

# Remote Astrophotography Using Slooh.com A Handbook

## Sample Chapters



Erik Westermann

*This book is dedicated to my mother, Ursula Westermann  
Thank you for everything you do*

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## Table of Contents

Introduction .....	1
Who Should Read This Book?.....	1
What's In This Book?.....	1
What You'll Need To Know.....	2
What You Need To Have.....	2
Conventions Used In This Book.....	3
Understanding The Role Of Slooh In Imaging .....	4
Understanding Slooh .....	5
Understanding The Slooh Telescopes .....	6
What People Use Slooh For .....	6
Next Steps.....	6
Understanding The Tools And Workflows .....	7
Mission Planning and Booking .....	9
Understanding The Slooh 500 List.....	9
Next Steps.....	9
Using KStars to Plan and Schedule a Mission .....	10
Next Steps.....	12
Planning and Booking a Coordinate Mission .....	13
Result of Booking a Coordinate Mission.....	14
Next Steps .....	14
Using the KStars Observation Planner .....	15
Mission Planning using DSO-Browser .....	15
Next Steps .....	15
Understanding Piggybacking Missions - A Quick Shortcut.....	15
Next Steps .....	16
For When You Don't Have a Plan - Watching Missions Live.....	16
Next Steps .....	16
Understanding Color And Filters .....	18
Next Steps .....	18
Understanding The Files Slooh Produces .....	18
Next Steps .....	19
Understanding FITS Files .....	20
Next Steps .....	20
Processing Your First FITS Image Using Fitswork.....	21
Next Steps .....	21

Understanding Stacking and Multi Luminance Processing.....	22
Next Steps .....	22
Understanding the Solar Telescope – Canary Five.....	22
Next Steps .....	22
Using GIMP to Enhance Images .....	23
Next Steps.....	23
Photometry, Stacking and Processing Using AstrolImageJ .....	24
Next Steps.....	24
Software Installation and Configuration .....	25
Online Resources .....	25
My Software Setup And Workflows .....	25
My Adventures In Exoplanet Hunting .....	25
My History with Astronomy and How I Found Slooh .....	26
Tools and Workflows I Used To Write This Book.....	28
Legal Notices .....	29

# Introduction

My name is Erik Westermann, and I have been observing the skies since I was in my early teens. I was always fascinated with the night sky, the movement of the moon, the patterns the stars made in the sky and was always curious about the sky.

Due to life and other circumstances, I essentially gave up on actively participating in astronomy. However, years later, when I restarted my hobby, I was both impressed and overwhelmed at the amount of information that was available. I learned that there are a lot of things to know to become a good astrophotographer yet there was not a single source of information that targeted someone new both to astronomy and new remote imaging using Slooh. I thought of all of the pain points I came across and how I ultimately overcame them. Sometimes solutions were easy, other times the solution was buried in layers of knowledge. I thought of writing blog posts about my findings, yet blog posts are meant to be short and concise and what I wanted to say wasn't going to work in that format. So the next best thing was to compile everything I learned into one easy to use format: this is that book.

This book is a sampler to give you an idea about what's in the book available from Amazon.com. I include about 34 pages of content from the book, which is approximately 160 pages long. I have indicated where content has been omitted and provide you with a summary where possible.

## Who Should Read This Book?

I have aimed this book at someone that's interested in astronomy at the beginner to intermediate level. You have an interest in the things you see in the sky at night but might not have a lot of background information and you want a place to start and have a good foundation to build upon.

If you're at the intermediate level, you'll also benefit from this book because I show you methods to improve your skills in composing your images, processing your images, and doing advanced things like photometry with your images.

I also intended this book to be for someone that's interested in expanding their knowledge based on practical advice and someone that has a willingness to experiment.

## What's In This Book?

This book is a handbook for taking great photos of the skies based using Slooh.com. I cover how to use Slooh.com to acquire images of just about anything in the sky and also explain what you can do with those images. I describe in detail how to process your images to get the best result and explain a lot about astronomy and astrophotography along the way.

I read lots of tutorials and watched videos where the author describes what you should do without explaining why you're doing it. I have tried to explain the 'why' wherever possible while giving you practical advice.

I explain throughout the book what each section covers and next steps to take so you're never left alone. However, I also wanted to make this book a useful resource for reference, so each chapter can stand on its own.

This book spans two broad parts: Mission Planning and Booking and Image Processing. There's a third part to the book in the Appendix where I discuss how I use Slooh, my adventures in exoplanet hunting and my history with astronomy and how I came across Slooh.com.

Of course, a book about astronomy would be incomplete if I didn't tell you about the tools and processes I used to write this book, so if you're interested, that's at the very end of the book.

## What You'll Need To Know

You're going to be spending a lot of time with your computer, so you need to be comfortable using it. I assume you're using a modern version of Windows.

You have to be comfortable with making folders, finding files, downloading things, installing software, and be comfortable enough to get yourself out of trouble. You should be relatively organized insofar as naming files and keeping them in different folders.

You should be comfortable using the internet, and a modern browser like Google's Chrome. You should also be comfortable using web-based applications where you have to sign-up or sign-in or enter detailed information on forms.

## What You Need To Have

You'll have to be a member of Slooh.com - either the Apprentice or Astronomer level. In this book, I cover advanced techniques which require the Astronomer membership level. If you're not signed up for the Astronomer level, you can skip those parts or temporarily upgrade your membership.

You'll need to be running a modern version of Microsoft Windows since I have you install and use software designed for it. You can certainly use Slooh.com without any of the software and this book covers those features as well. Your overall experience will be better with the software.

You'll have to have the ability to download and install software on your computer. Some systems restrict the rights you have on your own computer, so please make sure you can install software.

You'll require a stable and reasonably fast connection to the internet. Astronomy involves a fair bit of research, and you'll interact with Slooh.com online, so your connection has to be suitable for those purposes.

You'll ideally already have Google's Chrome browser installed. This is not a strict requirement; however, I used it during the writing of this book, so I discuss some of its capabilities.

All of the software I have you install is available online and it is free, so there's no cost involved beyond the Slooh membership.

## Conventions Used In This Book

Throughout the book, I'll ask you to type things or click on certain things. Where possible, I put the thing I want you to act on in quotes to separate them from the rest of the text.

Often, I ask you to type things and show them in quotes to make it easier to see. Sometimes things have embedded spaces, and the quotes help to offset that from the rest of the text. In those cases, just type what you see without the quotes.

I'll also often ask you to click things, or select them. I write out the name of the thing I'd like you to select, like "File".

Sometimes you need to make a series of selections from menus. I write those out as steps without quotes, like this for opening a file: File - Open.



# Understanding The Role Of Slooh In Imaging

There's nothing quite like having your own telescope in front of you, pointing it to wherever you like and viewing the night sky.

For astroimaging, along with your telescope, you need a camera. You'll also need a mount to assist in pointing the telescope, plus you'll need software to help you drive everything. You'll also require a camera to take photos. In astroimaging, the details matter and while a regular DSLR camera will do in many cases, once you get to a certain point, you'll find that you need a dedicated astroimaging camera. You also need software to help you manage the camera.

Once you have all that equipment, you need an observing site. Ideally, you want a site that has great seeing conditions with dark skies and little to no light pollution. You also want a location that has reasonably good weather to maximize the number of viewing nights available to you.

Ideally, you want to automate everything. While staying up late is nice some nights, it's not practical when you have a job or other commitments, so automation is key. It would be best to just set up whatever you want to view, and then have the results delivered to you the next day.

I just described everything that Slooh.com provides to you in the last three paragraphs.

Slooh.com is essentially "telescopes as a service". Slooh.com handles all of the details about the observing site, managing the telescopes and cameras, installing software, and all the rest for you. Plus they automate everything, so all you do is make reservations and get your images and data the following day.

So how does Slooh.com fit into an astronomer's hobby?

- Slooh.com can augment the number of viewing nights available to you
- You can use Slooh.com for research
- You can use Slooh.com to image targets that are too dim for your telescope or seeing conditions
- You can use Slooh.com to access observing sites that are far away and in ideal seeing conditions
- You can take great photos with Slooh.com
- Slooh.com has a great community of users and astronomers
- Slooh.com participates in outreach and education programs

I don't own a telescope and do all of my imaging using Slooh.com and other services. In fact, when I use other services, I compare their capabilities against Slooh.com's capabilities to get an understanding of when I might use something else (and that doesn't happen often).

## Understanding Slooh

As I explained, Slooh.com offers “telescopes as a service”, but it goes beyond that simple description.

Slooh.com is really special because it offers capabilities that are simply out of reach of the vast majority of astronomers. For example, Slooh.com offers its members eight different telescopes in two world-class locations, one on the northern hemisphere and one in the southern hemisphere.

Among those telescopes is the popular Canary One telescope - an instrument worth tens of thousands of dollars. It also has an incredible camera attached to it - also worth thousands of dollars. Also available to members is the unique Solar telescope, offering live views of the Sun whenever it's out. I had no idea I was so interested in the Sun until Slooh.com started offering this telescope - now I check it every day!

In addition to the telescopes, great observing site, and automation, Slooh.com has a great and active online community made up of other members and astronomers. The community regularly helps each other out in many different ways, does community-based projects, creates new software, and more. There are some regulars which you'll get to know pretty quickly like the image processing specialists, the asteroid hunters, comet hunters, scientists, and general users that just like to help out.

In addition, Slooh.com itself participates in the community by hosting special online events and shows. You might have even heard of Slooh.com during the solar eclipse of 2017 when Slooh.com made its feeds of the Sun available to the public. More recently, Slooh.com offered members a 360-degree tour of the domes and telescopes, this is actually where most of the photos in this chapter are from.

# Understanding The Slooh Telescopes

(content omitted from sample chapters)

This section provides an overview of the Slooh.com telescopes and explains some of their features.

## What People Use Slooh For

Given that there's so much choice not only in the telescopes Slooh.com offers, but also so much choice in terms of outreach and education, there are lots of possibilities, some of which I have already mentioned:

- Research
- Comet hunting
- Asteroid hunting
- Advanced astrophotography
- Deep sky observations
- Opportunity to contribute to community projects
- Opportunity to learn based on Slooh.com's webcasts and videos
- Participation in the active community
- To get more viewing nights which might not be possible with your own telescope
- Do advanced image processing

## Next Steps

Next, we're going to learn about the tools and workflows you'll use to work with Slooh.com and the lessons in this book.

# Understanding The Tools And Workflows

This chapter is all about software tools and the workflows you'll use to put them to use.

While it's possible to use Slooh.com without any additional software available to you, you get a better overall long-term experience with the capabilities the software gives you.

(content omitted from sample chapters)

This chapter provides you with an overview of the tools and workflows you'll use when imaging with Slooh.com

# Part One – Mission Planning and Booking

# Mission Planning and Booking

The night sky is always changing. People often navigate the sky using constellations and these constellations change based on the time of night and even change according to the season. Some constellations are always up in the sky because they're close to the North Star, which never sets in the northern hemisphere. In the southern hemisphere, there are three constellations that are always up because they're close to the star Sigma Octantis.

Keeping these exceptions in mind, the remaining constellations rise and set throughout the night and the constellations available for you to see change throughout the year. For example, the constellation Orion is visible in the northern hemisphere during the winter months but it not at all visible during the summer.

Given that the entire night sky is available to you when you plan an observation, how do you know what to view when you book a mission? This is where Slooh and some of the software you installed earlier come in.

This chapter explains and walks you through booking using the Slooh 500 list, you'll learn how to use KStars to plan a mission, and you'll do an advanced coordinate mission to get just the right shot of a grouping of galaxies.

## Understanding The Slooh 500 List

The easiest way to book an observation session, or mission, is to book it using the Slooh 500 list of objects. Slooh has curated a list of 500 objects in the sky that make for great looking photos and has not only made the list available to you, they have also integrated the list right into the reservation system, so you only need to make a couple of selections for a great photo!

The Slooh 500 list doesn't change, however, what you can pick from the list changes based on the time you are booking the mission. So you'll see a number of objects in the pick lists that are not available for you to pick now, but if you try a later time or another date, that object might just be available to you.

Later, we'll get into mission planning using KStars, the planetarium software you installed and configured earlier. KStars takes the mystery out of mission planning and helps you take amazing photos regardless of the object you choose to view - it also opens up the sky beyond the Slooh 500 list to many other things like comets, other galaxies, nebulas and even quasars over 8 billion light years away from us!

The rest of the chapter walks you through booking a mission using the Slooh.com 500 List. It includes detailed directions and screenshots to help you along the way.

## Next Steps

The next sample section walks you through using KStars to book a mission. KStars is free planetarium software and I explain how to install it in the Software Installation and Configuration section.

## Using KStars to Plan and Schedule a Mission

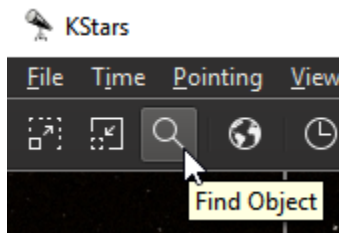
I remember when I signed up for Slooh initially, I was always taking photos of the same objects and didn't really have a good understanding about what was available to me for imaging. The photos all looked the same and I didn't really know what to do with them. It became frustrating and I actually stopped taking photos for a few months. During that time, though, I kept on reading and researching and eventually found planetarium software.

Planetarium software is an application that astronomers use to plan observations, do research, verify photos they have taken, log their observations, and even control the camera and telescope. Planetarium software contains a database of stars, planets, comets, asteroids, and even satellites. Using the database and some incredible math, the software makes it possible to figure out what's up in the sky on any given night from your location. The software is also interactive in that it shows you what the night sky looks like at any time so it also helps you compose your images before you see them, so there's a lot less guesswork involved in setting up a mission.

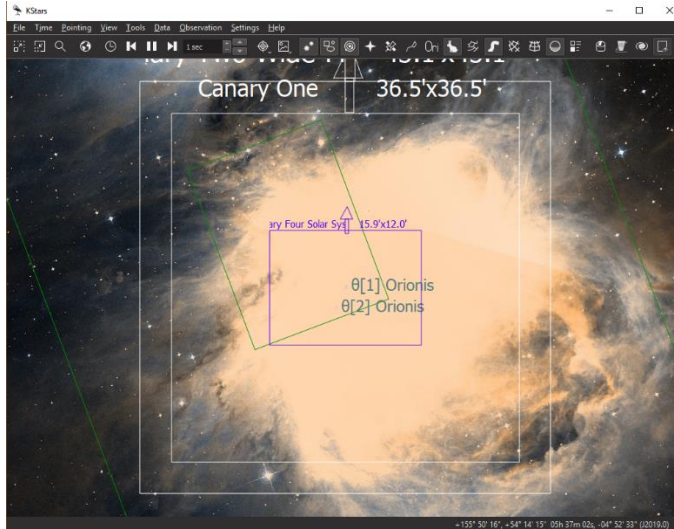
The sky database is central to any planetarium software and KStars does a good job of using publicly available databases for its sky map. I find that since I like to view unusual objects, TheSkyX offers databases that aren't readily available in other planetarium software. While I can certainly get much of the information I need online, there's nothing quite like working in a single application to get everything done in one place.

(some content omitted from the sample)

Click the Find Object button on the toolbar:



Type "M 42" (without the quotes) and hit enter. Your screen should look something like this:



If all you see is a black sky with some squares on it, there could be one of two issues:

- The image is taking some time to download, so you might have to wait a minute for it to show up
- You have not configured KStars to get images from the internet. It's a simple fix: select View - HiPS All Sky Overlay - DSS Colored

So what are we looking at?

The big bright area in the middle of your screen is a photo of M 42 downloaded from the DSS sky survey data. The DSS is short for the Sloan Digital Sky Survey, a series of photos taken of about 35% of the sky using a powerful telescope. The photos are available online for anyone to use and they make it possible for applications like KStars to integrate the photos, making them more readily available to you.

The green boxes are the boundaries and are not of interest to us at this time. The white boxes are the field of view indicators for the various telescopes. If you don't see the white boxes, go to the chapter on Software Installation and Configuration and follow the directions there for KStars setup.

Use your mouse wheel to zoom in and out so you can see all four of the field of view indicators. Based on that view, to capture the whole nebula in a field of view, you would need to use the Canary Three telescope. The Canary Two would also be a good alternative. The view from Canary One would be too narrow to capture the nebula, but you'd still capture a good photo using it.

So now we know what telescope we want to reserve and what our image is likely to look like, so that already has taken a lot of guessing out of the process of planning a mission, and all we've done so far is searched for M 42!



So now we have to figure out when the best time will be to view M 42.

(some content omitted from the sample)

## Next Steps

Great! Now we have one more reservation to try - a coordinate mission!

Coordinate missions are typically used by advanced users to point the telescope at an exact point in the sky when hunting things like comets, asteroids, or even satellites. Coordinate missions are also helpful when you want to compose your shot to make the best use of the telescope's field of view. That's the subject of the next section.

## Planning and Booking a Coordinate Mission

As I mentioned earlier, coordinate missions are typically used by advanced users to point the telescope at an exact point in the sky when hunting things like comets, asteroids, or even satellites.

I discovered the use of a coordinate mission when I realized I didn't want whatever I was looking at to be at the very center of view of the telescope's field of view. Sometimes there are a couple of galaxies close together, so rather than taking two photos, I might be able to capture both in one photo. In other cases, like with M 42, there might be particular regions I want to look at more closely while still focused on M 42 - I just don't want the main part of the nebula in the field of view.

Markarian's Chain is a group of eight galaxies that reside in the Virgo Cluster - another grouping of about 1,300 member galaxies. Markarian's Chain is a beautiful cluster and needs a telescope with a wide field of view to be able to capture all of it. In this section, I'll walk you through planning a mission to this chain of galaxies and compose a good shot of it. I also show you the result.

Since I'm writing this in the winter, Markarian's Chain is visible, but it might not be when you're reading this. The same principles apply, regardless of the object you're viewing, so feel free to follow along, even if you can't actually make the reservation - I include the result of this reservation so you get the complete picture here.

(some content omitted from the sample)

## Result of Booking a Coordinate Mission

I captured the result of the mission here for you:



As I mentioned when we were making the reservation, some of the galaxies are rather faint and the grouping is quite large, so it doesn't quite look like what we saw in KStars. Remember that the telescope used to capture images you see in KStars is about 250 cm wide so it captures much more light. The Canary Three telescope is 30cm wide, but this is still a great result from a single mission.

## Next Steps

Now you know how to make reservations using the Slooh 500 List and can use KStars to plan both a catalog and coordinate mission.

The next step is to further expand your horizons to include the entire night sky instead of just a few objects. We'll use KStars to plan to observe some different objects.

## Using the KStars Observation Planner

So far you've used KStars for looking up objects of interest and composing shots. Now we're going to use KStars to plan our observations using just about everything available in the sky.

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This section goes into detail about how to use KStars to find object that are up in the sky at any time. I explain how to use KStars to plan observation sessions, view objects before you image them, and how to plan a booking.

## Mission Planning using DSO-Browser

DSO-Browser is a very useful online planning tool. There are a lot of features and its capabilities have been improving during the years that I have been using it. Its primary functionality is similar to that of the KStars Observation Planner Wizard, except that it makes a number of selections for you, making the process even easier. Think of it as a search engine for things in the night sky.

The main advantage to using DSO-Browser is that you don't have to install anything - you just use your browser. I often find myself using it while I'm someplace where I can't install anything on the computer I'm using and want to research things to view using Slooh.

(content omitted from sample chapter)

This section discusses the use of DSO Browser, explaining how to set the location of the Slooh telescopes, and how to plan sessions to, for example, avoid the Moon. This section includes a detailed description and lots of screenshots to help you along the way.

## Next Steps

Now that you know how to plan a mission, I'll show you a way to explore how others use Slooh by piggybacking others' missions.

## Understanding Piggybacking Missions - A Quick Shortcut

This section explains how to use the piggyback feature to explore what other members are viewing using the Slooh.com telescopes.

## Next Steps

Next I'll explain another great feature of Slooh - watching the telescopes live. The great thing about this feature is that there are no limits - you can view missions for as long as you like and take as many photos as you want. And the best part is, there's no planning involved - you just sit back and enjoy the show!

## For When You Don't Have a Plan - Watching Missions Live

One of the nice features of Slooh is that you can watch missions as they are running as if you were sitting at the eyepiece of the telescope yourself.

This is a great feature because you can see the image on the telescope develop during the observation session. It's also nice when you want to gain insight into what others use the telescopes for.

(content omitted from sample chapters)

## Next Steps

Now that you've become an expert at planning and booking missions, you're going to have a lot of pictures on your hands. The next topic in this book focuses on the second half of imaging using Slooh - image processing.

I walk you through understanding the types of files Slooh produces, acquiring your images, and processing them to produce the best possible result.

## Part Two – Image Processing

# Understanding Color And Filters

(content omitted from sample chapters)

This section provides background on color and how the Slooh.com telescopes use filters to help you produce color images. This information is essential for understanding how to create better images and gain a better understanding of how the telescopes work.

## Next Steps

The next section discusses the files that Slooh.com makes available to you for download.

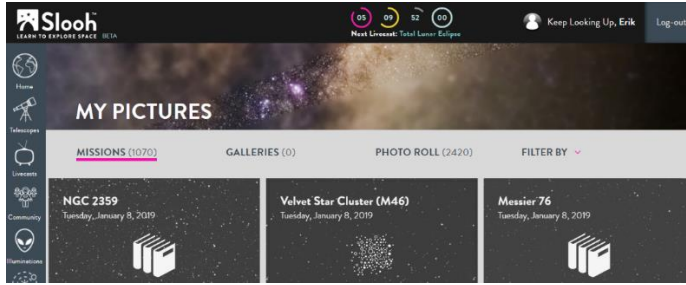
# Understanding The Files Slooh Produces

Slooh.com generates a number of files and saves them in your “My Pictures” area under your account.

When you schedule a mission at Slooh, the next day you get an email listing the status of your missions. If you’re lucky, the telescope was open and your missions completed. You can view your images in the My Pictures area - just select Telescopes - My Pictures, as shown:



When you open “My Pictures”, you see a list of the things you have imaged in the past, as shown:



(content omitted from sample chapters)

The rest of the section explains the relationship between the images you see in the “My Pictures” area and the processing recipe you might have selected when you booked the mission. I explain how the processing recipes work and their effect on your final images.

## Next Steps

Now that you understand the images Slooh produces for you and have seen what else is possible, it’s time to explore the other files Slooh produces for you: FITS files. FITS files contain a great deal of information and are very useful not only for producing better images, they’re also useful for doing things like scientific measurements and reporting observations to governing bodies like MPC.



## Understanding FITS Files

FITS is short for Flexible Image Transport System - it's a standard that was developed during the 1980s which defines a digital format for the storage and transmission of image data.

When you look at a JPG, PNG, or TIFF image, you're looking at the values of pixels encoded with color information. Each pixel on the image has color information associated with it and the colors are represented using a combination of red, blue, and green values.

The problem with this format is that you don't have intensity information. All you have is color. You can represent dimmer pixels using another color, like gray for example, yet you fundamentally don't have any information about how much light a pixel on the image represents. This is where FITS comes in.

When an image is read off the CCD camera in the telescope, it records the pixel values coming off the CCD. The CCD records the intensity of light that it captured while it was exposed to the target you're looking at. FITS files contain details about this intensity information. When we display a FITS image in black and white, we use different shades of gray to represent different intensities; however, the intensity values are still available to us.

(content omitted from sample chapters)

The rest of this section explains FITS files in more detail. I also explain what calibration is and why it's important and what Slooh.com does to your images, saving you a great deal of time and effort.

### Next Steps

Now that you understand the filters, the files Slooh produces and FITS files, it's time to start processing FITS images - that's the focus of the next section.

## Processing Your First FITS Image Using Fitswork

You have to be comfortable using FITS files and working in Fitswork to be able to process the images you get from Slooh. At first the steps can seem to be pretty involved, covering a lot of detail, but now that you understand about filters and the files you receive, things should start to make more sense.

This section walks you through processing your first FITS image using Fitswork, which you should have installed by now. If you haven't installed Fitswork yet, please go to the Software Installation and Configuration chapter and follow the directions there.

(content omitted from sample chapters)

The rest of the chapter explains how to acquire FITS files and walks you through using the free FitsWork software to produce a color image. While FitsWork is functional, it's not very user friendly and the workflow you need to produce a color image is not apparent.

### Next Steps

Now that you're comfortable with Fitswork and have some FITS data to experiment with, we're going to discuss understanding stacking and multi luminance processing.

## Understanding Stacking and Multi Luminance Processing

When you read articles or watch videos about astronomical image processing, you'll often come across the term "stacking". This section is all about stacking.

As you learned earlier, the Slooh telescopes take a number of images and combine them to produce the final color result. The Slooh telescopes only 'see' in black and white and fundamentally understand only pixel intensity information, so we use a combination of filters and software to combine the black and white images in such a way that we get a color image.

(content omitted from sample chapters)

The rest of the chapter explains what stacking is, alignment, exposure time, and understanding the multi luminance processing recipe which you can use to really enhance your images.

### Next Steps

Next, I explain about the Canary Five Solar telescope and after that we get into processing images using GIMP.

## Understanding the Solar Telescope – Canary Five

The Slooh.com Canary Five telescope, or Solar telescope is very different from the other telescopes. The most obvious difference is that this telescope is available during the day and is focused on the Sun. In addition, you cannot reserve this telescope like the others and the files it produces are different from the other telescopes.

(content omitted from sample chapters)

The rest of the chapter describes how to use the Canary Five telescope along with its features.

### Next Steps

Now that you understand the files Slooh.com produces and know how to use them, we'll use GIMP to enhance your images.

# Using GIMP to Enhance Images

(content omitted from sample chapter)

This section walks you through enhancing your images using GIMP, a free and popular imaging application that's often compared to Adobe's Photoshop.

I not only explain what to do, but also why you're doing those things to give you a better understanding of things like histograms and how they effect your overall image. I explain how to use the powerful Curves adjustment tool along with Levels adjustments.

## Next Steps

Now that you understand GIMP and the powerful tools it offers, and know how to use them, it's time to start editing your own photos from Slooh.com!

You're in a great position now to start capturing all kinds of images and perhaps do your own research!

The next chapter discusses using AstrolImageJ to take advanced measurements from your images to gain more insight into them and the information they hold.

If you're interested, I have included some more details about my own workflows using TheSkyX, Photoshop, and MaxIM DL. I also discuss some other activities I get into that are not within the realm of Slooh, but could easily be if you wanted to try: exoplanet research

I also discuss some of my background and how I came to Slooh.com and explain the tools and workflows I used to create this book.

Thank you for reading and I look forward to interacting with you directly or via the community at Slooh.com. My name at Slooh is ErikW.2014 and you can always reach me by email at [erik.westermann@gmail.com](mailto:erik.westermann@gmail.com).

# Photometry, Stacking and Processing Using AstrolmageJ

In astronomy, photometry is the measurement of the brightness of stars and other celestial objects in an image. These measurements can provide information about the object's structure, temperature, distance, age, etc. The measurements can also provide information about the quality of the overall image and can be used in time-based analysis to detect things like exoplanet transits and measure the variability of variable stars. Personally, I use the measurements to find faint objects in my images and to determine the quality of the images I use before I share them with others.

In this chapter I walk you through basic photometry, stacking, color image processing, and plate solving.

AstrolmageJ is derived from the popular imaging application called ImageJ, which has enjoyed broad use in various fields including medical imaging. AstrolmageJ is used by undergraduate students in astronomy as well as professional astronomers. Its goal is to be usable by a broad range of users including amateur astronomers.

AstrolmageJ is available across platforms so you can use it on Windows, Mac, and Linux. AstrolmageJ is in the public domain and uses publicly available services like Nova.Astrometry.Net for plate solving, so there's no cost involved.

(content omitted from sample chapters)

This is a detailed chapter on using AstrolmageJ to perform photometry. Photometry helps you gain more insights into your images and the data they contain. I explain stacking and aligning and how to produce a final image.

AstrolmageJ doesn't support Luminance images directly but I show you a method to help you integrate your luminance images for better results.

I also explain plate solving in AstrolmageJ and show you how to drastically speed up the plate solving process.

## Next Steps

Now that you have everything installed, working, and know how to use it, go forth and create beautiful and informative images!

The next sections is the "Software Installation and Configuration" section which you have already seen.

Beyond that is the “Online Resources” section where I provide links to resources I mentioned in this book.

I also discuss some personal issues like my software setup and workflows, my adventures in exoplanet hunting, my history with astronomy and how I came across Slooh.com, and I discuss the tools and workflows I used to create this book.

## Software Installation and Configuration

This section covers the download, setup, and configuration of the software tools I use throughout this book.

All of the software is free to use so there are no costs involved. All you need is the ability to install software on your system and a reasonable internet connection.

(content omitted from sample chapters)

This section provides detailed directions for downloading, installing, and configuring all of the free software I use in this book.

## Online Resources

(content omitted from sample chapters)

## My Software Setup And Workflows

I’m always curious about how others work and what tools they use, so I thought I would give you some insight into how I work.

(content omitted from sample chapters)

I discuss the software I use and my workflows for creating final images.

## My Adventures In Exoplanet Hunting

(content omitted from sample chapters)

In this section, I discuss how I work with data to find exoplanets and explain how I got into exoplanet hunting.

# My History with Astronomy and How I Found Slooh

I have always been interested in photography, taking as many pictures as I could to see what results I could come up with. In my late teens, I bought a used 35mm camera and took it out into the winter night to see what kind of image I could capture from the night sky. My first attempts were not that good, but I learned quickly. Looking back at it, those first images were mostly of a dark sky because where I was shooting was a very light-polluted area and few stars were resolved.

I bought a sky atlas at the time but couldn't make sense of all of the lines and figures on the map. I did learn about altitude and azimuth and managed to view a few stars using that to locate them - it was a small victory.

I was an avid reader and subscribed to all sorts of magazines including Discover and National Geographic. I also read Stephen Hawking's "A Brief History of Time" and was completely captivated by the physics behind what was in the sky. I have read that book many times and still re-read it today even though the information is slightly out of date.

Later, I joined the astronomy club in high school. We mostly sat around and discussed the sky and I found it very uninspiring and almost quit the club. Then, one meeting, the teacher who was also the head of the club announced that we were going on a field trip to the David Dunlap Observatory one night. I was intrigued by its description and also by the fact that black holes were proven to exist at that observatory.

We went to the observatory one night and from the moment I saw the large telescope, I knew I was hooked. It was not a good night for observing but they did have the large telescope pointed at a globular cluster. It is the only globular cluster I have ever seen through a telescope, but it was the most beautiful thing I have ever seen. Outside, on the grounds, some people had set up their own telescopes and I was intrigued by how open they were with sharing their knowledge. I looked through one of the telescopes and saw Saturn. I was amazed that you could see those two things through the telescopes.

That night, I was unable to sleep - I was too wound up by all of the thoughts of planets, stars, and other things I had seen. Suddenly, events like the Voyager takeoff, and photos it had taken and I had seen as a child made much more sense - they went from being fragments of curiosity to things that I was beginning to understand.

While my life changed quite a bit, my interest in astronomy always remained the same. I took every opportunity I got to look up at the night sky, I read a lot, and thought a lot. I stopped pursuing astronomy as a hobby because I had neither the time or money to put into it. I also felt that I didn't have a good understanding of what I needed to actively pursue the hobby anyway.

Much later on, I was searching online for things to view in the sky. I was a journalist at an online publication and was writing a story about space. I needed a photo of something spectacular to include with the article and was searching through images. I saw a lot of images, mostly from the Hubble Space Telescope, and was intrigued about all of the nebulas, galaxies, globular clusters, and other objects I found. I decided it was time to get back into astronomy, but knew now that where I live is not an ideal site for observing, so I needed something different.

I came across a site called the MicroObservatory (<http://mo-www.harvard.edu/OWN/>) where you can participate in remote imaging for free. You pick an object from a list of things to view, their telescopes image it, and send you a photo in one or two days. This is where I got interested in the idea of remote imaging and I still use the MicroObservatory today.

After much searching, I came across Slooh.com in 2014. It didn't take me long to sign up and start taking photos. You'd think I'd be thrilled at finally being able to just pick something and have an image of it the next day, but I was underwhelmed. The photos I got were, understandably, not like those that I had seen online. I also had no idea what to take photos of since I was still gaining a better understanding of the night sky. So I stopped taking photos and went back to what I was good at - reading. I learned a lot and returned to Slooh a few months later, this time armed with knowledge of how the telescopes work, what image processing is all about, how to find objects in the sky, and a range of other issues.

Ultimately, I managed to find my way. I now take great photos and do my own research using Slooh.com. I decided to produce this book to share what I had learned.



# Tools and Workflows I Used To Write This Book

If you read any forums or go to any astrophotography image sharing site, the first thing people ask after seeing an image is how the photographer got the image: they want to understand about the telescope, camera, and software used to create the image. People want to know that information so that they can better understand the process of creation and perhaps replicate the results.

A book about astrophotography would be incomplete if I didn't explain the tools and workflows I used to create the book.

I wrote this book in various locations using various computers. I primarily used Google Docs to write the chapters and keep them safe as I wrote. This allowed me to move from computer to computer while having all of my working files stored and safely backed-up.

I started the book by creating the table of contents – this took quite a long time and was probably the most boring part of the whole process. I had written other books in the past and knew that being grounded using the table of contents would make a big difference even I was eager to start writing. I designed the table of contents to be cohesive and easy to follow.

With the table of contents complete, I broke up my workflow between writing and developing examples. I could only take screenshots and install software on one of my computers, so I worked through examples and took screenshots all at one time. I took notes about what I wanted to say about each screenshot and kept everything together in a single Google Document.

Once I had all of my screenshots, I created the sample images I needed by booking missions, processing images, and saving them as I went along.

I then started writing the chapters by following my table of contents. I adjusted the table of contents as I made progress to add or remove content as I felt the need to.

Once writing was complete, I merged all of the content into one big Microsoft Word document. I added heading styles, fixed formatting, adjusted the sizes of screenshots and images, adjusted the page layouts and a lot of other boring things.

I kept the book backed-up using both Google Drive and Dropbox in addition to having a couple of copies on my computer and an external hard drive.

I created the final PDF by exporting from Microsoft Word and that's what you have a copy of now.

The software I used to create this book includes Paint.net, Photoshop, Greenshot, Microsoft Word, AstroImageJ, Fitswork, KStars, TheSkyX, MaxIM DL, and of course the Chrome browser.

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