

# THE MicroObservatory USERS' GUIDE

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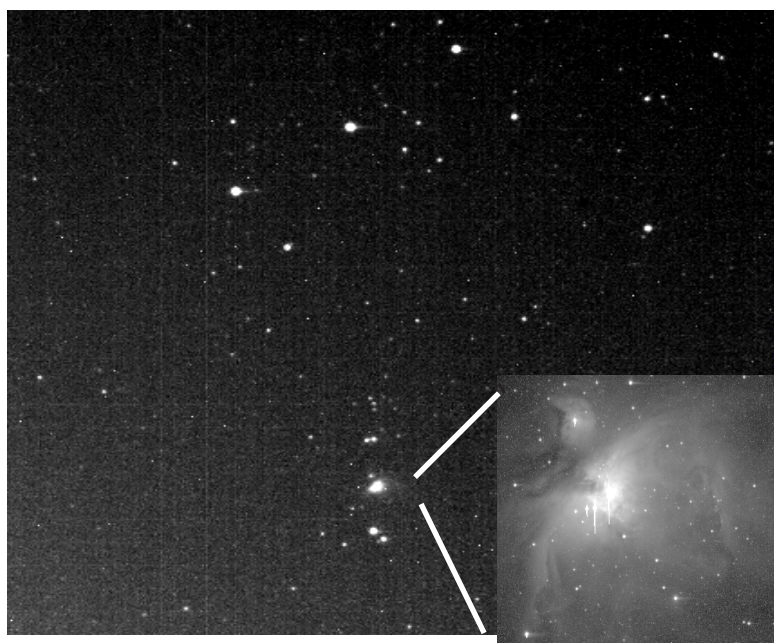
## INTRODUCTION

You are about to use a telescope that can detect objects far beyond our own galaxy... objects so distant that their light has been hurtling through space since before the first life emerged on land, nearly a billion years ago.

This telescope will do no more and no less than what you command it to do. Learn how to use it properly, and it will take you on a great adventure out in space and back in time, across our galaxy and far beyond.

## BEFORE YOU BEGIN...

Go out and look at the sky on a clear, dark night. No machine can replace your own eye... or your mind's eye. Get to know the constellations, when they rise and set, how they change with the seasons. They will be your road map as you navigate the universe.



Find good star charts. Read about the sky and learn which celestial events are headed your way. Try the challenges and puzzles that we will provide from time to time.

Above all, let your own curiosity and wonder be your guide. Get to know the mysteries of the universe that others, like you, are trying to solve.

*M42 - Orion's Nebula through MicroObservatory finder and main camera (inset). Can you find the 3 stars of Orion's belt?*

## GETTING STARTED

**ENROLLMENT.** You must be enrolled in order to control the telescopes. Enrollment is free, and is currently available through a proposal process described in the "ENROLL" section of the MicroObservatory Web Site. Even if you are not enrolled, you can explore all parts of MicroObservatory, including the latest images that users have taken, along with challenges and puzzles.

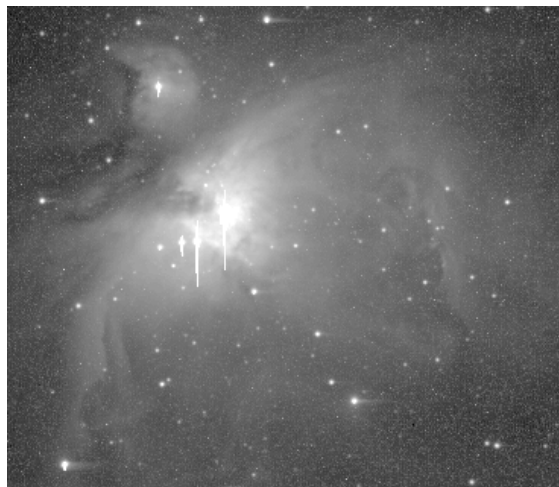
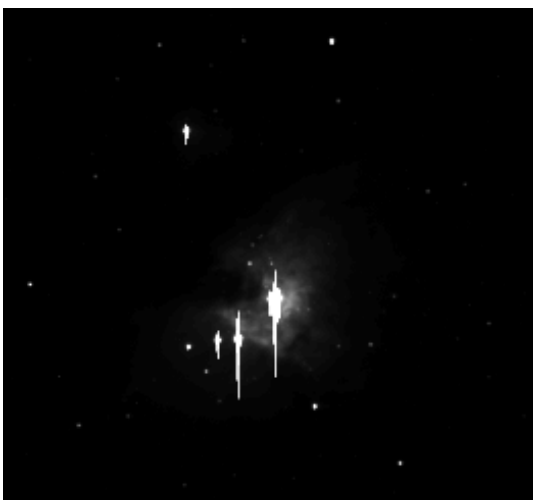
**WEB BROWSER.** If you are not already using one of the following web browsers, you will need Netscape, version 3.0 or newer, or MicroSoft Explorer 3.0 or newer, or a similar Web Browser that supports "frames" (multiple windows).

Your browser's window should be opened to its full width.

To get more viewing area, some browsers allow you to hide or shrink the control buttons at the top. (In Netscape, the Options menu allows you to hide the Toolbar, Location, and Directory Buttons, freeing more screen area.)

**HARDWARE.** You'll need a 28.8kbaud modem or faster to comfortably download images from the telescope.

**SOFTWARE.** You don't need special software to view images from the telescopes. (Images are returned in the GIF format, which is read by all Internet browsers.) HOWEVER, in order to get the most out of your images, it helps to have IMAGE PROCESSING software that lets you adjust the brightness, contrast, or background noise in your images. The telescopes can also return images in the FITS format, which contains more information, than GIF format. To view or process images in FITS format, you will need special software. See IMAGE PROCESSING section for obtaining this software.



*Orion Nebula, M42, before and after image processing.*

## SELECTING A TELESCOPE

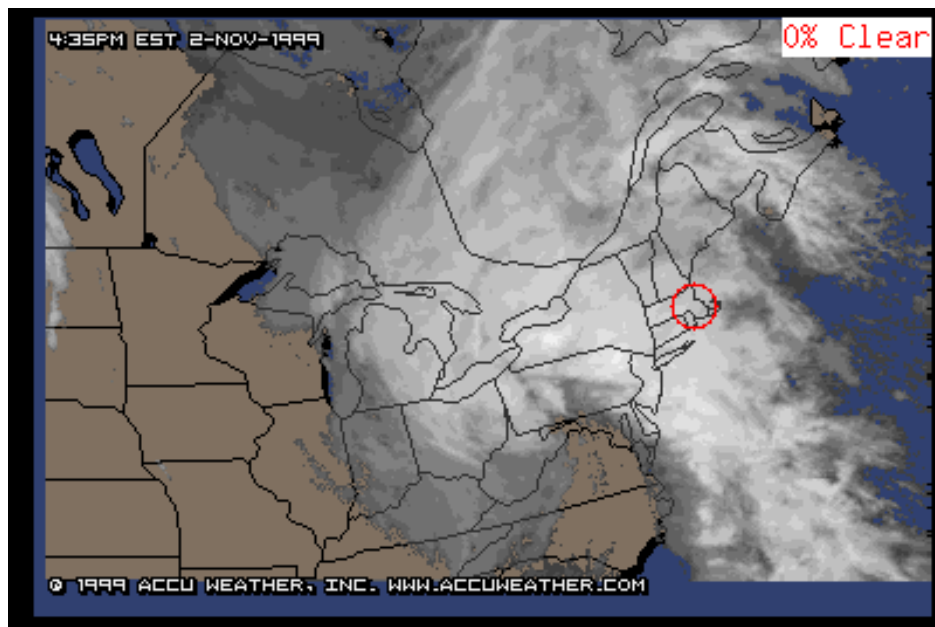
**SELECTING A TELESCOPE LOCATION.** To select one of the MicroObservatory telescopes, first go to the Telescope CONTROL CENTER. The map shows the location of MicroObservatory telescopes.

**SELECT TELESCOPE SITE**

Local Weather	Telescope Status	View Queue
<a href="#">Cambridge, MA</a>	Online	22 entries
<a href="#">Cambridge, MA</a>	Online	46 entries
<a href="#">Mauna Kea, HI</a>	Coming Soon	N.A.

Then click on map site to select telescope...

**CHECKING THE WEATHER.** You MUST check the weather at a telescope's location, using the buttons provided, before you use the telescope. The telescopes should only be used under clear skies.



**ACCESSING THE TELESCOPES.** Once you have determined that skies will be clear at the desired location, simply **click on the map** at the location you want. The control panel for that telescope will appear on your screen.

## TELESCOPE CONTROLS: TAKING AN IMAGE:

<b>CONTROL TELESCOPE</b>		
	<b>You are now controlling the MicroObservatory telescope (Ben) at the Harvard-Smithsonian Center for Astrophysics in Cambridge, MA. Longitude is 71.13. Latitude is 42.38.</b>	<b>Special Notes:</b> Blue-sensitive CCD detector. Working fine!
<b>Enter username and password:</b>	<b>Username:</b> <input type="text"/>	<b>Password:</b> <input type="password"/> <a href="#">Forgot your password?</a>

**AUTHORIZATION.** To send commands to the telescope, you must enter your: USERNAME and PASSWORD. You must use the username and password you chose when you enrolled. (A first initial and last name for username is recommended.) You can change your username or password by updating your current account info under the ENROLL menu.

**WHEN TO TAKE IMAGE.** You'll need to know WHEN the object you want is above the horizon and HIGH ENOUGH for you to take a clear image. (Usually, the higher in the sky it is, the clearer the image, because the telescope has to look through less atmosphere.) You can use astronomy magazines, other Web sites, or the "What's Up" information in this site to help you figure out "what's up when."

<b>When To Take Image</b>		
<b>Select one:</b>	<input checked="" type="radio"/> <b>Daytime</b>	<input type="radio"/> <b>At Night</b>
<b>For night viewing, select time:</b>	For viewing the Moon live in the daytime. 6AM to 6PM only, at telescope site. Current time at telescope is: <input type="text" value="12:13 AM"/>	6PM to 6AM only, at telescope site <b>When:</b> <input type="radio"/> PM <input checked="" type="radio"/> AM <b>Hour:</b> <input type="text" value="1"/> <b>Minute:</b> <input type="text" value="0"/>

"NOW." During the daytime (6 AM to 6 PM at the telescope's location), you can use the telescope "live". Just select the "Daytime" button and proceed. Your image will be ready within 2 to 3 minutes. This is ideal for observing the Moon from your classroom, when it is up during the daytime. Some planets are also observable during the day! Sorry, the telescope cannot take images of the Sun.

**AT NIGHT.** To take an image at night, you must set the telescope controls in advance; the telescope will automatically take the image at the time you specify (between 6 PM and 6 AM at the telescope's location). Don't forget to enter AM or PM and then the hour and minute desired. If the time slot is filled, the telescope will take the image as soon as possible after the desired time. (You can check the Information returned with your image to see exactly when the image was taken.)

## TELESCOPE CONTROLS: TAKING AN IMAGE:

**POINT TELESCOPE.** You can point the telescope in two different ways. Be sure to select the appropriate button.

**Where To Point Telescope**

Select one:  Using Coordinates  Using List Below

Then fill in coordinates or select from list.

**RA:**  
[ ] Hrs. [ ] Mins.

**Dec:**  
[ ] Degs. [ ] Mins.

**Name of target:**  
[ ]

- Venus
- Mars
- Jupiter
- Saturn
- Uranus
- Neptune
- Pluto
- Moon
- M-1 Crab Nebula
- M-3 Globular cluster
- M-11 Open cluster
- M-13 Globular cluster
- M-27 Dumbbell Nebula
- M-31 Andromeda galaxy
- M-34 Open cluster
- M-37 Open cluster
- M-42 Orion Nebula
- M-44 Open cluster
- M-45 Open cluster
- M-51 Whirlpool galaxy
- M-57 Ring Nebula
- M-81 Spiral galaxy
- M-82 Irregular galaxy
- NGC-4565 Spiral galaxy

**USING COORDINATES.** You can enter the **COORDINATES** of the desired object. These coordinates, called "Right Ascension" (RA) and "Declination" (Dec) are like a Zip Code that tells the location of an object on the sky. You'll want to use these coordinates for distant objects such as stars and galaxies. You can find an object's coordinates from star charts and catalogs available in books, magazines, on the Web, or elsewhere on this site. (The telescope's computer automatically takes into account the rotation of the Earth when it points the telescope.)

**USING LIST.** Use the convenient list for viewing the Moon and planets. Objects that are inside our Solar System (such as the Moon, planets, and asteroids) appear to move against the "fixed" background of distant stars, and their coordinates change with time. The MicroObservatory computer will automatically calculate the position of the object at the desired time and point the telescope for you. The list also contains other popular objects for viewing. Note: The Information returned with your image lists the actual coordinates (RA and Dec) used.

## TELESCOPE CONTROLS: TAKING AN IMAGE:

**CAMERA SETTINGS.** Use the buttons to select the MAIN or FINDER camera:

The MAIN CAMERA is used for most work. Its 1-degree field of view comfortably includes the Moon, planets with their moons, and all galaxies and nebulae except the Andromeda galaxy, M31.

The FINDER CAMERA has a 10-degree field of view (about half the size of the constellation Orion). Use the FINDER for observing constellations, comet tails, and other objects that spread across the sky.

**Camera Settings**

Select one:  Finder Camera  Main Camera

Then set exposure time and filter:

**Exposure:**  secs.

**Filter:**  
Clear

**Exposure:**  secs.

**Filter:**  
Clear

Zoom In  
 Zoom Out

Default Focus  
 Manual Focus:  
 (0 to 3300)

Take Picture Clear Form

F.S.D./R.G.

### SET CAMERA EXPOSURE AND FILTER:

- **FINDER CAMERA.** For most objects except for the Moon, use an exposure of about 60 seconds (up to a maximum of 300 seconds). Use the clear filter. For very bright objects like the Moon (which will appear the size of a nickel in the FINDER), use the Neutral Density Filter to cut down on the light, and use an exposure of 1 second or even less.
- **MAIN CAMERA:** See suggested settings page.
- **ZOOM IN/OUT.** For most objects viewed in the main camera, you'll want to keep the ZOOM OUT. While a zoomed-in image will be bigger, you're also more likely to miss your target if the telescope isn't pointing exactly dead-on. So use the ZOOM IN only when you're certain (from other images) that the target will be right in the center of the field of view. Remember, you can always zoom in to make your image bigger with image processing software.
- **FOCUS.** Always use the DEFAULT FOCUS. This automatically takes into account the thickness of any filters you may be using, and selects the best focus value. For certain special applications, it may be desired to defocus the image. This can be done with MANUAL FOCUS. Check with support staff first.
- **TAKE PICTURE.** It's a good idea to check your control panel to see you've entered your settings correctly. When you're ready to send the commands to the telescope, just hit TAKE PICTURE. (Sorry, there's no way to cancel a command once you've hit this button!)

**SETTINGS FOR THE MAIN CAMERA.** Here are some recommended settings for various celestial objects. (You may have to experiment.) **A great way to learn is to look at images that other users have taken... and then check the Information box returned with each image to see the settings that were used.**

**The Moon...**

Camera: Main

Filter: Grey (Neutral Density)

Exposure: .06 to 1 second

*Thought Question: Why do nebulae and galaxies need longer exposure times than planets and the moon?*

**Planets...**

Camera: Main

Filter: Clear, or experiment with filters

Exposure: 0.1 - 0.5 seconds for Venus, 0.5 - 1 second for Jupiter and its moons, longer for others.

Point Telescope: Use the pull-down list.

**Nebulae...**

Camera: Main

Filter: For emission nebulae, red or IR, but use Clear if object is dim.

Exposure: 15 to 45 seconds

Point Telescope: If not on pull-down list, input RA and DEC

**Galaxies...**

Camera: Main

Filter: Clear (or for special work, Red or IR which help cut down backgroundlight)

Exposure: 30 to 60 seconds

Point Telescope: If target not on pull-down list, use coordinates and input RA and Dec.

**The Sun...**

By appointment only for now.

## TELESCOPE CONTROLS: TAKING AN IMAGE:

CONFIRMATION OF YOUR IMAGE REQUEST. If you've entered information correctly, when you hit "take picture" you will get a screen with a message giving valuable information about your image, including the altitude and azimuth of the object at the time you have requested the image, and its Right Ascension and Declination. You may want to record these for future use. (The same information will be returned with your image).

### **Thanks for requesting an image!**

---

Altitude: 34 degrees 5.8 minutes  
Azimuth: 110 degrees 30.9 minutes  
Right Ascension: 01h 46.9m  
Declination: 09 degrees 24 minutes  
Object above the horizon, altitude is 34.096393.

You will be notified by e-mail when your image is ready.

Your reference number for this image request is **mdussault-11/05-12:18:22**.

To take another image: Click and hold the mouse button down in this window, and then select BACK IN FRAME from the pull-down menu.

Please limit yourself to **10** observations per day!

Please tell us about your observations  
by submitting this [form](#). (It will only take a minute!)

If you have entered some piece of information incorrectly, you will see a screen with an error message:

### **Sorry!**

Incomplete or incorrect information was provided.

**Altitude: -07 degrees 22.4 minutes**  
**Azimuth: 70 degrees 2.4 minutes**  
**Right Ascension: 01h 47.0m**  
**Declination: 09 degrees 24 minutes**  
**Wanted to go below the horizon, altitude is -7.372565.**



## GETTING YOUR IMAGE

**HOW LONG WILL IT TAKE?** The telescope will take the image at the time you requested or as soon thereafter as the traffic permits. It takes from one to several minutes to take an image. This includes the time to point the telescope, take the exposure, and download the image over the Internet to the MicroObservatory server in Cambridge, MA.

**WHEN WILL I KNOW?** The telescope will automatically send you an e-mail when your image has been taken. If your mail-server alerts you to incoming mail only at long intervals, you may find it faster to simply check the QUEUE for the telescope on the SELECT TELESCOPE page in the CONTROL CENTER. The QUEUE lists all images still waiting to be taken.

**RETRIEVE IMAGE.** When your image has been taken, it will be listed in the MicroObservatory IMAGE DIRECTORY. You can access this DIRECTORY from many parts of the Web site by clicking the button GET IMAGES.

### Latest MicroObservatory Images

**To view an image:**

- Click on the Filename.
- For quick access to a thumbnail-sized version of the image click on INFO next to the Filename. INFO will also give you information on how the image was taken.
- Image files are listed by date and time by default. You may sort this directory by "Username", "Filename", "Object", "Date", "Telescope" or "Size" by clicking on the appropriate heading below.
- To view our Image Archive Directory, which contains interesting images taken by users, [Click Here](#).
- Please note: To conserve space, images will be held for one week and then deleted.

<u>Username</u>	<u>Filename</u>	<u>Info</u>	<u>Object</u>	<u>Date</u>	<u>Telescope</u>	<u>Size</u>
kicklfip39	<a href="#">sw.starc.11m05d14b02m21s.GIF</a>	<a href="#">Info</a>	starcluster	05-Nov-99 14:05	Ben	001 K
cpeirce	<a href="#">CP.Moon.11m04d18h08m42s.GIF</a>	<a href="#">Info</a>	Moon	05-Nov-99 06:02	Ben	056 K
cpeirce	<a href="#">CP.Moon.11m04d18h17m04s.GIF</a>	<a href="#">Info</a>	Moon	05-Nov-99 05:57	Ben	001 K
cpeirce	<a href="#">CP.Moon.11m04d18h19m17s.GIF</a>	<a href="#">Info</a>	Moon	05-Nov-99 05:52	Ben	001 K

**FINDING YOUR IMAGE.** Images are listed in the order they were taken, with the most recent image at the top. If you prefer, you can RE-SORT this directory to list images alphabetically by USERNAME. Just click on the column heading, USERNAME. That way, all your images will be grouped together.

## GETTING IMAGES

**VIEWING AN IMAGE.** Just click on the filename and the image will appear on screen, in GIF format. If you are viewing a **SERIES OF IMAGES**, you may wish to view just a **THUMBNAIL** image for each. (This saves on the download time.) Simply click on **INFO**, to the right of the Filename for your image. You can keep scanning through your thumbnail images, using the arrows at top.

**VIEWING IMAGES IN FITS FORMAT.** The telescope takes images in FITS format, which contains more visual information than the GIF format used on the Web. The computer then converts the image to GIF format, and saves the image in both the GIF and FITS formats. The original FITS image is useful for advanced image processing, for measuring the brightness of objects, and for viewing fine detail. To retrieve a FITS image, first examine the GIF image by clicking on the Filename. Then Click on the "Save FITS image" link at the top of the image. The browser will save the FITS image. You will need special software to view or process this image. See **SOFTWARE**, below.

### Image Archive Directory



[Click Here](#)

**INFORMATION ABOUT YOUR IMAGE.** The telescope records a great deal of useful information about how each image was taken. To view this information, click on **INFO**, to the right of the Filename for your image.

#### **Header:**

Observer's Username: vivek  
Object: Moon  
Filenames: VR.Moon.11m04d08h45m05s.GIF and VR.Moon.11m04d08h45m05s.FITS  
Date: Thu, Nov 4, 1999  
Start Exposure: 8:47:01 AM  
Reference Number: vivek-11/04-08:44:17  
Comments: Coordinates for this image were chosen by a list.  
Town: Cambridge  
State: MA  
Country: USA  
Telescope's Name: Ben

#### **Camera:**

Camera: Main  
Exposure Time: 1.30 sec.  
Filter: Grey (ND4)  
Focus Value: 785  
Zoom: Out

**SAVING (DOWNLOADING) AN IMAGE.** Please refer to your Web browser's instructions for how to save images to your computer's hard-drive.

**DELETING AN IMAGE.** Images will be saved in the **IMAGE DIRECTORY** for one week and then deleted.

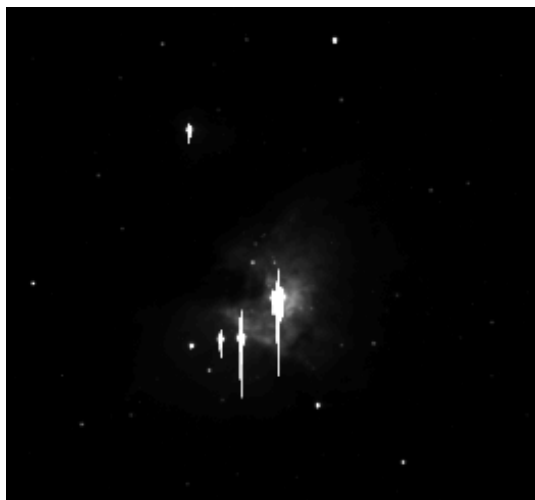
## PROCESSING YOUR IMAGE.

There is a lot more information in a typical image than meets the eye at first. To bring out the fine details, you must **PROCESS YOUR IMAGE**. Following is a brief description of the kinds of processing that may be useful in your experiments. For details, consult the Image Processing Guide and manuals of specific software programs.

**ADJUSTING CONTRAST AND BRIGHTNESS.** This is the simplest processing you can do. It is very useful for faint and low-contrast objects like galaxies or nebula.

**BACKGROUND SPECKS.** Some (or many) of the little white dots in your image are **NOT** stars: If they are a single pixel ("picture element") wide, they are likely to be background noise, called "hot pixels". This noise comes from the light-sensing electronic chip itself and is caused by heat, cosmic rays and other factors. You can eliminate this in programs like Adobe Photoshop that allow you to remove "dust" from photographs.

**BACKGROUND NOISE.** If you use the opaque filter and try to take a picture, you will **NOT** get a completely black image. That's because the telescope's light-sensing chip itself produces electronic "noise" that is interpreted as faint light. By **SUBTRACTING OUT** this noise from your image, you can bring out faint details. To do this, you need to use an image-processing program that allows you to subtract one image from another, that is, to subtract the "dark field" image taken with an opaque filter from the image you want to enhance. (Both images must have been taken with the same exposure time.)



*Orion Nebula, M42, before and after image processing.*