

# PRIMEFOCUS

Tri-Valley Stargazers



September 2020



## Meeting Info: Science with a Tiny Space Telescope

**Who:**  
Dr. Willem de Vries

**When:**  
September 18, 2020  
Meeting at 7:30 p.m.  
Lecture at 8:00 p.m.

**Where:**  
Virtual Meeting using: Zoom\*  
See the April or May issue of  
PrimeFocus for info on getting  
connected using Zoom.

### Inside

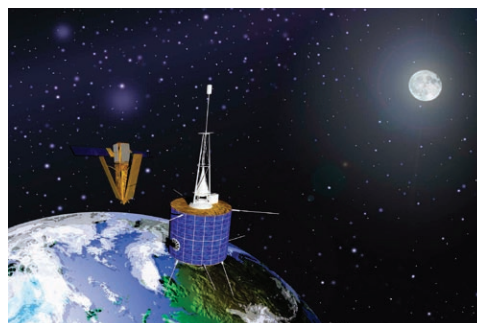
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## September Virtual Meeting Using "Zoom"\*

### Science with a Tiny Space Telescope

Dr. Willem de Vries, Lawrence Livermore National Laboratory

In this presentation I will present some exciting results from a recent imaging campaign that we conducted with our commercial spacecraft R&D partner. Our nano-satellite spacecraft carried a 25mm diameter, LLNL designed, monolithic Schmidt-Cassegrain telescope, and we used it to capture a large volume of imaging data over the 4 month collection period (Feb-May 2020). I will describe the optical system and its performance, and go over some of the initial results, ranging from terrestrial imaging, measurements of the atmospheric conditions at very high altitudes, to on-orbit debris detections and beyond.



Caption: On Feb. 10, 2009, a defunct Russian satellite, right, and a privately owned American communications satellite, left, collided near the North Pole, producing clouds of debris that quickly joined the orbital parade, increasing the possibility of future accidents. Copyright license CC BY-NC-SA 4.0. See: <https://www.llnl.gov/news/preventing-close-encounters-orbiting-kind>

**Bio:** Dr. Willem de Vries has over two decades of experience applying forefront analysis techniques to astrophysical research and their application to national security mission analysis, using a combination of ground- and space-based collection assets and modeling and simulation tools. He did most of his graduate studies at Space Telescope Science Institute (1995 – 1998), Baltimore (MD), using the Hubble Space Telescope. He joined Lawrence Livermore National Laboratory (LLNL) as a post-doctoral researcher in Physics in 1999 to work on astrophysical observations of the early Universe. He is currently serving as the Associate Program Leader (APL) for Mission Support in LLNL's Space Science and Security Program (SSSP).

### TVS Needs Your Help to Rebuild the H2O Observatory

Full coverage of the developing events regarding the destruction of the Hidden Hill Observatory can be found in this newsletter. On page 2, Observatory Director Chuck Grant writes about H2O Appeal. On page 5, the seven steps for recovery and rebuilding the observatory are outlined, and page 6 has images of the ruins.

Please consider making a donation to rebuild the observatory:

<https://charity.gofundme.com/o/en/campaign/tvs-observatory-rebuilding-fund>

TVS is a registered non-profit corporation and donations are tax-deductible.

## H2O Appeal By Chuck Grant

Mt. Hamilton, California, with the famous and historic Lick Observatory, is a few miles away in the background of the photograph below, but it is completely obscured by the smoke of the still burning SCU lightning complex fires. Fortunately, a major fire fighting effort was able to save Lick Observatory. Meanwhile, here, Hidden Hill Observatory, the home of the Tri-Valley Stargazers (TVS) just a few miles east, was not so lucky. This photograph shows where the 24'x 12' roll-off roof observatory building stood a few days earlier. Nothing was left but broken glass, melted aluminum, the steel frame of a picnic table, scattered steel parts, and the remains of the pier and mount.



Hidden Hill Observatory (H2O), although it was not given that name until much later, was built in 1983 by TVS club members to house (what would later be named) the "Jack Marling" telescope. Jack, amateur astronomy pioneer and founder of Lumicon, was responsible for making many innovative devices available to amateurs including narrow-band interference filters, film hypersensitization, digital setting circles, off-axis guiders, and others that we take for granted today. Jack donated to TVS a 17.5" Coulter Odyssey telescope and Meade DS-16 equatorial mount with a Mathus drive upgrade, Lumicon digital setting circles and the brand new Nagler 13mm eyepiece (now called type-1) among other things. This was a very advanced amateur telescope for the time. In its early days the telescope in this configuration participated in the amateur discovery and verification of planetary nebula, aided by the filters Jack designed and built. More verifications of PN discoveries by amateurs were done here than any other amateur site. Over the years, H2O was established as the best dark-sky observing site available to amateurs within a 1-hour drive from the East San Francisco Bay Area. Many club members observed visually, took astrophotos, and performed photometry (with a photomultiplier tube photometer). Hundreds of visitors were introduced to the beauty of the dark sky during Open House nights.

Eventually, the original Coulter cardboard tube began to sag enough that it could not hold collimation with heavy eyepieces or cameras and accessories, so a sturdy aluminum tube was built. At 135 pounds the OTA proved to be much too heavy for the old DS-16 mount. This was a big problem for TVS since a suitable mount was way beyond the available resources. The observatory was built almost entirely with materials and equipment donated over many years. A much heavier Parallax Instruments mount (with 2" shafts) was acquired at RTMC for about half price, but this too was not up to the task. Work was progressing on building a much lighter truss tube assembly suitable for the Parallax mount when a donation of an AstroPhysics 1200 mount suddenly appeared. The AP 1200 and aluminum tube OTA, although a little overloaded, proved to be a very steady mount. Upgrades were performed to the building and solar power system. A Paracor coma corrector and some new Nagler eyepieces were purchased. Work continued on the truss tube with the objective of bringing the total weight down as much as possible. After two years of renovations TVS was nearly ready to open the observatory for use by club members when the fire struck.

Both the aluminum and the truss tube assemblies were completely destroyed as were the 17.5" and 18" mirrors, all the eyepieces, accessories, electronics, and everything else in the building. The AP mount could not be salvaged. Even the pier will need to be replaced. The club is greatly saddened by this loss, but is quickly starting to make plans to rebuild a new and better facility. Replacing the equipment with what would be considered modern and high-quality today and building a user-friendly facility is far beyond the available resources given modern prices. Undaunted, TVS is launching a broad fund raising project to all those interested in promoting astronomical outreach and amateur astronomy. Donations can be made at <https://charity.gofundme.com/o/en/campaign/tvs-observatory-rebuilding-fund>. TVS is a registered non-profit corporation and donations are tax-deductible.

## News & Notes

### 2020 TVS Meeting Dates

Below are the TVS meeting dates for 2020. The lecture meetings are on the third Friday of the month, with the Board meetings on the Monday following the lecture meeting.

Lecture Meeting	Board Meeting	Prime Focus Deadline
Sep. 18	Sep. 21	
Oct. 16	Oct. 19	Oct. 02
Nov. 20	Nov. 23	Nov. 06
Dec. 18	Dec. 21	Dec. 04

## News and Notes (continued)

### Money Matters

As of the last Treasurer's Report on 08/24/20, our club's account balance is \$13,624.11.

### TVS Welcome to New Members

TVS would like to welcome new members Arvin Andiappan, Ed Carreno, Matthew Finger, Ashwin Panicker, Soundar Thiagarajan, and Sowmya Venkatesh. Please say hello and chat with them during our Zoom club meetings.

### TVS Summer Observing Program Awardees

Dennis Beckley completed the TVS Summer Observing Program, in addition to the five awardees mentioned in last month's newsletter.

As described in the article on p.4 of this newsletter, the Autumn Observing Program has been released for your observing pleasure.

### H2O: Open and Del Valle: Closed

H2O has been reopened after the post-fire clean-up was completed on September 10 by Roland Albers, Brian Blau, Ross Gaunt, Chuck Grant, and Ken Sperber.

The Del Valle observing site is NOT open for observing. Members will be notified via email and the website when it reopens

Please see the August newsletter for the COVID-19 restrictions that the club has adopted to ensure the safety of our members.

### TVS Star Party Descriptions

NOTE: ALL STAR PARTIES ARE SUBJECT TO POSSIBLE CANCELLATION PENDING THE STATUS OF STATE AND COUNTY

COVID-19 RESTRICTIONS.

Del Valle star parties are also public outreach events. They are jointly hosted with the EBRPD and held at the Arroyo Staging Area. The public is invited for the first 1.5-2 hours, while club members can stay the remainder of the night.

Tesla Vintners star parties are open to only club members and their guests. These star parties end at midnight, but participants can leave earlier, should they wish.

H2O star parties are open to the public. The open house ends at midnight, and all participants are encouraged to stay the duration. The drive to H2O takes about 1 hour, and the caravan leaves promptly from the corner of Mines and Tesla Rds.

### Outreach Star Party Schedule

Cancelled through September.

Contact Eric Dueltgen if you are interested in participating (outreach"at"trivalleystargazers.org).

### 2020 Club Star Party Schedule

October 17: Tesla Vintners

## Calendar of Events

### September 16, 11:00am

What: Searching and Characterizing Exoplanets with CHEOPS, ARIEL, and PLATO

Who: Profs. Willy Benz, Giovanna Tinetti, & Heike Rauer

Sponsor: SETI Institute

Online: REGISTRATION REQUIRED; <https://www.seti.org/event/searching-and-characterizing-exoplanets-cheops-ariel-and-plato>

continued on p.4

#### Officers

##### **President:**

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#### Volunteer Positions

##### **Astronomical League Rep.:**

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##### **Publicity Coordinator:**

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##### **Refreshment Coordinator:**

Laurie Grefsheim

##### **Webmaster:**

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info@trivalleystargazers.org

##### **TVS E-Group**

To join the TVS e-group just send an e-mail message to the TVS e-mail address (info@trivalleystargazers.org) asking to join the group. Make sure you specify the e-mail address you want to use to read and post to the group.



## Calendar of Events (continued)

NASA's Kepler mission and its successor TESS are not the only space telescopes dedicated to finding exoplanets. The European Space Agency (ESA) has embarked on the challenge of finding and characterizing those planets in orbit around stars other than our Sun. We'll discuss several of these missions in this special SETI Talks with leading European-based astronomers.

The CHEOPS mission (CHaracterising ExOPlanet Satellite) is to characterize exoplanet transits. The space telescope targets stars known to have a transiting exoplanet and focuses on better characterizing Earth-like and super-Earth exoplanets. Willy Benz, Professor at the Physics Institute at the University of Bern and Principal Investigator of CHEOPS, will tell us about the mission and its goals.

PLATO (PLANetary Transits and Oscillations of stars) will find and study a large number of extrasolar planetary systems. Heike Rauer, principal investigator of PLATO, will tell us how the mission could discover terrestrial exoplanets, some in the habitable zone of solar-type stars, and characterize them. Such analysis will pave the way for future missions that could one day image another Pale Blue Dot.

ARIEL (Atmospheric Remote-sensing Infrared Exoplanet Large-survey) aims to answer questions about how planetary systems form and evolve. Giovanna Tinetti, Head of the Astrophysics Group, UCL Department of Physics & Astronomy and Principal Investigator of ARIEL, will discuss this mission's future goals to observe more than 500 exoplanets ranging from Jupiter- and Neptune-size down to super-Earths in various environments.

### September 18, 6:00pm - 7:30pm

**What:** Where Jeff Bezos's Great Granddaughter Will Go for Her Honeymoon: The Top Tourist Sights of the Solar System

**Who:** Prof. Andrew Fraknoi

**Sponsor:** SETI Institute

**Online:** \$15, REGISTRATION REQUIRED; <https://www.seti.org/event/where-jeff-bezoss-great-grandaughter-will-go-her-honeymoon-top-tourist-sights-solar-system>

The tour will explore the most intriguing future "tourist destinations" among the planets and moons in our cosmic neighborhood. Stops will include the 4,000-mile lava channel on Venus, the towering Mount Olympus volcano on Mars (three times the height of Mount Everest), the awesome Verona Cliffs on the moon Miranda (which are the tallest "lover's leap" in the solar system), and the recently discovered salt-water steam geysers on Saturn's intriguing moon Enceladus (nicknamed "Cold Faithful."). The tour will finish with the latest images of the eerie vistas on Pluto.

Andrew Fraknoi retired in 2017 as the Chair of the Astronomy Department at Foothill College, and now teaches non-credit astronomy courses for older adults at The Fromm Institute at

the University of San Francisco and the OLLI program at SF State.

### September 20, 1:30pm

**What:** Solar Sunday Basics: Spots, Prominences, Filaments and More

**Who:** SJ Astronomy

**Sponsor:** San Jose Astronomical Association

**Online:** <https://www.meetup.com/SJ-Astronomy/events/272924146/>

Join us for this on-line event where we'll look in real time for prominences (often thought of as solar flares) and intricate texture within the Sun's chromosphere (its atmosphere). We'll also provide an overview of how we observe the Sun in different types of light (such as red, H-alpha light), share details about the structure of the Sun, and show spectacular images taken during prior years.

For more information see: <https://www.sjaa.net/calendar/>

### September 22, 7:15pm

**What:** Can Life Be Merely an Accident

**Who:** Dr. Robert Picionni

**Where:** Mt. Diablo Astronomical Society, Lindsay Wildlife Experience, Community Room, 1931 First St., Walnut Creek, CA 94597

**Cost:** Free

Details not available.

For more information see: [https://nightsky.jpl.nasa.gov/event-view.cfm?Event\\_ID=106413](https://nightsky.jpl.nasa.gov/event-view.cfm?Event_ID=106413)

### September 25, 8:00pm

**What:** Planetary Defense: Avoiding a Cosmic Catastrophe

**Who:** Dr. Megan Bruck Syal and Dr. Mary Burkey (LLNL)

**Sponsor:** Chabot Space and Science Center

**Online:** <https://chabot.space.org/events/events-listing/>

Our planet has been continually bombarded by asteroids since its formation, 4.5 billion years ago. While the frequency of large impacts has decreased, many potential Near-Earth Object (NEO) threats remain undiscovered, so if or when they will impact Earth remains unknown.

Most of the time, an impacting asteroid will simply burn up in the atmosphere, giving those on the ground a pleasant meteor shower display. However, depending on the size, composition, and impact location of the asteroid, the results could be catastrophic. Fortunately, if an Earth-threatening asteroid is discovered in time, there are ways to mitigate or even prevent a disaster. Astronomers now discover over 2000 new near-Earth asteroids a year. So far, none pose a significant risk.

However, if an asteroid is found to be on a collision course with Earth, it can be diverted by a few different methods.

## Calendar of Events (continued)

For long warning times (and asteroids that are not too big), a heavy “kinetic impactor” spacecraft can impact the asteroid at high speeds, giving it a slight nudge so that it safely misses Earth. When warning times are short, or the asteroid is large, a nuclear device can be sent to melt and vaporize enough surface material to deflect the asteroid. Very short warning time scenarios, where deflection is impossible, can be handled by using a similar device to fragment the asteroid into many small, well-dispersed pieces.

If none of the prevention options are possible, then evacuation and other emergency response measures will be put to use. In these cases, it is essential to know what areas would be affected by the impact in order to minimize casualties and damage. Scientists at LLNL provide simulation support in preparation for all the above scenarios so if the time comes when an asteroid is headed our way, we will be prepared.

To receive a notification when the talk begins, make sure to “Like” the Chabot Space and Science Center Facebook page.

## Autumn Observing Program

TVS is proud to announce our 2020 Autumn Observing Program. You can find our observing programs by going to our club website: [www.trivalleystargazers.org/observing.shtml](http://www.trivalleystargazers.org/observing.shtml)

To participate in the program, begin by downloading the observing list and sample observing log (available in both Excel and PDF formats) for the Autumn Program. The Autumn program consists of 23 objects, including Planetary Nebulae, Galaxies, Open Clusters, and various stars.

Once you’ve completed all your observations, submit your log in electronic format (Excel file or scanned PDF) to: [awards@trivalleystargazers.org](mailto:awards@trivalleystargazers.org). We’ll have an attractive certificate and mention in this newsletter for all who complete the program. So start making your observations today to earn a TVS Observing Award!

## H2O Observatory Rebuild

The TVS board has developed a 7 item action plan for the H2O rebuild:

1. Raise funds for the reconstruction of the observatory. The board is taking a multi-pronged approach to fund raising. The most visible component is the Charity GoFundMe site that was established on September 2 (<https://charity.gofundme.com/o/en/campaign/tvs-observatory-rebuilding-fund>). One can contribute through the GoFundMe page and via Paypal links that are on the TVS homepage. Or, one can send a check to: Tri-Valley Stargazers, PO Box 2476, Livermore, CA 94551. We are also contacting possible corporate donors.

2. Assess damage and clean-up the site. Clean-up of the site was completed on September 10. This work included disposal of hazardous material, namely electronics that were melted in the fire, disposal of metallic remnants of the building, the picnic table, and ash debris. Dead shrubs were also removed. We are considering removal of the large Pine tree from the observatory summit, but we need to get permission from the property owner before taking this action. The site is open for use with one’s own telescope equipment.

4. Reconstruction committee(s) need to be formed.

5. Firstly, the committee(s) will be tasked with deciding how many telescopes to purchase and the type/design of each. This depends heavily on the level of success of our fund raising. An ambitious configuration would include the purchase of two telescopes, one for observing, such as a large Dobson with goto capability, and a second imaging telescope. Such an aspiration likely requires that we exceed our \$30,000 fund raising goal. Secondly, the committee(s) will be tasked designing a new building for the telescope(s) that the rebuilding fund will support.

6. Construct new observatory

7. Buy and install the new equipment.

The proposed time line for the rebuild is:

2020 - Develop building plans and construction schedule

2021 - Observatory construction; equipment purchases

2022 - Telescope deployment and opening ceremony

In an effort to make the community aware of the loss of the observatory and the rebuilding effort, Roland Albers and Rich Combs were interviewed by Ruth Roberts of The Independent. The article was published on September 9, and it can be found online at:

[https://www.independentnews.com/news/astronomy-club-reaches-for-the-stars-to-rebuild-observatory/article\\_fb-cdb566-f303-11ea-90ea-0f59cc26a923.html](https://www.independentnews.com/news/astronomy-club-reaches-for-the-stars-to-rebuild-observatory/article_fb-cdb566-f303-11ea-90ea-0f59cc26a923.html)

The article on p.2 of this newsletter, by Chuck Grant, was written to let the broader astronomy community know of our plight. It might be submitted to Sky & Telescope and/or Astronomy magazine for potential publication.

The club also has a presence on FaceBook and Twitter. Please visit and contribute to these online resources so that TVS continues to be visible, especially in this time of need.



## H2O Observatory in Ruins

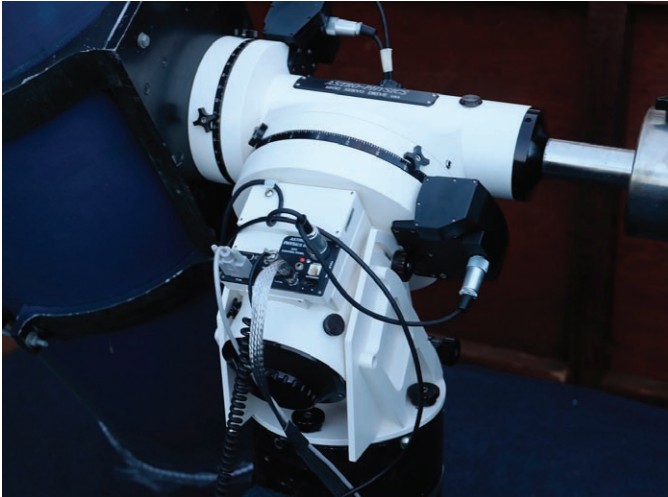


Image Captions: Upper left: "Before" picture of the AP1200 mount. Image Credit: Hilary Jones. Upper right: All that remained of the telescope, mount, and observatory after the fire. Image Credit: Janette Bennett. Lower left: Our classic TeleVue Nagler 13mm eyepiece from 1986 was scorched beyond repair in the fire. Image Credit: Ken Sperber. Middle right: During the cleanup Roland Albers shows a portion of the 18-inch mirror, Chuck Grant shows some of the melted aluminum from the old OTA, and Brian Blau shows a broken secondary mirror. Eric Dueltgen, Ross Gaunt, Gert Gottschalk, and Ron Kane also participated in the clean-up (not shown). Image Credit: Ken Sperber. Lower right: The extent of the fire damage has rendered the hillside unrecognizable. Image Credit Ross Gaunt.

## What's Up By Ken Sperber (adapted from S&T and The Year in Space)

All times are Pacific Daylight Time

### September

- 14 Mon The Moon and Venus are  $\sim 5^\circ$  apart with M44 to the upper left (Dawn)
- 15- Tue- For the rest of the month the Zodiacal light is visible in the east from a dark site, beginning about 2 hours before morning twilight
- 15 Tue The thin crescent Moon is visible with Regulus trailing by  $\sim 5^\circ$  (Dawn)
- 17 Thu **New Moon (4:00am)**
- 21 Mon The crescent Moon occults Beta Scorpii in the southwest during daylight, with the pair emerging in twilight (see September S&T, p. 50)
- 23 Wed **First-Quarter Moon (6:55pm)**
- 24 Thu The Moon, Jupiter, and Saturn form an arc  $\sim 11^\circ$  long (Dusk)
- 25 Fri Saturn, Jupiter, and the Moon form a triangle (Dusk)

### October

- 1 Thu **Full Moon (2:05pm)**
- 2-3 Fri- Venus and Regulus  $< 0.5^\circ$  apart (Dawn)
- 2 Fri Mars and the Moon rise in tandem (Evening)
- 6 Tue Mars nearest to Earth with widest disk until the year 2035 (Evening)
- 6 Tue The Moon is  $\sim 5^\circ$  from Aldebaran (Evening)
- 9 Fri **Last-Quarter Moon (5:40pm)**
- 11 Sun The Moon is  $< 2^\circ$  from M44, the Beehive Cluster (Morning)
- 13 Tue Mars reaches opposition (Visible all night)
- 14- Wed- For the rest of the month the Zodiacal light is visible in the east from a dark site, beginning about 2 hours before morning twilight
- 14 Wed Venus rises in the east followed by the thin crescent Moon (Dawn)
- 16 Fri **New Moon (12:31pm)**
- 20 Tue Algol shines at minimum brightness for 2 hours centered on 11:40pm
- 21 Wed The Orionid meteor shower peaks in the early morning
- 22 Thu The Moon, Jupiter, and Saturn form a triangle in the south (Dusk)
- 23 Fri **First-Quarter Moon (6:23am)**
- 23 Fri Algol shines at minimum brightness for 2 hours centered on 8:29pm
- 29 Thu The Moon and Mars are  $\sim 4^\circ$  apart (Evening)
- 31 Sat **Full "Blue" Moon on Halloween! (7:49am)**



# NASA Night Sky Notes

## Summer Triangle Corner: Altair

By David Prosper

Altair is the final stop on our trip around the Summer Triangle! The last star in the asterism to rise for Northern Hemisphere observers before summer begins, brilliant Altair is high overhead at sunset at the end of the season in September. Altair might be the most unusual of the three stars of the Triangle, due to its great speed: this star spins so rapidly that it appears “squished.”

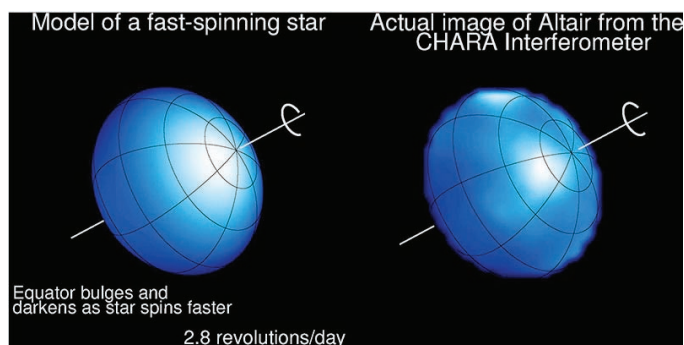


Caption: Altair is up high in the early evening in September. Note Altair’s two bright “companions” on either side of the star. Can you imagine them as a formation of an eagle and two swans, like the Koori?

A very bright star, Altair has its own notable place in the mythologies of cultures around the world. As discussed in our previous edition, Altair represents the cowherd Niulang in the ancient Chinese tale of the “Cowherd and the Weaver Girl.” Altair is the brightest star in the constellation of Aquila the Eagle; while described as part of an eagle by ancient peoples around the Mediterranean, it was also seen as part of an eagle by the Koori people in Australia! They saw the star itself as representing a wedge-tailed eagle, and two nearby stars as his wives, a pair of black swans. More recently one of the first home computers was named after the star: the Altair 8800.

Altair’s rapid spinning was first detected in the 1960s. The close observations that followed tested the limits of technology available to astronomers, eventually resulting in direct

images of the star’s shape and surface by using a technique called interferometry, which combines the light from two or more instruments to produce a single image. Predictions about how the surface of a rapidly spinning massive star would appear held true to the observations; models predicted a squashed, almost “pumpkin-like” shape instead of a round sphere, along with a dimming effect along the widened equator, and the observations confirmed this! This equatorial dimming is due to a phenomenon called gravity darkening. Altair is wider at the equator than it is at the poles due to centrifugal force, resulting in the star’s mass bulging outwards at the equator. This results in the denser poles of the star being hotter and brighter, and the less dense equator being cooler and therefore dimmer. This doesn’t mean that the equator of Altair or other rapidly spinning stars are actually dark, but rather that the equator is dark in comparison to the poles; this is similar in a sense to sunspots. If you were to observe a sunspot on its own, it would appear blindingly bright, but it is cooler than the surrounding plasma in the Sun and so appears dark in contrast.



Caption: The image on the right was created using optical interferometry: the light from four telescopes was combined to produce this image of Altair’s surface. Image credit: Ming Zhao. More info: [bit.ly/altairvsmodel](http://bit.ly/altairvsmodel)

As summer winds down, you can still take a Trip Around the Summer Triangle with this activity from the Night Sky Network. Mark some of the sights in and around the Summer Triangle at: [bit.ly/TriangleTrip](http://bit.ly/TriangleTrip). You can discover more about NASA’s observations of Altair and other fast and furious stars at [nasa.gov](http://nasa.gov).

This article is distributed by the NASA Night Sky Network, a coalition of hundreds of astronomy clubs across the US dedicated to astronomy outreach. Visit [nightsky.jpl.nasa.gov](http://nightsky.jpl.nasa.gov) to find local clubs, events, stargazing info and more.





Tri-Valley Stargazers  
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## Tri-Valley Stargazers Membership Application

### Contact information:

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

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

City, State, Zip: \_\_\_\_\_

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

Status (select one): \_\_\_\_\_ New member \_\_\_\_\_ Renewing or returning member

**Membership category** (select one): Membership term is for one calendar year, January through December.

\_\_\_\_\_ Student member (\$10). Must be a full-time high-school or college student.

\_\_\_\_\_ Regular member (\$30).

\_\_\_\_\_ Patron member (\$100). Patron membership grants use of the club's 17.5" reflector at H2O. You must be a member in good standing for at least one year, hold a key to H2O, and receive board approval.

**Hidden Hill Observatory Access** (optional): Must be 18 or older.

\_\_\_\_\_ One-time key deposit (\$20). This is a refundable deposit for a key to H2O. New key holders must first hear an orientation lecture and sign a usage agreement form before using the observing site.

\_\_\_\_\_ Annual access fee (\$10). You must also be a key holder to access the site.

**Donation** (optional):

\_\_\_\_\_ Tax-deductible contribution to Tri-Valley Stargazers

**Total enclosed:** \$ \_\_\_\_\_

Member agrees to hold Tri-Valley Stargazers, and any cooperating organizations or landowners, harmless from all claims of liability for any injury or loss sustained at a TVS function. TVS will not share information with anyone except as detailed in our Privacy Policy (<http://www.trivalleystargazers.org/privacy.shtml>).

Mail this completed form along with a check to: Tri-Valley Stargazers, P.O. Box 2476, Livermore, CA 94551.