

★ ABOVE THE FOG

• BULLETIN OF THE SAN FRANCISCO AMATEUR ASTRONOMERS •

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01. SFAA PRESIDENT'S NOTE | DECEMBER ELECTION

Hello SFAA members, and Happy Holidays.

We have a couple of announcements for you this month, which I will discuss in this issue of the newsletter.

The first announcement is that elections for the SFAA board of directors have begun. You should have received an email with the necessary information, such as descriptions of every candidate, a link to our online ballot, and how to print a paper ballot and mail it in if you desire to vote that way. Elections will run until December 31st.

I would like to thank everyone who decided to run for the board. We need members to be more engaged in how the club is run, and I appreciate those of you who give your time and attention to the board. I also want to thank those that have volunteered and continue to volunteer for our outreach activities, such as public star parties, bringing refreshments for the lectures, setting up chairs and putting them away at the end of the night. Our activities are a success because of your participation. Thank you.

We still have one remaining board director position to fill. That means we need one more candidate. We didn't want to delay the election any further, so we are asking anyone undecided about running to come forward and offer to fill this last position. Being short one board member is actually risky, because it makes it more difficult to have quorum at meetings. And without quorum, the board can't hold a vote on important matters.

The other announcement we have is that membership dues are going up starting in January 2020. The reason for the dues increase is because the cost of running SFAA has increased over the last few years, between the monthly fee for our membership management system, and the rent for our loaner telescope storage. The membership dues have not been increased for many years, even though costs have continued to increase.

Membership will increase by \$5 for single, family and supporting membership types. All other membership types stay at the same rate. If you recently joined, you don't have to worry about the dues increase for several months. Just be aware you will be billed an increased amount next year.

With the year coming to a close, I would like to wish our members a Happy New Year full of wonders and your favorite astronomy activities. See you in 2020 with a full slate of lectures, star parties and other outreach activities.

Clear skies,

P.J. Cabrera
President, SFAA

SFAA BOARD OFFICERS AND DIRECTORS

President	P.J. Cabrera	president@sfaa-astronomy.org
Vice President	Liz Triggs	vice-president@sfaa-astronomy.org
Treasurer	Scott Miller	treasurer@sfaa-astronomy.org
Secretary	Bill Kircher	secretary@sfaa-astronomy.org
Directors	Matthew Jones, Tom Kellogg, Brian Kruse, Jessica Miller, Will Silberman, Douglas Smith, and Kate Cabrera	

02. SFAA & BAY AREA ASTRONOMY EVENTS



DECEMBER 2019 – JANUARY 2020

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

Wednesday, December 18, 7:30 pm – 9:15 pm
Meeting and Lecture, [Randall Museum](#)

Saturday, December 28, 6:30 pm – 2:00 am
[Mt. Tam](#) Members Night (arrive BEFORE sunset)

Wednesday, January 15, 7:30 pm – 9:15 pm
Meeting and Lecture, [Randall Museum](#)

GET LIVE HELP WITH YOUR TELESCOPE!

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Are you a new telescope owner?

Or perhaps you could use some help with alignment, collimation, or other adjustments?

Like playing guitar or dancing the tango, learning to operate a telescope can, with great effort, be learned on your own.

However, it's much easier and more enjoyable to learn hands-on with experienced individuals.

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

BAY AREA ASTRONOMY EVENTS

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Long-time SFAA member, Kenneth Lum, assembles and reports a list of Bay Area Astronomy events. Check the following link for information and additional events:

<https://groups.yahoo.com/neo/groups/bayastro/info>

03. SFAA VOLUNTEER OPPORTUNITIES

VOLUNTEER OPPORTUNITIES

Contact: Will Silberman (volunteer@sfaa-astronomy.org)

Star Party Volunteers

- City Star Parties Will Silberman (volunteer@sfaa-astronomy.org)
- Mt. Tam Star Parties

Snack Volunteers Linda Mahan (speakerchair@sfaa-astronomy.org)

Marketing Volunteers PJ Cabrera (president@sfaa-astronomy.org)

Above the Fog Volunteers PJ Cabrera (president@sfaa-astronomy.org)

Star Party Volunteers

SFAA hosts 2 to 3 star parties every month throughout the year, including City Star Parties in San Francisco and observation nights on Mount Tamalpais. Between April and October, in partnership with Mt. Tam State Park, the Friends of Mt. Tam, and Wonderfest, SFAA provides telescope observing as part of a public monthly astronomy program. As a result, we need **experienced SFAA members to serve as volunteers for each of these events**. If you've been to a few star parties, you're familiar with the procedures, and you're able to commit to attending these events, **we can use your help!**

Volunteers are responsible for: checking weather forecasts prior to scheduled events, coordinating with other volunteers, providing cancellation notice due to inclement weather or dangerous conditions (e.g. forest fires). Volunteers are expected to arrive to events early, welcome and orient members, and hold a brief huddle for all telescope operators to review procedures and answer questions.

For Mt. Tam events, volunteers are tasked with:

- members night: ensuring every vehicle belongs to an SFAA member and has a parking pass; at the end of the night, volunteers make sure members understand how to lock the gate on the way out; and
- public astronomy program: coordinating with Friends of Mt. Tam volunteers to manage visitor parking.

Volunteers receive an e-mail once a month to coordinate on upcoming star parties. If you're interested in volunteering, or if you have questions, please contact Will Silberman at volunteer@sfaa-astronomy.org.

Snack Volunteers

SFAA needs volunteers to bring light refreshments to our monthly meetings and lectures at the Presidio Officers Club, on the **third Tuesday of each month**. Refreshments create a welcoming atmosphere for members and guests. Volunteers can donate snacks or provide receipts for expense reimbursement.

If you're interested in bringing refreshments, please send an e-mail to Linda Mahan at speakerchair@sfaa-astronomy.org and indicate which month(s) you can help with and what you'd like to bring.

Marketing Volunteers

SFAA needs volunteers to help post SFAA event updates to groups such as SFGate, SF FunCheap, Eventful, Bay Area Science, etc. If you're interested in marketing opportunities, please send an e-mail to PJ Cabrera at president@sfaa-astronomy.org.

Above the Fog Volunteers

SFAA distributes a monthly newsletter, *Above the Fog*. Volunteers are asked to submit an occasional article, astrophoto, and/or to serve as a member of the editorial team. If you're interested in contributing to these monthly newsletters, please send an e-mail to PJ Cabrera at president@sfaa-astronomy.org.

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

04. SFAA LECTURE SERIES | DECEMBER 18, 2019



EUROPA: THE SCIENCE OF AN OCEAN WORLD AND THE CLIPPER MISSION **ORKAN UMURHAN, PLANETARY SCIENTIST, SETI AT NASA**

In this talk, we will explore some of the more recent science questions pertaining to the possible life-bearing ocean world and the latest exciting developments in the planned mission Europa Clipper set for launch in 2026. Some work by our group focuses on seeking out terrestrial surface analogs of Europa's icy surface to study how a potential surface lander might operate. One such example is the so-called Devil's Golf Course in Death Valley. Orkan will discuss the possibility of other landforms like penitentes and the possible detection of water plumes high over Europa.

Orkan Umurhan currently works as an applied mathematician and Planetary scientist at NASA Ames Research Center. He works on geophysical and astrophysical flows. His current projects also include studying glacial ice flows on the surface of Pluto.

Randall Museum

199 Museum Way, San Francisco, CA 94114

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

SFAA'S GENERAL MEETINGS OCCUR ON THE 3RD WEDNESDAY OF EACH MONTH

05. UPCOMING SFAA LECTURES 2020

JANUARY 15TH | STEVE GOTTLIEB

Going Deep: The NGC and IC Project

In this lecture, Steve Gottlieb describes how a group of amateur and professional astronomers (The NGC/IC Project) have re-examined the source material used to compile the original NGC in 1888 and have produced a corrected NGC that reflects the original visual discoveries.

The NGC and IC objects were discovered over 100 years ago, but 15% - 20% have identification problems — poor positions, misidentifications, duplicate entries, incorrect classifications, and confusion with single or multiple stars. The NGC/IC sleuths have recovered hundreds of mistaken identities, lost objects, and solved long-standing contradictions in professional and amateur databases.

The NGC/IC Project's corrected database is now incorporated into several amateur software programs (SkySafari, StarryNight, TheSky, Voyager, Guide, SkyMap Pro, Cartes du Ciel, and more) as well as professional online databases such as NASA-IPAC Extragalactic Database, SIMBAD and HyperLeda. In this talk he will discuss the history of the NGC and give several examples of their catalogue sleuthing.

Randall Museum

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SFAA'S GENERAL MEETINGS OCCUR ON THE 3RD WEDNESDAY OF EACH MONTH

NASA's OSIRIS-REx Explains Bennu Mystery Particles



This view of asteroid Bennu ejecting particles from its surface on Jan. 6, 2019, was created by combining two images taken by the NavCam 1 imager aboard NASA's OSIRIS-REx spacecraft: a short exposure image, which shows the asteroid clearly, and a long-exposure image (five seconds), which shows the particles clearly. Other image-processing techniques were also applied, such as cropping and adjusting the brightness and contrast of each layer.

Credit: NASA/Goddard/University of Arizona/Lockheed Martin

Shortly after NASA's OSIRIS-REx spacecraft arrived at asteroid Bennu, an unexpected discovery by the mission's science team revealed that the asteroid could be active, or consistently discharging particles into space. The ongoing examination of Bennu - and its sample that will eventually be returned to Earth - could potentially shed light on why this intriguing phenomenon is occurring.

The OSIRIS-REx team first observed a particle-ejection event in images captured by the spacecraft's navigation cameras taken on Jan. 6, just a week after the spacecraft entered its first orbit around Bennu. At first glance, the particles appeared to be stars behind the asteroid, but on closer examination, the team realized that the asteroid was ejecting material from its surface. After concluding that these particles did not compromise the spacecraft's safety, the mission began dedicated observations in order to fully document the activity.

Animation of modeled particulate trajectory from Bennu: https://youtu.be/YxooQ_68M08

"Among Bennu's many surprises, the particle ejections sparked our curiosity, and we've spent the last several months investigating this mystery," said Dante Lauretta, OSIRIS-REx principal investigator at the University of Arizona in Tucson. "This is a great opportunity to expand our knowledge of how asteroids behave."

After studying the results of the observations, the mission team released their findings in a Science paper published Dec. 6. The team observed the three largest particle-ejection events on Jan. 6 and 19, and Feb. 11, and concluded that the events originated from different locations on Bennu's surface. The first event originated in the southern hemisphere, and the second and third events occurred near the equator. All three events took place in the late afternoon on Bennu.

The team found that, after ejection from the asteroid's surface, the particles either briefly orbited Bennu and fell back to its surface or escaped from Bennu into space. The observed particles traveled up to 10 feet (3 meters) per second, and measured from smaller than an inch up to 4 inches (10 centimeters) in size. Approximately 200 particles were observed during the largest event, which took place on Jan. 6.

The team investigated a wide variety of possible mechanisms that may have caused the ejection events and narrowed the list to three candidates: meteoroid impacts, thermal stress fracturing and released water vapor.

Meteoroid impacts are common in the deep space neighborhood of Bennu, and it is possible that these small fragments of space rock could be hitting Bennu where OSIRIS-REx is not observing it, shaking loose particles with the momentum of their impact.

The team also determined that thermal fracturing is another reasonable explanation. Bennu's surface temperatures vary drastically over its 4.3-hour rotation period. Although it is extremely cold during the night hours, the asteroid's surface warms significantly in the mid-afternoon, which is when the three major events occurred. As a result of this temperature change, rocks may begin to crack and break down, and eventually particles could be ejected from the surface. This cycle is known as thermal stress fracturing.

Water release may also explain the asteroid's activity. When Bennu's water-locked clays are heated, the water could begin to release and create pressure. It is possible that as pressure builds in cracks and pores in boulders where absorbed water is released, the surface could become agitated, causing particles to erupt.

But nature does not always allow for simple explanations. "It could be that more than one of these possible mechanisms are at play," said Steve Chesley, an author on the paper and Senior Research Scientist at NASA's Jet Propulsion Laboratory in Pasadena, California. "For example, thermal fracturing could be chopping the surface material into small pieces, making it far easier for meteoroid impacts to launch pebbles into space."

If thermal fracturing, meteoroid impacts or both are in fact the causes of these ejection events, then this phenomenon is likely happening on all small asteroids, as they all experience these mechanisms. However, if water release is the cause of these ejection events, then this phenomenon would be specific to asteroids that contain water-bearing minerals, like Bennu.

Bennu's activity presents larger opportunities once a sample is collected and returned to Earth for study. Many of the ejected particles are small enough to be collected by the spacecraft's sampling mechanism, meaning that the returned sample may possibly contain some material that was ejected and returned to Bennu's surface. Determining that a particular particle had been ejected and returned to Bennu might be a scientific feat similar to finding a needle in a haystack. The material returned to Earth from Bennu, however, will almost certainly increase our understanding of asteroids and the ways they are both different and similar, even as the particle-ejection phenomenon continues to be a mystery whose clues we'll also return home with in the form of data and further material for study.

Sample collection is scheduled for summer 2020, and the sample will be delivered to Earth in September 2023.

NASA's Goddard Space Flight Center in Greenbelt, Maryland provides overall mission management, systems engineering, and the safety and mission assurance for OSIRIS-REx. Dante Lauretta of the University of Arizona in Tucson is the principal investigator, and the University of Arizona also leads the science team and the mission's science observation planning and data processing. Lockheed Martin Space in Denver built the spacecraft and is providing flight operations. Goddard and KinetX Aerospace are responsible for navigating the OSIRIS-REx spacecraft. OSIRIS-REx is the third mission in NASA's New Frontiers Program, which is managed by NASA's Marshall Space Flight Center in Huntsville, Alabama, for the agency's Science Mission Directorate in Washington.

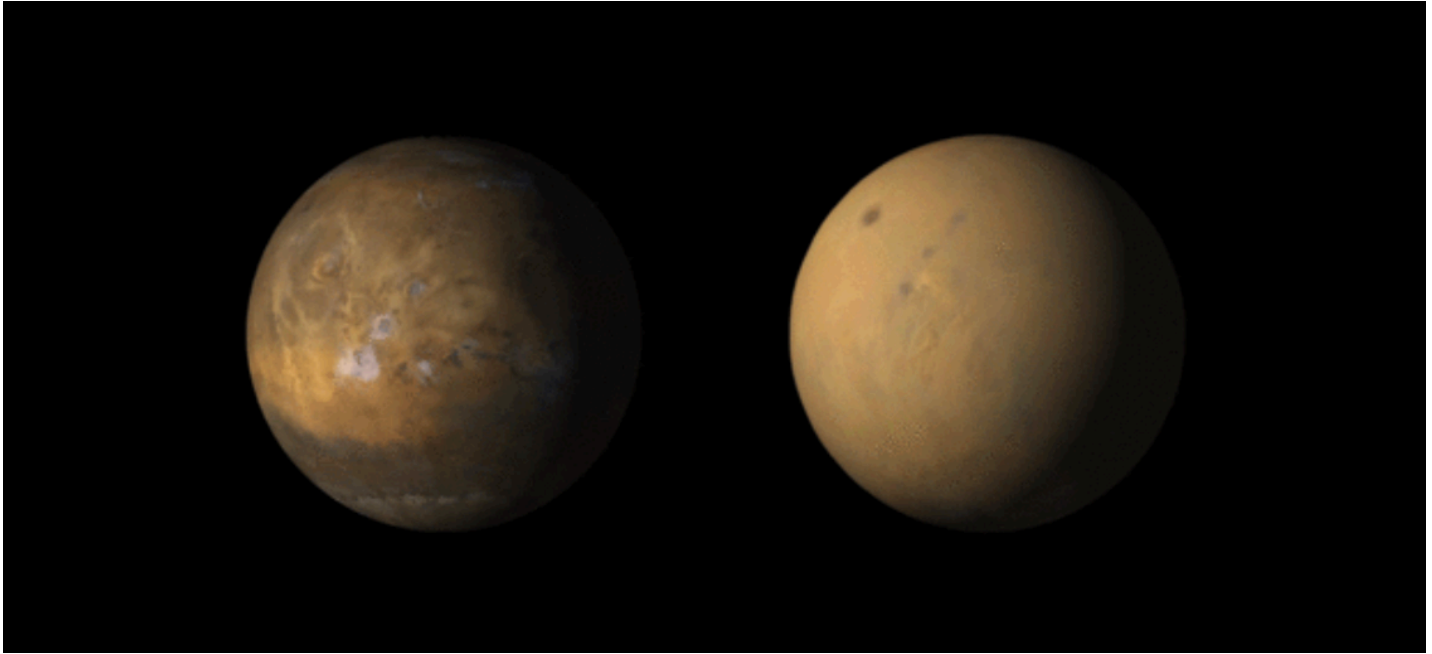
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Global Storms on Mars Launch Dust Towers Into the Sky



Global Storms on Mars Launch Dust Towers Into the Sky. Side-by-side movies shows how the 2018 global dust storm enveloped the Red Planet, courtesy of the Mars Color Imager (MARCI) camera onboard NASA's Mars Reconnaissance Orbiter (MRO). This global dust storm caused NASA's Opportunity rover to lose contact with Earth.

Credit: NASA/JPL-Caltech/MSSS

Dust storms are common on Mars. But every decade or so, something unpredictable happens: A series of runaway storms breaks out, covering the entire planet in a dusty haze.

Last year, a fleet of NASA spacecraft got a detailed look at the life cycle of the 2018 global dust storm that ended the Opportunity rover's mission. And while scientists are still puzzling over the data, two papers recently shed new light on a phenomenon observed within the storm: dust towers, or concentrated clouds of dust that warm in sunlight and rise high into the air. Scientists think that dust-trapped water vapor may be riding them like an elevator to space, where solar radiation breaks apart their molecules. This might help explain how Mars' water disappeared over billions of years.

Dust towers are massive, churning clouds that are denser and climb much higher than the normal background dust in the thin Martian atmosphere. While they also occur under normal conditions, the towers appear to form in greater numbers during global storms.

A tower starts at the planet's surface as an area of rapidly lifted dust about as wide as the state of Rhode Island. By the time a tower reaches a height of 50 miles (80 kilometers), as seen during the 2018 global dust storm, it may be as wide as Nevada. As the tower decays, it can form a layer of dust 35 miles (56 kilometers) above the surface that can be wider than the continental United States.

The recent findings on dust towers come courtesy of NASA's Mars Reconnaissance Orbiter (MRO), which is led by the agency's Jet Propulsion Laboratory in Pasadena, California. Though global dust storms cloak the planet's surface, MRO can use its heat-sensing Mars Climate Sounder instrument to peer through the haze. The instrument is designed specifically for measuring dust levels. Its data, coupled with images from a camera aboard the orbiter called the Mars Context Imager (MARCI), enabled scientists to detect numerous swelling dust towers.

How Did Mars Lose Its Water?

Dust towers appear throughout the Martian year, but MRO observed something different during the 2018 global dust storm. "Normally the dust would fall down in a day or so," said the paper's lead author, Nicholas Heavens of Hampton University in Hampton, Virginia. "But during a global storm, dust towers are renewed continuously for weeks." In some cases, multiple towers were seen for as long as 3 1/2 weeks.

The rate of dust activity surprised Heavens and other scientists. But especially intriguing is the possibility that dust towers act as "space elevators" for other material, transporting them through the atmosphere. When airborne dust heats up, it creates updrafts that carry gases along with it, including the small quantity of water vapor sometimes seen as wispy clouds on Mars.

A previous paper led by Heavens showed that during a 2007 global dust storm on Mars, water molecules were lofted into the upper atmosphere, where solar radiation could break them down into particles that escape into space. That might be a clue to how the Red Planet lost its lakes and rivers over billions of years, becoming the freezing desert it is today.

Scientists can't say with certainty what causes global dust storms; they've studied fewer than a dozen to date.

"Global dust storms are really unusual," said Mars Climate Sounder scientist David Kass of JPL. "We really don't have anything like this on the Earth, where the entire planet's weather changes for several months."

With time and more data, the MRO team hopes to better understand the dust towers created within global storms and what role they may play in removing water from the Red Planet's atmosphere.

For more information about MRO:

- <https://mars.nasa.gov/mro/>
- https://www.nasa.gov/mission_pages/MRO/main/index.html

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Application for New or Renewing Membership

1. Memberships, with dues payment, are for one year running from the member's join or renewal date.
2. New or renewal memberships sent in via USPS mail will have membership start date based on postmark date.
3. SFAA is a 501(c)(3) nonprofit organization. Membership dues are tax-deductible, as allowed by law.

This application is for:

- New**
 Renewing

Name: _____

Address: _____

E-mail: _____

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)

- Please mail me a Mount 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.