The Denver
OBSERVER
MARCH 2014

MARCH ON TO SPRING!!

THE NEEDLE GALAXY (NGC 4565) IN COMA BERENICES

As large and bright as many Messier objects, the spectacular edge-on Needle galaxy is aligned perpendicular to the Milky Way at a distance of about 40 light-years. It was discovered by William Herschel in 1785. The Needle Galaxy can be found in Coma Berenices. The companion galaxy NGC 4562 is a challenging object for larger telescopes. This image was acquired April 21, 2012 at the DAS EGK Dark Site by Darrell Dodge, using a modified Canon 450D DSLR camera through a C11 on CGE, RGB 22x300s (110 minutes).

Image © Darrell Dodge

Calendar

1.....New moon
8.....First quarter moon
9..... Daylight Saving Time Begins
16.....Full moon
20 ..... Vernal Equinox
23..... Last quarter moon
30.....New moon

Inside the *Observer*

MARCH SKIES

by Dennis Cochran

My astrological sign, Gemini, is visited by **Jupiter** this month, and then by the moon on the 10th. Procyon, the brighter of the two stars that make up Canis Minor, shines just to the south. This celestial landmark has a magnitude 11 white dwarf companion. Can you see it? And as for the "sign" stuff, is it true that all of our birth dates have migrated to other signs in the last two thousand years and the astrologers don't know it? What will we do? Aieeah!

The only other planet of note in the evening is **Mars**—he rises at 10 P.M. and comes up earlier and earlier as the month progresses. It becomes an all-night object by April. He brightens as he advances by more than a factor of two; by the end of the month Mars will be almost as bright as Sirius. It will take large scopes, however to see the tiny pinpoints of light flying in formation off of its surface towards the Earth, bristling with ray guns (younger readers may not know that a ray gun is a staple of early science fiction; think of "laser" for a synonym). Unfortunately, I seem to be the only person who can see them. Anyway, the March *Sky & Telescope (S&T)* has Mars observing information on pages 50 and 54.

S&T's Sue French writes about western Gemini on the magazine's page 56, including the not-to-be-missed **M35** globular cluster at $6^h\ 11^m$ +24°—while I will mention the eastern part. Open star clusters abound in the Gemini region, such as **M44, M46, M47, M48, M50** and **M67** (up in Cancer west of the α (alpha) star at $8^h\ 45^m$ +12°). M44 is the famous Beehive Cluster in the heart of the Crab just north of the meeting of its three lines of stars, but the others are

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PRESIDENT'S MESSAGE

by Ron Hranac

It's fair to assume that most members of the Denver Astronomical Society enjoy observing a variety of nighttime objects—and occasionally our nearest star, the Sun, during daylight hours—using a telescope or maybe even binoculars. Some enjoy astrophotography. And it's hard to argue with just sitting back to enjoy the view of a clear, dark night sky without any optical aid. But what do all of these have in common? They all involve observing or photographing a tiny sliver of the electromagnetic spectrum: that of visible light.

Professional astronomers don't limit their work to just the visible light portion of the spectrum. Indeed, there is a lot to observe outside of the realm of visible light; think radio waves through x-rays and even gamma rays. The non-visible wavelengths have a lot to tell about the nature of the universe. Unfortunately, it's pretty difficult or even impossible for the average amateur astronomer to conduct observations much beyond visible wavelengths. Or is it?

Have you ever considered radio astronomy? Before you start wondering if my caffeine levels have slipped to dangerously low levels, let me emphasize that you don't need the Karl G. Jansky Very Large Array or even the Robert C. Byrd Green Bank Telescope in your backyard to enjoy radio astronomy.

If you have a shortwave radio and a decent outside antenna (one made of wire will do), you already have the equipment for basic radio astronomy. Many high frequency (HF) ham radio transceivers include general coverage receive capability, which is ideal for radio astronomy in the shortwave spectrum. I've been a ham operator since the mid-1970s, and have occasionally used my ham equipment for casual radio astronomy. The Sun and Jupiter are both big radio transmitters of sorts, and some of their emissions can be heard on a shortwave radio or general coverage HF transceiver.

DAS President Ron Hranac during Solar Day at the Denver Museum of Nature & Science.
Image courtesy of Jeff Tropeano

Jupiter, for instance, is a source of radio signals known as decametric emissions in the roughly 5 MHz to 40 MHz portion of the spectrum. Amateur radio astronomy buffs listen for Jupiter's emissions in the vicinity of 20 MHz. The latter is within the reach of most shortwave radios, and high enough in frequency to avoid interference from many shortwave broadcast

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DAS SCHEDULE

MARCH

28-2 EGK Dark Sky weekend
8 Open House (Begins at 6:30 P.M.) International Sidewalk Astronomers Night
15 DAS Annual Banquet at Embassy Suites (Begins at 5:30 P.M.) Installation of Officers (See Page 6).
17 St. Patrick's Day
21 E-Board Meeting at Chamberlin (Begins at 7:30 P.M.)
28-30 EGK Dark Sky weekend

APRIL

8 Open House (Begins at 8:00 P.M.) *Jupiter and Mars!*
11 DAS General Membership Meeting at Olin Hall (Begins at 7:30 P.M.). Speaker: Dr. John Spencer (See back page)
14 Passover begins at sundown
18 E-Board Meeting at Chamberlin (Begins at 7:30 P.M.), Good Friday
20 Easter
25-27 EGK Dark Sky weekend

Open House costs: If the skies are clear, $2 per person ($5/family), and $1 per person in the event of inclement weather.
Public nights are held at Chamberlin Observatory every Tuesday and Thursday evenings beginning at the following times:
March 10 - September 30 at 8:30 P.M.
October 1 - March 9 at 7:30 P.M.
Costs to non-members are: $3.00 adults, $2.00 children.
Please make reservations via our website (www.denverastro.org) or call (303) 871-5172.

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The Executive Board conducts the business of the DAS at 7:30 p.m. at Chamberlin Observatory. Please see the Schedule of Events for meeting dates. All members are welcome.

www.denverastro.org

MARCH SKIES

(CONTINUED FROM PAGE 1)

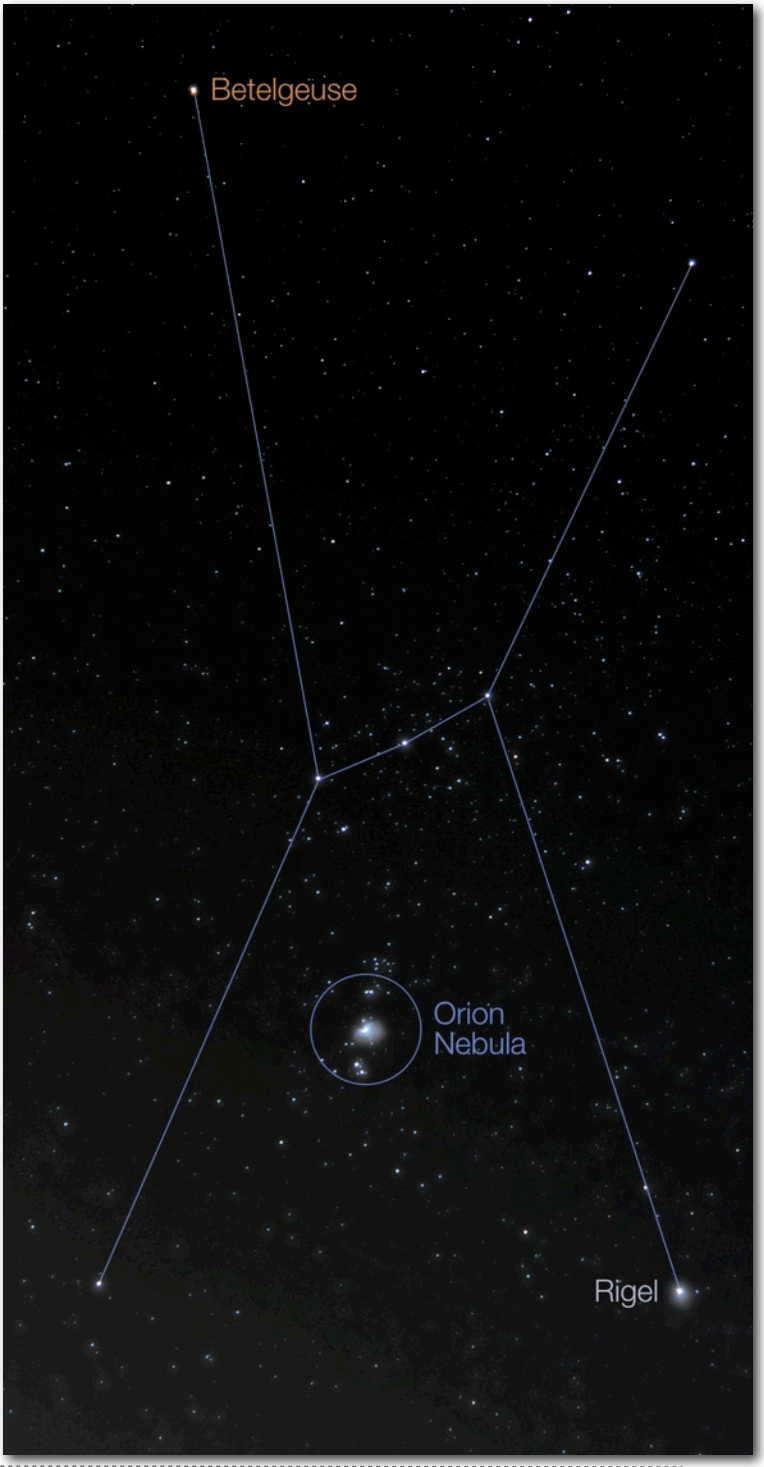
part of the environment south of Canis Minor in the region of Monceros, Canis Major and Puppis. Nothing much happens in Canis Minor itself.

Some coordinates: M47 and M48 are on either side of 7^h 40^m -15° (M48 is in the middle of nowhere at 8^h 15^m -6°), M50 is at 7^h 3^m -8°, **NGC 2506** is at 8^h 0^m -11° and **NGC 2539** is at 8^h 12^m -13° in Puppis. M44 you can find by eyeball. While you're looking at M46 and M47, slide straight south of M46 to -18.5° to find the planetary nebula **NGC 2440**. This object may require higher power.

A nebulous patch, **IC 2177,** on the Monoceros-Canis Major border has two more open clusters **NGC 2335** and **NGC 2343**, all of them around 7^h 9^m -11°. Now, move over to **M42** in **Orion's** sword—or scabbard—the major attraction of the region (it's famous as a star nursery), where you'll notice **M43** right above M42. It looks rather like a samurai's topknot. Directly south of that complex of glowing gas and dust is the **ι (iota)** star of Orion, a double whose companion is faint and hard to see. Another double is **η (eta)**; to find it run up the three stars of the belt and then back down an imaginary belt on the west side to η (eta) at 5^h 25^m -2°. Next, ooze down to **Rigel**—just west of it is the Witch Head Nebula. And don't forget the small and hard to see Horsehead Nebula, part of **IC 434** right under the ζ (zeta) star at the southeast end of the belt.

We will be switching to **Daylight Saving Time** on March 9, and we will spring forward with our clocks. And for you crazy dawn people, **Venus** will be next to the crescent moon on the 27th: **Photo op!** Don't wake me up, please.

A gear note: are Ritchie-Chretiens (R-C) the newest fad? They have been so expensive that they are usually found in permanent observatories. Now one sees ads for (barely) affordable ones, and once the Chinese get into full gear they may become as ubiquitous as Schmidt-Cassegrains once were. Although R-Cs are primarily for imaging, maybe someone will make one that is about f/10 and has a smaller secondary, for us primitive visual observers. As we prims like to say, "Unh-ukuk-gbgm-staz!" while we gesture with our hairy hands to the sky. ★



A HUNTER IN THE SKY

This constellation shot was made by Sorin with a Canon T3i using an EF-S 18-55mm IS II lens @ 55mm. He made a stack of 18 x 20 second exposures, ISO 800 with an overlay of the constellation. See more of his photos at *http://soggyastronomer.com.*

Image © Sorin

WELCOME NEW DAS MEMBERS!

Lisa Baca	David Grant
John Banks	Kate Hall
Josie Brodie	Lindsey Shaw
Julie Candia	Ramprakash Surulirajan
Vathana Crye	Alexanda Witze
Isaac Fluss	

ABOUT THE DAS

Membership in the Denver Astronomical Society is open to anyone wishing to join. The DAS provides trained volunteers who host educational and public outreach events at the **University of Denver's Historic Chamberlin Observatory,** which the DAS helped place on the National Register of Historic Places. First light at Chamberlin in 1894 was a public night of viewing, a tradition the DAS has helped maintain since its founding in 1952.

The DAS is a long-time member in good standing of the **Astronomical League** and the **International Dark Sky Association.** The DAS's mission is to provide its members a forum for increasing and sharing their knowledge of astronomy, to promote astronomical education to the public, and to preserve Historic Chamberlin Observatory and its telescope in cooperation with the University of Denver.

The DAS is 501 (c)(3) tax-exampt corporation and has established three tax-deductible funds: the Van Nattan-Hansen Scholarship Fund, the DAS-General Fund and the Edmund G. Kline Dark Site Fund.

More information about DAS activities and membership benefits is available on the DAS website at *www.denverastro.org.*★

DAS Software Review

SKY SAFARI 4 FOR IOS

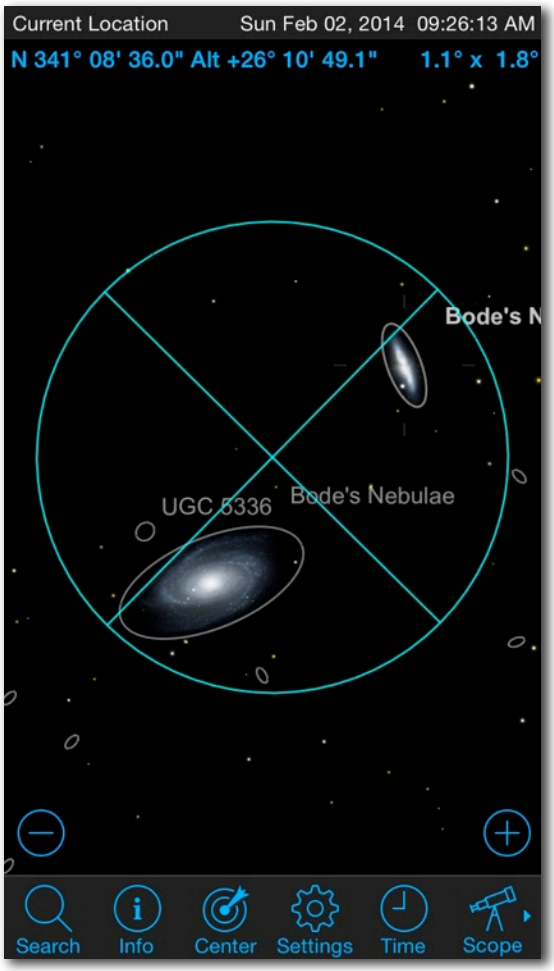
by Sorin

There are a number of planetarium apps available these days for iOS and Android devices. Sky Safari by Southern Stars has been one of those options for a while now, and the latest version 4 offers a lot of good reasons to make it your app of choice.

I've been using Sky Safari 3 for some time, and Sky Safari 4 since it was released in December on an iPhone 5 and an iPad 2. The new version requires iOS 7, which means you need an iPhone 4 or newer. The original iPad, and older iPod touch models are also excluded.

There are three versions of Sky Safari 4. The basic version at $2.99 includes all of the standard planetarium features with stars to 8th magnitude, along with a selection of comets and satellites. The Plus version at $14.99 adds telescope control (which requires a separate SkyFi or SkyWire adapter) and 2.6 million star catalog down to 12th magnitude. The Pro version at $39.99 includes a 27 million star catalog down to 15th magnitude, and galaxies down to 18th magnitude. The Pro version also includes a complete catalog of asteroids, comets, and variable stars.

One of the best features available in the Plus and Pro versions is the ability to enter in your equipment library. You can enter the details for all your telescopes, eyepieces, and cameras. You can then create combinations of your telescopes with different eyepieces or cameras and display a field of view overlay in the app. This is very useful for framing a photo or determining the set of eyepieces to keep handy for your observing session based on the objects you plan to target.



Sky Safari 4 on the iPhone showing M81 and M82 with a 1° FOV.

Another feature of Sky Safari that can't be underestimated is accuracy. Most planetarium software will deliver accurate coordinates for stars and nebulae, but comets and satellites can be a different matter. For instance, when trying to locate comet C/2013 R1 Lovejoy, I discovered that similar apps offered wildly differing coordinates that were several degrees off. With Sky Safari, I entered the RA and Dec coordinates displayed on the screen in the GoTo on my telescope, and it slewed right to the comet, dead center. It was a similar story for the former comet ISON a few weeks before its breakup as it rounded the Sun on Thanksgiving. While these tests were actually with Sky Safari 3, the new version appears to continue providing accurate locations for these sometimes fleeting objects. Even when not using a GoTo mount, I've found the object location in the star field to be extremely accurate.

Sky Safari 4 on the iPad. The overlay in this image shows the FOV for the author's Canon T3i DSLR camera mounted on a wide-field refractor and a Ritchey-Chrétien Astrograph over the Orion Nebula.

On my iPad 2, the app would, at times, freeze up for a moment while trying to pan around, and the compass can still be easily confused about the device's orientation when you point it up at the sky.

Despite these few minor issues, Sky Safari 4 Pro has become my planetarium software of choice both at home and in the field. The feature set is rich enough, and the interface good enough that Sky Safari 4 Pro on my iPad has completely replaced my use of Stellarium on the desktop.

You can find out more about Sky Safari for iOS as well as Android and MacOS versions at the Southern Stars website: *http://www.southernstars.com* or access the App store on your device and search for Sky Safari. ★

DON'T FORGET!

Banquet reservations are due by March 4th, and may be made online at *http://denverastro.org/banquet.html.* The cost is $25. Our speaker will be **Dr. Richard Allen Keen**, a meteorologist at CU who has a project for us involving brightness measurements of the moon during this year's two upcoming lunar eclipses.

Our annual spring banquet is a great way to meet our officers for 2014, and we'll enjoy a buffet of Chicken (or lack of chicken for the vegetarians) Pasta Primavera courtesy of Embassy Suites. **The location** is 10250 East Costilla Avenue, just south of Arapahoe and Havana behind the Outback Steakhouse. Come in casual business attire, enjoy the cash bar, and perhaps pick up an outreach award or two as we thank all of our club's participants for all that they do. For information, contact Lisa *(vp@denverastro.org)* or Dena *(secretary@denverastro.org).*

MEET YOUR FELLOW ASTRONOMER

by Dena McClung

This month's member profile features David Shouldice, a member of the DAS since the 1990s. He grew up in Winnipeg, Manitoba, and has always been interested in astronomy. When Comet Halley re-entered the inner solar system in 1986, he bought his first telescope, which unfortunately left a lot to be desired.

David and his wife, Carol, were introduced by a mutual friend to Larry Brooks, who had made his own refractor from plastic plumbing materials and a lens salvaged from a photocopier. They attended their first star party, the Rocky Mountain Star Stare in 1993, followed by the Texas Star Party with Larry.

When David joined the DAS, he was on his second telescope, which also had issues. Thanks to refiguring of the primary mirror, courtesy of Jerry Wilkinson (who taught mirror-grinding classes), he was finally able to enjoy exquisite views. David was inspired to design and build telescopes and related equipment for himself. Information about his equatorial table and aluminum 12.5-inch telescope can be found on the DAS website under the D-Files link. He presently uses his aluminum telescope and a 15-inch Dobsonian for his personal observing, mainly for planets and other celestial showpieces. He has used an SLR to capture images of the sun, some planets and the International Space Station.

David serves as a telescope operator and instructor on Chamberlin's 20-inch telescope. He advises trainees to enjoy their opportunity to introduce the public to the hobby. He recommends that they tell guests what to look for while at the eyepiece, as they may have no idea what to expect. He describes being an operator as a privilege, given that the care and protection of the telescope is of utmost importance.

In addition to sharing astronomy with the public, David enjoys spending time with other DAS members, discussing astronomy, and taking in the lectures at membership meetings.

David has compiled a collection of factual information about Chamberlin's history for use by volunteers who interact with visitors. He says he likes a good research project, and when Professor Howe's diaries surfaced in the late 1990s, they were of great value. More information came when Howe's great-grandson wrote some summaries of the diaries and collaborated with Dr. Stencel to publish a book about Howe and the observatory.

After graduating from the University of Manitoba with a degree in electrical engineering, he was hired by Boeing Aircraft, and began work monitoring equipment aboard the Boeing 737 during certification tests. During these flights, the test pilots put the aircraft through both routine and unusual maneuvers and situations, providing David with some unique experiences. Once, during a graveyard shift during flights conducted at Edwards Air Force Base, David got to see and touch an SR-71 Blackbird.

Subsequently, David was employed by Martin Marietta, where he worked on Voyager and the control system for NASA's Man Maneuvering Unit, used by astronauts while conducting spacewalks. Now retired, the greater part of his career was spent designing medical equipment.

David enjoys traveling to and photographing beautiful places; he and Carol have taken a number of cruises. He continues to attend star parties and would like to see Weekend Under the Stars return. He's also looking forward to the total solar eclipse in August of 2017. ★

David and his dog, Gwen, with his own creation, the 12.5-inch Dobsonian-style telescope.

Image courtesy: Carol Shouldice

PRESIDENT'S MESSAGE

(CONTINUED FROM PAGE 2)

stations. It's best to listen for Jupiter's decametric emissions during the nighttime hours, and the gas giant happens to be cooperating nicely right now with its presence in our night sky. Assuming you have your shortwave radio connected to a good outside antenna, tune to a quiet spot on the dial somewhere from about 20 MHz to 22 MHz or so and give a listen.

The two easiest decametric emissions to receive are so-called L-bursts (long bursts) and S-bursts (short bursts). L-bursts sound a little bit like ocean waves crashing ashore, and S-bursts sound like popcorn popping or maybe "slow" static clicks. Sample audio files of both L- and S-bursts can be found online at *http://radiojove.gsfc.nasa.gov/observing/sample_data.htm*.

If you don't have a shortwave radio, the Radio JOVE Project sells 20 MHz receiver kits as well as assembled and tested receivers, wire antenna kits, CDs, and more. See *http://radiojove.gsfc.nasa.gov/* for more information. The cost of the receiver-only kit starts at $165, and a kit with antenna and other goodies is $210. If you're not comfortable soldering a kit, the fully assembled and tested version is $295. There is always the option of commercially manufactured shortwave receivers such as Icom's IC-R75, but that particular model will set you back about $670. Of course, the latter provides much wider frequency coverage than the Radio JOVE Project receiver, and might open the door to yet another hobby, shortwave listening, known informally as SWLing.

By the way, your shortwave radio or one of the kit receivers also can be used to listen to the Sun. The previously mentioned link to sample audio files includes an example of the sound of solar emissions.

Another way to tune in to the Sun is with a DirecTv or DISH Network antenna and a few other goodies. DAS member John Anderson has had this kind of setup at some of our solar observing events at the Denver Museum of Nature and Science. I found a web page that includes a discussion about building a radio telescope using one of the pizza-size satellite antennas. Here's the link: *http://www.mikebrownsplanets.com/2013/06/summer-project-build-radio-telescope-at.html*

As you can see, it's fairly easy to get started in radio astronomy, and depending on how you go about it the cost can be quite reasonable. If you do decide to head down the radio astronomy path, be sure to include it in your public outreach activities at DAS open houses and other events. That would be a nice way to demonstrate that the visible light portion of the electromagnetic spectrum isn't the only place to explore the cosmos. ★

A MARATHON OF AN OBSERVING SESSION

by Darrell Dodge

The nights of March 1st and 29th, 2014 should be busy ones at the EG Kline Dark Site. The Moon is virtually new on both of those Saturday nights, which means those are the official Messier Marathon nights for 2014. March - April is the only time during the year when observers at perfect dark sites at our latitude can hope to accomplish the feat of observing all of the 110 objects in the modern version of Charles Messier's famous catalog of non-comets. For a lot of reasons, however, it's probably better to have a goal of trying to observe as many as you can, not the entire list (see the "Hints" box).

Because of the importance of starting to observe as soon as possible after sun-down, it's absolutely imperative that participants arrive at the site early (5:30 P.M. or so). Late arrivers will not only imperil their own chances of seeing the early objects, but may also make it difficult for other observers. Arriving well before dark is also a good idea because the site is often packed on Marathon nights.

We will have Marathon forms at the site, which provide a checklist of objects in one of the preferred orders for observing. And there will be a signup sheet for those wanting to make a competition out of it.

For those who've tried a Marathon, the feat seems impossible to achieve without clear skies and a lot of luck. But you'll also need perseverance and stamina too. Check the Friday, Saturday (and possibly Sunday) Clear Sky Chart and the DAS Yahoo Group to determine the best night to try.

This year six windscreens will be available at the Dark Site if the southerly winds start blowing, eliminating one possibility for bad luck. The activity at the exploratory oil well near the site is supposed to be "testing" this Spring, and hopefully will not be a problem. Please check the dark site Web page at *http://www.denverastro.org/dss.html* for information.

Because of evening and early morning challenges, absolutely perfect observing conditions are required to complete a Marathon at latitude 40 degrees north. (Lower latitudes down to 20 degrees north are better.) And we have found over the years that it's simply not possible to complete a 110-object marathon at our dark site, although several people have seen 109.

The toughest object in the evening is M74, the low surface-brightness face-on Sc galaxy in Pisces, which is dropping into the Denver nebula in the West as darkness tries to fall. Early evening objects like M74 and M33 will be easier during the March 1st, 2014 Marathon. The lack of an early-evening moon this year will make them even easier.

The early morning challenge is the globular cluster M30 in Capricorn, which rises just before the Sun. But the hills to the southeast of our dark site are just high enough to block it until the Sun is starting to turn the sky to a neon blue, which makes the cluster impossible to see in early March. Marathoners on March 29th will have a better chance but will probably lose M74.

"Go-to" marathons are becoming more and more acceptable, with some clubs setting up special categories for them. If you know the sky well, a "go-to" marathon is really not much easier than a "star-hopping" one, even during the trip through the Virgo galaxy cluster, (where it's essential to verify which galaxy is which). But one clear advantage is that you'll have more time to enjoy the view, and the different perspective and ability to compare objects that the marathon provides. Still, there's nothing that can match the feeling of accomplishment gained from doing any observing program the old-fashioned way.

What's the best telescope to use? Probably just one with a reasonable aperture (at least 4-5 inches), with which you're familiar. Very large scopes can make the marathon more difficult because there are so many more objects to sort through. Dobs are great for marathons because they are easy to move, have a wide field of view, and are easy to use between declination +30 and -30, where most of the Messiers are situated.

Let's all hope for clear skies and light winds this year! ★

LEO TRIPLET - NGC 3628, M66, M65

Which one of these galaxies is M66? M65? Marathoners will have to know to be able to count them in their checklist.

Darrell made this image on January 28, 2011 at Deer Trail, Colorado. He used a Honis-modified Canon 450D on an AstroTech AT8IN Imaging Newtonian telescope.

Image © Darrell Dodge

HINTS FOR HAPPY MESSIER MARATHONING

1. Practice difficult or unfamiliar areas of the sky a week or so before, using the telescope and observing aids you intend to use for the marathon.
2. Arrive at the site well before sundown.
3. Use a checklist that lists the objects in the approximate order you will be viewing them.
4. Don't try to use the marathon as a way to do or complete the Astronomical League's Messier Observing Program. The program requires detailed descriptive comments and there's not much time for that.
5. Do take the time to scribble some notable things about some of the objects. You'll appreciate having these later, especially when you're trying to remember if you really discriminated between easy-to-confuse objects like M86 and M84.
6. Aim for as many objects as possible, not necessarily ALL of the objects, and you may see more of them.
7. View easier objects first! Don't spend 30 minutes trying to see M74 while the other objects in the West are sinking out of sight (see #6). Observe M77, 31, 110, 32, and maybe M33 first.
8. If you miss M110 (an M31 companion galaxy), you may be able to see it in the morning.
9. Try not to panic when you start going through the Virgo/Coma Galaxy Clusters. These are all bright galaxies (except maybe for M90) and you should have plenty of time because there's a break in available objects to observe when you're done.
10. When you're out of objects to view, try to get off your feet and get something to eat and drink. You'll probably be busy from 7:30 P.M. to around midnight, but you can take a few short breaks in the middle of that period and a longer break (even a nap) sometime between 11 P.M. and 1:30 A.M.
11. Keep reviewing your checklist to make sure you've not forgotten an object. Common ones to overlook are M83 and M68.
12. Remember that all 110 objects were not seen in one night until 1985. Seeing more than 90 is a great achievement.
13. If you get totally clouded out this spring, it's possible to do 91 Messier objects or more in September.

DENVER ASTRONOMICAL SOCIETY OFFERS SCHOLARSHIPS

Did you know that the DAS has had a scholarship program in place since 1973? The Van Nattan-Hansen Scholarship program has, since its inception, awarded nearly $30,000. Here are the criteria that must be met: 1) Applicants must either be graduating high school seniors or undergraduate college students in good standing; 2) Enrollment equivalent to a half-time load for the academic term as defined by the institution; 3) Applicants will be considered no more than five times for a full-time student and eight times for a half-time student.

Applications must be received no later than June 15th of each year, and must be accompanied by transcripts showing a grade point average of at least 3.0 on a 4.0 scale (or equivalent), a dated and signed letter of intent demonstrating the applicant's interest and the declared major, and letters of recommendation from at least two reputable sources. Awards are normally made by August 1st. If you know of a deserving student who may qualify for a Van Nattan-Hansen scholarship, encourage him or her to apply. More information is available at *http://www.denverastro.org/vannattan.html*, or send an e-mail to *vnh@denverastro.org* ★

NASA'S Space Place

A TWO-TONED WONDER FROM THE SATURNIAN OUTSKIRTS

by Dr. Ethan Siegel

A Space Place Partners' article

Although Saturn has been known as long as humans have been watching the night sky, it's only since the invention of the telescope that we've learned about the rings and moons of this giant, gaseous world. You might know that the largest of Saturn's moons is Titan, the second largest moon in the entire Solar System, discovered by Christiaan Huygens in 1655. It was just 16 years later, in 1671, that Giovanni Cassini (for whom the famed division in Saturn's rings—and the NASA mission now in orbit there—is named) discovered the second of Saturn's moons: Iapetus. Unlike Titan, Iapetus could only be seen when it was on the west side of Saturn, leading Cassini to correctly conclude that not only was Iapetus tidally locked to Saturn, but that its trailing hemisphere was intrinsically brighter than its darker, leading hemisphere. This has very much been confirmed in modern times!

In fact, the darkness of the leading side is comparable to coal, while the rest of Iapetus is as white as thick sea ice. Iapetus is the most distant of all of Saturn's large moons, with an average orbital distance of 3.5 million km, but the culprit of the mysterious dark side is four times as distant: Saturn's remote, captured moon, the dark, heavily cratered Phoebe!

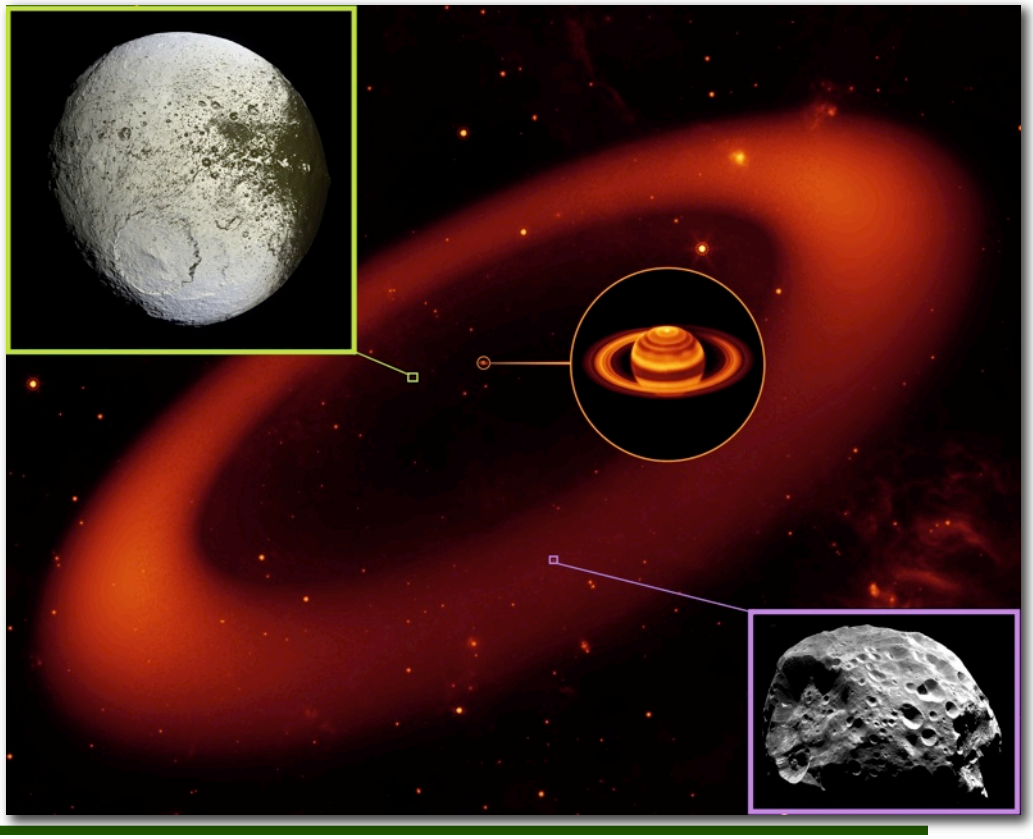
Orbiting Saturn in retrograde, or the opposite direction to Saturn's rotation and most of its other moons, Phoebe most probably originated in the Kuiper Belt, migrating inwards and eventually succumbing to gravitational capture. Due to its orbit, Phoebe is constantly bombarded by micrometeoroid-sized (and larger) objects, responsible for not only its dented and cavity-riddled surface, but also for a huge, diffuse ring of dust grains spanning quadrillions of cubic kilometers! The presence of the "Phoebe Ring" was only discovered in 2009, by NASA's infrared-sensitive Spitzer Space Telescope. As the Phoebe Ring's dust grains absorb and re-emit solar radiation, they spiral inwards towards Saturn, where they smash into Iapetus—orbiting in the opposite direction—like bugs on a highway windshield. Was the dark, leading edge of Iapetus due to it being plastered with material from Phoebe? Did those impacts erode the bright surface layer away, revealing a darker substrate?

In reality, the dark particles picked up by Iapetus aren't enough to explain the incredible brightness differences alone, but they absorb and retain just enough extra heat from the Sun during Iapetus' day to sublimate the ice around it, which resolidifies preferentially on the trailing side, lightening it even further. So it's not just a thin, dark layer from an alien moon that turns Iapetus dark; it's the fact that surface ice sublimates and can no longer reform atop the leading side that darkens it so severely over time. And that story—only confirmed by observations in the last few years—is the reason for the one-of-a-kind appearance of Saturn's incredible two-toned moon, Iapetus!

Learn more about Iapetus here: *http://saturn.jpl.nasa.gov/science/moons/iapetus.*

Kids can learn more about Saturn's rings at NASA's Space Place: *http://spaceplace.nasa.gov/saturn-rings.* ★

Images credit:Saturn & the Phoebe Ring (middle)—NASA / JPL-Caltech / Keck; Iapetus (top left)—NASA / JPL / Space Science Institute / Cassini Imaging Team; Phoebe (bottom right)—NASA / ESA / JPL / Space Science Institute / Cassini Imaging Team.



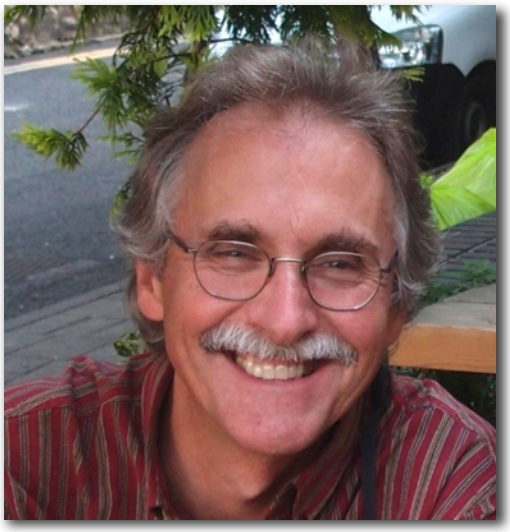
APRIL SPEAKER: DR. JOHN SPENCER

Talk: "New Horizons: On the Threshold of the Pluto System"

Dr. John Spencer is an Institute Scientist at Southwest Research Institute's Department of Space Studies in Boulder, specializing in studies of icy satellites using theoretical models, Earth-based telescopes, spacecraft observations, and the Hubble Space Telescope. A Ph.D in Planetary Sciences (University of Arizona, 1987), he spent four years in postdoctoral positions at the University of Hawaii before joining the staff of Lowell Observatory in Flagstaff in 1991, then came to SWRI in January 2004. He has also published research on Mars, asteroids, Pluto, and Triton, and will speak to us on his work for the New Horizons mission in coordinating the search for KBO flyby targets.

Dr. Spencer was responsible for temperature mapping of Jupiter's moons with the Galileo spacecraft's Photopolarimeter-Radiometer (PPR) instrument, and is now mapping temperatures on Saturn's moons using Cassini's Composite Infrared Spectrometer (CIRS). He is particularly interested in the volcanos and atmosphere of Io and ice eruptions of Enceladus.

He also co-led the science team for NASA's 2007 study of a possible Flagship mission to Enceladus, the 2008 - 2009 studies of the Jupiter Europa Orbiter mission, and the Satellites panel of the 2009-2011 Planetary Decadal Survey. Dr. Spencer's observations have discovered major volcanic eruptions on Io with HST and sulfur gas in Io's plumes, and co-discovered ice volcanic activity on Enceladus, the "Pac Man" thermal anomalies on Mimas and Tethys, oxygen on Ganymede, and that Io's atmosphere is highly asymmetrical. His theoretical work focuses on the extreme albedo dichotomy of Iapetus, nitrogen frost on Pluto and Triton, water frost on Jupiter's moons, and heat radiation from asteroids. ★



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