Your guide to go-t

SINCE THE INVENTION OF THE TELEscope, manufacturers have been striving to improve every aspect of this fine instrument. They learned that size and mobility are key issues in deciding how useful a telescope is. Great steps were taken to develop mounts so telescopes could be moved easily along the known paths of stars and planets. Dual-axis mounts, gears, clock drives, and motors were all part of this evolution. Then, the invention of computers helped move large telescopes to a new level of complication. Amateur astronomy benefited from microprocessor technology, which reduced the size of computers while increasing their power. This technology has ushered in the era of the "go-to" telescope mount.

Basically, a go-to mount has three elements: the microprocessor, encoders, and motors. The encoders tell the microprocessor the physical position of the mount (and thus the telescope attached to it) in relation to a set point. The microprocessor then inputs that information into a program that tells the motors what to do as each command is entered, such as, "go to Saturn." The motors then move the telescope into the position Saturn is known to occupy in the sky at that given moment. Ah, the wonder of computers and how they enrich our lives. Of course, these three elements are incorporated into telescopes in different ways: They can be added on, integrated into the mount, or interfaced through a control paddle.

The latest generation of go-to telescopes incorporates global positioning system (GPS) receivers and electronic compasses that pinpoint a scope's exact location on Earth. Many go-to drives also determine the exact date and time. Some even figure out if a telescope is level and, if not, they apply a correction. After all this, the alignment

o scopes

Computerized astronomy is here to stay, and we've got the lowdown on drives that use microprocessors to guide you through the sky. /// BY MIKE MARCOTTE

process begins. The operator still needs to center alignment stars in the eyepiece to ensure proper setup, but that too may change someday.

Another wonderful advantage to computerized telescopes is that planetarium software and a personal computer can be used to operate most of them. Some even can be operated remotely via the Internet. For amateur astronomers, the bottom line is that with a go-to scope, they can spend more time observing objects and less time trying to locate them. The bottom line for telescope makers is that go-to scopes generate more sales to beginners and others who want to be sure they have their desired objects in the field of view.

The objective of this article is not to review different go-to telescopes, but rather to look at what's available. The proliferation of these scopes is staggering, and the sheer numbers make it impossible to include all the go-to telescopes and manufacturers here. With that said, let's start with the two giants of the telescope industry: Meade and Celestron. These two companies account for the majority of telescope sales worldwide. Celestron and Meade each offer a variety of telescope types and sizes, with the majority having go-to capabilities. At this time, these two companies are also the only ones offering built-in GPS receivers.

Meade

Meade Instrument Corporation's huge selection of go-to telescopes uses four main types of computerized mounts and hand controllers. These consist of the #494 Autostar Computer Controller, the #497 Autostar Computer Controller, the Autostar II control system for the LX200GPS-SMT, and the #1697 Computer Drive System.

The #494 Autostar Computer Controller works with the DS series of telescopes and the ETX-70AT. It has a database of 1,500 objects, capacity for 200 user-defined objects, and 9-speed dual-axis operation. Meade's StarNavigator sky software allows you to hook up your PC with an optional #506 Connector Cable Set and go to any object on the PC display with a mouse click.

The DS series consists of three telescopes — all on single tine, alt-azimuth mounts: the DS-2070AT, a 2.8-inch (70mm) f/10 refractor; the DS-2114ATS, a 4.5-inch (114mm) f/8.8 Newtonian reflector; and the DS-2130ATS, a 5-inch (127mm) f/7.9 Newtonian reflector. The other telescope that uses the #494 Autostar is the ETX-70AT, a 2.8-inch (70mm) f/5 refractor. This telescope is on a sturdy ABS fork mount that allows for either tripod or tabletop use.

The #1697 Computer Drive System runs Meade's 4-inch (102 ED), 5-inch (127 ED), 6-inch (152 ED), and 7-inch (178 ED) apochromatic refractors mounted on the LXD 650 and LXD 750 equatorial mounts. This system is used with the dual-axis DC-servo-motor-controlled drive, which is available for the LXD 650 and LXD 750 mounts. The keypad controller resembles the Autostar but has a 64,359-object library, 9 high-torque dual-axis drive speeds for photo-guiding corrections, and fast-slewing of the telescope across the sky at any speed from 3° per second to 8° per second, adjustable in 1° per second increments. The control panel includes an RS-232 interface for personal computers, an optional electric focuser, and a north/south switch for telescope operation anywhere in the world.

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The #497 Autostar Computer Controller is used with the ETX-90AT, ETX-105AT, ETX-125AT, LX90, and the equatorially mounted LXD55 series. This Autostar has a database of more than 30,000 objects and capacity for 200 user-defined objects. In addition, it can go to any object for which you have coordinates. You also can use a computer running planetarium software to operate the telescope's go-to system.

The ETX-AT models of this group employ the Maksutov-Cassegrain optical design. The ETX-90AT has a 3.5-inch (90mm) aperture at f/13.8. The ETX-105AT has a 4.13-inch (105mm) aperture at f/14. The ETX-125AT has a 5-inch (127mm) aperture and operates at f/15. All these models come with the #884 Deluxe Field Tripod and can be used in either alt-azimuth or equatorial mode. They also can be used without a tripod on any level surface, such as a tabletop.

The Meade LXD55 series consists of six models that use the Autostar control system: three Schmidt-Newtonians, two achromatic refractors, and one Schmidt-Cassegrain, all mounted on the LXD55 German equatorial mount. All LXD55-series telescopes use a quick-release cradle-ring assembly, so the optical tubes can be removed easily from the mounts for transport.

The three Schmidt-Newtonians are the SN-6, a 6-inch (152mm) f/5; the SN-8, an 8-inch (203mm) f/4; and the SN-10, a 10-inch (254mm) f/4. The two achromatic refractors are the AR-5, a 5-inch (127mm) f/9, and the AR-6, a 6-inch (152mm) f/8. The lone Schmidt-Cassegrain in this series is the SC-8, which has the same tube as the LX200 but mounted on the LXD55 mount.

The other telescope that uses the #497 Autostar Controller is the LX90. The 8-inch

Meade Autostar II Computer Controller

Celestron NexStar 60GT

Meade LX200GPS-SMT

LX200 panel detail

f/10 Schmidt-Cassegrain optical tube is identical to the tube on the LX200, but the mount is similar to the ETX-AT models. This gives the scope the larger optics of the LX200 but the better portability of the smaller ETX-AT models.

At the top end of the telescopes offered by Meade is the LX200GPS-SMT series. These telescopes are all controlled by the Autostar II, which has a database of 145,000 objects; a 200-object user-defined library; and times and dates of sunrise/sunset, moonrise/moonset, Moon phases, meteor showers, equinoxes and solstices, to name just a few of the menu functions. Also included are timers, alarm functions, a red-LED utility light, and a low-battery warning alarm. The Autostar II also features 2,000 custom tracking rates, including sidereal and lunar modes, plus 7 alignment modes and an integrated GPS receiver. This series of telescopes comes in aperture sizes of 7-inch, 8-inch, 10-inch, 12-inch, 14-inch, and 16-inch. All these scopes use the Schmidt-Cassegrain optical design, except for the 7-inch, which is a Maksutov-Cassegrain. Other features of these scopes include a primary mirror lock, heavy-duty fork mounts, and Smart Mount, which enables your telescope to correct for systematic pointing errors, regardless of the cause.

Celestron

Celestron's entry-level go-to telescope line is the NexStar GT series. This telescope line is characterized by a single-arm, motorized, alt-azimuth mount. This series, which uses a NexStar Computerized Hand Controller with a database of 4,000 objects, consists of five telescopes: the NexStar 60GT, a 2.4-inch (60mm) f/12 refractor; the NexStar 80GT, a 3.1-inch (80mm) f/5 refractor; the NexStar

114GT, a 4.5-inch (114mm) f/9 Newtonian reflector; the NexStar 130GT, a 5-inch (130mm) f/5 Newtonian reflector; and the NexStar 4GT, a 4-inch (102mm) f/13 Maksutov-Cassegrain. This last scope is somewhat different from the others because of its more complex Maksutov-Cassegrain design. The design of the base and mount makes it more stable, so this telescope can sit securely on any flat surface or be mounted on a tripod. The arm also has a built-in holder for the hand controller.

The Celestron Advanced Series comes in refractor, reflector, and Schmidt-Cassegrain models. All these scopes are mounted on Celestron's CG-5 German equatorial mount. The go-to models of this series also use the NexStar Computerized Hand Controller but feature a 40,000-object database with room for hundreds of user-defined objects. The "quick-align" feature allows observers to set up the tracking mode without having to do a two-star alignment. A full menu of features provides for various safety functions, such as cord wrap and slew limits. The available go-to models in the Advanced Series are the C5-SGT, a 5-inch (127mm) f/10 Schmidt-Cassegrain; the C6-RGT, a 6-inch (150mm) f/8 refractor; the C8-SGT, an 8-inch (203mm) f/10 Schmidt-Cassegrain; the C8-NGT, an 8-inch (200mm) f/5 Newtonian reflector; the C9¼-SGT, a 9¼-inch (235mm) f/10 Schmidt-Cassegrain; and the C10-NGT, a 10-inch (254mm) f/4.7 Newtonian reflector.

An intriguing offering by Celestron is the NexStar "i" series. This series consists of only two Schmidt-Cassegrain telescopes: the NexStar 5i, a 5-inch (127mm) f/10; and the NexStar 8i, an 8-inch (203mm) f/10. In their standard configurations, these two scopes are not go-to systems, but the "i" series is

designed to be fully upgradeable. By adding the optional NexStar Computerized Hand Controller, both of these telescopes can become full go-to instruments. If you wish to upgrade even further, you can empower either telescope with GPS capability by adding the CN-16 GPS plug-in accessory. The CN-16 GPS accessory also can be used with the go-to scopes of the Celestron Advanced Series.

Jumping to what might be considered the flagship series of Celestron, we come to the NexStar GPS series: the NexStar 8GPS, NexStar 9¼GPS, and the NexStar 11GPS, all of which contain full go-to capabilities and a GPS receiver that fully automates the date, time, and location. With this information, the telescope will find true north, correct any leveling issues, and then start the alignment process. The NexStar Computerized Hand Controller is standard on these models. These telescopes are, as the numbers indicate, 8-inch (203mm), 9¼-inch (235mm), and 11-inch (279mm) scopes. All are f/10 Schmidt-Cassegrain models. The NexStar 8GPS and 11GPS models also are compatible with Celestron's Fastar Lens Assembly. This system allows you to replace the secondary mirror, which is attached to the front corrector lens, with the optional Fastar Lens Assembly and a CCD camera. With this setup in place, your NexStar is transformed into an ultra-fast, wide-field, f/2 imaging system. To observe visually with your NexStar, just reverse this procedure.

Celestron's newest series of go-to scopes is the CGE series. This series consists of observatory-class Schmidt-Cassegrain telescopes that come in 8-inch (203mm), 9¼-inch (235mm), 11-inch (279mm) and 14-inch (356mm) apertures, which are known as the CGE 800, CGE 925, CGE 1100, and

Vixen Star Book Controller

Vixen SPHINX mount

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CGE 1400. Each of these telescopes comes mounted on the CGE go-to German equatorial mount. The Celestron CGE telescopes use the same tubes as the 8GPS, 9¼GPS, and 11GPS telescopes, while the CGE 1400 uses the C14 optical-tube assembly. All these scopes use the NexStar Computerized Hand Controller and are compatible with Celestron's CN-16 GPS accessory. The 8-inch, 11-inch, and 14-inch models are Fastar compatible.

As you can see, both Celestron and Meade have huge selections of telescopes for everyone, from the beginning amateur to the lifelong hobbyist. But although these two companies dominate the telescope market, lots of other companies offer computerized go-to mounts for telescopes.

Vixen

As of this writing, the newest go-to telescope drive comes from Vixen North America. The Vixen SX, or SPHINX, mount with the SX-HAL110 heavy-duty aluminum tripod can handle a 22-pound (13.5-kilogram) load. The SPHINX mount is a perfect complement to Vixen's 8-inch VC200L catadioptric telescope.

Go-to capability comes to the SPHINX mount with the addition of the Star Book hand controller. The Star Book liquid-crystal display screen measures 4.7 inches diagonally, and its zoom buttons allow quick target acquisition. In all, 22,725 objects are stored in its database.

Dobsonian go-to scopes

Another type of go-to system is the truss-tube Newtonian telescope. John Dobson's "Dobsonian" mount for the Newtonian telescope made them portable. Once "Dobs" became popular, the ability to locate and

/// TIPS ON ALIGNING A GO-TO TELESCOPE

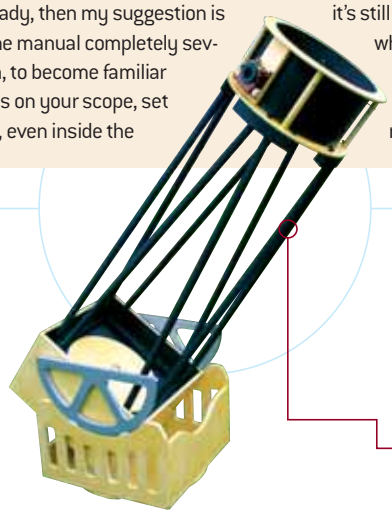
In the search for a first telescope, many "newbies" to amateur astronomy have been tempted to buy a computerized telescope, which has the allure of operational ease and speed. Unfortunately, some who have taken that step are left with less than satisfying results. The one thing beginning observers seem to overlook is that effectively using the computer on these telescopes requires some experience and practice. A basic knowledge of astronomy — including finding true north, knowing how to find key constellations and guide stars, and understanding how the apparent motion of the sky moves objects from east to west — is a must. Having a bit of knowledge in these areas can greatly simplify telescope use. Even telescopes with global positioning systems (GPS) often leave newbies flustered. My suggestion to those who would like to purchase a go-to telescope is to learn the basics of how a telescope works (in relation to the sky) by either spending some quality time with an experienced telescope owner or investing in a basic, manually operated telescope first.

If neither of these options appeals to you because your new go-to scope is sitting in your living room already, then my suggestion is that you read the manual completely several times. Then, to become familiar with the controls on your scope, set it up in daylight, even inside the house if you have room. As you read the instructions, learn and practice the procedures for each function, especially alignment. Schedule several of these practice sessions — trust me, you can't practice too much.

When you feel comfortable enough to set the telescope up for a real observing session, pick a location that has a fairly clear, level spot with as few obstructions as possible. For the drive to acquire and track celestial objects accurately, it must be level. Also, in order to align a telescope without GPS, you need to know the location's coordinates (longitude and latitude) and the exact time. Most go-to systems will give you a list of cities with coordinates to choose from, but if you observe outside a city, you'll need the coordinates of your location to maximize the accuracy of the drive. Always get to the observing site with plenty of daylight left to set up your scope properly. I like to be on location at least an hour before sunset. Remember that once it gets dark, everything is going to be ten times harder — fifty times harder if you haven't practiced.

Once you've set up the scope, make sure to align the finder scope with the main scope while it's still light out. Why align the finder scope when you have a computerized go-to system? If the telescope's drive doesn't center the object (for whatever reason), often it's just outside the eyepiece's field of view. A quick look through the finder scope will help you locate the object for re-centering. Finder scopes usually are small-aperture instruments, so I try to select bright objects as the first targets of my viewing session. To align your finder scope, choose a stationary object on Earth as far away as possible.

When the stars appear, proceed with the telescope drive's two-star alignment process. While you're learning (say, the first five or ten times), use your lowest magnification eyepiece to ensure you get the alignment stars in the field of view. Increase the magnification as you get more experience. Because most telescopes do not track while you're aligning, quickly center the star, and then move to the next step. It's been my experience that allowing the scope to remain on the last alignment star for a minute before using the go-to function seems to help the scope stay in alignment better. If, after aligning the telescope, it's still having problems locating objects, double-check that you entered the right date, time, and location, and then repeat the alignment procedure. It's embarrassing to realize the telescope is not aligning properly because you forgot to turn off the daylight saving time option or didn't set the date correctly in the first place. Remember, go slow, then go-to.



Obsession 18-inch Dobsonian reflector

SkyGear 16-inch Dobsonian reflector

track objects across the sky via go-to drives was not far behind.

Several companies currently produce a truss-tube Newtonian telescope with go-to capabilities. One of the first companies to expand the "truss Dob" telescopes into the go-to realm was Starmaster Telescopes. Starting with the Sky Commander Digital Setting Circles system, Starmaster developed its SkyTracker Go-To-Then-Track drive system. Starmaster will install this option on all its truss-design Dobsonian telescopes, which have apertures of 11 inches, 14.5 inches, 18 inches, 20 inches, 24 inches, and 28 inches.

Obsession Telescopes, the largest seller of truss Dob scopes, offers a go-to system on its 12.5-inch, 15-inch, 18-inch, 20-inch, and two of its 25-inch telescope models. Obsession uses the Argo Navis Digital Setting Circles (DSC) system combined with the Servocat Go-to Tracking Drive. This system includes a 29,000-object database, spiral search, and slip return that allows the observer to come back to an object when the telescope has been accidentally bumped or moved.

SkyGear Telescopes is another truss Dob telescope maker that uses the Servocat Go-to Tracking Drive. SkyGear gives you the option of using this drive with either the Argo Navis DSC or the Sky Commander setting circles and offers either system on their 12.5-inch, 16-inch, 20-inch, and 24-inch TravelScopes. SkyGear's cabinetry is CNC (computerized numerical control) machined to a high tolerance. This level of precision facilitates better go-to movement due to the accurate geometry of the mount.

One company offering truss Dob telescopes with the Servocat System combined with either the Argo Navis DSC or Sky Commander setting circles is NightSky

Telescopes, which offers scopes in the 12.5-inch to 22-inch range.

Only the mount, please

Another class of go-to drives involves only the mount. In other words, various types of telescope optical tubes can be mounted to complete the system. One popular go-to system is made by Astro-Physics. Their GTOCP3 Control Box and Computer Keypad provides go-to operation for the company's 400GTO, 600EGTO, 900GTO and 1200GTO mounts, each of which has high-quality, DC-servo-motor-drive electronics. These mounts can be operated either with the GTO handheld computer keypad alone or with various popular computer software packages.

Takahashi also offers several mounts that have go-to capacity: the EM-10 TPC Jr., the EM-200 TPC Jr., the EM-200 TPC, and the EM-500 TPC. All of these are high-end mounts for the serious amateur.

After-market go-to

I'd like to mention a few odds and ends before we wrap up. GoTo and Tracking Systems, a company that can be found on the Internet at *www.gototelescopes.com*, will install a go-to system on almost any telescope. Another telescope after-market company is Digital Astronomy, located on-line at *www.digitalastronomy.com*. Digital Astronomy offers many accessories for telescopes, including a plug-in GPS system for Meade go-to telescopes.

Believe it or not, the world of computer-controlled, go-to telescopes is just beginning to blossom. If the past is any indicator, the future is sure to be a fast-paced race for telescope innovations. A

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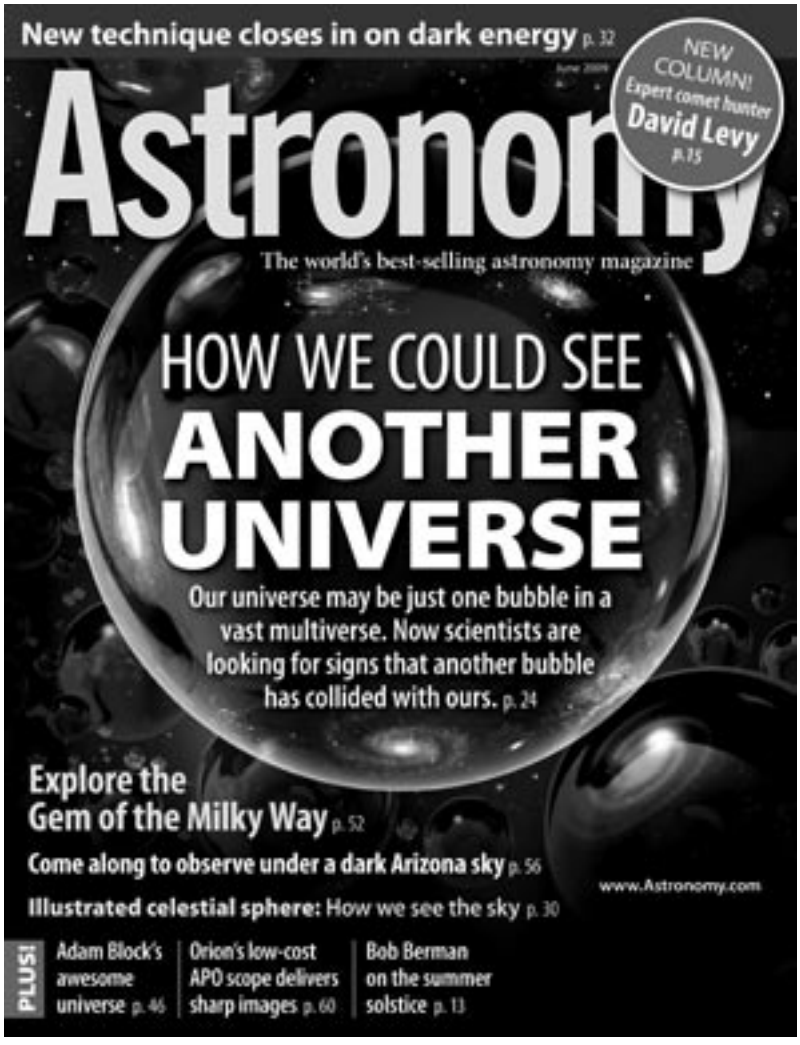

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