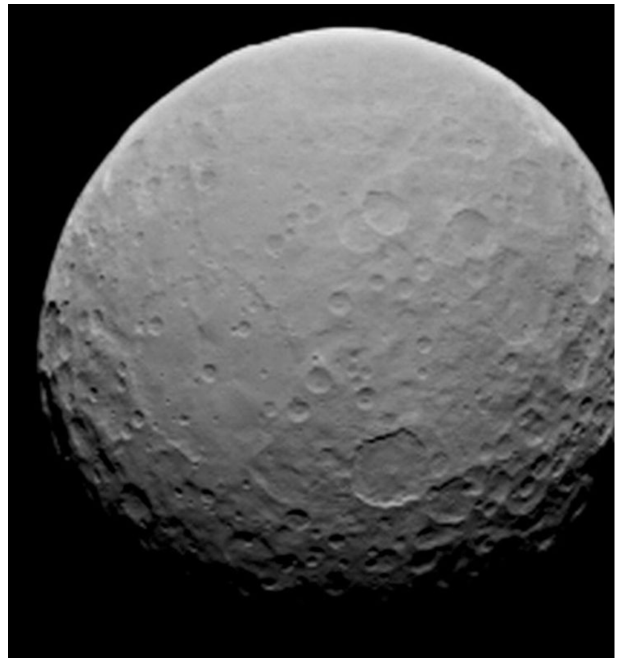
Temecula Valley Astronomer

The monthly newsletter of the Temecula Valley Astronomers May 2017

Events:

General Meeting : Monday, May 1, 2017 at the Temecula Library, Room B, 30600 Pauba Rd, at 7 pm. Skip Southwick will present "What's Up", Clark Williams will present a short "IFI" and Steve Thornton will give a talk about the Lowell Observatory. Refreshments by Chuck Dyson.

For the latest on Star Parties, check the web page.



PIA19183: Views of Ceres on Approach - Feb. 19, 2015 . Credit NASA/JPL.

WHAT'S INSIDE THIS MONTH:

Send newsletter submissions to Mark DiVecchio <markd@silogic.com> by the 20th of the month for the next month's issue.

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General information:
Subscription to the TVA is included in the annual $25 membership (regular members) donation ($9 student; $35 family).

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Cosmic Comments – May/2017
by President Mark Baker

I am one who truly believes Mankind's destiny is an off-planet one. And as an American, the last ten years have left both NASA and I on the short end of things. The best thing to come out of the decade is the development of commercial spaceflight enterprises. And yes, the USA still holds the technological edge over other countries and entities as evidenced by the successes of the current robotic Missions throughout the Solar System. But these were all in the planning stages before this last decade… IT has provided no Missions of true value for the future.

Other countries and commercial venues are now the ones pushing the envelope to get MAN out there. The way things are going, and regardless of who gets "there" first, the USA will more than likely be paying for parking in orbit, and rent on any surface space it is allocated…!!!

BUT… I'm heartened of late to see so many scientists stepping "outside the box" in the specific area of propulsion. I catch Deborah giving me odd looks and sidelong glances as I analyze related mathematics and observe discussions and videos that dig deep into this subject. We can no longer be Neanderthal in our approach to moving things…we have got to STOP BURNING THINGS!!! Warp drives, Alcubierre engines, and the promising EMdrive, all put the USA back in the forefront, but only if we acquire the technology first…and there is serious competition to prevent that.

The prize for success is beyond Humanities wildest dreams… even the Solar System becomes just a small step for Mankind, the Galaxy a Sunday jaunt, and the Universe an extended cruise!!! True, the mathematics need some tinkering with, especially related to energy sourcing, but I'm confident that humans will make it so… it is their destiny!!!

And yes, the TVA helps the process along by piquing the interest of our local students, teachers, parents, and general communities. One person may someday crack the barrier, but all people will benefit from that singular success.

Clear, Dark Skies my Friends…

Looking Up – May 2017
by Curtis Croulet

First Quarter Moon is May 2 at 7:47 PM PDT; **Full Moon** is May 10 at 01:42 PM PDT; **Last Quarter Moon** is May 18 at 5:33 PMPDT; **New Moon** is May 25 at 12:44 PM PDT.

Mercury is too close to the Sun to be observed.

Venus is in the morning sky. It is brightest on the morning of April 30. Then it dims slightly from mag -4.7 to -4.5.

Mars remains in Taurus the entire month. It is low in the southwest at sunset, getting lower by the day. Mars is too tiny and too low in the sky for observation. It dims even further from mag +1.6 to +1.7, and it shrinks from 3.9 to 3.7 arc sec.

Jupiter is now in prime position for observing in the evening sky. It's up most of the night.

Saturn rises in late evening. It rises a bit before 9 PM at the end of the month. Opposition is June 14. The ringed planet is now in retrograde motion, moving westward among the stars.

Uranus is still unobservable. **Neptune** is in the pre-dawn sky, in Aquarius.

Pluto is a morning object in northeastern Sagittarius.

A minor meteor shower, the **Eta Lyrids Meteor Shower,** occurs between May 5 and 12. Peak is May 10.

Let's look up.

That bright star in the northeastern sky as darkness falls is Arcturus. When I was learning my stars in the 1950s, the appearance of Arcturus in the evening sky was a welcome sign that we were heading into the warmer, drier season. It's rather hard to miss Arcturus these days, but a phrase some people use to find it is "arc to Arcturus, spike to Spica." That means to follow the curve of the Big Dipper's handle to find Arcturus, and then shoot a straight line to Spica down in Virgo. As we get into summer, and Vega, Deneb, and Altair come into the sky, this phrase may help to sort out the bright stars.

Arcturus is in the constellation Boötes. The constellation is properly pronounced "boh-oh-teez." Those two little dots over the second "o" are called a dieresis, and they tell you that the second vowel is to be pronounced separately. I once lived in a neighborhood in San Diego where Boötes was the name of one of the streets. The street signs omitted the dieresis. Everybody pronounced the street's name as "boots." It looks to me like the word "dieresis" also needs a dieresis, but I don't recall ever seeing it with one. I digress.

The name Arcturus derives from its Greek name *Arctouros*, which derives from the Greek word *Arktos*. Our word Arctic derives from *Arktos*. But it doesn't mean "north." *Arktos* means "bear." I'm not sure that the Greeks knew about polar bears. The reference is to the constellation we call Ursa Major (from Latin), the Great Bear. Boötes is a herdsman who is guarding his flock from the bear. His "flock" is all of the other constellations. What we Americans call the Big Dipper is an asterism that is part of Ursa Major. In some cultures the bowl of the Big Dipper was the bear, and in some cultures the three stars that form the handle of the Big Dipper are hunters pursuing the bear. The constellation Canes Venatici, the Hunting Dogs, represents dogs that belong to the hunters.

At magnitude -0.05, Arcturus is the fourth brightest star in the night sky. Some older books list it as sixth, but its brightness was reevaluated several years ago with data from the Hipparcos satellite. For people who live north of about 37 degrees north latitude (about the latitude of, say, San Francisco), Arcturus is the second brightest star in the night sky, after Sirius. They are too far north to see Canopus, which for us is a familiar sight in the far south on mid-winter evenings.

Arcturus lies at a distance of about 37 light years. In the 1930s it was thought to be 40 light years away. To open the Century of Progress International Exposition in Chicago in 1933, light from Arcturus was focused on a photo-electric cell to generate current to flip a switch to turn on the lights to open the exposition. Arcturus was chosen because its light was believed to have begun its journey during the World's Columbian Exposition of 1893, 40 years prior to 1933.

Arcturus is about 20 times larger than the Sun. Arcturus is a class K2 III star, which makes it cooler than the Sun. I am personally, certifiably, color-blind. Some colors that most people see as distinct are confusingly similar to me. Therefore, I approach the matter of Arcturus's color with some trepidation. I can say that many books and observers describe it as orange. Robert Burnham Jr., in his classic *Burnham's Celestial Handbook*, describes Arcturus as "golden yellow or 'topaz.'" Apparently some people have described it as reddish.

Arcturus has some interesting properties. Since the Sun and the Solar System lie on the inner edge of the Orion Arm of the Milky Way Galaxy, we should expect most of the stars in our vicinity to be Population I stars. Population I stars are "young" stars, relatively rich in "metals." In astronomy, "metals" are all elements heavier than helium. I know, that's not what you learned in chemistry class. But Arcturus is a Population II star, which means it's an "old" star, formed before the interstellar medium had been enriched with "metals" by exploding supernovae. In the Milky Way, Population II stars are mostly in the core of the galaxy. So why is Arcturus here?

Well, there's another piece of the puzzle. Arcturus has, for its distance, a rather large "proper motion." It's moving in relation to the background stars. Arcturus moves 2.29 arc seconds per year, which accumulates to more than a degree in 2000 years. Arcturus has an orbit about the galactic center that is contrary to the orbits of most Milky Way stars. There's a hypothesis that Arcturus originated in another galaxy that collided with the Milky Way. I should point out that Arcturus's motion has brought it about as close to the Sun as it will ever be.

Clear skies.

Random Thoughts
by Chuck Dyson

The Rockets of NASA

As I write the Thoughts for this month, the space probe DAWN is slowly changing its orbit plane over the dwarf planet Ceres. By the time you read this the probe will be orbiting between the Sun and Ceres and this will allow it to best observe the bright spots that are on the surface of Ceres.

Turns out that the bright spots (faculae) are composed mostly of carbonate salts and are thought to be about 800 million years old; this is an indication that Ceres is still active or is rendered active by asteroid impacts. You should also know that Ceres is not Dawn's first port of call and may not be its last. When Dawn was launched in 2007 the space craft weighed in at 1217.7 Kg. of which 747Kg. was the probe itself and 471.6 Kg. was fuel for the main engine and the attitude control thrusters (In spacecraft, unlike children, attitude control means point this way, not stop that right now!) and what about the science package you know the stuff that actually does the work, the reason we sent the space probe out there in the first place. The Dawn science package is a whopping 35.25 Kg. Am I sure of my numbers? Yep! It is always shocking to find out just how small space probes are compared to the size of the rockets that get them into space. When you consider that the launch weight of the Dawn rocket was 321,900 Kg. it is shocking to find out that the science package is only 0.00015% of the launch weight but if you look at the weight of the entire probe, all 1217.7 Kg. of it then things get a little better and the percentage goes to 0.0052% of the launch weight. For comparison, when the average person gets into the average SUV then he or she represents a payload that is 0.057% of the total vehicle weight and fully loaded the average SUV will move a payload that is equal to about 30% of its total weight; so, what gives here?

First of all the SUV is staying on the ground and not lifting the payload and itself; secondly the SUV is only carrying fuel and not the oxidizer needed to get the fuel to burn and do work (the SUV uses the oxygen it gets from the air, big weight savings); thirdly we often take the old SUV for trips without enough gas to get us there and back. Our rocket however must have at least enough "gas" to get into orbit as NASA has seen fit to not build any gas stations between earth and orbit and the obvious advantage of being in orbit is you do not need gas to come home as you merely wait until your orbit decays over time and have an uncontrolled reentry (think opportunity to roast weenies, marshmallows, and experience the Mother of all Landings).

To understand a little more about why our science payloads are so small let's look at actual rocket lifting capability. The Delta IV is NASA's big lifter at this time and it will put 28,790 Kg. into LEO (low earth orbit) and that is an altitude of 350 to 450 Km. and that is where the space station hangs out. The same rocket configuration will place 14,220 Kg. into GTO (geosynchronous transfer orbit). This is an orbit that has perigee at about 400 Km. but has apogee at 35,786 Km. over the equator and when the space craft is at apogee the engines are fired again and the spacecraft is given a boost that will place it in an elliptical orbit to another body (Moon, Mars) and this is called a Hohmann transfer orbit, notice that the higher that we go the less we can lift. Next if we have the same rocket place a satellite into a GEO (geosynchronous orbit) our maximum weight is 6,750 Kg. This is a perfectly circular orbit over the earth's equator at 35,786 Km. and is used for communication satellites but note that as our orbit is higher still the payload is smaller still.

We don't want our little DAWN space probe to go just 30,000, 60,000, or even 1,000,000 Km. we want our probe to go more than 600 million Km. and do a lot of maneuvering. It is time to tell our chemical rockets to move over and say hello to our ion rocket engine. Why do we want an ion engine? In the world of rocket engines specific impulse is everything and specific impulse is how much push you get out of each kilogram of fuel. A chemical rocket burns fuel at a very high rate and this gives it a lot of thrust even though its specific impulse is on the low side of things. The ion engine "burns" fuel at a very slow rate but has a very high specific impulse; so, for only a little fuel, the ion engine gets a big push, sort of. The two stages of chemical rockets that put DAWN into orbit each burned for about 280 seconds, consumed several metric tons of fuel, and produced many Kilo-Newtons of thrust. The ion engine will operate for 2000 days, consume 424 Kg. of fuel, and will produce about two hummingbirds of thrust. It is this little thrust over long periods of time that enable DAWN to match orbits with an asteroid, go into orbit around it, change the altitude and plane of the orbit, and eventually exit the orbit and go on to another target and do the whole thing over again.

Another space probe that has been in the news lately is the New Horizons. The New Horizons probe is much smaller than DAWN and was launched on top of a much bigger rocket because when you are going to Pluto the need, the need is for speed. The New Horizons probe had only chemical reaction thrusters on it because when it was doing the Pluto fly by, the probe needed to change attitude and orientation quickly and ion thrusters would be much to slow to get the job done. There was a price to pay for the chemical thrusters on New Horizons as the fuel weight was 77 Kg and the science package was 30 Kg. It seems then that we have two types of engines, big thrusters, big fuel gulpers, and little thrusters, little fuel gulpers (ion engines can produce big thrust but to do so they need an unholy amount of electricity).

Is there no other option? Well, in my best Star Wars, yes young Jedi but it comes from the dark side of the energy world. In the 1960's and the 1970's several engineering groups designed, built, and tested atomic rockets; however, by the 1980's public opinion being what it was, the projects were canceled here in the U.S.A. at least, but it appears to be a different story in the Soviet Union. Now, perhaps spurred on by the Soviet progress in this area, the US has started the nuclear thermal rocket project. The Nuclear Thermal Propulsion (NTP) spacecraft will operate only in space, will have a specific impulse that is two to three times greater than chemical rockets, and will basically ferry men and material between planets, a space tug. Look for riots in Berkeley when they get wind of this one.

If you would like to know more about rockets and their design or if this article has thoroughly confused you and you would like some clarity please feel free to visit the following web sites:

Index of rocket slides: This is NASA's intro to basic rockets and to how they work and how to calculate flight paths and orbits.

Engine list of Atomic Rockets: A light hearted approach to a very serious look at how atomic and ion engines work. Light hearted yes, but the author is very serious about his math, consider yourself warned.

Nuclear Thermal Propulsion (NTP): A Proven Growth Technology for Human NEO/ Mars Exploration Missions: A very serious and very comprehensive paper.

Basics of Space Flight: Do you want to set up your own space program? This program will absolutely get you started.

Cheers
Chuck

Observations
May 2007

By Curtis Croulet

I want to thank all of those who brought scopes and helped with the goto telescope demo last month. It was a lot of fun. I learned some things, and some people were probably content simply to enjoy the views of Saturn and the Moon.

Thank you also for helping with the Astronomy Day star party at Santa Rosa Plateau Ecological Reserve on April 21 and at Thompson Middle School on April 27. I was unable to attend the Thompson event but it appears that we had a good turnout of scopes. Thank you to everybody for coming through for these events.

To my sorrow, I can't tell you what our May program will be. We've been trying desperately to get confirmation from JPL as to whether they will or will not come. As of this moment, I don't know.

In any event, I do hope you'll turn out at the usual place.

NOAA's Joint Polar Satellite System (JPSS) to monitor Earth as never before

By Ethan Siegel

Later this year, an ambitious new Earth-monitoring satellite will launch into a polar orbit around our planet. The new satellite—called JPSS-1—is a collaboration between NASA and NOAA. It is part of a mission called the Joint Polar Satellite System, or JPSS.

At a destination altitude of only 824 km, it will complete an orbit around Earth in just 101 minutes, collecting extraordinarily high-resolution imagery of our surface, oceans and atmosphere. It will obtain full-planet coverage every 12 hours using five separate, independent instruments. This approach enables near-continuous monitoring of a huge variety of weather and climate phenomena.

JPSS-1 will improve the prediction of severe weather events and will help advance early warning systems. It will also be indispensable for long-term climate monitoring, as it will track global rainfall, drought conditions and ocean properties.

The five independent instruments on board are the main assets of this mission:

> The Cross-track Infrared Sounder (CrIS) will detail the atmosphere's 3D structure, measuring water vapor and temperature in over 1,000 infrared spectral channels. It will enable accurate weather forecasting up to seven days in advance of any major weather events.
>
> The Advanced Technology Microwave Sounder (ATMS) adds 22 microwave channels to CrIS's measurements, improving temperature and moisture readings.
>
> Taking visible and infrared images of Earth's surface at 750 meter resolution, the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument will enable monitoring of weather patterns, fires, sea temperatures, light pollution, and ocean color observations at unprecedented resolutions.
>
> The Ozone Mapping and Profiler Suite (OMPS) will measure how ozone concentration varies with altitude and in time over every location on Earth's surface. This can help us understand how UV light penetrates the various layers of Earth's atmosphere.
>
> The Clouds and the Earth's Radiant System (CERES) instrument will quantify the effect of clouds on Earth's energy balance, measuring solar reflectance and Earth's radiance. It will greatly reduce one of the largest sources of uncertainty in climate modeling.

The information from this satellite will be important for emergency responders, airline pilots, cargo ships, farmers and coastal residents, and many others. Long and short term weather monitoring will be greatly enhanced by JPSS-1 and the rest of the upcoming satellites in the JPSS system.

Want to teach kids about polar and geostationary orbits? Go to the NASA Space Place: https://spaceplace.nasa.gov/geo-orbits/

Caption: Ball and Raytheon technicians integrate the VIIRS Optical and Electrical Modules onto the JPSS-1 spacecraft in 2015. The spacecraft will be ready for launch later this year. Image Credit: Ball Aerospace & Technologies Corp.

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