Sean Walker

The ASI120MM Camera from ZW Optical

This highly versatile camera was made for planetary imaging.

ALL PHOTOS BY THE AUTHOR

ZW Optical ASI120MM

U.S. price: from $328

zwoptical.com

The company's website includes a list of worldwide dealers, including High Point Scientific and OPT Telescopes in the United States.

The ZWO ASI120MM camera is sold as a complete package, including USB and autoguiding cables, software, telescope and lens adapters, and a fisheye lens. The 2-meter (6½-foot) USB cable provides the camera's power as well as its communication with a host computer running 32- or 64-bit Windows XP or higher software.

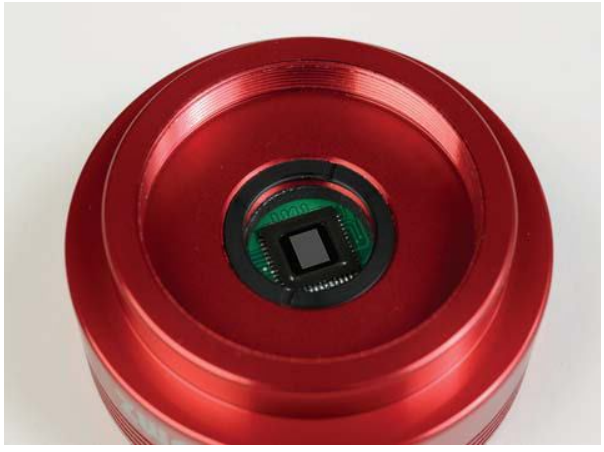
It's been more than a decade since digital imaging became amateur astronomy's preferred method for monitoring the planets. And each passing year brings more advances in the form of new cameras and new or updated image-processing software. One of the newest cameras is from ZW Optical, a company founded by amateur astronomers in 2011 that specializes in making astronomical imaging equipment.

Unlike "planetary" cameras appropriated from the machine-vision industry, ZW Optical's ASI120MM was designed for planetary imagers from the get-go. Its compact, round body is only 62 millimeters (about 2⅜ inches) in diameter, and its primary mounting is a female T

thread, making it readily compatible with filter wheels and other astronomical accessories. The front of the camera is 2 inches in diameter, albeit only 5/16 inch long, so it can fit directly into 2-inch focusers. The camera comes with a T-to-1¼-inch nosepiece as well as an adapter that steps the T thread down to a C thread for use with conventional video lenses. Also included is a CCTV lens with a 2.1-mm focal length that allows recording an extremely wide, 150° field of view and is useful for all-sky photography. The rear of the camera body has a ¼-20 threaded socket for attaching the unit to any standard photographic tripod.

At the heart of the ASI120MM is an Aptina MT9M034 CMOS sensor with 1.2 megapixels in a 1,280-by-960-pixel array. This chip is currently the most sensitive camera on the market for planetary imaging at visual wavelengths, especially at the blue and green end of the spectrum. This short-wavelength sensitivity is noteworthy because blue light is particularly affected by atmospheric seeing, leading to more blur when shooting planetary videos. But the chip's high blue sensitivity enables imagers to use shorter exposures and faster frame rates than other chips are capable of achieving, giving us a better chance of beating the seeing with more frames. I found this to be particularly useful when imaging Saturn, the dimmest of the easily visible planets, or when recording fine structure in the thin clouds on Mars.

The camera I tested has a USB 2.0 interface with its host PC, but in mid-April the company announced that a USB 3.0 version is in the works and will have up to double the full-frame rates of the model I tested. The USB 2.0 model has a maximum download speed of 30 frames per second (FPS) for full frames at full resolution. This is more than adequate for wonderful, high-resolution captures of the Sun and Moon. When imaging the planets, the camera supports on-chip, region-of-interest (ROI) cropping, which enables users to download only the portion of the detector recording the planet. This allows much higher frame rates, up to a blazing 215 FPS, depending on the crop you choose.



A glass window seals the camera body and prevents dust from settling on the CMOS sensor.

With the included *FireCapture* program or appropriate third-party software such as *MaxIm DL* or *PHD Guiding*, the ASI120MM will function as an autoguider. The modular ST-4 port on the camera body allows a convenient connection between the camera and a telescope mount's autoguiding input.

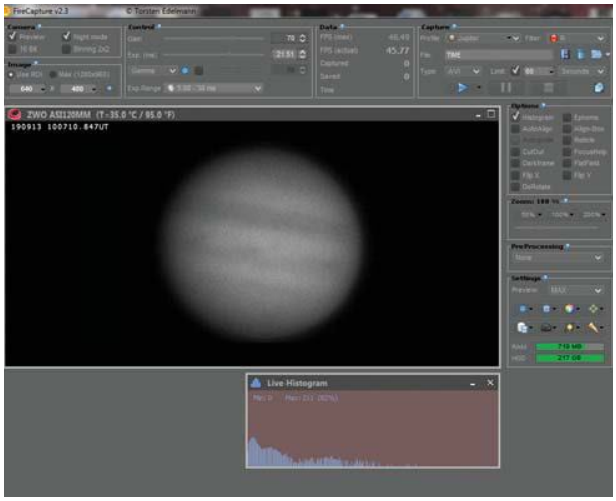
Although the camera is shipped with a mini CD-ROM disk that includes device drivers, operating software, and a manual, it's best to check the manufacturer's website and download the latest drivers. Installation is quick and easy, and my colleague Dennis di Cicco and I tried the camera on half a dozen different desktop and laptop machines running versions of Windows software from XP up through Windows 8. For unknown reasons, it would not work with one laptop running Windows 7 despite working fine on other Windows 7 computers. We assume that the computer is the problem.

Operating *FireCapture*

The ASI120MM is supplied with *FireCapture*, a camera-control program written by planetary imager Torsten Edelmann. It is hands down the most well-thought-out camera-control software I've used for planetary imaging. It supports many popular camera models, including ones manufactured by The Imaging Source, Celestron (including the Skyris series reviewed in last April's issue, page 62), Basler, Point Grey Research, and QHY.

FireCapture includes helpful features that enable you to minimize the settings you have to change for different tasks (such as focusing or shooting with various filters). It also automatically creates a log of all your settings that is recorded along with each video. Thus, it's really worth the time to familiarize yourself with the program before heading out to your telescope on the first night. This is especially true because some of the features aren't particularly intuitive at the outset.

Among the software's best features are shooting profiles that include user-defined presets for the gain,



```
FireCapture v2.3 (beta 13) Settings
-----------------------------------
Camera=ZWO ASI120MM
Filter=R
Profile=Jupiter
Diameter=36.36"
Magnitude=-2.12
CMI=173.0° CMII=84.0° CMIII=220.8°
(during mid of capture)
FocalLength=6810mm
Resolution=0.11"
Filename=Jup_190913_091813_R.avi
Date=190913
Start=091813
Mid=091843
End=091913
Duration=60s
Frames captured=2767
File type=AVI
Extended AVI mode=false
Compressed AVI=false
Binning=no
ROI=640x480
FPS (during start of capture)=46
Shutter=0.000ms
USBTraffic=86
Gain=70
Brightness=10
AutoExposure=off
Gamma=50 (off)
Histogramm(min)=0
Histogramm(max)=255
Histogramm=100%
Noise(avg.deviation)=13.64
AutoAlign=false
PreFilter=none
Limit=60 Seconds
Sensor temperature=24.3 °C / 75.7 °F

---------------Timestamps---------------------
Frame 1: 190913 091813.362UT
Frame 2: 190913 091813.384UT
Frame 3: 190913 091813.406UT
Frame 4: 190913 091813.428UT
```

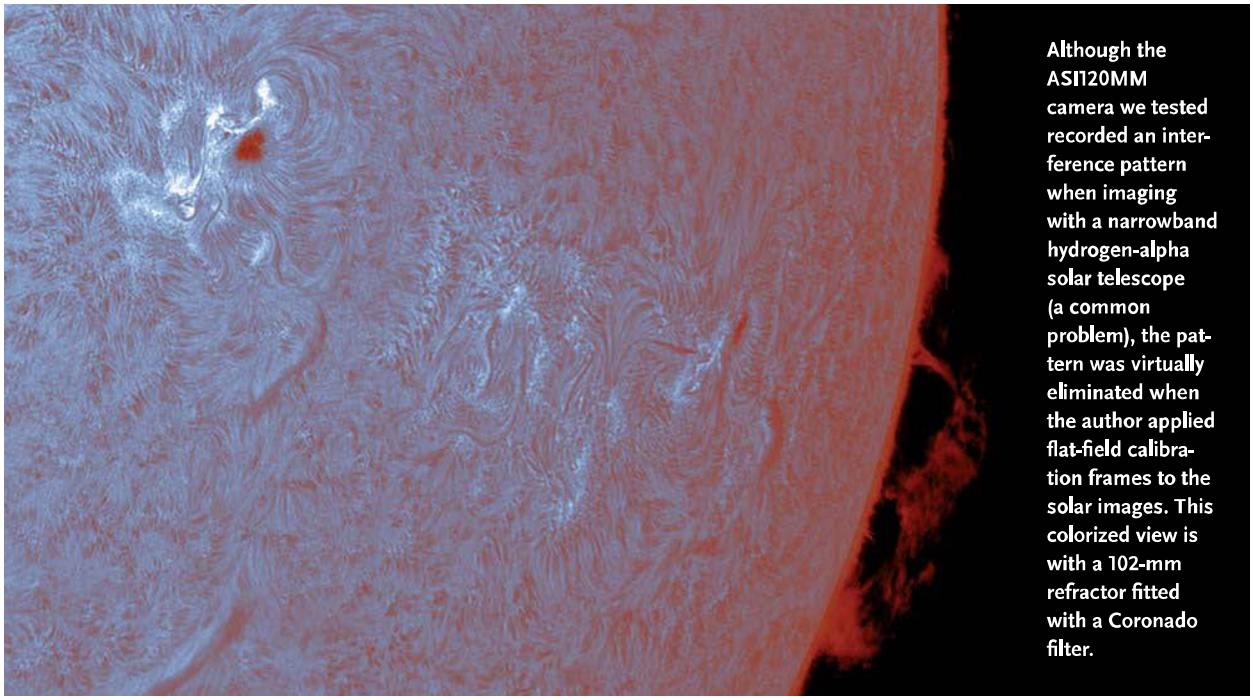
Far Left: **Described in the accompanying text, the *FireCapture* camera-control program supplied with the ASI120MM is the best planetary-imaging software the author has ever used. Especially noteworthy are its user-defined presets for shooting the Sun, Moon, and planets through various filters.**

Near left: **In addition to video clips, *FireCapture* records a detailed log with the settings used for the video as well as information about the target and a separate time stamp for each frame in the recorded video.**

exposure, and length of your capture for each video based on your target. There are built-in profiles for all the bright planets (except Mercury), as well as the Sun and Moon. You can also define the individual settings for each filter you shoot with (Edelmann has listed all the commonly used filters for planetary imaging from ultraviolet through infrared, including a methane filter).

Other *FireCapture* features include a graphical display of the video's real-time histogram, which helps you set the gain and exposure. The program can display an ephemeris for each of the major planets, giving you precise information about your target's apparent diameter, magnitude, and the central meridian visible when you're shooting. If you input your telescope's focal length, *FireCapture* will calculate the exact image scale recorded by your videos. All of this information is included in the log file that's created for each video. This material is particularly helpful if you record a transient event in your video, such as a rare impact flash on Jupiter.

To reduce noise in your videos, *FireCapture* lets you



Although the ASI120MM camera we tested recorded an interference pattern when imaging with a narrowband hydrogen-alpha solar telescope (a common problem), the pattern was virtually eliminated when the author applied flat-field calibration frames to the solar images. This colorized view is with a 102-mm refractor fitted with a Coronado filter.

record a dark frame just before you begin shooting a video clip. This dark frame is then automatically subtracted from every frame in the video.

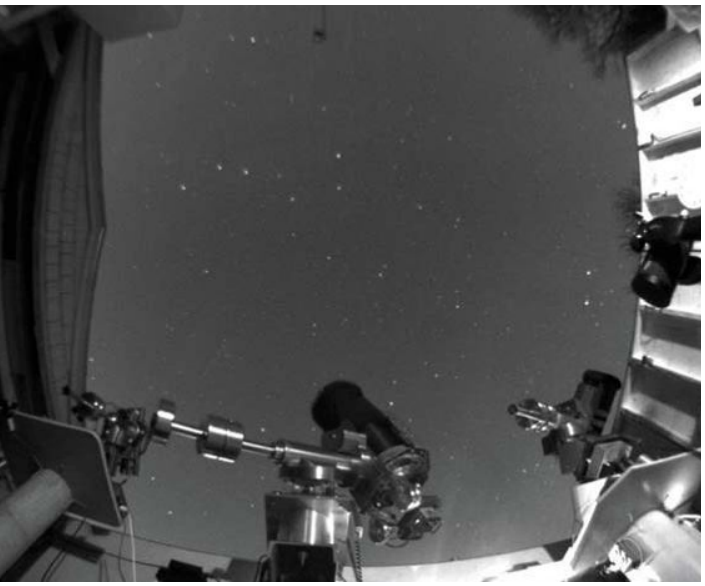
In the Field

Once at the telescope, I found the ASI120MM to be a bit different to use than other video cameras. Its tiny, 3.75-micron-square pixels were roughly half the size of those in other cameras I've tested. This required a weaker Barlow lens than I typically use for matching the pixel scale to my target. Planetary imagers often aim for images scales of 0.25 to 0.1 arcsecond per pixel, depending on the seeing conditions. I settled on an image scale of 0.12 arcsecond per pixel for the Jupiter image on this page.

Using *FireCapture*'s histogram display in conjunction with the user-defined exposure settings for each filter, I could set independent exposure levels for my red, green, and blue videos. This led to an aesthetically pleasing color balance in my images after stacking. The software's FocusHelp feature was useful for quickly establishing sharp focus in my videos when the seeing conditions were at least average. It matched the focus that I could achieve by eyeballing small planetary features such as white ovals on Jupiter, or the sunward limb on Mars.

Using an ROI of 640 by 480 pixels, I managed to record Jupiter videos at 46 FPS when the planet was far from opposition, and upwards of 70 FPS when it was closest to Earth last January. After stacking and sharpening the images, I was quite pleased with the results, which held up to the quality of the other cameras I've used.

The only minor issue I noted was that the background sky in each video had a small, though detectable noise level. Later analysis suggests that it might be a fixed structure in the camera's dark signal. If so, I might have mitigated it by using *FireCapture*'s automatic dark-frame subtraction mentioned above, but I didn't do so at the time.



The fisheye lens supplied with the camera can be used for meteor photography. This 10-second exposure with the camera sitting on the floor of senior editor Dennis di Cicco's observatory records all the naked-eye stars visible in his suburban-Boston sky.

WHAT WE LIKE:

- High sensitivity
- Small and lightweight
- Designed for astronomical imaging

WHAT WE DON'T LIKE:

- Problems running with some PC processors
- Videos have a slightly noisy background

Jupiter presents many small white and reddish storms, bluish festoons, and other subtle color contrasts in this image captured with the author's 12½-inch Newtonian reflector on the morning of September 19, 2013.

Whereas the ASI120MM is more sensitive than other planetary cameras in visible wavelengths, its sensitivity drops off at the red end of the spectrum, particularly at near-infrared wavelengths. This isn't a major problem, but if you image Jupiter with a methane filter, you'll need longer exposures than you would with cameras that have chips with higher red sensitivity.

One feature that sets this camera apart from other planetary video cameras is its ability to be used for long-exposure astrophotography. Although I had fun playing with this aspect of the ASI120MM, the chip is very small compared with today's DSLRs or CCD cameras made specifically for deep-sky imaging. Moreover, the chip is not cooled, so getting decent deep-sky results could be tricky.

Dennis enjoyed using the camera with its fisheye lens as an all-sky imager for recording meteors. The camera's high sensitivity limited exposures to about 15 to 20 seconds under his suburban skies, but these were long enough to capture all the naked-eye stars. As is typical with this class of fisheye video lens, the quality of star images falls off as they approach the edge of the field.

The ASI120MM has a modular jack wired with the de facto industry standard ST-4 configuration, thus enabling the camera to be used as an autoguider. Although we didn't test this feature, others have reported that it performs well. Users must install ASCOM drivers for the camera to work as an autoguider with the popular software programs *MaxIm DL* and *PHD Guiding*.

Overall, ZWO's ASI120MM is a champion performer, especially considering its very attractive price. Users will get a lot of bang for the buck. ✦

An avid planetary photographer, imaging editor ***Sean Walker*** *is also an accomplished painter in his free time.*