

# Focused

The Valley of the Moon Observatory Association Newsletter  
(a non-profit science and astronomy education organization)



Summer 2017

Volume XX Number 3

## Tabby's Star

*By Loren Stokes*

The exoplanet-hunting Kepler space telescope spent four years observing 150,000 stars for transit events. More than 4,500 of those stars have periodic dips in intensity presumably as exoplanets cross their surface along the line-of-sight with Kepler. Consider our Sun and its eight planets viewed from many light years away in the plane of our solar system. When Jupiter crosses in front of the Sun, the intensity would drop by 1% as Jupiter is 10% the diameter of the Sun. Earth being only 1% the diameter of the Sun would block only 0.01% of the light.

Unique among the 150,000 stars Kepler observed is Tabby's Star, named after Louisiana State University astronomy professor Tabetha Boyajian. In April 2016 she announced a star viewed by Kepler had ten intensity dips over four years varying from 0.5% to 20% and lasting from days to weeks with no periodicity. An exoplanet transit should take only a few hours. In addition, the star's intensity dimmed by 4% over the four years of observation with the largest drop near the end of observation. This discovery quickly made mainstream news and the Science Friday radio show with speculation of a large alien structure causing the intensity dips.

Could the intensity observed be caused by a giant structure (perhaps under construction) around the star such as a Dyson sphere designed to extract energy from the star? This caused me to do a few calculations to appreciate what a difficult task this would be.

Consider an alien spherical structure around a star that absorbs all the star's light and converts it to some form of useful energy. Let's say the sphere has a radius of 10 million miles so it won't melt. Say it is very thin, only one inch thick. The volume of this thin spherical shell is a whopping 20 billion cubic miles, 7% the volume of the Earth. This seems unlikely.

Instead, consider a belt structure in orbit around a star. Again, take a radius of 10 million miles and a width of 20,000 miles. This would block 3% of a sun-like star's intensity. Again, take a belt thickness of just one inch. The volume of this thin circular belt is a more manageable 20 million cubic miles, 1000 times smaller than that of the complete sphere.

The hypothetical belt would have a surface area of 13 billion square

*(turn to **TABBY** on Page 3)*

<http://www.rfo.org>

## Public Events at Robert Ferguson Observatory

### July 22, Saturday

Public Solar Observing 11 am – 3 pm  
Public Observing Night 8 pm

### August 19, Saturday

Public Solar Observing 11 am – 3 pm  
Public Observing Night 8 pm

### The 2017 Solar Eclipse

#### August 21, Monday

Public Solar Observing 12 am – 4 pm

#### September 23, Saturday

Public Solar Observing 11 am – 3 pm  
Public Observing Night 8 pm

### Astronomy Day

#### September 30, Saturday

Public Solar Observing 11 am – 3 pm  
Public Observing Night 8 pm

Evening public viewing is \$3 per adult, 18 years or older, plus \$8 per car parking fee. Donations accepted. Dress for cold nights!

### RFO Classes (see Page 3)

#### Night Sky Summer Series

July 17      July 24      August 14

#### Observing Labs

Star Death      September 16

#### Focus Nights

Focus on Saturn      July 19

Be sure to check out our website at <http://www.rfo.org> for the RFO weather forecast and other interesting information.

**Focused**

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**VMOA Mission Statement**

The VMOA is a group of volunteer amateur  
and professional astronomers organized as  
a non-profit association to provide educa-  
tional programs about science and astronomy  
for students and the public. To that end,  
the VMOA operates the Robert Ferguson  
Observatory in Sugarloaf Ridge State Park in  
association with California State Parks.

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## President's Message

*By Steve Smith*



One score and zero years ago, our founders brought forth in this State Park, a new observatory, conceived under clear skies, and dedicated to the proposition that all women and men--if they're looking through a telescope--are created equal.

It was only twenty years ago that RFO first opened its door to the public--and yes, I do mean "door" in the singular, as there was only one telescope in what's now called the West Wing.

Many of you know some or all of that history: the observatory being built in successive phases, telescopes moving in and out of the facility, the State Parks closing Sugarloaf Ridge in 2011, quickly followed by the splendid and successful reopening of the park under the management of Team Sugarloaf. RFO volunteers have come and gone, but twenty years is not all that long, and many of the original observatory actors are still onstage, continuing to thrill visitors with the ongoing production.

RFO's energy is generated by its volunteers, and while we value, cherish, and absolutely need those original cast members, it's always delightful to have new volunteers join us and continue the good work.

This past May saw yet another New Docent Training class go through its paces, with 11 new astronomers ready to go and already hard at work.

But as I write this, I wonder about the next 20 years at RFO, and imagine some future VMOA president quietly thinking about what to write in the summer message to the subscribers and volunteers. If he or she (or android?) decides to write about those past 20 years, what would be written about RFO in 2017?

As it turns out, quite a lot. One of the most important tasks any nonprofit can undertake is that of Strategic Planning, and that thoughtful deliberation of the observatory's future is now well underway. We won't know those results until the end of the year, but it will certainly contain the core principles that have sustained us for these past 20 years. But, one should also expect a number of new--and very bold--ideas for the future. RFO's popularity and impact on the local Bay Area community has never been greater, and now is the time for vision and very large steps.

As our future president looks back at this time period, he'll see remarkable changes in the observatory's capabilities. Last year saw the debut of the new 40" reflecting telescope in the West Wing. A year and a half later, that scope continues to wow both volunteers and visitors alike, garnering well-deserved praise and publicity for the observatory.

And this year--this very month of June--sees the debut of yet another new telescope, an absolutely pristine 20" Ritchey-Chretien that will be used for astrophotography and research. This new CCD system--scope, mount, cameras and accessories--is a generous donation from the University of

*(turn to **PRESIDENT** on Page 3)*

## RFO 2017 Class Schedule

### Night Sky Classes

Each class includes a lecture on the constellations of the season, their history and mythology, and how to find objects within them. Learn the bright stars and deep-sky objects of the night skies. After each presentation (sky conditions permitting), you will enjoy a review of the constellations in the actual night sky and learn how to find them for yourself. The constellations, and the objects within them, will be viewed through binoculars and telescopes, including the Observatory's 40-inch reflecting telescope, until or beyond 10:30 pm (depending upon interest and enthusiasm).

The continuing Summer Series classes will be held on Monday, July 17 & 24, August 14 at 8:00 pm.

The upcoming Fall Series classes will begin on Monday, September 18 at 7 pm.

Fee: \$75 for 6-class series or \$23 for a single class.

To reserve a space in this popular class, email: [nightsky@rfo.org](mailto:nightsky@rfo.org)

Find more information about RFO's Night Sky Classes online at <http://www.rfo.org>

### Observing Labs

An intensive telescope observing session after a brief presentation on the night's theme.

Handouts/Observing lists provided.

### Star Death: The End of Stellar Fusion

Saturday, September 16, at 7 pm [Raincheck date: Wednesday, September 20]

Attendance limited to 10.

Fee: \$30.

For reservations, email: [nightsky@rfo.org](mailto:nightsky@rfo.org)

Find more information about RFO's Observing Labs online at <http://www.rfo.org>

### Focus Nights

Focus Nights are a personal learning and viewing experience at Robert Ferguson Observatory. Focus Nights will be limited to 20 guests and will offer a more intimate and thorough introduction to astronomy. The program will start at dusk with an in-depth presentation that is the evening's "focus." After the presentation, guests will begin viewing the skies using our three featured telescopes. Focus Nights subjects can include planets, star clusters, galaxies, and nebulae.

**Focus on Saturn** Wednesday July 19, at 8 pm [Raincheck date: Wednesday, July 26] Attendance limited to 20.

Fee: \$25. Tickets available through Brown Paper Tickets.

Find more information about RFO's Focus Nights online at <http://www.rfo.org>

*(PRESIDENT from Page 2)*

San Francisco, and replaces the CCD system we've had in the East Wing for a number of years. In all, over 20 volunteers worked to bring this telescope to life, with its public debut at June's two star parties on the 17<sup>th</sup> and 24<sup>th</sup>.

That future president has a lot to look back on!

As for me, I'm looking ahead to the rest of 2017, thankful for the supporters and volunteers at RFO. I don't know what RFO will look like 20 years from now, but from my vantage point (usually in the East Wing), it looks awfully sweet right now in 2017.

*(TABBY from Page 1)*

miles. Turning the star's light into some form of useful energy (such as electricity) should have a fundamental thermodynamic efficiency less than 100% which should generate enormous amounts of waste heat. Yet no such heat (infrared radiation) has been seen coming from Tabby's Star using infrared telescopes.

Explaining the star's behavior by natural causes is not easy. Giant sunspots or swarms of asteroid debris don't fit the data well. Neither does a planet crashing into the star leaving behind debris blocking some light. Such debris should be very hot and should radiate heat like the alien belt above.

Tabby's Star is 1,300 light years away. Perhaps interstellar gas and dust is blocking some of the star's light from reaching us. If the dust is clumpy and moving across our line-of-sight, it could cause random dips in brightness. But none of the other Kepler stars show these features. All the stars Kepler measured are near the star Vega and occupy a small patch of sky. Clumpy dust should block other star's intensity too.

Future observation of Tabby's Star could confirm or deny the clumpy dust theory. Dust should absorb and scatter more blue light than green or red light. An alien structure should block all colors uniformly. Spectroscopic  
*(turn to TABBY on Page 5)*

# Watching the 2017 Summer Sky

by Jack Welch

The big story this summer is the total solar eclipse on 8/21 in a swath across the U.S. from Oregon to South Carolina. I'll return to discussion of the eclipse at the end of this article.

But first, let's consider the planets. *Mercury* has a moderately good evening apparition from about 7/8 to 7/29, reaching a maximum altitude 45 minutes after sunset of 6° on 7/21. Then Mercury has its best morning apparition of the year from about 9/5 to 9/21, with a maximum altitude 45 minutes before sunrise of 8° on 9/13. It will be near Venus, Mars and Regulus throughout much of this period, coming *very* near the bright blue star *Regulus* in *Leo* around 6am on 9/10 and then *very* near Mars around 6am on 9/16. Note that Mars will be two magnitudes dimmer than bright Mercury so challenging to spot (use binoculars). While this planetary dance is worth watching for many mornings, the illustration shows a particularly nice arrangement on the morning of 9/18.

Venus-Moon pair. The crescent moon is again near Venus around 5am on 8/18-19 and around 6am on 9/17-18 (see illustration). Around 6am on 9/19 Venus will be so near the bright blue star Aldebaran that they should both appear in the same telescope field of view!

*Mars* is in conjunction with the sun on 7/26 so mostly not viewable this summer. However, it does begin to emerge low in the eastern predawn sky during September, with the presence of Mercury (above) serving as an aid in spotting Mars.

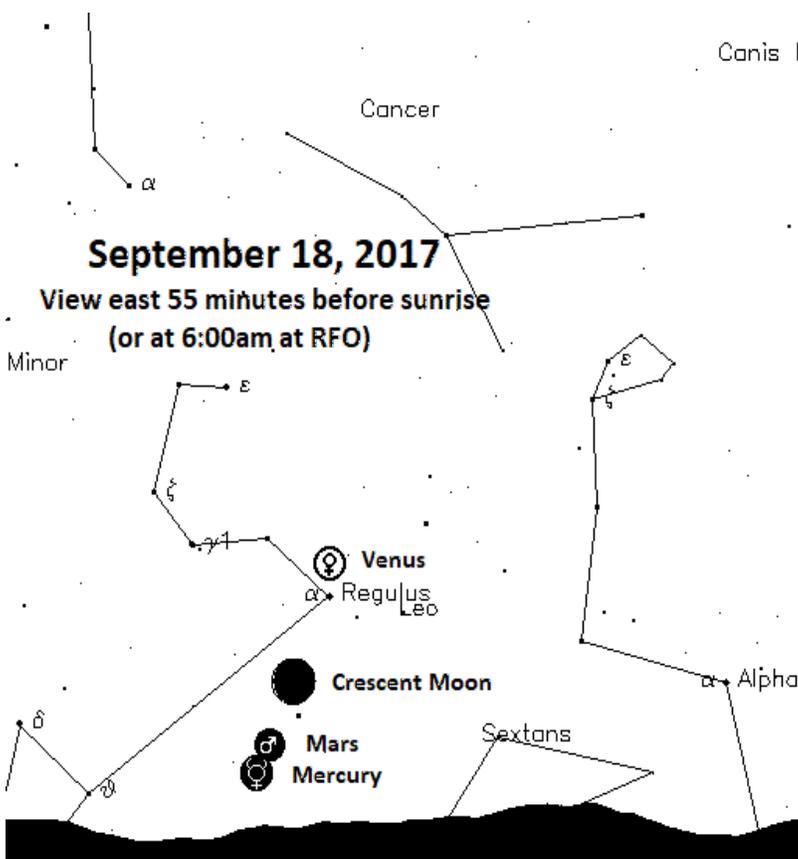
Now well past opposition, *Jupiter* is bright and conspicuous in the evening sky in early summer. There are still some interesting Jovian satellite events to observe during July (see our website), but by August Jupiter will be low in the west, setting early, and will disappear into the glare of sunset by the end of September. Jupiter will be very near the moon around 11pm on 6/30 and again near the moon around 10pm on 7/28. The crescent moon is near Jupiter at 8:30pm on 8/24 and 7:30pm on 9/21.

Jupiter is near the bright star *Spica* in *Virgo* early in September, coming nearest on the evening of 9/5.

*Saturn* was at opposition on 6/15 so is well placed for observing throughout the summer. However, its southerly declination makes the viewing less optimal for us northerners. Saturn's rings are now at their maximum tilt of 27°. The ring tilt will decrease over the next 7 years until they will be edge-on and seem to disappear. The moon will be near Saturn around 10pm on 7/6, 11pm on 8/2 (very near), 9:30pm on 8/29, and 9pm on 9/26. Saturn will end retrograde motion on 8/25.

*Uranus* in *Pisces* is mostly a morning object this summer. However, by the end of summer it will be rising before 9pm and located about 1° north of the beautifully named star *Torcularis Septentrionalis* (*omicron Piscium*) as it approaches opposition. Meanwhile, *Neptune* in *Aquarius* is at opposition on 9/4 when it reaches magnitude 7.9 and a disk size of 2.3" and will be located almost exactly half-way between *lambda* and *83 Aquarii*.

In addition to the close pairings already mentioned, the moon will be very near bright blue star *Regulus* around 10pm on 6/27. And the crescent moon will be *very* near the bright orange-red star *Aldebaran* around 2:30am on 8/16. A month later, on 9/12, the moon will occult Aldebaran: the star disappears behind



*Venus* is very prominent as the "Morning Star" all summer. The crescent moon will be very near Venus around 4:30am on 7/20, with the bright red star *Aldebaran* and the *Pleiades* star cluster, both in *Taurus*, above the

the moon around 4:29am and reappears around 5:49am. For truly avid experienced observers, the moon occults many *Hyades Cluster* stars from about midnight until the Aldebaran occultation that same morning. These are mostly challenging reappearance events so require observers to obtain calculations for the exact observing location. Also challenging is a daytime graze occultation of the bright Hyades star *Hyadum-I* around 11am on 7/19. The southern graze limit line passes across Petaluma, just south of Sonoma, and over the southern part of the city of Napa. Those near this line or up to about 12Km north can observe a graze occultation of this close double star. Observers will need to perform graze calculations for their exact observing location. Finally, two nice occultations occur on a single evening in early September. First, the moon will occult the bright triple star *pi Capricornii* at about 10:38pm on 9/2. Then, the close double star *rho Capricornii* disappears behind the moon at about 12:09am on 9/3. For the RFO site, there will be about a 7 second gap between the disappearance of the two components. (All occultation details calculated with Occult4 for the RFO site).

From 9/19 to 10/2, the *Zodiacal Light* is visible in the east before morning twilight. This glowing band of light is caused by sunlight reflecting off fine particles in the plane of our solar system (the “ecliptic plane”). It appears as a tall tilted tapering triangle of light with its base in the ENE, rising through *Leo*, continuing through *Cancer* and then losing itself in the glow of the Milky Way in *Gemini*. A clear and dark eastern sky is essential. It is easily visible from Sugarloaf Ridge State Park. Look for it between about 4:45 to 5:30am.

Conditions for viewing the *Perseid Meteors* are poor this year, with the peak scheduled for noon locally, the peak activity expected to be low, and moonlight interfering. On 8/12 the gibbous moon rises at 11:12pm so meteor viewing will be poor after that. Happily, meteor activity usually persists for several days around the peak so it could be worthwhile to watch for meteors on evenings after 8/12.

Now for that solar eclipse on Monday 8/21! Locally (near RFO) it will occur from 9:01 to 11:37am with maximum eclipse of 82% at 10:15. This should produce very noticeable dimming of sunlight. RFO will be open for eclipse observing and presentations from 8am to noon. As always with solar events, only use SAFE VIEWING METHODS to avoid eye and instrument damage, including possible blindness! RFO has

inexpensive solar viewing filters for sale, and methods such as pinhole projection can be found online. If you are heading toward the path of totality in order to view the sun in total eclipse (an experience not to be missed if one has the chance!), be aware that extreme crowds are anticipated. Few reservations remain and those that do are expensive. Even with reservations, prepare to arrive at least a day or two in advance and possibly stay until 8/22. Gasoline and other items may be in short supply so plan accordingly.

For additional sky events and details, use the “What’s Up in the Night Sky” link on our website. Or join our email list (link on website) and receive monthly emails with sky-watching details and more. The summer officially ends with the *autumnal equinox* at 1:02pm on 9/22.

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(**TABBY** from Page 1)

observations during an intensity dip compared to no dip should determine which is happening.

As Tabby’s Star’s intensity dips are not predictable, continuous measurements are desired. A crowd-funding campaign using Kickstarter has raised enough funds to monitor the star for the next two years. Boyajian will use a global network of robotic telescopes, called the Las Cumbres Observatory, for the observations.

Reference: Sky and Telescope, June 2017.

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## Focus on Saturn

### Wednesday July 19 at 8 PM

RFO presents “Focus on Saturn”: an evening dedicated to the famously ringed planet. After everyone has had their fill of Saturn, the telescopes will be turned on other wonders of the evening’s sky. This evening is limited to 20 guests. Tickets available from Brown Paper Tickets. \$25 General, \$20 Senior (62+) and Youth (under 18) Raincheck night: Wednesday, July 26th.

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## Sonoma County Astronomical Society Annual Starbeque

### Saturday August 26 at 2 PM

Join our friends and astronomy awareness allies from the Sonoma County Astronomical Society at their annual picnic and bbq event at the observatory. Bring a dish to share and enjoy this beautiful and wonderful day of fellowship.

# Valley of the Moon Observatory Association

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