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REVIEWED: CELESTRON'S SKYMASTER PRO ED BINOCULARS

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REVIEWED

Celestron SkyMaster Pro ED binoculars

The binoculars that beat chromatic aberration

Celestron's line of SkyMaster binoculars are back with the promise of no colour fringing. **Steve Ringwood** checks out whether they really do keep the stray colours at bay.

▶ The Celestron SkyMaster ED Pro 15 × 70s and 20 × 80s. The binoculars have a protective rubber coating on the outside and pressurised nitrogen on the inside. Images: Celestron.

In recent years there has been a trend towards foreshortened refractor telescopes. This has been, on the one hand, to facilitate portability, since beforehand refractors have been famously unwieldy. On the other hand, a shorter focal length permits the wider fields of view currently favoured by astro-imagers, but shorter focal-length refraction increases the problem of chromatic aberration (false colour). This has been remedied in these telescopes by the introduction of new (ED) glasses of low wavelength dispersion (see box on page 84).

Binoculars, being essentially two short-focal-length telescopes harnessed together, were waiting patiently in the wings to have this optical treat lavished upon them too – and this has now been happening at pace.

The main thrust of this upgrade of Celestron's SkyMaster range is the use of ED glass. Instruments using such glass can employ descriptions such as apochromatic, or semi-apochromatic, but in this case Celestron are happy to simply describe the SkyMaster Pro EDs as "virtually free of chromatic aberration". It sets a high bar regarding the reduction of chromatic aberration and the consequential improvement of resolution and contrast, and I was keen to see how well this claim was demonstrated.

Celestron's new ED series comes in three flavours, 7 × 50mm, 15 × 70mm and 20 × 80mm, of which the latter two were used in this review.

The main thrust of this upgrade of Celestron's SkyMaster range is the use of ED glass.

Out of the box

The binoculars are coated in a smooth, black, rubber-armoured livery that gives them a positive, tactile feel. With apologies to Celestron, I tried a grip test with wet hands, confirming that the barrels are pretty non-slip in heavy dew. Interestingly, a similar exercise wearing fabric gloves proved not so 'sticky'. In a future iteration I would therefore recommend that Celestron considers a textured surface rather than smooth, and certainly that users test their gloves before they 'let slip'.

In common with many binoculars, they operate via a centre focus wheel with a right-side eye dioptre adjustment. The centre focus wheel is nicely chunky and responds well (even with gloves!). The right-side eye dioptre adjustment is imparted by an impressive pair of opposing ribbed finger pads that make delicate adjustment really easy.

Conjoined caps protect the eyepieces, with the objectives covered by slip-on caps that deserve further comment. These caps are held to the barrel by a split ring of rubber, the idea being that the cap can be slipped off yet be retained by its 'hinge' connection. However, there is no pip of rubber opposing the hinge to assist lifting the cap off, so all the observer can do is attempt a firm grip with fingernails prying into the tiny gap between the

At a glance: 20 × 80mm

Price:	£399.99
Magnification:	20×
Objective lens diameter:	80mm
Angular field of view:	3.4 degrees
Linear field of view (at 1,000 metres):	59 metres
Exit pupil:	4.0mm
Eye relief:	15.4mm
Close focus:	30m
Interpupillary distance:	72mm (max), 56mm (min)
Dioptre adjustment range:	±3
Limiting stellar magnitude:	+12.02 (ideal); +11.02 (moderate); +10.02 (poor)
Lens coatings:	fully multi-coated XLT Coatings
Prism glass type:	BaK-4
Weight:	3.492kg
Environmental protection:	waterproof (IPX7)
Nitrogen filled:	yes
Tripod adaptable:	yes
Carrying case:	deluxe nylon

At a glance: 15 × 70mm

Price:	£319.99
Magnification:	15×
Objective Llens diameter:	70mm
Angular field of view:	4.4 degrees
Linear field of view (at 1,000 metres):	77m
Exit pupil:	4.4mm
Eye relief:	15.7mm
Close focus:	13m
Interpupillary distance:	72mm (max)); 56mm (min)
Dioptre adjustment range:	±3
Lens coatings:	fully multi-coated XLT Coatings
Prism glass type:	BaK-4
Weight:	2.089kg
Environmental protection:	waterproof (IPX7)
Nitrogen filled:	yes
Tripod adaptable:	yes
Carrying case:	deluxe nylon

◀ The 15 × 70s with the accessories they come with (the 20 × 80s come with the same accessories). Image: Celestron.

▲ The 20 × 80mm shown mounted on the author's binocular fork mount. The objectives are protected by flip-off end caps. Image: Steve Ringwood.

cap and retaining ring. What is more, in trying to do this, the retaining ring of rubber on the barrel can slip off too. It is not clear if this is intentional.

It may be that this ability to totally remove this rubberised confection is to facilitate the fitting of third-party (or homemade) dew tubes, for these binoculars have none. The objective lenses are barely recessed a centimetre from the ends of their barrel – and therefore open to the ingress of chilly dew. Indeed, in the cold spring evenings during this review, rapid dew deposition occurred several times. It seems almost laughable to me that the R&D department works creditably hard to incorporate new glass technology, yet (probably budget related) fails to protect it from our wet atmosphere with older technology that still works. Binoculars sans dew tubes seem to be a growing trend. An opening here I think for an enterprising cottage industry of retrofit dew tubes.

▼ The flip-off end caps, which can come off entirely if you want them to. Image: Steve Ringwood.

As for mounting, the heavier 20 × 80mm binoculars come with a centre rail fitted with a mounting post – and the not so heavy 15 × 70mm pair fields a standard photo-thread bush at the hinge front. Both worked well.

A litmus test

In general terrestrial use, the fiercest optical test I know is the view through a tree canopy against a backdrop of strong sunlight. In this territory, even very expensive binoculars fear to tread. However, these Celestrons fared very well indeed. I could hardly persuade myself that the branches were fringed with any false colour at all – and even that suspicion only betrayed itself with my eyes held off the centre of the optical axis in untypical fashion. I was very impressed. As the 'virtually colour-free' claim was holding up, I was now keen to be looking up.

The sky unfolds

The binoculars proudly bear an emblem of Jupiter and its satellites on the left-hand barrel to signify their ED credentials, so it seemed only right that this planet was able to present itself as the first target of the review.

Although now rapidly diving towards the Sun after its November opposition, Jupiter was still bright and high as twilight fell in the spring sky. Indeed, the planet's stellar altitude reminded me that these binoculars address the needs of both celestial and terrestrial users, for the eyepieces are not angled to save broken necks as some dedicated astro binoculars are. I was able to view the planet fairly comfortably only because my fork mount allowed me some room to get beneath the eyepieces – and if purchasers intend to use these binoculars specifically for astronomy then thoughts on how they are mounted need to be included. Hopefully, one day, someone will conceive the idea of having hinged eyepieces (oops, did I just do that?) so that binoculars can be used at any angle in both spheres of activity with equal comfort.

The visual fields of these binoculars are impressively wide, 3.4 degrees for the 20 × 80mm and 4.4 degrees for the 15 × 70mm. The turquoise–blue cast of a still twilit sky did reveal a field stop that was a little soft, rather than a stark hard circle, but it was not obtrusive and disappeared as the sky darkened.

Definition in both pairs was very good. Jupiter's globe was a cleanly defined disc and its satellites Io, Ganymede and Callisto were tack sharp in accompaniment. Staying with the 20 × 80s for a slightly closer approach, I was keen to see how much jovian detail was visible, even at this low magnification. There was a hint of belts, but the 80mm aperture was pushing so much light into the

disc that my wish was to make it just a little dimmer.

Here is where Celestron plays an ace, for the internal ridge of the eyepieces is fitted with a 1.25-inch filter thread! So I reached for an ND filter (I only had one) and, by deploying this, Jupiter's belts were easier to make out. The eyepiece threads are there of course to deploy pairs of all sorts of filters – especially those for deep-sky observing. It means that you do not need to purchase expensive, gigantic deep-sky filters for the 70mm or 80mm objectives, but it does mean that you will have to buy them in pairs and place them where their surfaces are within the range of long greasy eyelashes (eyelashes are always greasy).

The 3.4-degree field of the larger binoculars was exactly right for enfolding the two-degree extent of the Pleiades open cluster, the next celestial target that presented itself as true night fell. The field was such a confusion of so many brightened stars that at first glance the classic 'miniature Plough' pattern was not so obvious. Pleasingly, the stars were pinpricks against a dark backdrop, and remained so even when I cajoled them towards the edge of the visual field.

Thankfully, much lower down towards the south, the Sword of Orion was a glory in both pairs. Contrast was very good, with the star clusters and nebula within this huge linear feature a diagonal slash of light crossing the field. I was also struck by the fact that, even at the wide scale presented at 15× and 20×, with careful observation the Trapezium of stars within the Great Orion Nebula (M42) could be made out. It provided a great demonstration of the resolving power of these ED objectives.

Jupiter's globe was a cleanly defined disc and its satellites Io, Ganymede and Callisto were tack sharp in accompaniment.

It was quite an education comparing the benefits of each pair. The larger 20 × 80mm had the advantage of both additional light grasp and a slightly higher power that effectively darkens the background sky, so that the nebula was slightly better contrasted. Yet the extra full-degree field of view afforded by the 15 × 70mm made visible a swathe of stars not encompassed by its larger brother. This might make for a difficult decision by potential purchasers!

Returning again to the ED credentials, I possess a standard achromatic (non-ED) pair of 20 × 80mm binoculars with a comparable field of view, made by another well known brand. I was therefore mischievous enough to pitch mine against Celestron's to see if there was indeed clear optical water between the abilities of each.

Once more on Orion, and although the field stop itself was more sharply delineated in my own pair, the peripheral stars were certainly not! The performance of the corrected optics on Celestron's part were very impressive. But the real evidence surfaced as I returned to Jupiter. The SkyMaster Pro EDs could not be persuaded to show

▼ Dioptre adjustment is enabled by glove-friendly knurled finger lugs. This image also shows the recessed eye ring threaded for 1.25-inch filters. Image: Steve Ringwood.

Both pairs of the Celestron SkyMaster Pro EDs ready for the night's action. The larger pair sits on a binocular fork mount, which proved necessary for observing objects sitting at higher elevations. Image: Steve Ringwood.

ED optics

Since this new release of the SkyMaster rests primarily on the use of ED components in the optics, it is worth exploring this facet further.

As Isaac Newton so ably demonstrated, if you refract white light through a single piece of glass, it separates itself into a spread of rainbow colours. This is not helpful when you are trying to pin them all into a small focal point. Attempting to do so results in pretty colour fringes surrounding the edges of objects that you want to observe. Newton's answer was to suggest a telescope that employs a curved mirror, rather than a lens, to focus light – like the one, by the way, he had just invented. Newton's excellent self-marketing worked a treat, stalling the development of the refractor for over half a century, until someone had the idea of combining two optically dissimilar pieces of glass, thus creating the achromatic refractor.

Yet even the achromatic refractor lets a trace of achromatism (false colour) slip by – that is, until the coming of new glasses that provided sufficiently low dispersion of wavelengths to eliminate colour fringes (apochromatic). The use of these ED (Extra-low Dispersion) glasses minimises the focus spread of different wavelengths of light, producing images that are truly free of false colour and which are super-sharp by virtue of all the light arriving at the same place.

Readers will, I am sure, be delighted to learn that glass manufacturers do not rest on their laurels, and that to the pantheon of low-dispersion glasses we must include Extraordinarily Low (ELD), Special-Low (SLD) and Ultra-Low (ULD). All of these feed into the marketing claims of optical instruments being apochromatic, semi-apochromatic or simply colour-free.

anything other that a clean and sharply defined disc, whereas viewed through my own pair, there for all to see was the tell-tale chromatic fringe of purply false colour. And my own pair, albeit only achromatic, were not cheap either!

The impressive light grasp of the 20 × 80s allowed me to pick out the Andromeda Galaxy (M31), despite it being challengingly immersed in the gloom of lower altitude – and almost in the same line of sight as an inconsiderate neighbour's security light, thus demonstrating two capabilities at once.

I turned the larger pair's gaze to the Beehive Cluster (M44) and as it turned out they presented me with one of the best views of the object that I have had in a long time.

Before switching back to the wider field 15 × 70s, I turned the larger pair's gaze to the Beehive Cluster (M44) and as it turned out they presented me with one of the best views of the object that I have had in a long time. Simply a cloud of busy stars, clearly deserving its name. Almost at the zenith, the altitude of this object did make me wish again for angled eyepieces, but the glory of the view was worth the pain, brief as it was.

The smaller pair, boasting a field that captures almost twice as much sky, showed the cluster in its context (and made it easier to find!), Despite a slightly lower light grasp, a field of nearly four-and-a-half degrees (nine Moon-widths) is not a feature to be sneered at and I would not therefore want to have to choose a preference between them.

What I was looking forward to was a shot at the Moon. Like a backlit tree, there is no more fearsome challenge to a pair of binoculars than the blinding contrast of the lunar surface. Uncompromising weather thwarted my attempts at this, the final challenge, until quite late in the review, when at last a fine, deep-blue evening revealed a five-day old crescent.

Deploying the 20 × 80mm, the view was simply mind-blowing, once my eyes had become accustomed to the blinding light (note to self, need two ND filters!). Careful focusing elicited incredible resolution as the Moon swam within its generous 3.4-degree field.

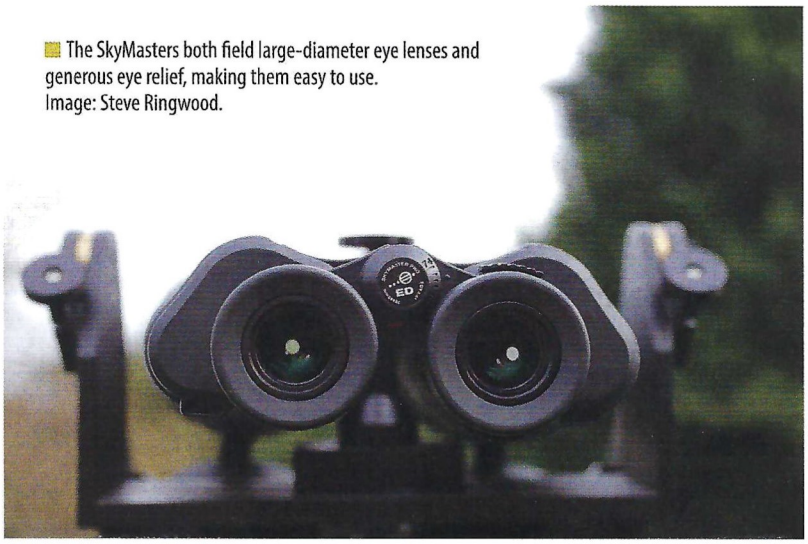
Near the centre of the Moon, abutting the terminator, the walls of the crater Theophilus appeared to rise high above the surrounding terrain. Astonishingly, I could even make out the broken peak at its centre. Not far away, sunlight grazing the 'coastline' of Sinus Asperitatis could be made out, snaking its way deep into the unlit hemisphere.

Great colour-free definition was also evidenced by the horns of the crescent, each piercing the darkness down to the finest point without a glimmer of false colour.

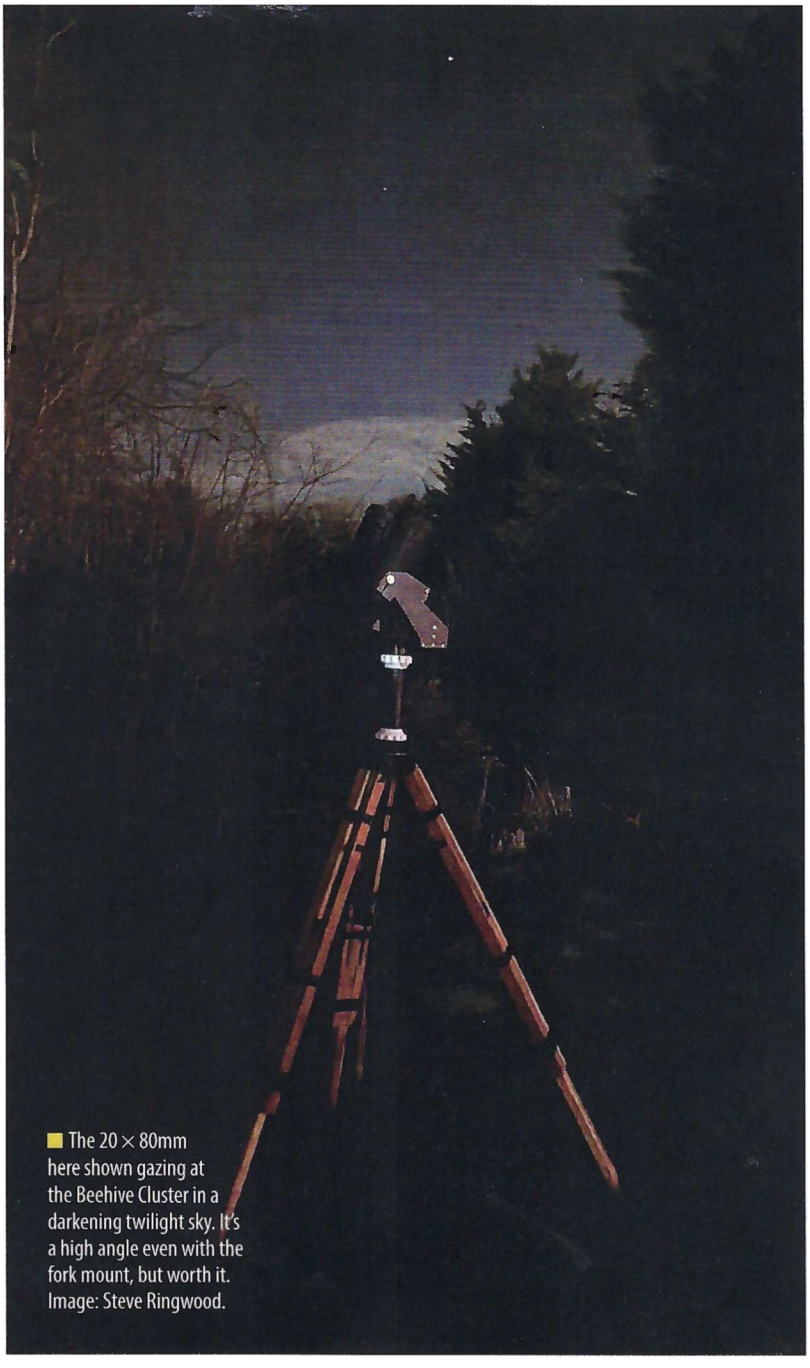
Moving away from the terminator to the sunward hemisphere, the glaring smooth arc of the globe was a scimitar sharp curve that met the dark background sky with nothing in between. I have expensive eyepieces that can't even do that!

While it is very true that equivalent non-ED binoculars are available at half the cost of those reviewed, I can say that the advantages of ED optics are clearly demonstrated in these pairs from Celestron. They have given me a great chase around the sky. Although I will not be laying aside my long-serving achromatic pair any time soon, my experience with these ED enabled binoculars has given me pause for thought.

Steve Ringwood is a regular contributor to *Astronomy Now*.



The SkyMasters both field large-diameter eye lenses and generous eye relief, making them easy to use. Image: Steve Ringwood.



The 20 × 80mm here shown gazing at the Beehive Cluster in a darkening twilight sky. It's a high angle even with the fork mount, but worth it. Image: Steve Ringwood.