

Astronomy Club of Asheville

Using
Digital Setting
Circles
with Your
Telescope

March 3, 2011

Digital Setting Circles

Just What Are They?

- Digital Setting Circles (DSCs) are an accessory piece of equipment for telescope mounts that help observers **accurately locate objects** in the night sky.
- DSCs utilize **digital read-outs** (viewed on a small CPU screen) to guide the observer on where to point the telescope on its mount .
- First introduced in the 1980s.
- DSCs use the **celestial coordinate system**.

How Astronomers Find Objects in the Sky

- * Earth is mapped with a coordinate system of **latitude** and **longitude**.
- * **Asheville** is located at latitude **$35^{\circ} 36$ m North** of the equator and **$82^{\circ} 30$ m West** of the prime meridian.
- * Similarly, the sky is mapped with a coordinate system of **declination** and **right ascension**.
- * Declination is the equivalent of latitude and right ascension is the equivalent of longitude.

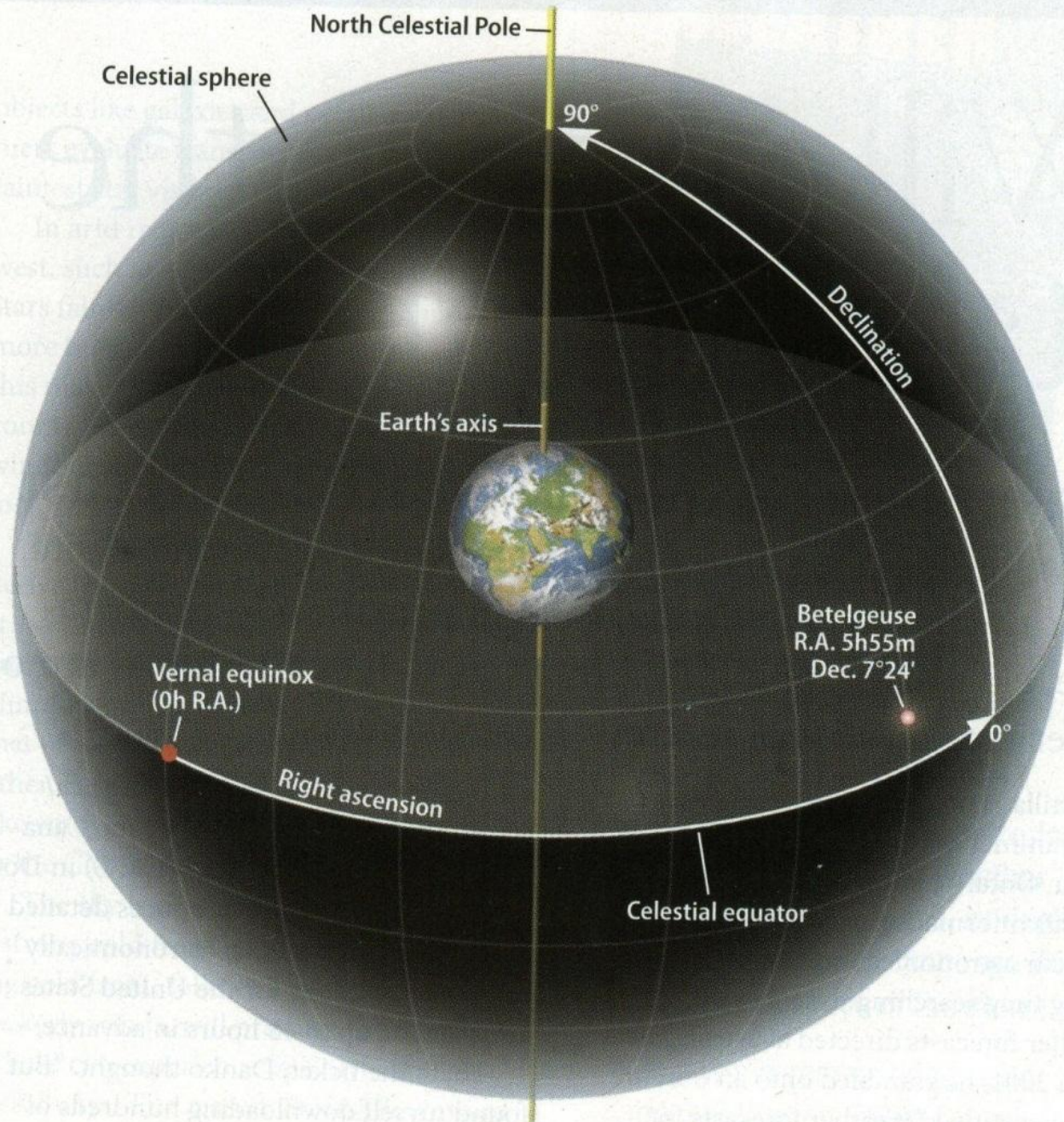
How Astronomers Find Objects in the Sky

- * **Declination (DEC)** marks an object's position in relation to the celestial equator. The **celestial equator** is an extension into the sky of earth's equator.
- * Objects on the celestial equator are designated 0 degrees. Objects lying north of the celestial equator range in designation from 0 to +90 degrees at the North Pole.
- * Objects south of the celestial equator are designated from 0 to -90 degrees at the South Pole.
- * Each degree is broken down into 60 minutes, and each minute into 60 seconds.

How Astronomers Find Objects in the Sky

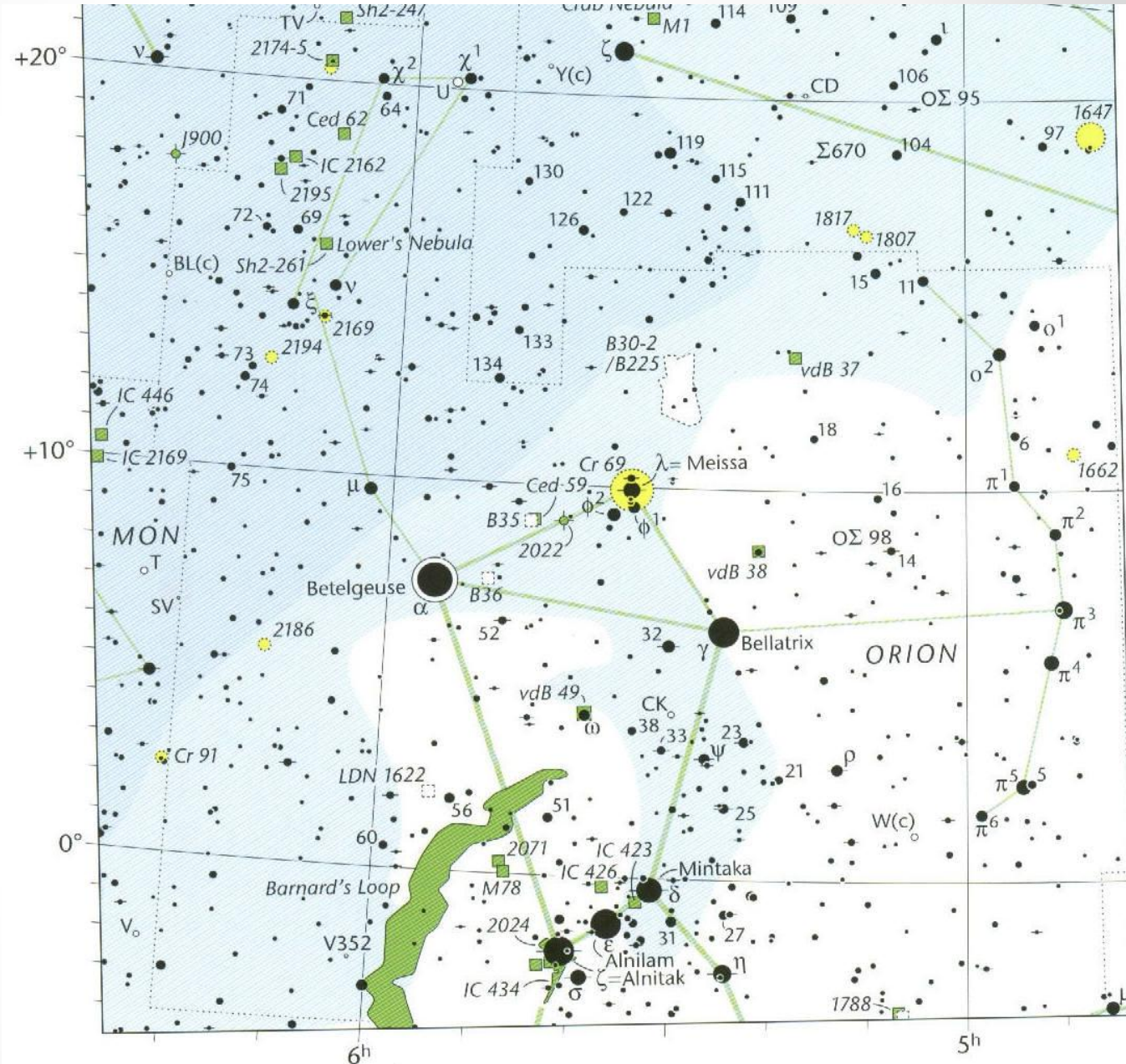
- ✦ **Right ascension (RA)** marks an object's position across the sky “west to east” (right to left) along the celestial equator.
- ✦ Right ascension is recorded in a 24-hour system of hours, minutes and seconds.
- ✦ Right ascension begins measurement with 0 hours at the vernal equinox in the constellation Pisces. Remember that the **vernal equinox** is where the ecliptic and the Sun cross the celestial equator in March.
- ✦ Right ascension proceeds for 24 hours, from west to east along the celestial equator, before returning to the vernal equinox.

Understanding celestial coordinates

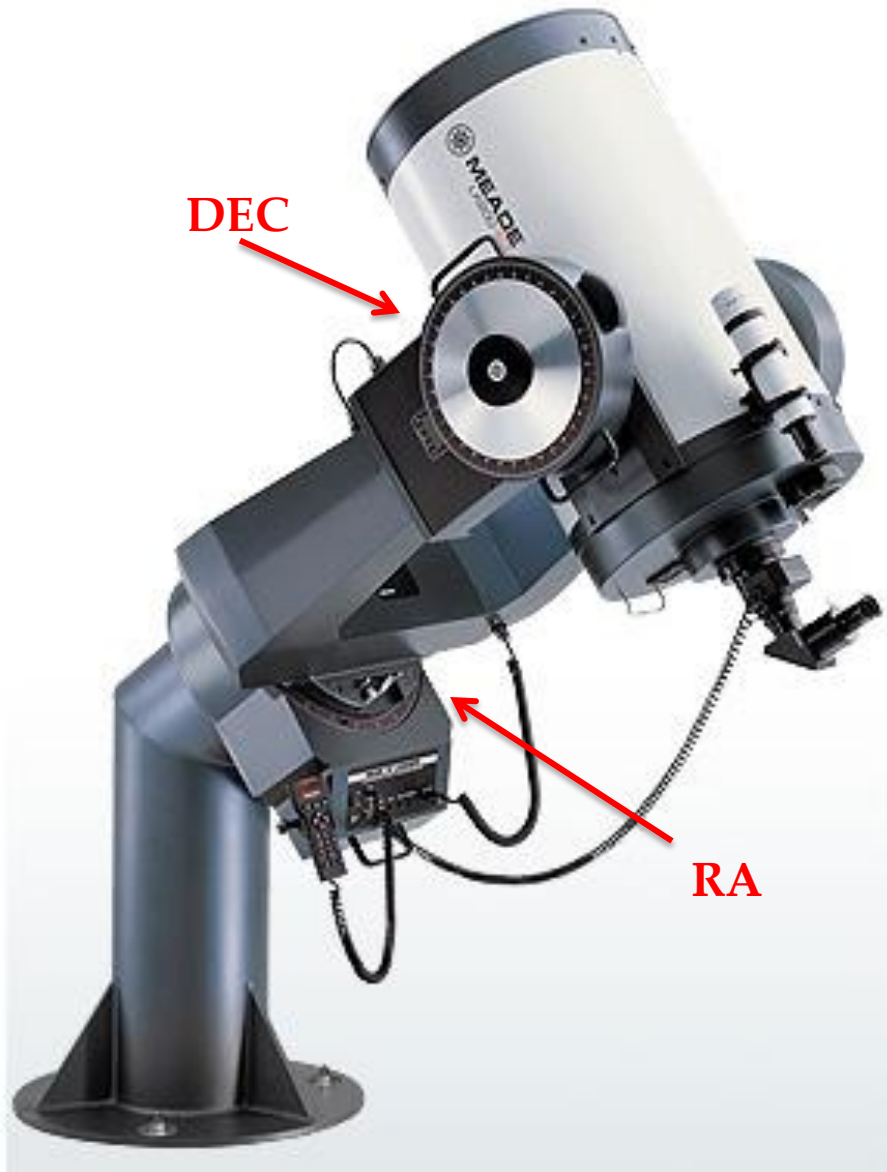


RA and DEC on a Star Chart

- Notice that the RA coordinates increase from west to east (right to left).
- Notice the DEC coordinates are positive above the celestial equator.
- All objects in the sky have a celestial address.
- Betelgeuse =
RA: 5h 55m
DEC: +7° 24m



Analog Setting Circles



DEC
Circle >



RA
Circle >



Why Use Digital Setting Circles

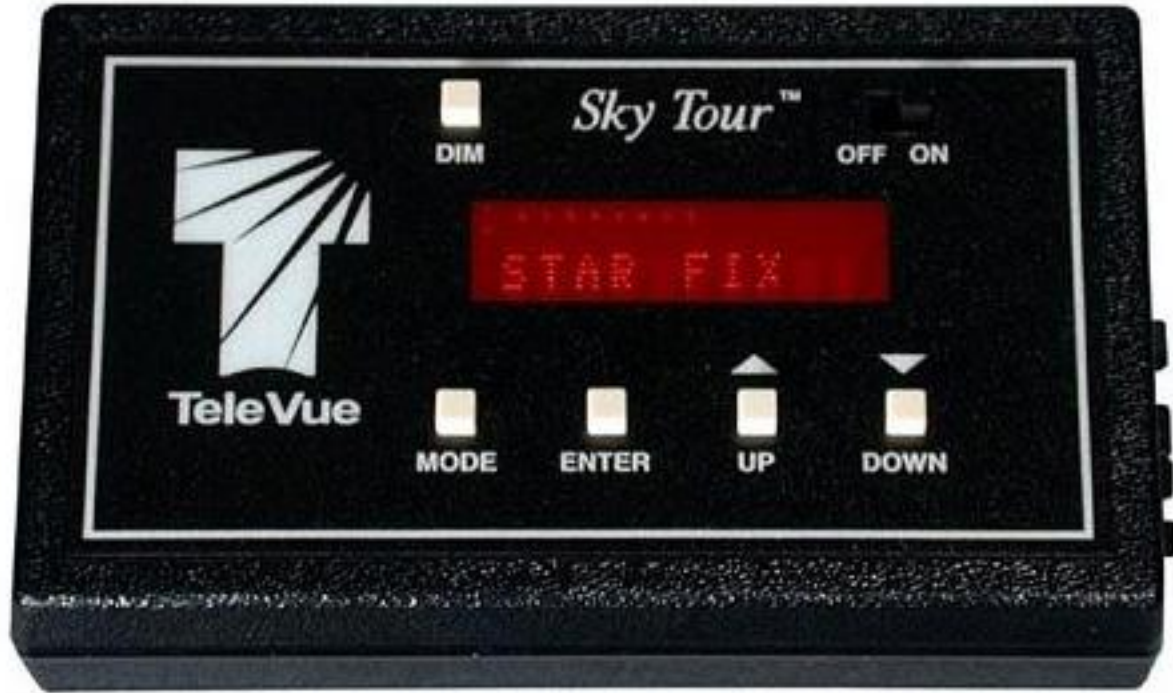
- Even the most experienced observer can benefit from DSCs.
- It speeds up your time (over “star hopping”) in locating objects, especially faint objects.
- Light pollution can make many celestial objects difficult to locate.
- If you are doing outreach, you will minimize wait time for your guests.
- DSCs are much more accurate than mechanical, analog, circular setting circles that come on many telescopes.
- DSCs are easy to use.

Differences Between DSCs and Go-To Telescopes

- Go-To telescopes, once initialized, may not be used in “manual mode” without requiring re-initialization to enter “go-to” mode.
- DSCs allow you to switch between uses with or without the DSCs, and no re-initialization is required.
- For someone who knows the night sky, this can be a very nice feature.
- Both systems have a large database in their CPUs of the many objects in the night sky, including the planets.

Components of the DSC System

1. CPU with celestial database.
Most of them use a 9V battery.
Lithium works better in cold weather and lasts longer.
2. Encoders.
3. Cables and attachment hardware.



Words of Caution about DSCs

- Make sure that your mount will take the encoders by contacting the mount manufacturer, the encoder manufacturer or both.
- Make sure the encoders will be compatible with your CPU.
- It's generally a good idea to purchase the encoders, CPU and attachment hardware from the same manufacturer.
- Not all telescope mounts will adapt to using encoders and hence can't use a DSC system.

The DSC CPU

- DSC CPUs vary in their CPU capacity and functions.
- Some have a celestial database (library) as small as a couple hundred objects, others up to 30,000.
- Databases usually include the planets, and **catalogs** of all 110 Messier objects, some or all the NGC and IC objects, many binary stars, and other indexed objects.
- In cold weather these CPUs can have performance problems.
- Consider using an eyepiece dew-**heater**, wrapped around the CPU.
- Beware of battery power running low!
- Always bring a **spare battery**.
- Many DSC CPUs have a RS232 cable interface to connect to your computer for updates and programs.

The RS232 and USB Adapter



These cables are used for updates of the DSC CPU via a computer with an internet connection.

The DSC Encoders – Motion Counters

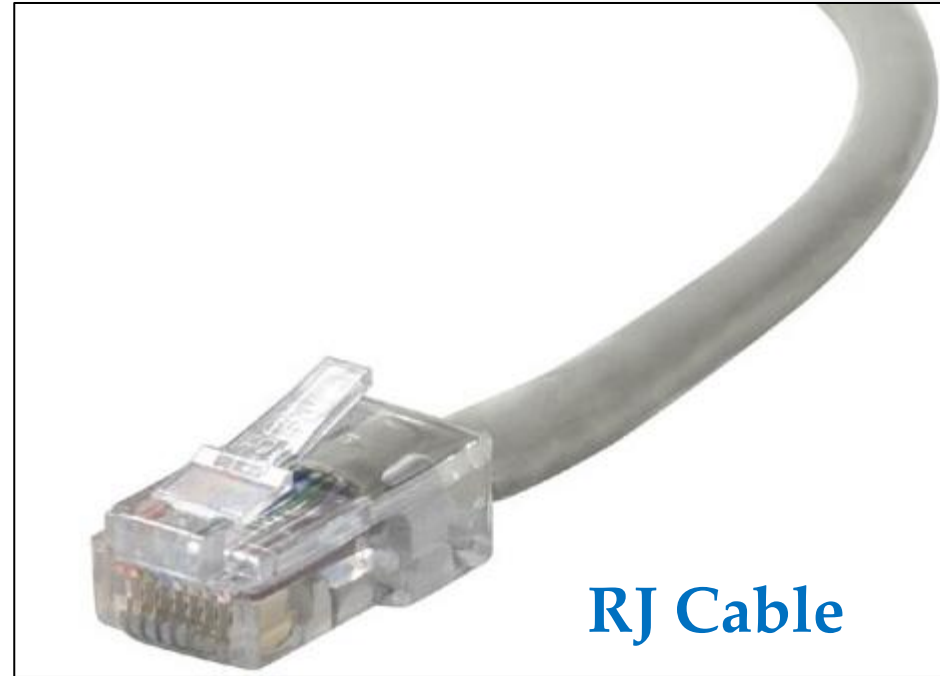
- A telescope mount has 2 axes, for example, altitude and azimuth for an alt-az mount.
- DSC systems use 2 encoders: one for each axis.
- Encoders, along with their mechanical gears, act as “step counters” that record the tics, steps or pulses of the mount’s motion along with the mount direction.
- The higher the encoder pulses per revolution the more accurate the encoders will be.
- An encoder with 4,000 pulses per revolution of the telescope axis, will yield accuracy of about 5 arc minutes --- 360 (the degrees in a circle) divided by 4,000.
- An encoder with 2,000 pulses would result in half that pointing accuracy.

The DSC Cabling and Attachment

- Encoders are usually connected to the CPU with **RJ socket cables**, resembling modular telephone outlet cabling and plugs.
- Cables and the CPU must be attached to the telescope mount securely.



Velcro



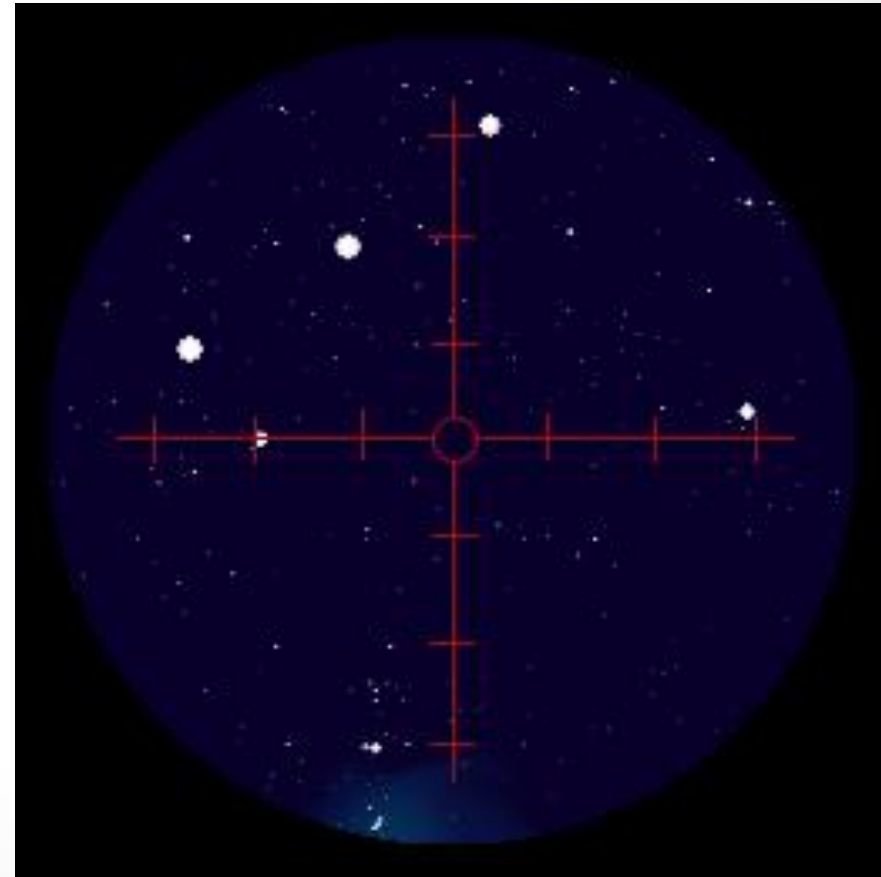
RJ Cable

Initializing the DSC System

- Your tripod/mount should be reasonably **level**.
- Besides increasing the accuracy of the DSC computer, it increases the **balance and stability** of the telescope.
- The initialization varies somewhat from one DSC manufacturer to another, but the process is very similar to that used with many “go-to” telescopes.
- For locating the **planets**, you must **enter a date** into the CPU.
- You usually have to select **2 bright alignment stars** in the night sky – do not select ones that are at the zenith or along the horizon. These 2 stars must be in the CPU alignment star database.
- For best accuracy try to pick 2 stars that are **at least 60 degrees apart in the sky**.

Initializing the DSC System

- Use of an eyepiece yielding magnification of 75x or more increases the accuracy of the alignment process.
- Use of an **illuminated reticle eyepiece** increases the accuracy even more.



Other Features of the DSC System

- “Identify” function
- “Realignment” function
- “RA/DEC” function
- “Favorites” function

Manufacturers and Prices

- **Jim's Mobile, Inc. (JMI)** offers the greatest variety of DSCs that work on many different mounts with compatible encoder kits.
- JMI complete systems run from \$475 to \$740
- **Sky Engineering's Sky Commander XP4** is a great CPU, but you need to buy the encoders separately.
- The XP4 CPU sells for \$295.
- **TeleVue's Sky Tour** package works only with TV's Gibraltar mounts.
- Sky Tour complete systems sell for about \$595
- **Orion Telescopes** sells DSC systems that come packaged with their "push-to" Dobsonian reflectors.
- Complete DSC packages for these "Dobs" run only \$200 – a bargain even for this less accurate system.

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