



Observatories on the Web

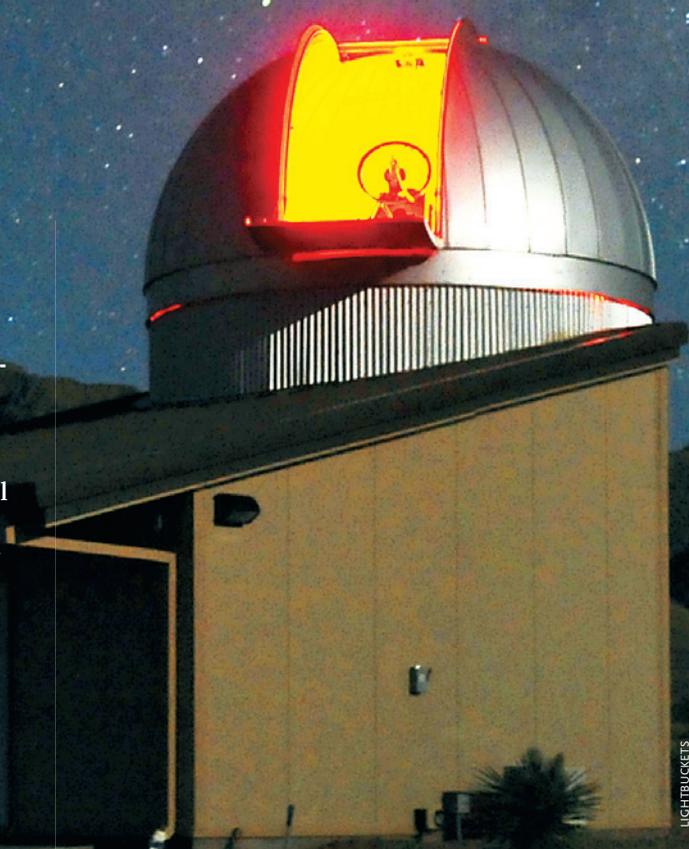
You can rent time to observe from home with top-notch telescopes and CCD cameras around the world. How well does this work?

ANDY MACICA



KEN MOGUL OF NEWNAN, Georgia, is among the growing cadre of observers working with high-end telescopes to measure the brightnesses of stars for the American Association of Variable Star Observers. But only recently has this 55-year-old labeled himself an amateur astronomer. For more than 20 years Mogul worked as a flight attendant, mainly covering northern routes between the U.S. and Europe. His interest in astronomy was inspired by occasional work breaks when he'd marvel at the Milky Way and aurorae through cockpit windows.

Mogul's initiation as a "real" amateur happened barely two years ago, after he suffered a disabling accident that left him bedridden about 20 hours a day. Mogul says that astronomy has saved his life intellectually; that alone makes his story fascinating. But it's even more so when you learn that this talented observer doesn't own a telescope. Instead, he rents telescope time at web-based observatories around the world, planning and executing all of his observations from a home computer.



LIGHTBUCKETS

Web-Based Observatories

A web-based observatory (WBO) is an internet tool that makes high-end observing equipment available to the public. Whether you are a beginner, a seasoned astrophotographer, a science teacher, or a researcher, there are WBO services available for your needs.

WBOs are the logical melding of today's astro-imaging technology and widespread high-speed internet access. Computer-controlled CCD cameras entered the amateur scene about 20 years ago, followed soon after by computerized Go To telescope mounts. By the turn of the century software developers had created the necessary automation for observers to set up high-end observatories that could be remotely operated over the internet. WBOs make this technology available, for a modest fee, to any computer user with internet access.

WBOs offer lots of benefits. Like me, many amateurs live in light-polluted suburban areas. I image from my backyard, but my best work is done by transporting my equipment to locations away from city lights. The WBOs I sampled for this story are in the kinds of locations most of us only dream about. They tend to be at higher elevations, very far from city lights, and experience good year-round weather.

Some have telescopes in the Southern Hemisphere, giving me a chance to image many fascinating objects that can't be seen from my home in California. And I can do it with premium equipment. On those occasions when I've traveled south of the equator, I've been limited to carrying little more than a small telescope or a good pair of binoculars.

With WBOs, there's no equipment to transport or set up, and weather is only an issue for time-sensitive observations. But given the geographic distribution of the telescopes, it might be possible to have at least one under a clear sky at the right time. Indeed, some WBOs legitimately claim to have 24/7 dark-sky access, as well as policies that allow users to work around poor weather conditions without incurring extra costs.

WBOs offer a bridge for beginner and intermediate observers by making high-quality equipment available without the risk of a substantial investment. Beginners can start with easy imaging modes that produce good results, and then transition to more advanced imaging as they develop the necessary skills. The experience can be far less frustrating than starting out with a lot of new gear that you have to set up and master on your own.

There's also an advantage for those of us who are already seasoned astro-imagers and want to try our skills on very high-end equipment. This reflects on my own experience, since I've often wondered what images I could produce with a top-notch telescope at a premier



You can hear more about Mogul's story in an interview he did with astronomer Doug Welsh, available as a Slacker Astronomy podcast at www.slackerastronomy.org/shows/081224-sa.mp3.

site. WBOs provide that opportunity. They don't replace my telescopes, but they put another tool in my toolkit, while also extending my reach to celestial objects located anywhere in the sky.

The cost varies according to what you want to do, and there are a variety of payment plans. Some services require an annual fee. Others have you purchase points that are used to schedule observations. In some cases you request that an image be made with parameters you select, but the WBO maintains the freedom to queue your observation to its own schedule. And there are WBOs that allow direct, real-time control of the telescope and imaging equipment.

What follows is an overview of four WBOs based on my own experiences using them.

Slooh

Mike Paolucci, an experienced internet entrepreneur, founded Slooh in 2002 with the idea of creating a user-friendly observatory that anyone with web access could use. It's an affordable service with a simple user interface that's particularly well suited for beginning astro-imagers.



Current web-based observatories are located under skies that most amateur astronomers only dream about. These domes for Slooh's telescopes in the Canary Islands share the same sky as adjacent world-class professional observatories.

It's also a good service for children, and Slooh has been focusing its efforts on attracting a youthful audience with its "Slooh Kids" program. It provides online tutorials aimed at stimulating a child's interest in and understanding of astronomy. Combined with live access to the observatories, Slooh is an excellent introductory experience. For about \$15 you can purchase 100 minutes of access time, or there's an unlimited annual subscription available for about \$50.

Slooh has four observatories. Two are in the Canary Islands off the northwest coast of Africa; the others are at Mount Dehesa in Chile and the Macedon Ranges in southern Australia. The available telescopes range from a 77-mm apochromatic refractor for wide-field imaging to a 20-inch Dall-Kirkham Cassegrain for deep-sky work.

Although Slooh doesn't give you exclusive access to an observatory, it's a "live" experience. Users can access any observatory that is online and imaging. You can follow the progress of the images as they are acquired and save them in your own gallery or download them to your own computer.



ANDY MAGICA

Slooh refers to its imaging sessions as missions, and you can browse through the website's Mission Schedule to see if there's already a plan to observe an object you'd like to image. If there is, then you simply need to be at your computer at the appropriate time to be part of that mission. When you're online with an observatory you have no indication if the telescope is being shared simultaneously by others.

If your object of interest isn't already on the schedule, or if you want to image it at a different time, then you use the website's Reserve Mission page to schedule your own time slot. Other pages provide a real-time day/night map showing the observatories and their weather conditions. You can cancel a reserved mission if the weather doesn't look favorable.

Slooh's observing method works because most of the imaging details are handled by the observatory. You select only the object, time, and high or low magnification for your observation. The observatory controls the exposure time (maximum is 5 minutes) and whether the image will be color or monochrome.

LightBuckets

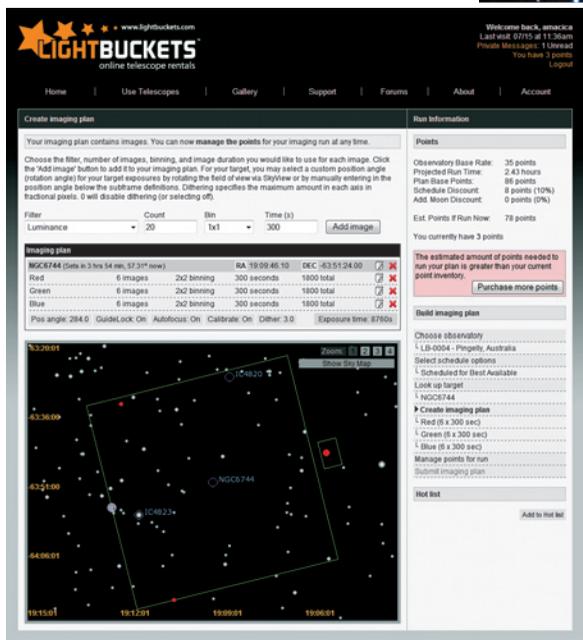
Steve Cullen, founder and CEO of LightBuckets, retired to the small town of Rodeo, New Mexico, after a successful technology career in California. Far from city lights and at an elevation of 4,000 feet, Rodeo was an ideal location for Cullen to build a personal observatory for his 24-inch Ritchey-Chrétien reflector. As the telescope was being hoisted into the dome, Steve thought to himself, "Wouldn't it be cool if other people could use a telescope like this?" Thus the inspiration for LightBuckets was born.

This WBO currently has five telescopes available. In addition to the 24-inch, users can access a 12½-inch

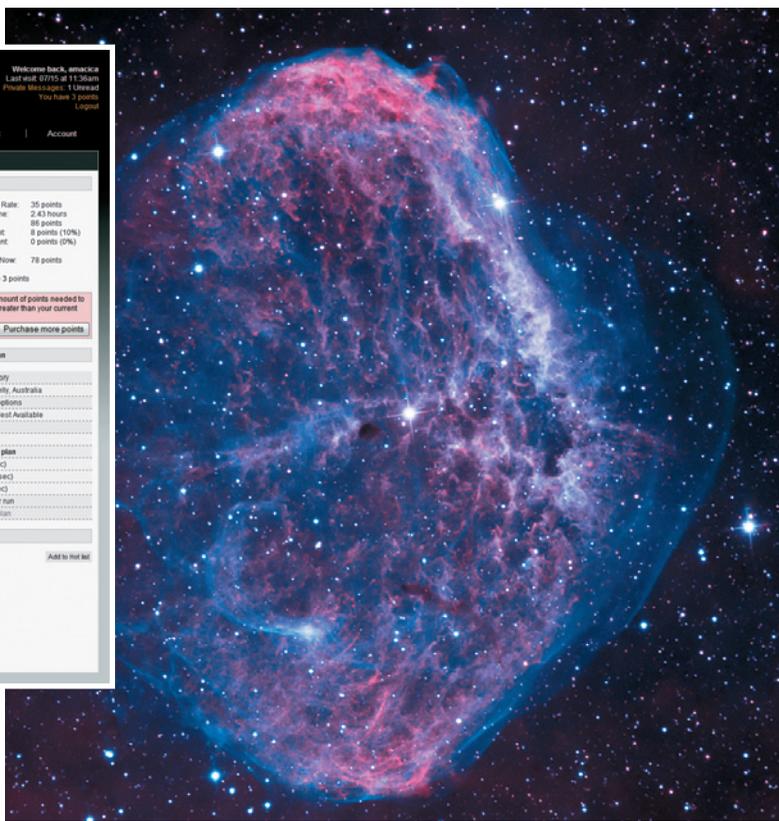
Ritchey-Chrétien and an 8-inch wide-field Newtonian in Rodeo and 14½- and 16-inch Ritchey-Chrétien telescopes in Australia. There are plans to bring more scopes online in the Northern and Southern Hemispheres. The LightBuckets home page provides details on all of its equipment.

Navigating LightBuckets' recently redesigned website is very straightforward, and the Support page provides detailed help if you

Observing with Slooh's telescopes is a "live" experience; users can log onto any telescope currently operating and follow the progress of images as they are captured. The observatory maintains a detailed schedule of upcoming imaging "missions," and users can participate in those scheduled by others as well as ones they plan themselves. At left is the author's Slooh image of the nebulous complex NGC 3324 deep in the southern constellation Carina.



The LightBuckets user interface has star charts that aid in setting up images. This narrowband view of Crescent Nebula, NGC 6888, was captured with the scope pictured below.



JIM WOOD AND EMANUELE COLOMANTO

need it. You begin by submitting an observing plan, and LightBuckets responds with e-mail status reports telling you when the plan is started, when it's completed, if it needs to be rescheduled, and when your images are available for downloading. You pay for the observations with points purchased at the website.

For beginners, there's LightBuckets Easy Imaging. You specify a target, whether the image is to be color or monochrome, and the amount of detail recorded (based on a

scale of 0 to 10, with 10 requiring the longest exposures). Before you submit the plan, you're given an estimate of the exposure time and the number of points deducted from your account. For these simple plans, LightBuckets handles the technical details of which telescope and what specific imaging parameters are used.

For experienced astro-imagers, there's the Use Telescopes option that gives you more control of the imaging session. You get to select the telescope, whether you or the observatory queues the observation to a particular time, and the exposures parameters, including duration, filter, binning, and number of images to make in a sequence. There's even a star chart displayed for your object showing the CCD camera's field of view to aid in framing and selecting a guide star. You get immediate feedback on the points that will be deducted from your account. Once the plan is submitted, you can monitor its status on the website.

Global Rent-A-Scope

Arnie Rosner, the founder of Global Rent-A-Scope (GRAS), lives near Los Angeles, California, where observing conditions make it difficult to pursue a passion for astronomy. Others with this problem have built their own remotely operated observatories. But rather than an individual incurring the expense of a remote setup, Rosner envisioned an astronomers' cooperative that would pool resources and share expenses. This was the motivation behind GRAS, which currently has 13 telescopes online.



The largest LightBuckets instrument currently online is this RCOS 24-inch f/8 Ritchey-Chretien reflector in New Mexico, fitted with a large-format CCD camera.



GLOBAL RENT-A-SCOPE

This menagerie of telescopes in New Mexico is only part of the selection available from Global Rent-A-Scope. In addition to narrowband filters used to make the image of the Large Magellanic Cloud at right, this observatory also has setups for UBVRI photometric observations, complete with integrated analysis software.



JOHN GLEASON

Seven are in Moorook, Australia, and another six are in Mayhill, New Mexico. They range from 16-inch Ritchey-Chrétien and 12-inch Dall-Kirkham reflectors to 4.2-inch refractors for wide-field imaging. Users set up an account with GRAS and purchase points on an as-needed basis or with a monthly subscription plan. The website makes it easy to understand how many points per hour are required for each telescope, as well as how much time you'd have available on a particular instrument based on your current account balance.

GRAS provides many modes of operation. You can go live to any available telescope, make a reservation to go live at some later time, or submit a plan that will execute automatically at a specific time in the future. The user

always controls the schedule for the imaging session. The website provides current weather information at the observatories as well as telescope status and availability.

For the novice astro-imager there's One Click Image. With this mode you're presented a list of currently visible objects and their details, including their current elevations above the horizon. You simply pick an object from the list and the telescope slews to it and takes a 5-minute exposure. There are more advanced modes that let you specify details such as exposure duration, filter, and camera binning. In all cases you are able to monitor the real-time status of the exposure and see the image as soon as it's finished.

For seasoned astro-imagers and researchers, there are three GRAS modes of operation that I'll cover briefly. One is to submit a plan that you prepare with the *Astronomer's Control Panel* (ACP) scripting language. The plan



DAVID PLESKO AND WARREN KELLER / CHERRY MOUNTAIN OBSERVATORY

In addition to its 14½-inch Ritchey-Chrétien reflector (right), Cherry Mountain Observatory maintains two 10-inch Schmidt-Cassegrain telescopes for video and webcam imaging. The Horsehead Nebula in Orion was captured with one of the observatory's refractors.



CHERRY MOUNTAIN OBSERVATORY

For more information about the online observatories mentioned in this article, you can visit their websites: slooh.com, lightbuckets.com, global-rent-a-scope.com, and cherrymountainobservatory.com.

can be executed immediately (if the telescope is available), or run at a specified time in the future. Scripting makes it easy to image multiple objects in a single session.

Another mode of operation lets you make detailed brightness measurements with telescopes at both GRAS observatories that are equipped with special UBVRI filters. The photometry analysis is done with *Photometrica*, software developed by Geir Klingenberg of Norway. A researcher submits a scripted plan, and the images are automatically calibrated with bias, dark, and flat-field images before being uploaded to a *Photometrica* FTP site. The researcher can then activate the program to generate light curves for the objects of interest.

GRAS also offers Direct Control, which lets you slew the telescope, focus the camera, set up autoguiding, and have full control of the CCD camera. Reserving a telescope for direct control needs to be coordinated with the observatory staff in advance. When you're operating a telescope with Direct Control, your computer screen looks very much like what you'd see at the telescope, with desktop icons for applications such as Diffraction Limited's *MaximDL*, Software Bisque's *TheSky*, and *FocusMax*. You simply launch these applications and use them to operate the telescope.

Cherry Mountain Observatory

David Plesko founded Cherry Mountain Observatory in Fredericksburg, Texas, after a successful 20-year business in computer technology. The dark skies coupled with Plesko's childhood passion for astronomy and science were driving forces behind the project, and he subsequently expanded his goals to make the observatory open to the public.

Cherry Mountain Observatory has five telescopes ranging from a 14½-inch Ritchey-Chrétien reflector to a 4-inch refractor. It also has two 10-inch Schmidt-Cassegrain reflectors equipped with video and webcams, which sets it

Web-based Observatories Compared

	Slooh	LightBuckets	Global Rent-A-Scope	Cherry Mt. Obs.
Telescopes 10-inch and larger	4	4	8	3
Wide-field telescopes	4	1	5	2
Northern-Hemisphere sites	1	1	2	1
Southern-Hemisphere sites	2	2	1	0
Easy mode	Yes	Yes	Yes	No
Advanced mode	No	Yes	Yes	Yes
Direct control	No	No	Yes	Yes
Schedule for later (unattended)	No	Yes	Yes	Yes
Live monitoring	Yes	Yes	Yes	Yes
Color imaging	Yes	Yes	Yes	Yes
Monochrome imaging	Yes	Yes	Yes	Yes
Narrowband imaging	No	Yes	Yes	Yes
Photometry	No	V filter	UBVRI filters	No
Exclusive ownership of data	No	Yes	Yes	Yes
Data formats	BMP, PNG	JPEG, FITS, FITS calibration	FITS, FITS calibration	JPEG, FITS, FITS calibration
Approximate cost (12- to 15-inch telescope)	\$50/year	\$35/hour*	\$37/hour	Negotiated

*Promotional discount rates are in effect in early 2010; check website for details.

apart from the other WBOs. A video session can be broadcast to a web service for sharing with multiple users.

The observatory primarily caters to intermediate and advanced users, as well as researchers. While the website has detailed information about the equipment available, all plans for using it are negotiated via e-mail and/or telephone. It's an iterative process. You work with the observatory staff to define your imaging goals, and the staff responds with a proposed plan tailored to your needs. This process is free. When everyone agrees to the plan, you pay for its execution through a PayPal account. The observatory staff then schedules and executes the plan and sends you an e-mail with details for downloading the image data from a private FTP site.

Whether you simply want to dabble, shoot astrophotos for fun, or gather data for advanced research projects, there are telescopes available for online rental that can help you out. Your personal window on the universe is just a few mouse clicks away. ♦

Observer and astro-imager Andy Macica is an engineer working on machine-vision systems. He frequently volunteers at Lick Observatory near his home in San Jose, California.