

Focused

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



Summer 2011

Volume XIV Number 3

A New Window

By Robert Davis

Last time we said goodbye to Discovery. This time we are going to bid a fond farewell to Endeavour. Like Discovery, Endeavour has served us well. Its first launch took place on May 7, 1992 and its final launch took place on May 16, 2011. It flew 25 missions, spent 299 days in space and flew over 122 million miles. And like Discovery, Endeavour has had that one mission that kind of stands out from all its others. For Discovery it was the launching of Hubble and for Endeavour it was beginning construction of the International Space Station (ISS). The very first piece of the ISS was the Zarya Control Module which was launched into orbit atop a Russian Proton rocket in November of 1998. In December of 1998, Endeavour took up the Unity Module and this is the first time astronauts had to go out in to space and put pieces together. At the time Endeavour set all kinds of records for extravehicular activities such as duration and number of personnel out at the same time. In years to come this bright shiny moment may just fade a bit when compared to Endeavour's final mission.

While most of the final mission dealt with delivering supplies and spare parts there was one special piece of equipment that Endeavour delivered that has the potential for increasing our understanding of the Universe just like Hubble did. When Galileo pointed his

telescope at the night sky it was a new window into the Universe and amazing things were discovered. The Moon had mountains and valleys and craters. Jupiter had satellites. Venus changed size as it went through its phases. Our understanding of the Universe would never be the same. When the Hale 200 inch was built it was a new window into the Universe and amazing things were discovered. Edwin Hubble used it to discover that those mysterious nebulous objects were galaxies unto themselves and that they were millions of light years away. Our understanding of the Universe would never be the same. When the Hubble space telescope was launched it was a new window into the Universe and, needless to say, our understanding of the Universe would never be the same. If you haven't guessed by now, the new piece of equipment taken to the ISS by Endeavour is a new window into the Universe. And if the history of Astronomy has shown us anything, then our understanding of the Universe may be about to change.

The device is simply called the Alpha Magnetic Spectrometer (AMS) and it is essentially a big magnet with some electronics, and the stuff that it is designed to detect could prove the

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<http://www.rfo.org>

Public Viewing at Robert Ferguson Observatory

June 25, Saturday

Public Solar Observing noon – 4 pm
Public Observing Night 9 pm

July 30, Saturday

Public Solar Observing noon – 4 pm
Public Observing Night 9 pm

August 27, Saturday

Public Solar Observing noon – 4 pm
Public Observing Night 9 pm

September 25, Saturday

Public Solar Observing noon – 4 pm
Public Observing Night 8 pm

October 29, Saturday

Public Solar Observing noon – 4 pm
Public Observing Night 7 pm

Evening public viewing is \$3 per adult, 18 years or older, plus \$8 per car State Park fee. Donations accepted. Dress for cold nights! For current observatory information call (707) 833-6979.

RFO Classes (see Page 3)

Night Sky Summer Series

June 28 July 26 August 2 & 23

Night Sky Fall Series

September 20 & 27 October 18 & 25
November 22 & 29

Observing Labs:

June 26 September 23

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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 educational 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.

VMOA Board of Directors

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President's Message

by Colleen Ferguson



It's an exciting time for all of us that support the Robert Ferguson Observatory. It's exciting in very good ways – a dramatic new web site, a growing group of docents keeping the observatory buzzing with activity, a 40" telescope taking shape - and it's exciting in scary ways – potential park closure and all the uncertainty and activity that goes with that prospect.

Let's start with the good stuff. If you haven't been to the www.rfo.org web site lately you're in for a big surprise. Long time RFO docent and award-winning editor of Sonoma Skies (the newsletter of the Sonoma County Astronomical Society) Cecelia Yarnell launched RFO into a beautiful new web site in April. Many other docents contributed content, photos and ideas but I know we all agree that Cecelia is the one who made the site sparkle with dramatic color and aesthetic appeal. The site is so impressive that when we decided it was time for a new RFO brochure to replace the outdated blue-and white version I wanted it to essentially serve as an invitation to visit the web site. So Cecelia did an awesome job designing a new "rack card" style

brochure that is sure to turn heads and generate interest in RFO.

Some of these dramatic new brochures will go with George Loyer and several other docents to the State Parks rally in Sacramento. Please see the editorial written by George for more information about the proposed closure of Sugarloaf Ridge State Park. If you live in California, an easy way to support keeping parks open is to go to www.calparks.org and click on Take Action. The California State Parks Foundation will send a customized letter on your behalf to your elected representatives in Sacramento. The letters sent on my behalf may not change the decision to close the parks but sending them felt like the right thing to do. How can our elected officials do a good job representing us if we don't tell them what we want?

Meanwhile the amazing volunteers at RFO are continuing to do what they do best – sharing the universe with the community and getting rave reviews for doing so. One of our most active docents and Board members, Steve Smith, conducted research at RFO last winter that contributed data to an American Association of Variable Star Observers partnership with the Hubble Space Telescope. Steve was one of just 10 amateur astronomers whose data was accepted as part of this project. The star they imaged goes by the inauspicious name of Hubble variable number one, or V1, and resides in the outer regions of the neighboring Andromeda galaxy, or M31. Visit the Hubble Heritage Project site <http://heritage.stsci.edu/2011/15> to learn more and to see biographies of Steve and his prestigious colleagues. I'm impressed! Steve does an awesome job showing the sky to the local community; now he's put RFO on the map in an international way. Steve
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2011 RFO Summer & Fall Class Schedule

Night Sky Series

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, deep-sky objects, and visiting planets 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 24-inch reflecting telescope, until or beyond 10:30 pm (depending upon interest and enthusiasm).

The continuing Summer Series classes will be held on Tuesdays

Classes start at 7:30 pm on June 28, July 26, August 2 & 23

The upcoming Fall Series classes will be held on Tuesdays

Classes start at 7:00 pm on September 20 & 27, October 18 & 25, November 22 & 29

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

E-mail: nightsky@rfo.org to reserve a space in this popular class

Observing Labs

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

Handouts/Observing lists provided. Attendance limited to 6.

Fee: \$30.

For reservations, email: nightsky@rfo.org

Star Birth: Diffuse Nebulae, Star Formation, and Open Clusters

Sunday, June 26, at 8:30 pm [Raincheck date: Wednesday, June 29]

Star Death: The End of Stellar Fusion

Friday, September 23, at 7:00 pm [Raincheck date: Wednesday, September 28]

<http://www.rfo.org>

DPR Plans to Close Sugarloaf Ridge

An Editorial by George Loyer, Founding President of VMOA

Ruth Coleman, Director of the California Department of Parks and Recreation (DPR), announced in late May that to meet a \$23 Million budget cut mandated by Governor Brown she had ordered that 70 out of 278 State parks be closed by July 2012. At a June 10, 2011 legislative hearing held at Spring Lake Park by Assemblyman Jared Huffman (San Rafael) and Michael Allen (District 7 that includes Sugarloaf Ridge), Ms. Coleman described the decision making process the staff went through to choose the parks that would be closed. The most important criterion appeared to be the revenue that the park is bringing in, since each park closed removes that revenue from the DPR budget. Two-thirds of the DPR budget comes from its own revenues with the remaining third coming from the general fund where the cut was made. Further cuts will result in more park closures that increase the amount of lost revenue, until this approach collapses when revenues are not able to cover the reduced subsidy from the State. Most clearly she said that no matter what happens to the State budget, this budget amount will not be restored.

Despite this bad news, non-profits from around the state and individuals are lobbying their representatives to restore these funds. Individuals are writing letters to State Senators, State Assemblymen and to the Governor, pointing out the folly of saving this small amount of "budget dust" on the backs of the tottering State park system. Lobbying efforts will continue on June 21 at a California State Parks Foundation sponsored political rally and exhibit to be held on the North Lawn of the State Capitol at 10AM – 2PM. The State parks system has suffered repeated cuts in funding over the last 15 years, resulting in a \$1.3 Billion backlog of infrastructure capital work throughout the system and an expense budget situation where DPR has filled only 40% of its identified positions in order to keep all parks open. The lack of support by our elected representatives for the park system has quietly, silently driven the park system to the edge of collapse in the State. It will take years of lobbying and continuing work with

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Watching the 2011 Summer Sky

by Jack Welch

This summer our attention turns to *Neptune* as we celebrate the first anniversary of its discovery. “But wasn’t Neptune discovered 165 years ago?” you’re wondering. Yes ... counted in Earth years. But a Neptune year is 164.8 Earth years. This first Neptune year anniversary occurs on the afternoon of 7/12 when Neptune completes one full orbit since its discovery by us Earthlings. The 165th Earth year anniversary occurs on 9/23. Between these two dates, Neptune is at opposition in Aquarius on 8/22, when it is largest and brightest for telescope viewing. Even so, it will be a tiny blue dot 2 magnitudes dimmer than the dimmest naked eye star. RFO will celebrate this Neptune “birthday” at our public observing night on 8/27. Join us that evening to learn more about the interesting story of Neptune’s discovery.

Working inward through our solar system, *Uranus* is observable in Pisces during morning hours all summer, and all night by the start of fall when it is at opposition on 9/25. Uranus begins retrograde motion on 7/10.

Saturn is in the western evening sky during July, lower during twilight in August, and disappears into the setting sun in September. The moon is near Saturn on the evening of 7/7 (and near the bright star *Spica* the following evening). A crescent moon is near Saturn and *Spica* at 8pm on 8/31. The star is above the moon to the left and Saturn is above to the right.

Jupiter is very prominent in the morning sky this summer. By August it rises around midnight, and it begins retrograde motion on 8/30. The moon is near Jupiter at 2am on 7/24, at 4am on 8/20, and late on the evening of 9/16.

Mars is increasingly prominent in the predawn sky, rising around 4am in late June and around 2:30am by September. It moves from Taurus (July), through Gemini (August) and into Cancer (September). Look for the crescent moon between Mars and the *Pleiades* star cluster at about 4:30am on 6/28 (use binoculars to enjoy the cluster stars). Mars is near (slightly north of) the orange star Aldebaran at 4:30am on 7/6. Aldebaran will be half a magnitude brighter than Mars. It is interesting to compare the colors of these two objects. The *Pleiades* is again higher in the sky, and Jupiter is very bright and higher still. The crescent moon is near Mars at 4am on 7/27. Mars is near the bright open star cluster M35 at 4am on 8/6. The moon is again near Mars at 4am on 8/25 and 3:30am on 9/23.

Venus is at superior conjunction (far side of the sun) in August and so not viewable most of the summer. It vanishes into the sunset in early July and reappears in the morning sky during September, rising about 30 minutes before sunrise by the end of the month.

Mercury makes up for Venus’s absence by providing its best evening apparition of the year from about 6/23 to 7/28. It reaches maximum altitude (about 10° 30 minutes after sunset) on 7/8. Look for the crescent moon near Mercury starting around 9pm on 7/2 and 7/3. The 4% crescent is lower than Mercury on the 2nd and a 10% crescent higher than Mercury on the 3rd. (The next evening the crescent moon is near the bright blue star *Regulus* around 10pm.) Also, from 7/4 to 7/8 Mercury passes near the *Praesepe* star cluster (M44). Use binoculars to spot the cluster stars.

Mercury then provides a very good morning apparition from about 8/25 until 9/16. It reaches maximum altitude (nearly 11° 30 minutes before sunrise) on 9/4. Starting around 6am on 9/6 look for Mercury very near the bright blue star *Regulus*.

Three bright asteroids are at opposition this summer. The easiest to view will be *Vesta* which is at opposition on 8/5. Look for it about 2° north of the star *24 Capricorni*. At magnitude 5.6 it is a possible naked eye object and will be the brightest object in the field north of the star. *Pallas*, which is at opposition on 7/29, will be more challenging at magnitude 9.5 and about 2° south of *gamma Sagittae*. Finally, *Ceres* is at opposition on 9/16 at magnitude 7.6 near the star *2 Ceti*. (Detailed star charts are required for spotting these last two asteroids.)

The famous *Perseid Meteor Shower* peaks on the evening of 8/12, one day before the full moon. Thus, the bright moonlight will greatly obscure viewing of the meteors this year. The *South Delta-Aquarid Meteor Shower* may compensate somewhat since it peaks on the morning of 7/29, the day before the new moon. However, this shower only produces up to 5 or 10 meteors per hour, though it lasts for at least 8 days centered on the peak.

The official end of summer is the *Autumnal Equinox*, which occurs at 2:05am on 9/23 this year. A few days later on 9/27 the new moon will occur a mere 14 hours before perigee when the moon is closest to the earth, producing very large tides to start off the fall observing season. Stay tuned for the next issue of *Focused* for more!

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existence of dragons, unicorns and fairies. Well, not really. The stuff it is designed to detect is high energy particles and what it really hopes to find sounds almost as mythical and outrageous. It will be looking for the source of dark matter, strangelets, and antimatter galaxies. The fact that dark matter exists can hardly be debated these days. It has gravitation effects that we can clearly detect but we just don't have a handle on what it actually is. The AMS could give us vital clues. Strangelets are a bit more obscure. Everyday matter, the kind of stuff we interact with every day, is made up of subatomic particles, and as best as we can determine, the fundamental building blocks are quarks. Quarks come in a variety of flavors: up, down, top, bottom, strange and charm (some of them were discovered in the sixties). Our everyday matter is 'built up' from up and down quarks. Strangelets are blobs of up and down quarks with strange quarks, in roughly equal numbers, thrown into the mix, and at the moment are still hypothetical. The Large Hadron Collider (LHC) has the potential for creating strangelets and that is one of the ways in which the "Doom and Gloomers" say the LHC will destroy the world. It is hypothesized that any regular matter that comes into contact with strange matter gets instantly converted. You might say it becomes one with the strangeness. In any case, if there are strangelets wandering around out there they could provide science with a better understanding of microquasars and tiny, primordial black holes, and the AMS can detect them. And as for antimatter galaxies, if that doesn't equate to a dragon I don't know what does. Of course antimatter is nothing new. We've been creating it in the lab for decades. We know that antimatter and matter don't play nice together and will annihilate if they come into contact with each other. So how could an entire galaxy of the stuff exist in our universe of regular matter? The basic idea is that the Big Bang must have produced about the same amount of matter and antimatter. One of the latest theories suggests that for every billion antimatter particles, there were a billion *and one* matter particles, and that imbalance was enough. But there are those that wonder if maybe some clouds of antimatter survived out on the fringes and formed galaxies. If they were near enough we would see evidence of their existence because there would be some point in intergalactic space where solar and antisolar winds would collide and annihilate. But what if these antimatter galaxies were so far away that our current telescopes could not detect them via their electromagnetic radiation? They could be spewing out antihelium nuclei that could potentially survive a journey through intergalactic space and reach the AMS.

I know this sounds pretty fantastic but the man behind the project is Samuel Ting. In 1976 he won the Nobel Prize for the discovery of the J particle (now referred to as the J/Psi). If you go the Nobel Prize website and look him up you will see a list of awards too numerous to list here. He is a

member of several international physics societies and holds degrees from universities from around the world. The team he has put together for this project is as equally impressive, consisting of some 600 physicists from 56 institutions in 16 countries. After doing some reading about Samuel Ting one is left with the feeling that if anybody can create a device to detect antimatter galaxies it is Samuel Ting. The heart of the AMS is a big magnetic cylinder just a tad over a meter in diameter and 0.8 meter tall. It is made up of over 6,000 2x2x1 inch blocks of Neodymium-Iron-Boron magnets. At the entrance to the cylinder is an incoming detector, and at the exit is an outgoing detector. These detectors are so sensitive they can track a particle traveling up to 98% the speed of light. To put that into some sort of perspective imagine a stop watch that starts when a particle hits the starting line and then stops when that particle reaches the finish line 0.0000000015 seconds later. In between the incoming and outgoing are a series of devices to determine the mass of the particle, what type of particle it is (electron, proton or positron), the charge of the particle and how much energy the particle has. The AMS has been bolted on to the ISS. It needs to be in space because the Earth's atmosphere absorbs most of the charged particles the AMS team wants to detect. During its lifetime, the AMS will detect countless numbers of particles. Most of them will be expected, already known about high energy charged particles but as Mr. Ting puts it: "The most exciting objective of AMS is to probe the unknown – to search for phenomena which exist in nature that we have not yet imagined nor had the tools to discover."

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also recently coordinated a training session at RFO by astrophotographer Ken Crawford. Ken Crawford's images have been featured in numerous magazines, books, websites, movies, and public displays. Ken loves to show how amateurs achieve professional results combining art and technology by giving invited talks throughout the country. You can see Ken Crawford's images at his website www.imagingdeepsky.com. Nineteen amateur astronomers and RFO docents participated in the intense image processing session on June 8.

After an extended training period dodging spring storms the new docent class of 2011 graduated on April 6. Congratulations to new and returning docents Jim DeManche, Mike Dranginis, Michael Eckstein, Ted Judah and Christopher Myers. It's great to see many of these graduates actively volunteering.

A lot of people learn about RFO through word of mouth from others who have had a wonderful experience at the observatory. But in case there are people out there

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The Universe Walk

By Loren Stokes

Most of us are familiar with the Planet Walk located near the RFO in Sugarloaf Ridge State Park. The Sun and planets are scaled to fit within the park's boundary. The Sun's diameter is about two feet, and the dwarf planet Pluto is located near Brushy Peak 1.5 miles distant.

Now imagine a scale model of our observable universe whose edge is roughly 13.7 billion light years distant. Let's place that edge at Brushy Peak. Our Milky Way galaxy is 100,000 light years across. 13.7 billion light years is 137,000 times the size of our galaxy. The 1.5 miles to Brushy Peak is about 7,900 feet, or 95,000 inches. Dividing this by 137,000 gives the size of the Milky Way in our model: 0.7 inches, the diameter of a dime. So if our Milky Way galaxy was the size of a dime, our observable universe would extend 1.5 miles to Brushy Peak. That is a vast distance compared to a dime, but certainly not infinite. I can hold up a dime next to the Sun and see the Brushy Peak ridge easily. (To see Brushy Peak itself, you need to walk to the parking lot by the horse stable).

In our scale model, the Andromeda galaxy, located 2.5 million light years away, is 18 inches from our dime. The Virgo Cluster of galaxies, located 54 million light years away, is 32 feet from our dime. The brightest visible quasar, 3C 273 located 2.4 billion light years away, is 1,400 feet from our dime, about a quarter mile.

The most distant thing we can observe today is the Cosmic Microwave Background Radiation (CMBR). When the universe was only 380,000 years old, its temperature had cooled to 3,000 kelvins. This allowed neutral atoms of hydrogen and helium to form. Previously, the radiation emitted from the hot primordial plasma was scattered by free electrons. The neutral atoms allowed the radiation to pass unimpeded. This black body radiation had a temperature of 3,000 kelvins and a peak emission wavelength of 1 micron (1,000 nanometers) in the near infrared. The radiation we observe today has a temperature of just under 3 kelvins and a peak emission wavelength of a bit more than 1 millimeter.

This CMBR has cooled by a factor of nearly 1,100 and increased in wavelength by this same factor. This is the red shift of the CMBR. Since the radiation was emitted, the universe has expanded by this same factor. The radiation has been traveling for nearly 13.7 billion years. Today, the atoms that emitted the radiation are around 46 billion light years away. How far away were they when they emitted the CMBR? 46 billion light years divided by 1,100 gives

just 42 million light years. The atoms were closer to us than the Virgo Cluster is today, 26 feet in our model. Yet it took nearly 13.7 billion years for the CMBR to reach us through the ever-expanding space.

Einstein's Theory of Special Relativity states that all laws of physics are the same to anyone moving at a constant velocity (not accelerating). Further, there is no absolute zero velocity. One velocity is just as valid as another. The Milky Way and Andromeda galaxies are moving towards each other, and the pair is hurtling towards the Virgo Cluster, but the laws of physics are the same for all.

However, the CMBR is different in that there is a unique velocity through space where the CMBR is neither red- nor blue-shifted in any direction by the Doppler effect. The peak wavelength of the CMBR would be the same looking in any direction of the sky. (This is not the case as seen from Earth). Although the laws of physics don't change, there does appear to be a unique velocity after all, one that can be called absolute zero velocity.

Next time you stand in front of the Planet Walk's Sun hold up a Milky Way dime and look up to the Brushy Peak ridge to get a feeling of the vast (but not infinite) scale of our observable universe. How much larger is the universe beyond which we cannot observe? According to Inflation theory, it must be much, much larger to explain why our observable universe appears so flat and homogeneous.

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those representatives to reverse this steady decline and to rebuild what has been lost already.

Director Coleman also outlined what she meant when she said the parks will close. She says that park gates will remain open, but closed parks will no longer be supported with services like water supply management, trash removal, law enforcement, sanitation services and campground management. Parks "closed" in this way will be monitored, she hopes, by watchful citizens who will report problems in the parks caused by the lack of these services. She also stated that she is looking for alternative management proposals that could be implemented temporarily or permanently to take over these parks from DPR.

Assemblyman Huffman has sponsored A.B. 42 which makes it possible for non-profit organizations, in limited circumstances, to take over management of parks that are scheduled to be closed. It has been passed in the Assembly, and is now going through the process that will bring it to a

vote in the Senate. Few non-profits are prepared, however, to take over such a large operation (including the VMOA). Director Coleman and Sonoma County Regional Park Director Caryl Hart both suggested at the Spring Lake legislative hearing that joint management proposals from county and city governments, non-profits, philanthropy, and private business organizations will likely be necessary to make workable proposals for these parks.

The VMOA board is gathering information from DPR park management on expenses and revenues associated with Sugarloaf Ridge, and is investigating proposals that would take advantage of the campground as a privately-managed revenue source and the park's proximity to the Hood Mountain Regional Park managed by Sonoma County. In addition, the board has already made informal agreements with local DPR management for RFO to continue to operate "special events" in a "closed" park, allowing public observing, private group reservations and VMOA operations and activities undertaken by docents at the observatory. In support of those efforts, Caryl Hart is also taking the lead with LandPaths and other non-profits and governmental groups to create a Sonoma Parks Alliance that will support efforts to create joint organization agreements and to chart a path for continuing growth of parks as envisioned by LandPaths and others.

This is a difficult time for Californians and for the park system and other common-good institutions in our State. Citizen participation in the structure of the solutions will be essential to setting priorities as we see they must be. When we built the observatory, we envisioned it lasting for 50 years or more. It won't do that by remaining the same – change will come, and we will bring some of it. In the end, ours will be a stronger organization and will continue to serve our community with increasing effectiveness.

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who haven't heard about RFO yet, Jim DeManche is making sure that anyone who is connected online and interested in astronomy knows about RFO through Facebook, Yahoo, Meetup and Twitter. For those who prefer to spend an evening strolling through the Downtown Market on Wednesday nights in Santa Rosa, docents staffed a booth promoting RFO and the Sonoma County Astronomical Society on May 11 and June 8. The star of the show was Rob Davis with his telescope focused on the moon and a line of folks waiting for a view. It's encouraging to hear the people that stop by the booth, look at the model and say "hey, I've been there" and then start telling us about their experience. But we still get quite a few who say "What observatory?" which makes the time

at the market worthwhile. This year we also got to promote the Smithsonian Institution's *Beyond: Visions of Planetary Landscapes* exhibit at the Petaluma Museum during those two nights at the market. If you're local and haven't yet been to the exhibit you don't have much time since it ends July 4. As described on the museum's web site, "the exhibit paints a rarely seen and mesmerizing portrait of our solar system's diverse worlds and their moons" and shouldn't be missed. Through the duration of *Beyond*, Len Nelson and other volunteers are showing the sky to museum visitors and promoting RFO.

Meanwhile plenty of people have been coming to RFO for Night Sky classes, for private events and for public viewing on clear days and nights. The last clear public night of the semester brought lots of local students to RFO for class credit at their school. So with all this wonderful activity going on at RFO and the observatory being promoted in many ways, I'm hoping and working with others towards a positive outcome to the State Park closure situation. Whether or not the park is closed, the observatory will be open and continuing to "provide educational programs about science and astronomy for students, the public and in support of educators" per the VMOA mission statement. Summer is here and the skies are bound to be clear for many months. Keep looking up!



RFO booth at Santa Rosa Downtown Market

Valley of the Moon Observatory Association

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