

Sky WAA tch



▲ A Hole in the Middle ▲

Olivier Prache captured this image of M106, a spiral galaxy in Canes Venatici, with his Hyperion 12.5" astrograph and ML-16803 CCD camera (12 hours total exposure in March and April). Also in the image at the upper right is the spiral galaxy NGC 4217. At 80,000 light years in diameter, M106 is slightly smaller than our Milky Way. It lies at a distance of 23.5 light years.

M106 is a Seyfert II galaxy, whose spectral lines are characterized by emissions from highly ionized gas. X-ray and radio images of M106 reveal two so-called ghostly arms which appear to be material heated by shock waves. The culprit is thought to be a super massive black hole at the galaxy's center. For more information, see the [Chandra X-ray observatory site](#).

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Events for May 2013

WAA Lectures

“The Fantastic Discoveries of Astronomy Made Possible by Modern Infrared Detectors”

Friday, May 3rd at 7:30pm

Lienhard Lecture Hall, Pace University Pleasantville, NY

Our speaker will be Dr. James W. Beletic, Vice President, Space & Astronomy at Teledyne Imaging Sensors, Inc. He will discuss the cutting-edge astronomy that is made possible by the outstanding properties of modern infrared detectors. See an abstract of his talk on page 7 of the April issue of the [SkyWAAatch](#). Dr. Beletic received his Ph.D. in Applied Physics from Harvard University. He has worked at MIT Lincoln Laboratory, the Georgia Institute of Technology, and the European Southern Observatory (ESO). Free and open to the public. [Directions](#) and [Map](#).

Upcoming Lectures

Miller or Lienhard Lecture Hall, Pace University Pleasantville, NY

On June 7th, Alan Witzgall will present on the History of the Telescope. Mr. Witzgall is currently a Senior Optician for Fastpulse Optics in Saddle River, N.J. Lectures are free and open to the public. There will be no lectures in July or August.

Starway to Heaven

Saturday May 4th, Dusk

Meadow Picnic Area, Ward Pound Ridge Reservation, Cross River

This is our scheduled Starway to Heaven observing date for May, weather permitting. Free and open to the public. The scheduled rain/cloud date is May 11th. Participants and guests should read and abide by our [General Observing Guidelines and Disclaimer](#). [Directions](#).

Call: 1-877-456-5778 (toll free) for announcements, weather cancellations, or questions. Also, don't forget to periodically visit the [WAA website](#).

New Members. . .

Lee Mingione - New Rochelle
Christopher Freeburn - Yonkers

Renewing Members. . .

Ruth and Eugene Fischer - Pleasantville
Everett Dickson - White Plains
Karen Seiter - Larchmont
Rob & Melissa Baker - West Harrison
Raymond Herbst - Mahopac

Members Classified

As a service to members, the WAA newsletter will publish advertisements for equipment sales and other astronomy-related purposes. Ads will only be accepted from WAA members and must relate to amateur astronomy. Please keep to 100 words, include contact info and provide by the 20th of the month for inclusion in the next issue. The newsletter is subject to space limits; so ads may be held to subsequent issues. The WAA may refuse an ad at its sole discretion. In particular, price information will not be accepted. Members and parties use this classified service at their own risk. The Westchester Amateur Astronomers (WAA) and its officers accept no responsibility for the contents of any ad or for any related transaction.

Send classified ad requests to:

waa-newsletter@westchesterastronomers.org.

WAA APPAREL

Charlie Gibson will be bringing WAA apparel for sale to WAA meetings. Items include:

- Caps, \$10 (navy and khaki)
- Short Sleeve Polos, \$12 (navy).



Almanac

For May 2013 by Bob Kelly

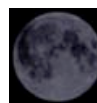
Up all night, at its brightest for the year Saturn captures the interest of all telescope users. Jupiter needs no introduction, but the outstandingly bright, mighty King of the Planets is brought down low into the twilight, leading to a three-planet-pile-up low in the west-northwest for the Memorial Day weekend.

This time, when I say “Binoculars will help you find [a great astronomical sight!] low in the twilight sky”, you should take my advice. I know last month’s comet was harder to see than I thought it would be, but look this Memorial Day weekend for the pile-up of bright planets low in the part of the sky just above where the Sun sets. Spying Venus, Jupiter and Mercury, all together in the wide view that binoculars provide, will be worth digging out the bi-optic device and finding a clear western horizon! Some observers might see the trio in daytime, only about 16 degrees east (following) the Sun. Be very careful! as inadvertent viewing of the Sun can seriously damage your eyesight.

Saturn is just past opposition, rising at sunset, getting higher in the evening sky this month, which gives us a clearer view of Saturn’s rings and moons that are sure to excite lovers of the planets, as they wow the guests at our star parties. It’s brighter than all but seven stars, but not as obvious as Jupiter was. A good spotting scope or most telescopes will show the rings that makes Saturn different from the other bright lights in the sky. Saturn is still tiny, even in a telescope, but if you get a steady sky and increase the magnification, Saturn’s rings will show some details and the subtle cloud bands and moons will be visible. Rings A and B are divided by 3,000 mile wide Cassini Division. (Named for the astronomer who described it, not the spacecraft.) I’ve only glimpsed the Division occasionally, on the sides of the rings, but I think that A and B are slightly different shades of white. If you see a thin, gray band on Saturn, just above the rings, that is the sparser C ring silhouetted against the planet. The rings’ shadows are not visible this month with Saturn lined up with the Earth and Sun. This



May 2



May 10



May 17



May 24

alignment hides the shadows of the rings on the planet and vice versa. The bright rings add over half a magnitude to Saturn’s brightness.

Saturn’s Titan is the second largest moon in the solar system, smaller than the champion, Jupiter’s Ganymede. However, if you put the two side-by-side (if you could!), Titan’s 125-mile thick, opaque, cloud layer would make Titan look larger. Titan, at magnitude +8.4, is visible in telescopes that show the rings. See an almanac or position chart or app for Saturn’s moons to see how many of Saturn’s moons you might find with a moderate or larger telescope.

Strange two-faced moon Iapetus is visible to the south of Saturn around May 10th. It moves west of Saturn, brightening to magnitude +10, as it approaches greatest elongation on the 30th. Most of Saturn’s moons don’t pass behind the planet’s disk because the tilt of their orbits matches the tilt of the rings. Iapetus is out of the plane shared by the rings and the main moons, giving future Iapetians a great view of Saturn’s rings for much of the moon’s 79-day trip around Saturn.

On the 24th, the Moon is involved with three events that you may not be able to see. First, Beta Scorpii will appear to travel along the northern edge of the full Moon between 9 and 11pm. To our south, Beta will disappear behind the Moon. From here, it may appear to go in and out of lunar valleys, but if the lunar mountains are still sunlit, magnitude +2.6 star will be hard to see, even in a telescope. Second, the Moon will have a weak penumbral eclipse near midnight that night. It will not be noticeable to our eyes. Even on the Moon, it would be a partial eclipse of the Sun by the Earth, only visible from the Moon’s South Pole. Third, the Moon is closest to the Earth for May on the 25th, 21 hours after full Moon, so the lining up of the Earth, Moon and Sun in a straight line, augmented by a closer than usual Moon, will make tides higher than normal. A fourth event you are unlikely to see is the annular eclipse of the Sun on the

10th, at sunrise in Australia and later in the south Pacific ocean.

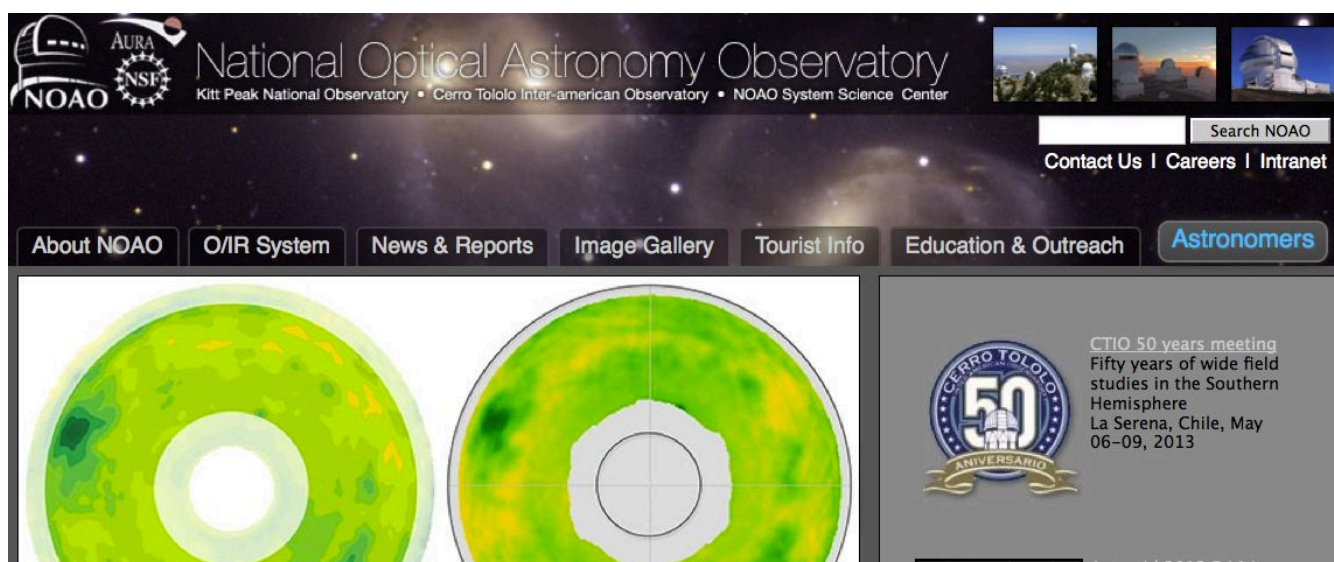
The crescent Moon makes a nice photo op with Jupiter on the 11th and 12th. Will the lunar apogee on the 13th make the Moon look noticeably smaller? The Moon just misses Spica on the 22nd.

Twilight lasts longer near the summer solstice, so earth-orbiting satellites are visible later each night, some as late as midnight. The ISS is not visible here for the first half of the month; after that, it is seen in the morning sky. In early June, the ISS is visible as often as five times a night, every 96 minutes.

Bob's Heads UP blog is at bkellysky.wordpress.com.

Articles and Photos

Internet Corner: National Optical Astronomy Observatory



For an update on the activities at some of the nation's premiere observatories, try the website for the National Optical Astronomy Observatory or NOAA (<http://www.noao.edu>). Composed of the Kitt Peak National Observatory, Cerro Tololo Inter-American Observatory and the NOAO System Science Center (NSSC), NOAO has further ties to a network of many of the world's other great observatories (see **O/IR System Tab**).

The **About Tab** describes NOAO's mission and offers links to its component observatories. Under the NSSC heading you'll find a link to take a virtual tour of the Gemini North observatory. It's worth a virtual trip.

The **News & Reports Tab** provides articles and press releases on recent topics of interest related to NOAO's mission. They are well done containing some interesting photos; for example, Press Release 13-02 describes the fly-by of asteroid 2012 DA14.

The release contains video of the event. For more, intriguing astrophotos, click the **Image Gallery Tab**. The gallery contains a current image as well as hypertext links to dozens of past images. The concentration is primarily deepsky, but with some solar system objects. The link to messier objects should be particularly helpful to amateurs planning an observing session.

The modern astronomical observatory stands out as a marvel of technical achievement. Visits to these observatories can prove memorable. See Larry Faltz' articles: *The WAA Transit of Venus Expedition to Hawai'i* and his four-part article beginning with *An Astronomy Vacation in Arizona: Part I: Flagstaff*. So the adventurous or merely peripatetic should check out the **Tourist Info Tab**. Lastly, educators should be sure to peruse the **Education and Outreach Tab** for some informative links.

Connecting a Go-to Scope and a Computer by Larry Faltz

You can't overestimate the impact that computers have had on our hobby. There isn't an element of amateur astronomy that they haven't touched, except perhaps for the near-extinct process of amateur mirror-grinding (although soon there'll be an app for that, I bet). Getting up-to-the-minute news about astronomical phenomena is now a hobbyist's expectation. I have apps that notify me every time a new exoplanet is discovered and when a solar flare is detected. You can get emails about supernovae and comets within minutes of their discovery. Images from both space-based and ground-based telescopes (most of the latter from amateurs) are posted almost instantly, and there are sites that offer live viewing from around the world (one afternoon in 2012 I watched a video broadcast from Pakistan of a Jovian shadow transit). There are a large number of individual applications, many available for free, to aid planning your sky-watching sessions, logging your observations, acquiring and processing images (including powerful stacking programs like Registax) or just showing maps of the night sky or planets. Every research observatory and university has an informative web site. The on-line astronomy community, through [Yahoo groups](#), [CloudyNights.com](#), [NightSkyNetwork.com](#), [Astromart.com](#), or any one of thousands of other web sites, discussion groups and blogs, provides a vast amount of content on every aspect of the science and the hobby. Although observing seems somewhat of a solitary endeavor, any star-party, club meeting, NEAF show or on-line discussion group proves that fundamentally astronomy is a social hobby.

Many telescope mounts now have dedicated computers that permit accurate acquisition and tracking of solar system and deep-sky objects. The cost of computerized scopes has dropped drastically since their introduction in 1986 (the 8" Celestron Compustar SCT, \$3,333 in 1986 dollars), while their accuracy, database content, reliability and ease-of-use have also improved, with the most recent crop even able to align themselves. I think most amateurs would agree that it's pointless to purchase a non-go-to motorized mount these days. There's still a role for simple dobsonian or alt-az mounts for casual viewing, but anyone attempting serious deep-sky observing or astrophotography is going to opt for a computerized mount (astrophotographers particularly value their

autoguiding and remote operation capabilities). Telescope computers, except for the most basic ones like the iOptron Cube, can be linked to other computers to enhance their capabilities.

It's easy to connect your computerized go-to telescope to a computer, but why would you want to do that? My CPC800 has over 45,000 objects in its database, more than I'll ever observe. Well, for one thing, there's the sheer pleasure of doing it. It's a way of multiplying your toys, an attraction for those of us in the gearhead wing of the hobby. I'm one of those people who feel incomplete if there's a jack on the back of my hi-fi that doesn't have something plugged into it, and the same goes for my telescope. Those of you who've seen Locutis in action (Celestron CPC800+Mallincam) know what I mean. But it's really quite useful to have the scope's computer and a laptop or netbook talking to each other.

The main value of a link-up is to be able to display the scope's position on a planetarium program, such as TheSky or the free Cartes du Ciel, among many others. Besides indicating your location, the software shows other objects in the vicinity, and you can direct the scope to move to them simply by clicking on the screen. Another click will bring up information about each object. There are also planning programs, like SkyTools, Deepsky Astronomy or AstroPlanner, that can enhance your observing sessions. These are database programs that create a filtered observing list (for example, all planetary nebulae currently above 30 degrees altitude at your current location that are brighter than magnitude 11) and they can connect to the scope so you can go to the object directly from the program.

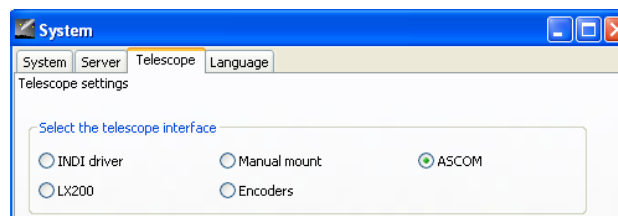
Telescopes talk to computers through the venerable RS-232 protocol, a remnant of the old serial communications days. There are much faster interfaces now (like USB and Firewire) but RS-232 is simple and the amount of information exchanged between the scope and the computer is perfectly capable of being handled at the standard 9600 baud rate. Celestron and Meade sell a serial cable that plugs into the handset (where the RS-232 port is located) and terminates in a DB-9 serial connector. About the only complication is that modern computers no longer have serial ports, so you have to use a serial-USB adapter. A reliable one (many people favor the

Keyspan USA-19H) costs less than \$30. Drivers for 32 and 64 bit Windows operating systems and Mac OS's are available. The drivers create a "virtual com port", which you will select in your software application. One exception I know of to the need for a physical serial-USB adapter is the iOptron family of mounts. Their hand controllers have a USB port and use a regular USB cable to connect the handset to the computer. The adapter function is implemented via software, a program called USB2COM, downloadable for free from their web site.

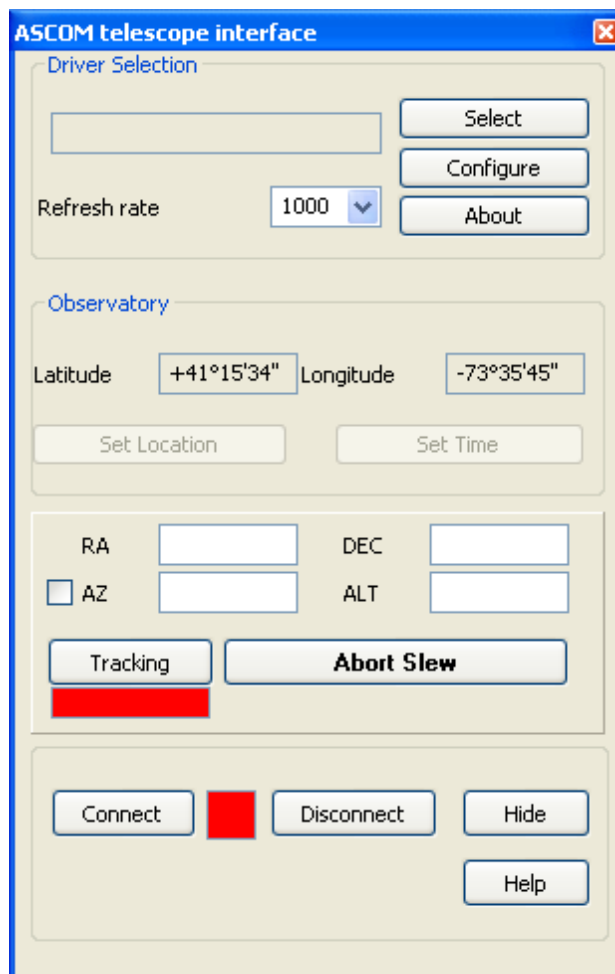
But it's not quite plug-and-play. To ensure that the various makes of telescopes and the wide variety of software programs talk with each other, the astronomy world has developed a common set of signals for Windows operating systems, called ASCOM. ASCOM allows software applications to talk to the hardware without the programmers having to worry about the hardware's specific instruction language. Think of it as a "universal translator" for astronomy hardware. As long as the hardware developer has written an ASCOM driver, any ASCOM-compliant software can talk to it. It's not just for telescope mounts: ASCOM interfaces work with dome rotators, cameras, filter wheels, field rotators and focusers. You can even have more than one program talk to the telescope at the same time. And even better, ASCOM is free. Download the current version at <http://ascom-standards.org>. The only thing you will need to do on your computer is make sure you have the most current version of Microsoft's .NET framework, which is also free from Microsoft. If you are using Mac software, you may have to use software that has a direct scope interface built in, such as SkySafari, or use a planetarium program for Mac that utilizes specific plug-ins for your telescope from the free [INDI Library](#), an open-source cross-platform application that supports Mac.

Here's how it works with a Celestron CPC800 and a laptop running Cartes du Ciel (more about that program later), but other hardware and software work similarly. Download the ASCOM Platform 6SP1 and the Celestron Unified driver. They are easy to find on the ASCOM website. They install into the proper folders so your software can find them (in your Program Files folder, some are in the ASCOM subfolder and some in Common Files/ASCOM). Align your telescope using the hand control. Once it is tracking, connect the serial cable from the base of the handset to the Windows computer using the serial-USB adapter. Open Cartes du Ciel and select

Telescope on the Menu. Under **Telescope Settings**, verify that ASCOM has been selected as the interface.



Click on **Telescope/Control Panel** on the menu bar to open the ASCOM Telescope Interface dialog box.

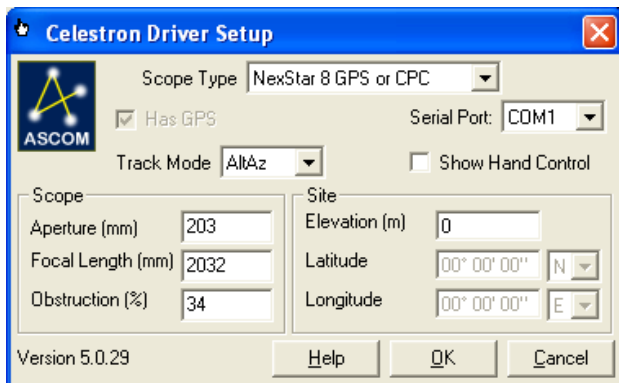


The Control Panel in Cartes du Ciel (BTW, the coordinates are for the Meadow Parking Lot at Ward Pound Ridge)

Click on **Select**, which opens up the "ASCOM Telescope Chooser". Choose the Celestron driver, which contains specific drivers for every computerized Celestron model.



When you click **OK**, you return to the Interface. Click on **Configure**. This opens the driver set-up. Choose the driver for the proper Celestron scope, the serial port (if you've forgotten it, open Device Manager, select Ports and you'll see the adaptor and its chosen com port) and whether you are set up to track in alt-az or equatorial mode. You might want to check **Show Hand Control**, which displays a set of pushbuttons on your screen that you can click on to slew the scope manually.



Then click **OK** to return to the Interface.

When all is ready and connected, click on **Connect**. The red box next to the control should turn green, and your scope will be connected to the software. The cells in the ASCOM Telescope Interface will display the scope's RA, Dec, Alt and Az.

Now the fun begins. Hide the Telescope Interface. On the menu bar, click **Telescope** and **Track Telescope**, and the star map will display exactly where the scope is pointing. As you move the telescope with the hand control, the map will stay synchronized. Similarly, if you right click on objects on the screen, you can select *Slew to Cursor* and the scope will move to the object.

It's a good idea to test your equipment indoors, by doing a *faux* "one star align" just to get the scope thinking it's pointing at an object, and then connecting the computer and implementing the software interface. Then you can check out all the software's functionality without wasting valuable observing time. There are notes provided with each ASCOM driver that you can review if you are having connection issues.

Once everything is up and running, you will realize that in the dark someone is inevitably going to trip over the cable that goes from the scope to the laptop, and one, the other or both will be destroyed. Bad deal! But you can make the connection wirelessly and completely avoid the potential for tragedy in the darkness.

The first wireless RS-232 device was a Bluetooth device made by Starry Night, called Bluestar. It was about the size of packet of playing cards and ran on 2 AA cells. You needed a proper Bluetooth "dongle" for your computer, and I found some of them didn't work well. Ultimately I had success with this device when I got a thumbnail-sized \$12 dongle from Micro Center that came with excellent interface software. Bluetooth has a range of 20-30 feet and once connected seems quite reliable. However, I recently upgraded to a 64-bit laptop and found that Starry Night hadn't developed a 64-bit driver for the device and in fact had completely discontinued supporting it. My new laptop's internal Bluetooth 4.0 could detect the Bluestar but simply couldn't talk with it.

Technology came to the rescue in the form of a new Wi-Fi interface, the Southern Stars SkyFi (also sold by Orion under the name StarSeek, which is the one I got). It's just a bit larger than the Bluestar and runs on 4 AA cells or external power. It comes with several cables for Orion scopes, but one of them was compatible with the Celestron so I didn't have to use my bulkier Celestron serial cable and a null modem adaptor (supplied). It acts as a Wi-Fi router, setting up a network to which you link via the Wi-Fi receiver on your computer, just as with a wireless network at home or at Starbuck's. Its range is at least 150 feet. The StarSeek was designed to easily connect to a specific Orion/Southern Stars smartphone planetarium application, but it's easy to connect to a PC. The only additional piece of software you'll need is a virtual port driver, which makes the Wi-Fi connection think it's going through a serial port. I downloaded a free one, the HW VSP, developed by a Czech manufacturer

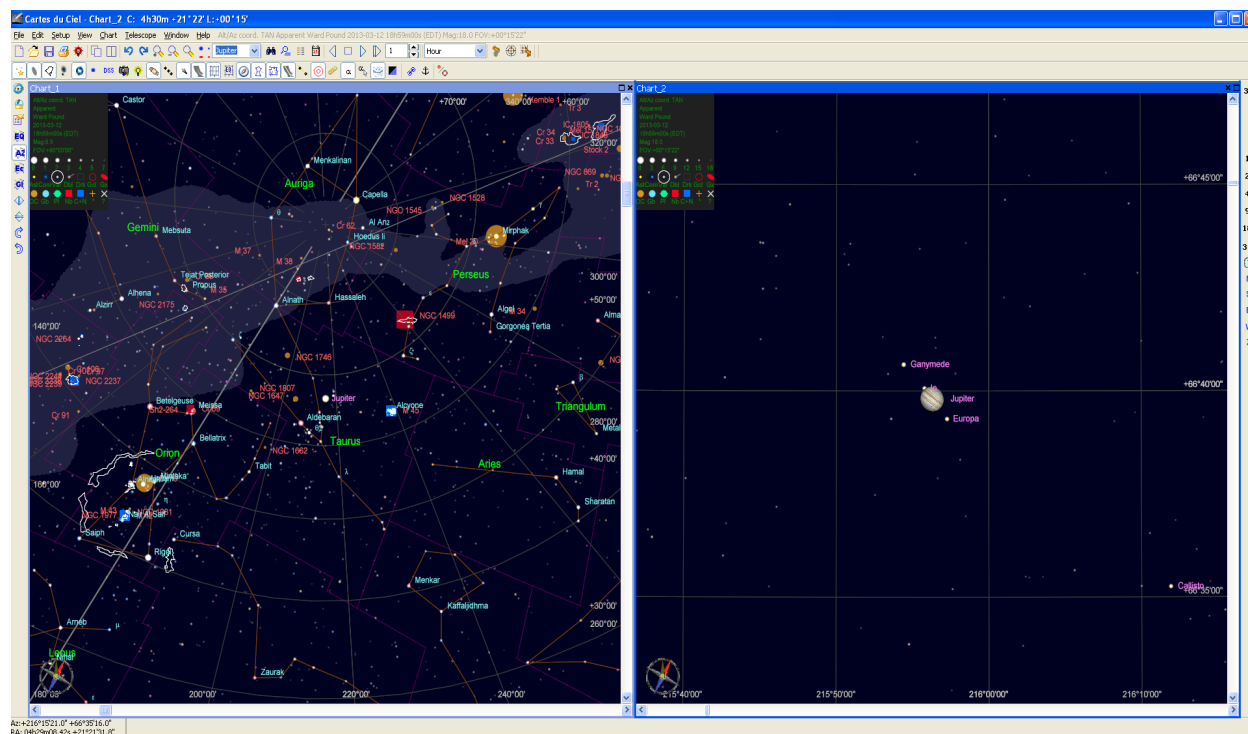
of control systems. It was easy to set up the communications protocol. First, you link to the router by entering a specific IP address in your browser. You make some configuration changes (primarily renaming the network and providing an encryption key so someone else with a computer at your star party doesn't take over control of your telescope!) and note the port number. Then you set up the virtual port driver and give it the information it needs, choosing a com port in the process. Once set, it's resident in Device Manager and you don't have to worry about it again. It used com7 on my laptop. Once I got everything right, the connection was flawless. I was even able to have both a planetarium program and a planning program connected to the scope at the same time.



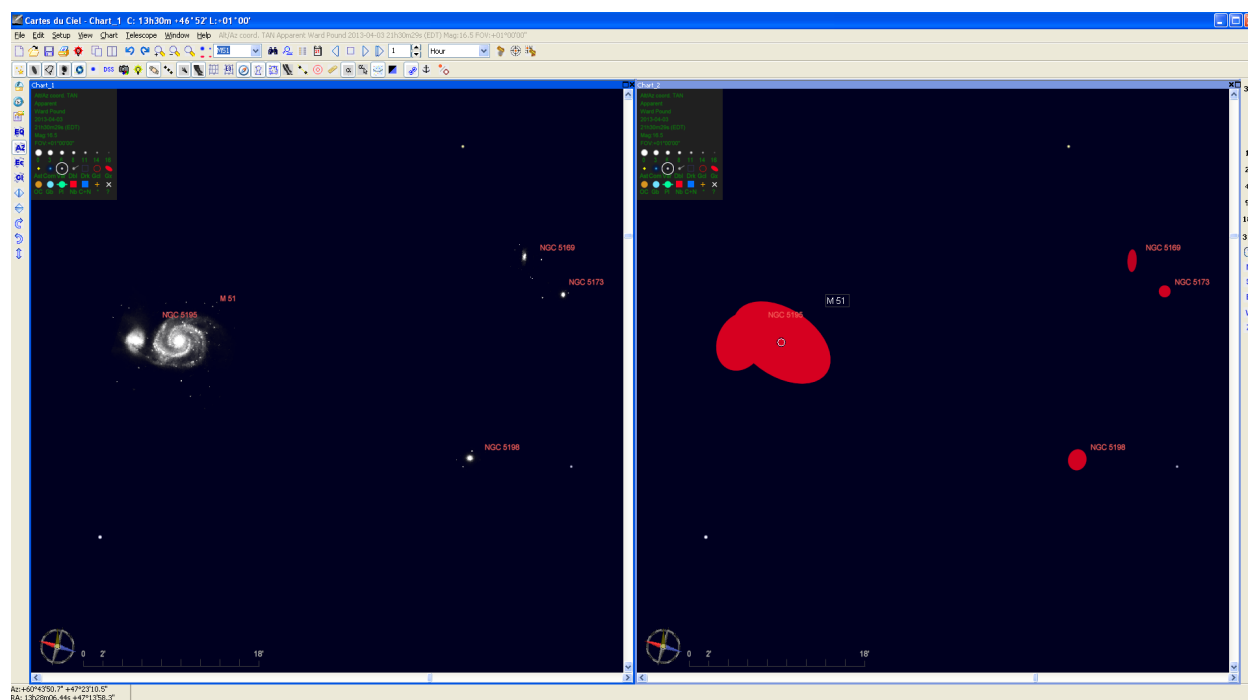
Orion StarSeek with hand and smartphone, for size comparison
(photo from Orion)

I have to put in a plug here for the planetarium program Cartes du Ciel. It's written by Frenchman Patrick Chevalley, who makes it available completely for free (you don't even have to register your email address), and you can interact with him via the CdC Yahoo group if you have questions or suggestions. It's regularly upgraded and improved. The current version, as of this writing, is 3.8, with further upgrades in the works (you can even be a beta tester for Patrick if you wish). It's a very accurate, sophisticated and capable program. Although it comes with basic solar system, stellar and deep sky

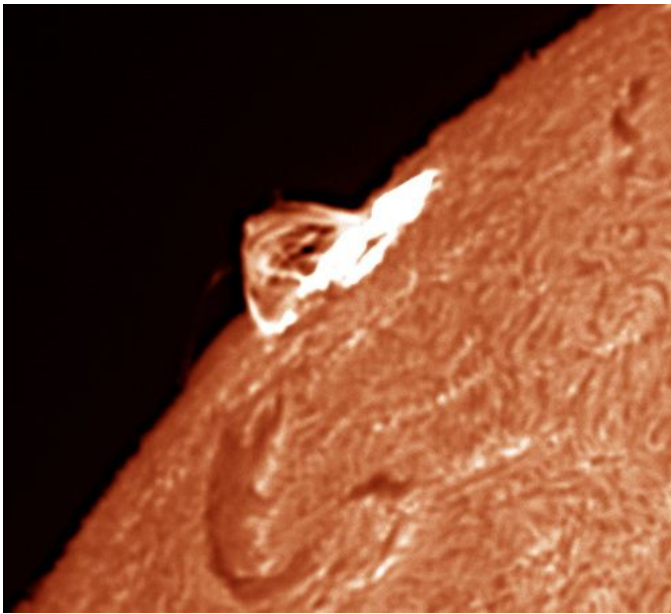
catalogues, you can easily add databases by downloading additional catalogues from the CdC website, from other Internet sites or, most advanced of all, from professional VizieR "Virtual Observatory" catalogues available from Harvard, the University of Strasbourg or other astronomy research locations. Using this function I made a few thousand of the brightest quasars available to my maps (displayable with a click), as well as the Abell and Hickson galaxy clusters, and my most magnified (smallest field of view) maps show stars from the 4UC catalog, which goes down to 16th magnitude. You can control when and how various objects are displayed, whether constellation figures and boundaries are plotted, whether to show equatorial or alt-azimuth coordinates and/or the ecliptic. A single click connects to the Minor Planet Center at the Harvard Smithsonian Center for Astrophysics to download the most up-to-date comet and asteroid ephemerides (this is a particularly useful function since hand control databases don't have these objects). If an Internet connection is available, it will link to the Sloan Digital Sky Survey to overlay images on the map but also can overlay from an image library of the 9,894 deep sky objects in the venerable Saguro Astronomy Club database, so you won't miss not having the SDSS link in the field. It provides accurate displays of the moons of Mars, Jupiter, Saturn and Uranus (and ours, of course). You can open two or more windows and link them, which allows you to see a wide-field display and a detail of the object of interest. All of the display functions, colors, and labels are configurable. You can even choose the language it uses from among 26 options, including Icelandic and Malayam. You can change the time and location temporarily so you can plan a future evening's observing. The search function includes Messier, NGC, IC, PGC and PK objects as well as stars (by name or SAO number), named DSO's, planets, comets, asteroids, and constellations. The program also has a nice calendar function to display rise, transit and set times for solar system objects, including details about illumination, position and even eclipses. The CdC web site is <http://www.ap-i.net/skychart/start>. Take a look at it, even if you're not planning a scope-PC interface.



Cartes du Ciel displaying Jupiter in linked windows, left field of view 90°, right 15'.



Linked windows of a 1° field near M51 displaying the Sloan Digital Sky Survey image (left) and symbols (right), selectable with a single click on the menu.



◀ **Big Boom**

Courtesy of John Paladini is this image of a solar flare that occurred on April 5th. John took the picture with a Chameleon Point Grey camera through a 60mm Lunt solar telescope.



◀ **Death Valley Photo**

Larry Faltz took this image of the moon from Furnace Creek in Death Valley using a Canon T3i, 18 mm focal length camera (a 20-second exposure, f/4, ISO 800, fixed camera position). Notes Larry: To capture the stars, I had to overexpose the setting 3½-day moon on April 14th. Orion is to its left, the Hyades just below and Jupiter just to the right.



◀ **NEAF**

Courtesy of David Parmet, we can see WAA Vice-Presidents Charlie Gibson and Claudia Parrington and WAA President Larry Faltz manning the WAA booth at the Northeast Astronomy Forum (NEAF).



A NEAF panorama courtesy of Barlow Bob Godfrey

Notes from the April 6th Starway to Heaven **by Bob Kelly**

The high, thin clouds, augmented by aircraft contrails, moved across the sky from their home low in the western sky, providing a thin veil in various parts of the sky. We started our Starway to Heaven observing session with a brief glimpse of a large sunspot on the setting sun via an 8inch dob with solar filter. Then, at the prompting of Mitch, who brought his 13.1 inch dob, we learned that Ganymede, Jupiter's largest moon, was throwing its shadow on Jupiter's forehead. We managed to spot the dark spot on the occasion when Jupiter stopped bouncing around in our scopes. We tried to see the shadow in Sharon's 90mm scope, but I don't know if we got the right combination of eyepieces and seeing to achieve that. Comet PanSTARRS managed to elude us again; blending into the cirrus, and down in the trees by the time it got dark enough to see it.

Overall, it was a good night, starting with the bright objects – Jupiter, the Orion Nebula; later, Saturn; and for the wide-field and binocular crowd, the Pleiades. All these and more were fun to show to the 50+ students from Fordham who arrived via bus and cars halfway through the evening.

I didn't get a chance to see through Francis' Unitron refractor that he was assembling at the beginning of the evening, but I remember obsessing over them in S&T when I was a kid. Gary's Obsession 12.5 inch is famous for its dob tracking mount. Dave found M3 and some of its neighboring globular clusters and more. Claudia's telescope (like most of us) would talk to anyone, and she and Kevin brought cookies! They and Sharon and Steven were having quite a party over there. Students were impressed with the sighting of all four of Jupiter's brightest moons, despite Callisto's attempts to stay out of the field of view. They were wowed by ringed Saturn and its largest moon, Titan.

Doug's 90mm Meade refractor showed the students the view that one can get in a telescope without a central obstruction. (If 'Jupiter' looks like a large bright disk, with a black dot in the center, the dob you are using is out of focus.) Mitch noted Rhea and/or Dione in the 13.1 inch, identifying them on the map on his tablet computer. The spot where they were looked like a faint fuzzy patch in the 8inch. The students dared us to push the 8inch to 200x despite the fuzziness of Saturn. The increased size was a wonderment to them, but suddenly Saturn looked like a featureless, unfocusable oval. I blamed a newly smudged eyepiece, Sharon thought her eyesight had gone blurry, Dave wondered why his sharp view was going so, so bad. When no eyepiece brought Saturn into focus, I wanted to slap the side of the scope, like when our old 1960s TV went on the fritz. (Not a good thing to do, so I didn't.) In a few minutes, word got around that we were all seeing the effects of really bad seeing, perhaps an aircraft contrail had crossed in front of the planet. In a few minutes, a reasonable view of Saturn returned and the young eyes of our student guests noted the faint banding of Saturn's cloud tops.

As the temperature dropped into the low 30s, thanks to the mostly clear sky and light winds, the yellow buses departed to bring the students back to warmer rooms. Despite the sharp cooling, no dew or frost formed on the scopes due to very low humidity. But, suddenly the cold and lateness of the hour got to many of us and it was time to go home.

Exploring the Water World

In some ways, we know more about Mars, Venus and the Moon than we know about Earth. That's because 70% of our solar system's watery blue planet is hidden under its ocean. The ocean contains about 98% of all the water on Earth. In total volume, it makes up more than 99% of the space inhabited by living creatures on the planet.

As dominant a feature as it is, the ocean—at least below a few tens of meters deep—is an alien world most of us seldom contemplate. But perhaps we should.

The ocean stores heat like a “fly wheel” for climate. Its huge capacity as a heat and water reservoir moderates the climate of Earth. Within this Earth system, both the physical and biological processes of the ocean play a key role in the water cycle, the carbon cycle, and climate variability.

This great reservoir continuously exchanges heat, moisture, and carbon with the atmosphere, driving our weather patterns and influencing the slow, subtle changes in our climate.

The study of Earth and its ocean is a big part of NASA's mission. Before satellites, the information we had about the ocean was pretty much “hit or miss,” with the only data collectors being ships, buoys, and instruments set adrift on the waves.

Now ocean-observing satellites measure surface topography, currents, waves, and winds. They monitor

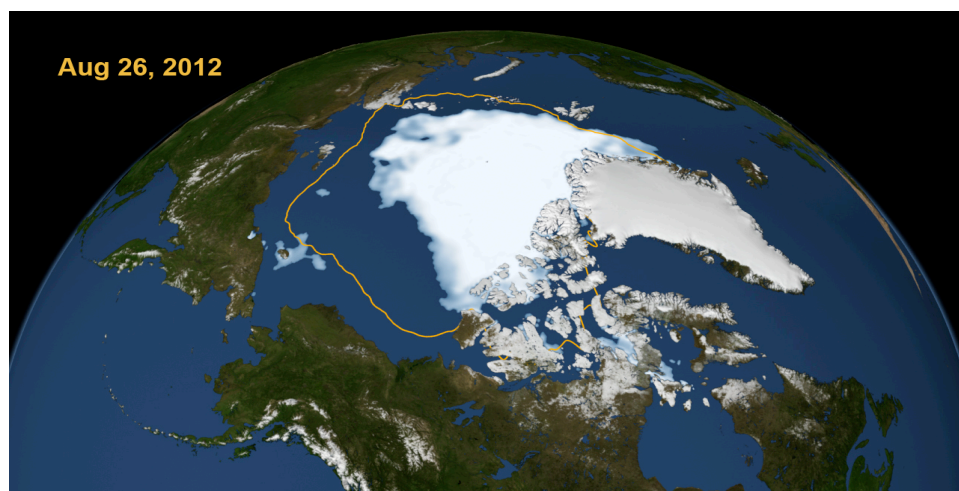
the health of phytoplankton, which live in the surface layer of the ocean and supply half the oxygen in the atmosphere. Satellites monitor the extent of Arctic sea ice so we can compare this important parameter with that of past years. Satellites also measure rainfall, the amount of sunlight reaching the sea, the temperature of the ocean's surface, and even its salinity!

Using remote sensing data and computer models, scientists can now investigate how the oceans affect the evolution of weather, hurricanes, and climate. In just a few months, one satellite can collect more information about the ocean than all the ships and buoys in the world have collected over the past 100 years!

NASA's Earth Science Division has launched many missions to planet Earth. These satellites and other studies all help us understand how the atmosphere, the ocean, the land and life—including humans—all interact together.

Find out more about NASA's ocean studies at <http://science.nasa.gov/earth-science/oceanography>. Kids will have fun exploring our planet at The Space Place, <http://spaceplace.nasa.gov/earth>.

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This image from September 2012, shows that the Arctic sea is the smallest recorded since record keeping began in 1979. This image is from NASA's Scientific Visualization Studio at Goddard Space Flight Center.