa.gov)



# San Francisco Amateur Astronomers

PO Box 15097  
San Francisco, CA 94115

## Application for New or Renewing Membership

1. Memberships, with dues payment, are for one year running from standard renewal dates of 1 July to 30 June and 1 January to 31 December. SFAA is a 501(c)(3) nonprofit organization. Membership dues are tax-deductible, as allowed by law.
2. Submitting appropriate dues in April, May, June, July, August, September, membership will run to 30 June of the next year.
3. Submitting appropriate dues in October, November, December, membership will run to 31 December of the next year; submitting appropriate dues in January, February or March, membership will run to 31 December of the same year.
4. Renewals are maintained at the original membership date unless the renewal is made later than the original cutoff date (e.g. September or March as described in 3). In such cases the membership date is shifted to the next renewal date 30 June or 31 December.
5. New or renewal memberships sent in via USPS mail will have membership start date based on postmark date.

### This application is for:

- New**
- Renewing**

Name: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

Email: \_\_\_\_\_

Home Telephone (optional): \_\_\_\_\_

Cell Phone (optional): \_\_\_\_\_

**Membership Type:**  Individual \$25.00    Family \$30.00    Student \$10.00    Supporting \$75.00  
 Institutional \$40.00   **(All dues tax-deductible as allowed by law.)**

**SFAA T-shirt, add \$10.00 and select size:**    XL    XXL

**Please mail to me a Mt. Tamalpais Parking Permit (1 per membership)**

### To complete the membership process:

- A. Print and fill out this form
- B. Make check or money order payable to San Francisco Amateur Astronomers
- C. Mail this form and payment to:

**Treasurer, SFAA**  
**PO Box 15097**  
**San Francisco, CA 94115**

Both new and renewing members will receive a verifying email from the SFAA upon completion of the membership process.