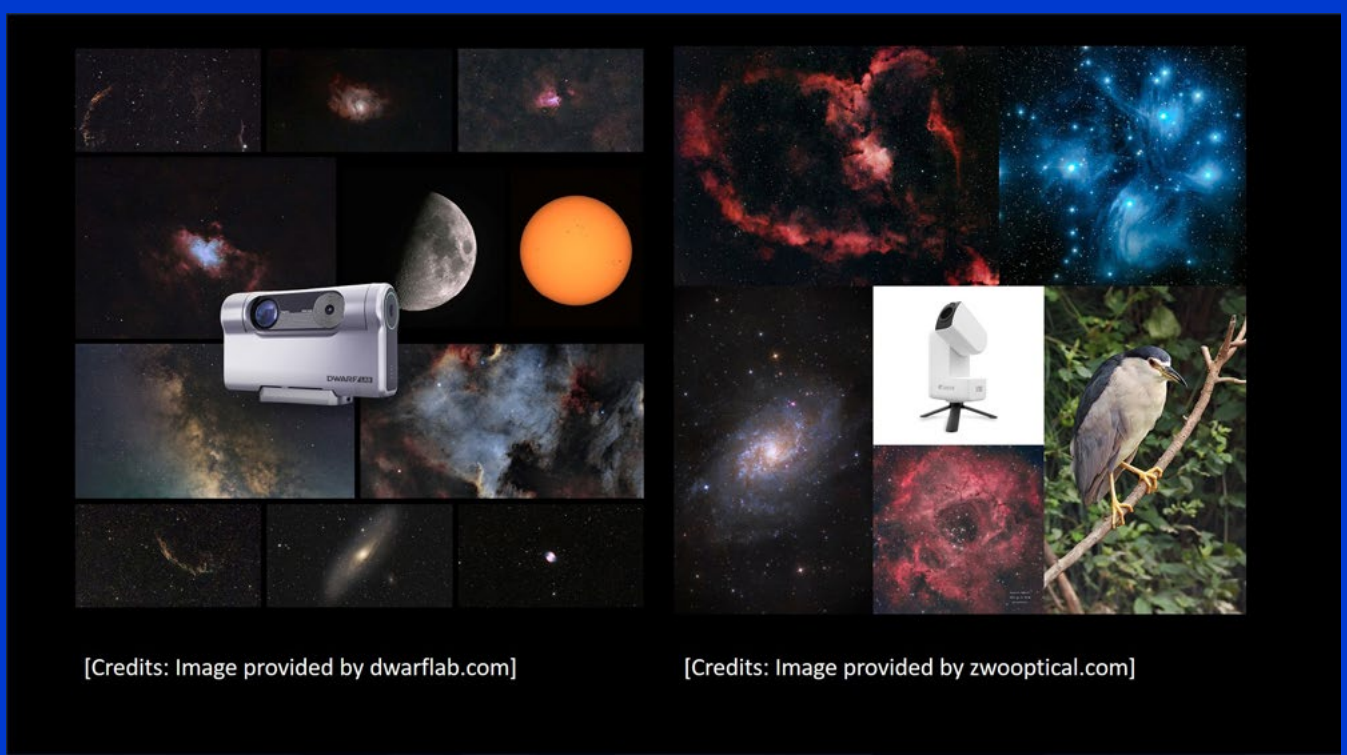
# Smart Telescopes in Comparison

## Technical analysis, image quality and practical evaluation for beginners and advanced users in astrophotography

Angelika Kolb-Telieps



[Credits: Image provided by dwarflab.com]

[Credits: Image provided by zwooptical.com]

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First image taken with the prototype of the Celestron Origin in Stuttgart city center.

[Credits: Celestron]

Front page image: Dwarflab III with pictures taken with it, kindly provided by Dwarflab.

# Abstract

In astrophotography, compact, fully integrated telescope systems - so-called smart telescopes - are experiencing a strong upswing. Even in the few weeks in which this white paper was written, development has progressed rapidly. In particular, parallactic tracking is a quantum leap. This white paper provides an overview of the models currently available from various manufacturers such as ZWO, Celestron, Vaonis, Dwarflab and Unistellar. It is aimed at both beginners and experienced deep-sky photographers. The white paper compares the systems with each other and with classic astrophotography setups in terms of technical features, ease of use, image quality and expandability. It also contains results from interviews with providers.

The test results show that beginners can easily access astrophotography with the most cost-effective and intuitive smart telescopes. They are even suitable for introducing children to astronomy. Devices that allow a little more flexibility are suitable for travel photography by experienced astrophotographers or as a second device. The quality of images taken with the Celestron Origin almost reaches that of comparable, classic setups with post-processing. The gap continues to close. It should be noted that although smart telescopes are fun to use, they have now outgrown the realm of gimmickry.

# Introduction

The trend towards intelligent telescope systems is changing the approach to astrophotography. Instead of manual mounts, external cameras and software control, these all-in-one devices offer a compact solution: alignment, focusing, object recognition, GoTo, tracking, image capture and processing - everything is integrated and fully automated via an app.

The question for beginners is whether they can achieve the image quality they want with a relatively low budget and low technical access barriers. Many advanced astrophotographers are skeptical about the newcomers to the market, but are still considering whether they can use them for travel because of their low weight. Most of them, including myself, are following developments very closely.

This white paper is aimed at:

- Beginners who want to get into deep-sky photography without any technical hurdles at low-threshold prices and
- Advanced users who are looking for a mobile addition or quick alternative to their existing equipment.

It compares current models from leading manufacturers such as ZWO, Celestron, Vaonis, Dwarflab and Unistellar on the basis of technical data, practical strengths and weaknesses as well as evaluations by experienced astrophotographers, including Kai von Schauroth, Daniel Nimmervoll, Frank Sackenheim (astrocologne) and Cuiv - The Lazy Geek. Reports in the astronomy forums were also spotted. I myself looked at some smart telescopes in operation and their results. I also conducted interviews with providers at the Astronomie- und Techniktreff (ATT) 2025 trade fair. I (still?) take photos myself with the TS121SDQ telescope with a focal length of 677 mm.

The smart telescopes were developed for deep sky photography and can also be used for the moon. Neither focal lengths nor cameras are suitable for planetary photography. This is also not the claim of the manufacturers.

Objectives of this white paper:

- Technically sound evaluation of current models, including image quality
- Clear comparison to classic astrophotography
- Objective help for purchasing decisions

# Overview about the smart telescopes

## Seestar S30 and S50 from ZWO

Seestar S30
[own photos taken at the ATT 2025]

Seestar S50

## DWARF II und DWARF III von Dwarflab

DWARF II
[Credits: Presskit Dwarflab]

DWARF III

## Vaonis Vespera II

Vespera IIII
[Credits: Media Kit Vaonis]

## Celestron Origin

[own photo on the Star Campus Athos on La Palma, courtesy of Kai von Schauroth]

# Comparison of the Properties of Smart Telescopes

Until recently, the mounts of all smart telescopes available on the market were azimuthal. This has changed rapidly in recent weeks. Dwarflab, ZWO and Celestron now also offer equatorial mounts. Azimuthally tracked telescopes have to work with short exposure times and capture the celestial objects again and again. This means that the edges of the stacked images are not smooth.

All of the devices examined have a GoTo function for automatically moving to celestial objects, which is not always the case with classic mounts in the affordable range. They align themselves automatically and are controlled via smartphone apps. Operation is intuitive. They stack the finished images. The software of all devices in particular is undergoing rapid development. If you are looking for more flexibility, you will naturally have to make more adjustments.

The telescopes can even be used for nature photography. The two focal lengths of the Dwarf telescopes are particularly useful for this.

The operating time of the batteries of the smart telescopes is 6 hours, with Dwarf II and Vespera II only 4 hours. Longer operating times stated by the manufacturers could not always be verified in tests, although the age of the batteries also plays a role. For long winter nights, that doesn‘t sound very long at first. However, it must be taken into account that the times for setting up the telescopes, for which classic astrophotography requires considerably more time, are extremely short. Some devices can also be connected to a socket or power bank during operation.

Table 1 in the appendix 1 summarizes the most important features and ratings of current devices. The properties of the brand new telescopes presented at the ATT 2025 have been taken into account as far as known.

While the prices of the Chinese manufacturers ZWO and Dwarflab are in the three-digit range, those of the Europeans are significantly higher. A similarly serious difference can be seen in the weights of the telescopes. With the exception of the Vaonis Vespera II, the European manufacturers rely on mirror technology, while the Asians use refractors.

ZWO and Vaonis have installed small sensors in the cameras to match the smartphone technology. The large sensors from other manufacturers are not always optimally matched to the technology used.

As expected, the larger and heavier devices have the longest focal lengths and largest apertures. However, a considerable improvement in the focal ratio was only achieved in the Origin. Compared to the smart telescopes, the common classic telescopes tend to have higher focal ratios, which means that you can expose longer and thus improve the signal-to-noise ratio. However, the smart colleagues are enormously fast. With my TS121SDQ, for example, I only have f/5.6. The resolution is 1.1. It is not surprising that the two smart telescopes at the lower price limit have the poorest resolution.

Astronomers often use narrow-band filters in deep-sky photography. Some of these filters are permanently integrated in most smart telescopes. In all cases, a light pollution filter is included. This limits the flexibility that the astrophotographer would otherwise have with a filter wheel or slide-in filter. With the Dwarf II and Vaonis Vespera II, any filter can be used. The Unistellar telescopes are also equipped with solar filters. A solar filter can be mounted on the Origin.

All smart telescopes offer live stacking so that the user can follow the image composition on their smartphone or tablet. The images are processed directly in the device, sometimes with AI amplification or noise reduction. Unfortunately, this sometimes results in images that are over-sharpened, too contrasty or saturated.[1] If you want, you can also export the data and process them yourself using the usual tools, such as PixInsight or Astro Pixel Processor. Unfortunately, Unistellar does not offer export in RAW format, which offers the best options for manual image processing.

For those who like to participate in community projects, the eVscope 2 offers the opportunity to do so in the Citizen Science projects.

# Review of manufacturer-independent test reports

The technical data listed above is primarily taken from the manufacturer's specifications, but has been confirmed in objective test reports with one exception. The exception is Vaonis Vespera Pro, which did not image round stars in tests by Schauroth [1]. Vaonis attributed this to production errors of the new telescope type, which are usually avoided by quality controls. Vespera Pro, the successor to the Vespera II, is available for around €3,000.

Even more exciting than the technical data is the quality of the images that can be achieved with the smart telescopes. Of course, the telescopes' batteries must be charged before use. Unfortunately, I have not found any manufacturer-independent, comparative tests in which the Unistellar telescopes were also taken into account.

All the telescopes tested suffer from tracking problems, which is why the user has to sort out images. However, this also occurs with the classic setup. ZWO, Dwarflab and Vaonis have an automatic mosaic mode, which requires sophisticated imaging and processing techniques with classic telescopes.

The following test reports have been included in this review:

- from the magazine astronomie 47: Seestar S50, Vespera Pro and Celestron Origin [1]
- YouTube video by Daniel Nimmervoll: Seestar S50, Celestrun Origin und klassisches 10" telescope [2]
- YouTube-Videos by Cuiv, the Lazy Geek: Seestar S30, Seestar S50 and Dwarf II [3]
- Website sterngucker.de: kurzer Test des Unistellar eVscope 2 [4]
- YouTube-Video of Wido' Astroforum: Seestar S50, Dwarf II, Vaonis Vespera II, eVscope 2 and eQuinox 2 [6]
- YouTube-Video of astrocologne: Celestron Origin, Takahashi Epsilon mit ASI Air und ASI AM5 [7]

For copyright reasons, I do not show any images of celestial objects from the individual tests in this white paper. However, such images have been created and published. At the end I provide references in which numerous images are shown.

## 1. Construction of the telescopes

With the exception of the Origin, all smart telescopes are simply set up and a tripod may need to be attached - extremely simple. The Origin comes in three parts simply because of its weight, but can be set up in less than 5 minutes, which, depending on the type, is at most half the time of a classic, mobile telescope.

After the mechanical assembly, the connection is made with the respective app of the smartphone or tablet. The connection is possible over a free distance:

- 15 m for the S50
- 8 m for the Vespera Pro
- 5 m for the Origin

The Seestars' app is rated as especially user-friendly.

The Origin has a connection for a power supply unit for longer exposure times. In contrast, a classic telescope usually requires several power supply units and additional devices such as the camera, a guider, a focuser, etc. are connected. The control software of the smart telescopes can be connected either via cable or WLAN.

Depending on the celestial object, a filter can then be added. However, Schauroth [1] found that this led to a yellowish cast with the Seestar S50.

## 2. Aligning and focusing

With the exception of the Unistellar telescopes, the operator only has to start the initialization of the smart devices and wait a few minutes. With the classic method, this is only possible with sequencer software such as N.I.N.A. or ASI Air. Otherwise, a polar finder is used for polar alignment and focusing on the stars manually or via a focuser.

## 3. Approaching the object

The celestial object is selected in the app and the smart telescopes move to it. This works in a similar way with classic GoTo mounts. If you don't have one, you have to use a finder scope and it's not always easy with faint objects. The apps of the smart telescopes sometimes contain information about the celestial objects, which is another advantage for inexperienced astronomers and children.

The Origin and the Dwarf III even offers the luxury of sequencer software. This allows the entire sequence to be planned and set in advance. It should be noted that it can only be followed on one and the same device.[2] Sky atlases are available in this telescope and in the Unistellar telescopes.

## 4. Exposure

The default setting for smart telescopes with an azimuthal mount is 10 seconds. However, the times can be adapted to the conditions and the object. The Origin is the most flexible with 0.5 - 45 s. With classic telescopes, exposure times of minutes are usually selected in order to minimize the sky noise, with special objects, such as the Orion Nebula, down to 30 s. Such long exposure times can only be realized with parallactic tracking, even with the smart colleagues.

Due to the design of the Seestar S30 and the Vespera Pro, the sky section is the largest in the devices tested.

Nimmervoll [2] and Cuiv [3] have also worked with flats and darks in order to be able to perform the image corrections that are common in astrophotography. It is noteworthy that the Seastar S50 automatically uses the darks once they have been created.

The Seestar S30 is extremely easy to use, but offers experienced astrophotographers fewer possibilities to intervene. With the Seestar S50, on the other hand, autofocus can be activated, flats and darks as well as dithering are possible. Tracking is more stable.

A video function is also integrated in the Dwarf and Seestar telescopes.

## 5. Stacking and image processing

While classic image processing takes place after the images have been taken, the smart telescopes carry out this processing directly in the device during and after taking the images. However, all devices also offer the option of exporting data, unfortunately Unistellar does not export in RAW format and with the Dwarf III the images are already pre-stretched, which limits the options for manual post-processing. For example, color calibration can no longer be performed.

With the eVscope 2, the image is also shown on an OLED display on the telescope.

## 6. Image quality

All testers agree that the image quality of all smart telescopes can be significantly improved by subsequently processing the data in appropriate programs such as PixInsight. Unfortunately, the Vespera Pro did not score well in terms of image quality.[1] Compared to its little brother, the S30, the images from the Seestar S50 are less noisy.

All other smart telescopes led to high-contrast nebulae and galaxies after longer exposure times of one or, in Tokyo [3], several hours, with the images from the Origin being the most detailed. After 3 nights, even in Tokyo with the Seestar S50, the trapezium of the Orion Nebula became recognizable. In mosaic mode, however, the quality of the S50 suffers. The best resolution was achieved in all tests with the Origin. However, as Nimmervoll [2] noted, it does not come close to that of a 10“ Newtonian telescope with a focal length of 1,000 mm (6” on the Origin) and an IMX 571 mono sensor, which he tested in parallel under the same conditions. He does not fail to mention the price of his equipment of around €8,000, which is significantly more expensive than the Origin. A 6“ hypograph delivers marginally better image quality than the Origin[2].

Sackenheim compares images of M 65 from the Leo triplet, taken with the Origin and his Takahashi Epsilon telescope.[7] The first thing that catches the eye is the different image section. After drizzling the Takahashi photos, the resolution of both images is comparable. Sackenheim evaluated the signal-to-noise ratio in the galaxy and for the background. The result is that the Epsilon delivers the better values. The parallactically tracked Origin has not yet been independently tested. Improvements can be expected in this area.

Due to the azimuthal mounts, these smart telescopes require continuous image rotation. In addition to the unsightly edges, this results in circular noise artifacts in the stacked images, which are also difficult to eliminate in manual post-processing. This problem has been solved in the devices with parallactic tracking.

There are also issues if dithering is not used. While the Seestars dither, this is not the case with the high-quality Origin. This results in the usual artifacts. The only way out is to darken the background of the picture considerably.

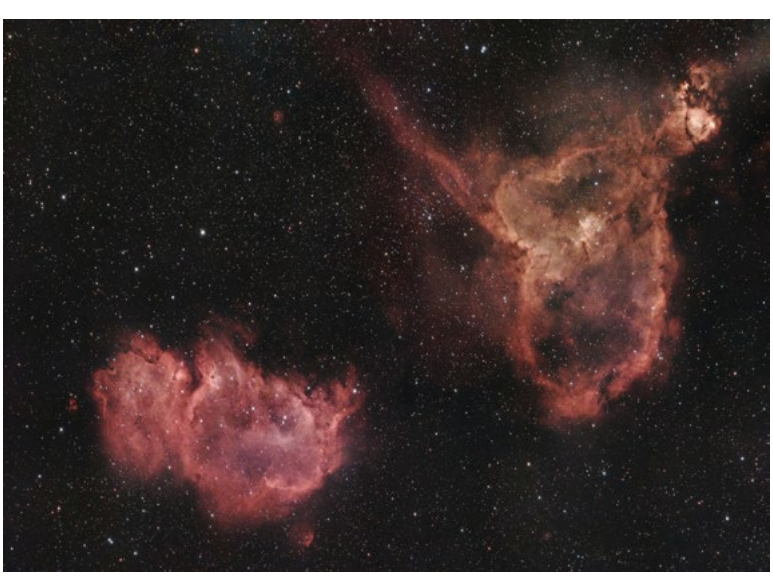
The results of the eVscope in Wido‘s test report are not convincing. However, no exact recording parameters are given. [6]

# Field Reports from the Internet

The following forums and websites were analyzed:

- Astrotreff [8]
- Astrobackyard [9]
- Cloudy Nights Forum [10]

The results are summarized in Table 2 in the appendix 1. They do not provide any new findings compared to the independent test reports.



Mosaic of the Heart and Soul Nebulas, taken with the Dwarf III

[Credits: Presse map Dwarflab, image of Daniel Ethier]

# Interviews with Suppliers at the ATT

**1. Marcus Schenk from Astroshop**

Marcus Schenk from Astroshop with the Origin and books which he worked on

The interview with Marcus Schenk was conducted at the trade fair. Marcus Schenk works at Astroshop.de and is the author of several books on stargazing. At ATT 2025, he spoke to me about the topic of smart telescopes.

*CellaPix*: I would like to welcome Mr. Schenk from Astroshop. Good morning.
*Schenk*: Good morning. Nice of you to come to me with your questions.

*CellaPix*: The first questions relate to the target group and the motivation. Who exactly are your smart telescopes aimed at?

*Schenk*: First of all, beginners, of course. When we added telescopes this time, we thought that beginners would definitely be the main target group. However, it has now also become clear that we have more and more advanced people who are interested in astronomy and astrophotography because, of course, more features are now being added.
Astroshop is a retailer that naturally offers a wide range of telescopes. When the smart telescopes came along, we said:, 'Yes, that sounds exciting.' ... But of course we always check it out a bit, because we want it to be useful for our customers.

*CellaPix*: Are they more your regular customers or have you also gained new customers as a result?
*Schenk*: Well, we have also gained new customers as a result. Many beginners naturally find it easier to deal with it, and yes, also people who are otherwise a bit interested in nature or nature photography and have also thought about it, 'Yes, this topic would be exciting and I would like to look into it again. But the telescopes sound so huge.'

*CellaPix*: That brings us to the users. Let's move on to the user experience and operation. How low is the barrier to entry really?
*Schenk*: It is always reported to be very low.

*CellaPix*: What do your users experience the first time they use it?
*Schenk*: Well, it's relatively intuitive. Users find that they are given a system that works straight away. It works with an app and you can find your first objects straight away. So I experience it again and again and that applies to all smart telescopes, some more and some less. So yes, you have to differentiate a little. For example, there is the Celestron Origin, which has the look of a large, normal telescope. You need to know more about that: So here's the tripod and here's the mount and there's the tube, I set it up. Or how to deal with sensitive optics, for example. But for the smaller ones, it definitely applies. ... And then there's also the sense of achievement. Well, that also applies to people without a technical background.
I also had a conversation with a hobby astronomer at the last trade fair. She said that she would like to have something simple like this next to her Dobsonian telescope, because she is a visual observer, so that she can run it on the side.

*CellaPix*: Development is progressing rapidly. How do you ensure that the devices will still be usable and enjoyable in 2-3 years' time?
*Schenk*: First and foremost, of course, we are a dealer, but we are also a manufacturer with our Omega brand. We have a fully equipped workshop with optics, electronics and mechanics and try to fulfill all customer wishes. ... Even the people who are familiar with it. And apart from that, we are in close contact with the manufacturers.

*CellaPix*: Let's come back to the advantages and limitations compared to the classic setups. You have already mentioned the intuitive operation. Are there any other advantages?

*Schenk*: The Smart Group is very portable because they are small and light. Everything is integrated, there are no tangled cables, and that is of course reason enough for many people to use it as a second device, for example. ... I've just had another conversation. An astrophotographer who said that he had never taken as many photos in the last few years as he has recently because he has this smart telescope.

*CellaPix:* Are there also disadvantages?
*Schenk*: For example, you don't have much individuality, so you have to rely on what the manufacturer puts in there and how they design the app and the exposure times. And of course there is the other world, where people put together their own systems, individually, then choose which cameras they use, then the filters. ... And I just think it's nice when both worlds exist side by side. I compare astronomy to a big tree with lots of branches. Smart telescopes are also a branch that is definitely on the rise.

*CellaPix*: There is a debate as to whether this is serious astronomy or a gimmick. How do you see it? What can users still learn about astronomy?
*Schenk*: Personally, I'm an observer who does it out of an emotional fascination and I don't like to associate it with seriousness. But I know what you mean. It's a beautiful thing. You can take it seriously, quite seriously. You also get to know the sky. You have to think about which objects you want to observe. Of course, it's a bit different to going out with a Dobsonian. I have to set that up. Then I have to look at the star chart to find the object. You're perhaps a bit closer to it.

*CellaPix*: Let's move on to the last point: outlook and further development. How do you see the future of smart telescopes as a retailer?
*Schenk*: I think there will be more to come. I am experiencing a very, very high level of interest in smart telescopes among our customers. And the first key features have now been integrated into the apps by the manufacturers and I think this is just the beginning. If we now look at everyday life with the new technical developments and AI etc., you can see how much is coming at the moment, how fast-moving it all is.

*CellaPix*: Thank you very much for the interview, Mr. Schenk.
*Schenk*: Thank you very much.

Trifid nebula, taken with a Unistellar telescope, left before and right after image processing with Vivid Vision [Credits: press kit Unistellar]

## 2. Sales ManagerHerwig Diessner from Celestron


Herwig Diessner with the Celestron Origin at the booth

Celestron, manufacturer of the Origin automated telescope system, provided detailed written responses to the interview questions for this white paper. In the following, central statements are summarized in a highly abbreviated and thematically structured form. Selected quotes illustrate the manufacturer's perspective. Celestron deliberately no longer speaks of "smart telescopes", but of "home observatories" and sees the sweet spot in deep-sky photography. Diessner proudly presents the new Origin with parallactic tracking at the ATT.

### Target groups and motivation

Celestron does not see smart telescopes as competition to classic systems, but as a category of their own. They are intended to appeal to beginners, but also to ambitious users through their efficiency and convenience. Educational institutions such as planetariums or public observatories are also part of the target group.

"We see smart telescopes as a logical addition to classic astrophotography - for anyone who wants to observe and photograph the sky quickly and conveniently. ... As a beginner, you can simply observe the sky without any in-depth prior knowledge and create high-quality images, even from the light-polluted city center. Only the large aperture of the optics and the fast aperture of f/2.2 make this possible, without the automatic image processing having to be too aggressively post-processed in order to ‚develop' attractive images in high resolution".

### Operation and user experience

Despite its size, the Origin system is ready for use in just a few minutes. The entire recording process, from starting up to the first image, is highly automated and intuitive.
"After just 10 seconds, the first image is visible on the cell phone display in the Origin app. The comment from most users is simply: ‚Wow!"

We have made a quantum leap in the user experience for the ATT: we are introducing the Origin with parallactic tracking. "With the support of the polar altitude cradle and StarSense autoguider together with automatic polar alignment, long exposures are possible, the duration of which is only limited by the full well capacity of the camera sensor."

### Technical philosophy

"Celestron's aim is to produce results similar to those of classic setups: "The Origin is an astrograph that doesn't have to shy away from comparison even with expensive special setups, especially for deep-sky imaging."

Celestron emphasizes that the Origin offers great light yield due to the fast live stacking and the high-quality optics with f/2.2. The combination of powerful hardware and app support is designed to significantly differentiate the user experience from the classic telescope.
"The Origin combines speed, brightness and ease of use in a new form - without complicated setup."
Celestron sees a high degree of future viability thanks to the modular design.

### Limitations and outlook

Celestron sees smart telescopes as the future of astrophotography: "... we are seeing the beginning of a new kind of astrophotography, in which the cumbersome handling of many different components, which all have to interact perfectly, is increasingly receding into the background, allowing more focus to be placed on obtaining good raw data." After the parallactic tracking, Celestron is planning the mosaic mode and: "... how great would an Intelligent Observatory with a 36 cm aperture be!"

### 3. ZWO team

ZWO booth

I conducted the interview at the ATT with the team from ZWO USA.

One of ZWO's managers describes the wide appeal of smart telescopes: "It's not just experienced imagers we're targeting. We're also designing for beginners, kids, educators, families—anyone with a curiosity about nature and the night sky."

By automating complex processes, smart telescopes significantly lower the technical barrier. "Even kids can use them—like my daughter, who started when she was ten. Today's kids are especially good with technology," she adds.

ZWO's mission is to make astronomy more inclusive and accessible. Traditionally, astrophotography was a niche hobby due to its technical complexity and time demands. "You used to sit out for hours to capture images," she explains. Cost was another major hurdle: "People could easily spend over $5,000 on equipment. As a result, it was only accessible to a small segment of the humanity."

But curiosity about the universe is universal. ZWO's smart telescopes aim to turn that curiosity into a hands-on experience. "With smart telescopes, we break down the barriers. For around $400 to $500 before tax, you can get started—no need to understand polar alignment or tracking mechanics. All you need is a smartphone."

The user experience is simple:

- Pair your smartphone with the smart telescope
- Select your target
- Start imaging with a single click

"Our goal is to bring the wonders of the dark sky to everyone. That's the motivation behind our work."

To ensure users continue to enjoy their smart telescope over the long term, ZWO draws on over a decade of experience, especially in software development. The company's founder, Sam Wen, with a background in software engineering, remains personally involved in product development. ZWO provides constant software updates and maintains a dedicated customer support center. Warranty coverage includes two years of service with shipping costs covered. "We keep adding features at no extra charge—for example, we recently just added an equatorial mode."

Even experienced astrophotographers use Seestar telescopes as travel-friendly or secondary devices. "We see smart telescopes as both scientific tools and fun gadgets," the manager notes. "But from an educational perspective, especially for kids, the first experience is crucial. It sparks interest and sets the foundation." The Seestar app also enhances learning: "When you choose a target, the app provides basic information about what you're imaging—so you're learning as you go."

Innovation remains central to ZWO's roadmap. "We plan to release new products every year." Most recently, the company launched the Seestar 30 Pro, featuring an upgraded 4K sensor and expanded internal storage of 256GB.

# Conclusions

The cheapest, lightest and easiest to use smart telescope is the Seestar S30. I recommend it for beginners who are not yet sure whether they will stick with this hobby.

If your interest and budget are a little bigger, the Seestar S50 offers more advantages, e.g. with the autofocus and calibration images as well as the better image quality. Both Seestars were developed by the manufacturer for smartphone applications and are perfectly suited for this purpose.

The Dwarf III is the next step up from the Dwarf II. It offers even more possibilities than the Seestar S50, e.g. the sequencer software. It is compact and lightweight and can therefore also be of interest to experienced astrophotographers as a second instrument for traveling.

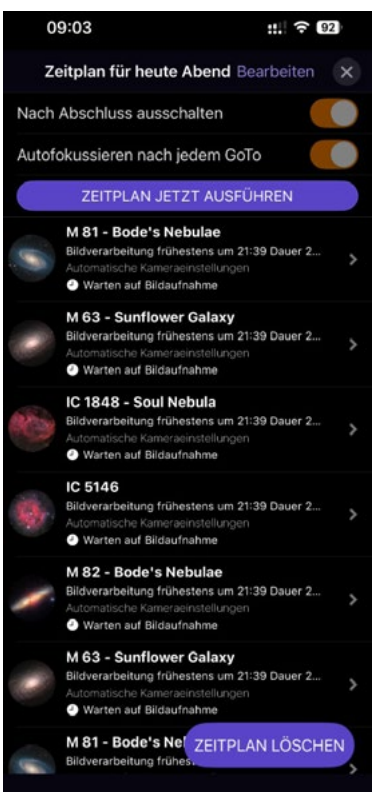
The sun photographed with Dwarf III.
[Credits: Press kit from Dwarflab]

Because of its weight, the Celestron Origin is less interesting as a travel telescope. However, its image quality is not far from that of classic telescopes - and at a significantly lower price and reduced effort. It is also an option for beginners with some experience who want to climb to the next level. The images even allow for larger prints.

At this point, I will limit myself to the smart telescopes from ZWO, Dwarflab and Celestron. They can be tracked parallactically and impress with their image quality in the targeted sector. The Origin and the Dwarf III now even have sequencer software. The gap to the classic setups is rapidly closing.

Nevertheless, most astrophotographers with many years of experience - at least for the time being - stick with their familiar telescopes. On the one hand, habit probably plays a role. On the other hand, they still offer a few advantages over their smart colleagues: e.g. more flexibility thanks to the filter wheel and rotator, which can also be controlled with sequencer software such as N.I.N.A. and ASI Air. This allows them to take pictures autonomously throughout the night. In addition, the smart telescopes currently only offer focal lengths up to a maximum of 6 inches (Origin).

However, there is another interesting application for the smart telescopes: the simple, inexpensive devices from ZWO and Dwarflab are suitable for introducing children to astronomy, both in the family and in schools. In this sense, they are also interesting for other educational institutions, such as public observatories.




Sequencer-Software of the Celestron Origin

In summary, it can be said that smart telescopes have a clear advantage over classic telescopes in terms of price/performance ratio and a much lower entry threshold in terms of training requirements. The gap is narrowing all the time. Smart telescopes are now more than just a gimmick. It will be exciting to see how the journey continues.

I also do not want to let down those who are already thinking about buying a smart telescope. In Appendix II you will find checklists with questions that can help you with your purchase decision, one for beginners and a second for advanced users.

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Imprint

CellaPix | Angelika Kolb-Telieps
Siebensternweg 7
38678 Clausthal-Zellerfeld
Germany
Telefon: +49 5323 987 1191
E-Mail: angelika@cellapix.de
https://www.cellapix.de
Umsatzsteueridentifikationsnummer: DE76198034052


Visit me on YouTube:
youtube.com/@cellapix

# Appendix I

**Table 1: Comparison of prices and technical features of current smart telescopes (prices as of March 2025)**

| Model | Type | Approx. price [€] | Sensor | Focal length [mm] | Aperture [mm] | Focal ratio [mm] | Resolution [arcsec] | Field of vision |
|---|---|---|---|---|---|---|---|---|
| ZWO Seestar S30 | Refractor | 550 | Sony IMX662, 2 MP | 150 | 30 | 5 | 4.6 | 1,2° × 2,13° |
| ZWO Seestar S50 | Refractor | 700 | Sony IMX462, 2 MP | 250 | 50 | 5 | 2.4 | 1,2° × 0,7° |
| Dwarflab DWARF II | Refractor | 600 | Sony IMX415, 8 MP | 100 | 24 | 4.2 | 4.8 | ~1,3° × 0,7° |
| Dwarflab DWARF III | Refractor | 700 | Sony IMX678, 8,3 MP | 150 | 35 | 4.3 | 3.9 | ~0,8° × 1,4° |
| Vaonis Vespera II | Refractor | 1.600 | Sony IMX462, 2 MP | 200 | 50 | 4 | 2.8 | 1,6° × 0,9° |
| Unistellar eQuinox 2 | Reflector | 2.100 | Sony IMX347, 7,7 MP | 450 | 114 | 4 | 1.7 | 0,34° × 0,45° |
| Unistellar eVscope 2 | Reflector | 3.800 | Sony IMX347, 7,7 MP | 450 | 114 | 4 | 1.7 | 0,34° × 0,45° |
| Celestron Origin | Reflector | 5.300 | Sony IMX178 color | 335 | 152 | 2.2 | 0.9 | 1,27° × 0,85° |

| Model | Parallactic tracking | Weight [kg] | Filter | Image export format |
|---|---|---|---|---|
| ZWO Seestar S30 | possible | 2 | Magnetic solar filter included | JPEG, FITS |
| ZWO Seestar S50 | possible | 3 | Integrated, not interchangeable | JPEG, FITS |
| Dwarflab DWARF II | no | 1 | Interchangeable (deluxe kit) | JPEG, TIFF, FITS |
| Dwarflab DWARF III | possible | 1 | 4-fold integrated | FITS, JPEG, TIFF |
| Vaonis Vespera II | no | 5 | Optional filter drawer | JPEG, TIFF, FITS |
| Unistellar eQuinox 2 | no | 7 | Firmly integrated | PNG, JPEG |
| Unistellar eVscope 2 | no | 9 | Firmly integrated | PNG, JPEG |
| Celestron Origin | against surcharge | 19 | Filter drawer | FITS, JPEG, TIFF |

# Appendix I

**Table 2 Reviews from the internet**

| Model | Strengths for beginners | Strenghts for advanced | Disadvantages | Differences to classic equipment |
|---|---|---|---|---|
| ZWO Seestar S30 | Affordable, very light and portable; easy operation via app | Cheap | Limited aperture and resolution | Significantly less detail and flexibility |
| ZWO Seestar S50 | Fast, uncomplicated | Compact, flexible | Low resolution, no filter selection | Significantly less detail |
| Dwarflab DWARF II | Very affordable, versatile | Mobil | Limited performance | Entry aid only |
| Dwarflab DWARF III | More features, still simple | Filter selection, dithering | Still limited aperture | A little closer |
| Vaonis Vespera II | Design, easy to use | Mosaic | Small aperture, little sharpness | Less depth |
| Unistellar eQuinox 2 | Eyepiece feeling, simple app | Citizen Science, Memory | Expensive, small field of view | Observation experience, but lower image quality |
| Unistellar eVscope 2 | High-quality digital eyepiece; easy handling | Good image quality; suitable for citizen science projects | High price; limited flexibility | Closer to classic equipment, but not equivalent |
| Celestron Origin | High quality, simple operation | Large aperture | Heavy, expensive | Comes closest to the results of classic equipment |

# Appendix II

## Part a: Beginners

### 1. Do I want to take photographs at all - or just observe?

Many smart telescopes combine both, but the focus is clearly on image acquisition. If you only want to observe visually, a classic Dobsonian is more suitable - and you will experience the objects more directly.

### 2. Is the image quality good enough for me - or do I want more?

Smart telescopes deliver surprisingly good results - but not at the level of classic astrophotography with DSLR, telescope and post-processing. If you simply want beautiful images for your smartphone, you're in good hands here. However, if you want to get more out of your data, you will eventually reach the limits of resolution, noise and detail.

### 3. Am I ready to deal with image processing?

Many smart telescopes deliver finished images directly to your cell phone. However, if you want to get more out of your images, you can often export the raw data and edit it yourself. This requires programs, training - and patience. Is that what you want, or do you want the result to be as finished as possible?

### 4. Where will I photograph - stationary or mobile?

Smart telescopes are usually lightweight and easy to transport. Perfect for the balcony, garden or vacation. Nevertheless, pay attention to the power supply, internet connection and weather - because "smart" does not mean that clouds and dew problems solve themselves.

### 5. How important is the price for me?

Smart telescopes are cheaper than many complete systems - but they are still an investment. You can get models with different sensor sizes and functions from 500 euros. With the Celestron from Origin, you are already in the four-digit range.

### 6. Is it easy enough for me to get started - or do I need more guidance?

Many manufacturers promise "foolproof" operation. If you are starting from scratch, it is worth starting with a device with particularly good user guidance (e.g. DWARF or Seestar). With the Origin, even experienced astro-photographers had to clarify questions with the salesperson when using it for the first time, but this quickly led to solutions. Are you ready for this?

# Appendix II

## Part b: Advanced users looking for a second device

### 1. Am I looking for a compact second device for traveling or spontaneous sessions?

Smart telescopes such as Seestar or DWARF are extremely mobile and ready for use within a few minutes. Perfect for nights with a limited time budget or as a second system when traveling. Also ideal if you want to track a second object in parallel to your main equipment, e.g. if you are primarily observing.

### 2. Am I prepared to compromise on image quality and control?

Automatic exposure times, restricted dithering and limited filter options are all part of the concept. If you can accept these compromises in favor of convenience and speed, you will be rewarded with amazing results - especially with nebulae and large sections of the sky. Even mosaics are possible.

### 3. Does the additional purchase justify the price for me?

Smart telescopes are not free either. So the question is: will I use the device regularly - or will it just remain a well-intentioned companion in the cupboard?

## Part c: Advanced users who want to switch to a smart telescope

### 1. Is the Celestron Origin a real alternative to my previous setup?

Currently, the Origin is the only smart telescope with parallactic tracking and GoTo system at a higher level. It offers significantly more manual control and higher image resolution than most other smart devices - but it is also significantly more expensive. A complete switch is only an option if you are prepared to do without classic control programs and fully embrace the Celestron ecosystem.

### 2. What compromises do I have to make when switching - and am I prepared to do so?

Less influence on individual parameters, limited software compatibility and a different image aesthetic are among the biggest changes. The resolution and noise behavior are (still) behind classic cameras. In return, you gain mobility and simplicity - but lose control and flexibility.

### 3. Can I use my existing experience - or do I have to retrain?

You will find out: Much of what you know about tracking, calibration and guiding is no longer needed with smart telescopes. Instead, you will get to know new apps, operating logics and interfaces. A changeover is therefore not just a simplification of your old system - it's a system change.

### 4. Do I have to decide now - or is it worth waiting?

Patience is often an advantage, especially with new technologies. The market for smart telescopes is developing rapidly - and sensors, software and functionality improve with every generation. If you are currently still happy with your classic setup, it may be worth waiting for the next model cycle or new providers.