FIRST LIGHT

See an interactive 360° model of this camera at www.skyatnightmagazine.com/ASI2190MM

ZWO ASI290MM cooled monochrome CMOS camera

Excellent sensitivity and image quality define this high frame rate device

WORDS: PETE LAWRENCE

VITAL STATS

- **Price** £771 for the cooled mono (uncooled mono £432; cooled colour £774; uncooled colour £391)
- **Sensor** Sony IMX290LQR CMOS, 1,936x1,096 pixel array
- **Pixels** 2.13 megapixels, each 2.9µm square
- **Speed** 170fps at 10-bit or 128fps at 12-bit; higher frame rates available with regions of interest
- **Size** 78mm diameter, 110mm length (with 1.25-inch adaptor fitted)
- **Weight** 433g
- **Supplier** 365Astronomy
- **www.**365astronomy.com
- **Tel** 020 3384 5187

SKY SAYS...
This camera is extremely sensitive and excellent for both Solar System targets and deep-sky imaging

There's a certain cinematic feel to the view you get from ZWO's ASI290MM cooled monochrome camera, thanks to its HD aspect Sony IMX290LQR sensor. Designed to provide HD video for 'machine vision' applications, the sensor also turns out to be extremely well suited to astronomical imaging. The camera is available in colour (ASI290MC) or monochrome (ASI290MM), with or without cooling. This review covers the cooled mono version.

The camera's 1,936x1,096 pixel output is great for large targets such as the Sun and Moon, and also works well for 'family' shots of Jupiter and Saturn that include their brighter moons. The sensor at the its heart – the Sony IMX290LQR – also supports region of interest zoning, so you can restrict its output to a more conventional aspect if you so desire.

Each pixel is 2.9µm square. This is small compared to typical high frame rate cameras and raises issues over sensitivity and noise. Smaller pixels capture less light than larger ones, resulting in a lower signal and consequently a reduced signal-to-noise ratio.

Thankfully, there are sensor characteristics that offset these issues. For example, the IMX290LQR uses back illumination. Most CMOS sensors in astronomical high frame rate cameras have the circuitry associated with each pixel in front of the photosensitive layer. A small proportion of incoming photons may be blocked or reflected by this design. In a back-illuminated sensor the layers are flipped during manufacture so the light blocking elements sit behind the pixel. This increases the amount of light captured, raising the signal-to-noise ratio.

A question of scale

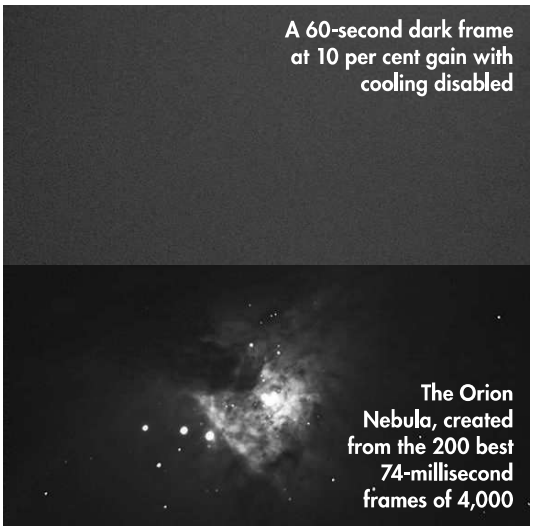
One very noticeable effect of the camera's small pixels is an increase in image scale. For a given setup the image produced on screen appears magnified compared to what you'd see using a camera with larger pixels. This effectively allows you to get closer to your subject without the use of an optical amplifier, such as a Barlow lens. However, you need to be cautious if you do use optical amplification, as it's easy to go over the top and reduce quality for no added benefit. ▸

THE BOON OF BANISHING AMP GLOW

During a recent review of ZWO's ASI224MC cooled camera (October 2016) we felt that the image quality for long exposures was let down by significant amp glow. We are happy to report that this is not an issue with the cooled ASI290MM. A 60-second dark frame at 10 per cent gain showed no sign of amp glow at all. The camera has peak sensitivity around 590nm and its impressive infrared response remains better than 50 per cent peak sensitivity at 850nm, tailing off to around 14 per cent peak sensitivity at 1,000nm.

The ASI290MM is superb at Solar System imaging and certainly fast enough to catch those fleeting moments of good seeing that planetary imaging relies on. Its excellent red and infrared sensitivity makes it ideal for use with planetary filters that work at longer wavelengths.

The cooling function helps reduce thermal noise during the longer exposures typical in deep-sky imaging. Our deep sky tests produced very clean frames, something that was confirmed by the clarity of our 60- and 120-second dark frames.



A 60-second dark frame at 10 per cent gain with cooling disabled

The Orion Nebula, created from the 200 best 74-millisecond frames of 4,000

CAMERA COOLING

The ASI290MM has active cooling assisted by a fan and large heat sink that occupies two-thirds of the body. The sensor can be chilled to 35-40°C below ambient, but a 12V/2A power supply (not included) is required for this. Desiccant tablets reduce moisture and frosting in the sensor chamber.

ST-4 GUIDE PORT

The ST-4 compatible autoguiding port on the rear allows this device to be used as a guide camera when connected to a suitably equipped equatorial mount. A 2m guide cable is supplied. The camera's superb sensitivity means that it's unlikely you'll be short of a guide star.

USB 3.0 PORT

The large pixel array and high frame rate of the ASI290MM necessitates a fast connection to its host computer. This is achieved by a USB 3.0 interface at the rear of the body. A 2m USB 3.0 cable is provided. The camera can be connected to a USB 2.0 port but its maximum frame rates will be greatly reduced.

FIRST LIGHT

SKY SAYS...
Now add these:

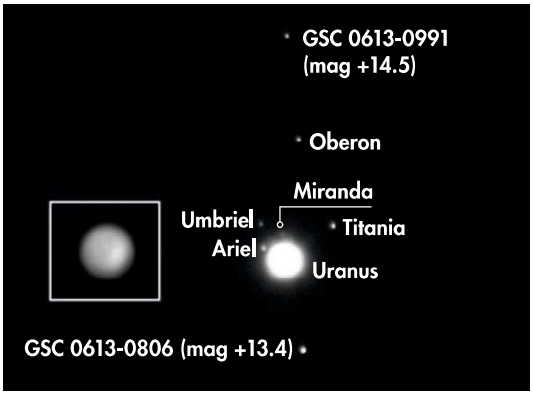
1. 365Astronomy 12V/2A adaptor for ZWO cameras
2. 365Astronomy imaging flip mirror
3. ZWO Atmospheric Dispersion Corrector

▸ The camera has 12-bit or 10-bit (high-speed) modes. The 12-bit mode produces the highest dynamic range (the most greyscale tones) and the lowest noise characteristics, and is the one recommended by ZWO for use with astronomical targets. The camera can operate at up to 170 frames per second (fps) for full frame 10-bit captures or 128fps in 12-bit mode. In use, our mid-range laptop struggled to get over 90fps for 12-bit captures. Setting a smaller region of interest allows you to easily exceed these values. Using the high-speed setting appeared to produce vertical artefacts with our setup.

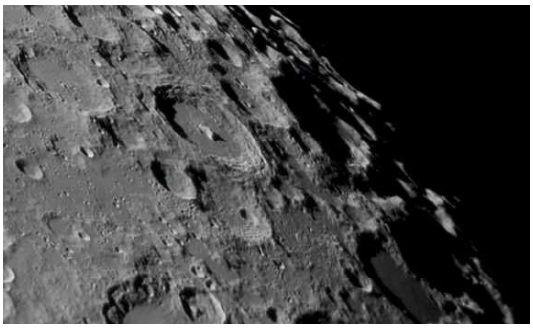
Access to the mode settings and all other camera functions requires the use of third-party applications such as SharpCap or FireCapture (both free). In addition, ZWO provides the necessary camera driver via their website, with support for Windows, Mac OSX and Linux.

We found this camera to be extremely sensitive, and excellent for both Solar System targets and deep-sky imaging. While imaging Uranus through a 14-inch Schmidt-Cassegrain, we increased exposure to one second to try and capture the planet's moons. We were delighted to record all five of its brighter satellites together with two field stars, the dimmest of which was mag. +14.5. The banding seen on Uranus's disc, meanwhile, is testament to the IMX290LQR sensor's excellent red and infrared sensitivity.

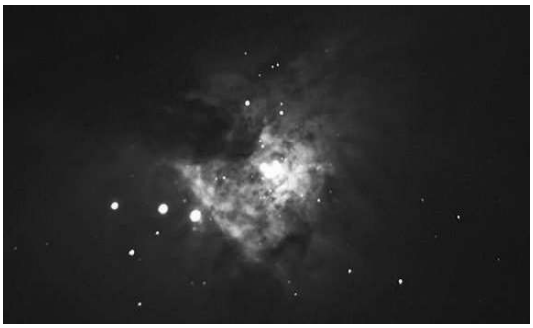
Its deep-sky prowess is due to its high sensitivity and low noise. Thermal noise can be kept in check by engaging the camera's cooling option, but you do need a suitable 12V/2A power supply for this. It's efficient too, reaching –20°C from an ambient temperature of 16°C in a little over 100 seconds. We were impressed that a 2,000-frame capture of the nebula M43 through our 14-inch Schmidt-Cassegrain revealed stars down to magnitude +16.0 during 0.3-second exposures. The chip also supports 2x2 binning to further increase sensitivity at the expense of resolution, reducing the full frame to 968x548 pixels.



▲ Uranus and its moons, along with a pair of faint stars



▲ The large pixel array is great for lunar imaging



▲ M43, created from a series of 0.3-second exposures

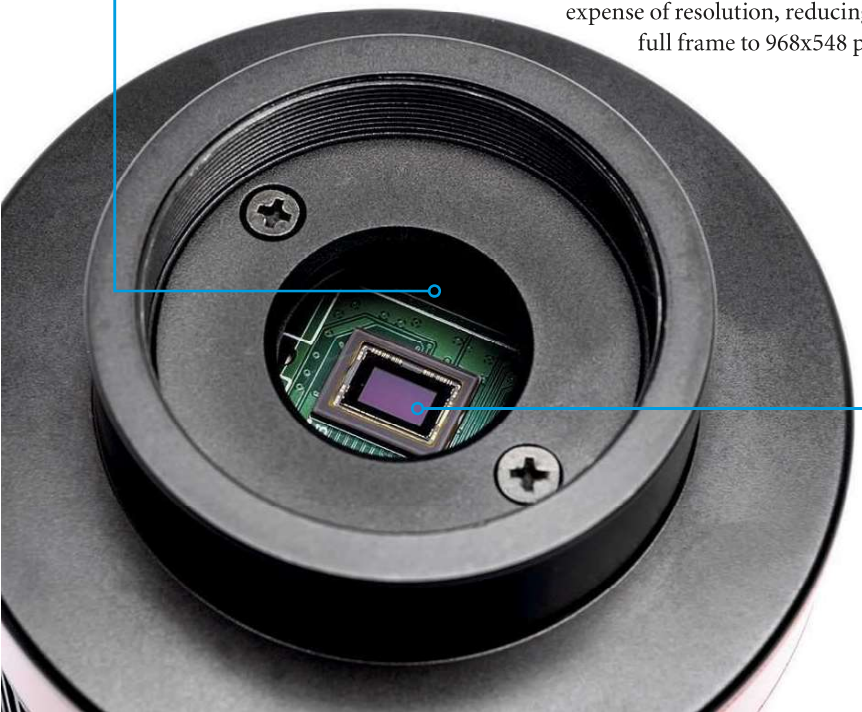
There's no doubt that this is a strong contender when it comes to Solar System imaging, with excellent deep-sky performance too. The camera has an exposure range of 32 microseconds up to a maximum of 2,000 seconds, offering exciting opportunities for chasing smaller objects such as planetary nebulae or galaxies. S

VERDICT

BUILD & DESIGN	★★★★★
CONNECTIVITY	★★★★★
EASE OF USE	★★★★½
FEATURES	★★★★½
IMAGING QUALITY	★★★★½
OVERALL	★★★★★

ANTI-REFLECTION WINDOW

The camera's sensor is protected by a clear anti-reflection optical window. This is screwed in place and is not intended for regular removal. The window provides a useful barrier against dust and importantly has no infrared-blocking characteristics. This allows you to use the camera to its full potential with the window in place.



IMX290LQR SENSOR

The camera's headline act is its Sony IMX290LQR CMOS imaging sensor. The chip delivers an HD letterbox proportioned imaging area of 1,936x1,096 pixels (2.13 megapixels), each a tiny 2.9µm. Importantly for short-exposure high frame rate imaging, the camera has an impressively low read noise of just one electron at 30dB.