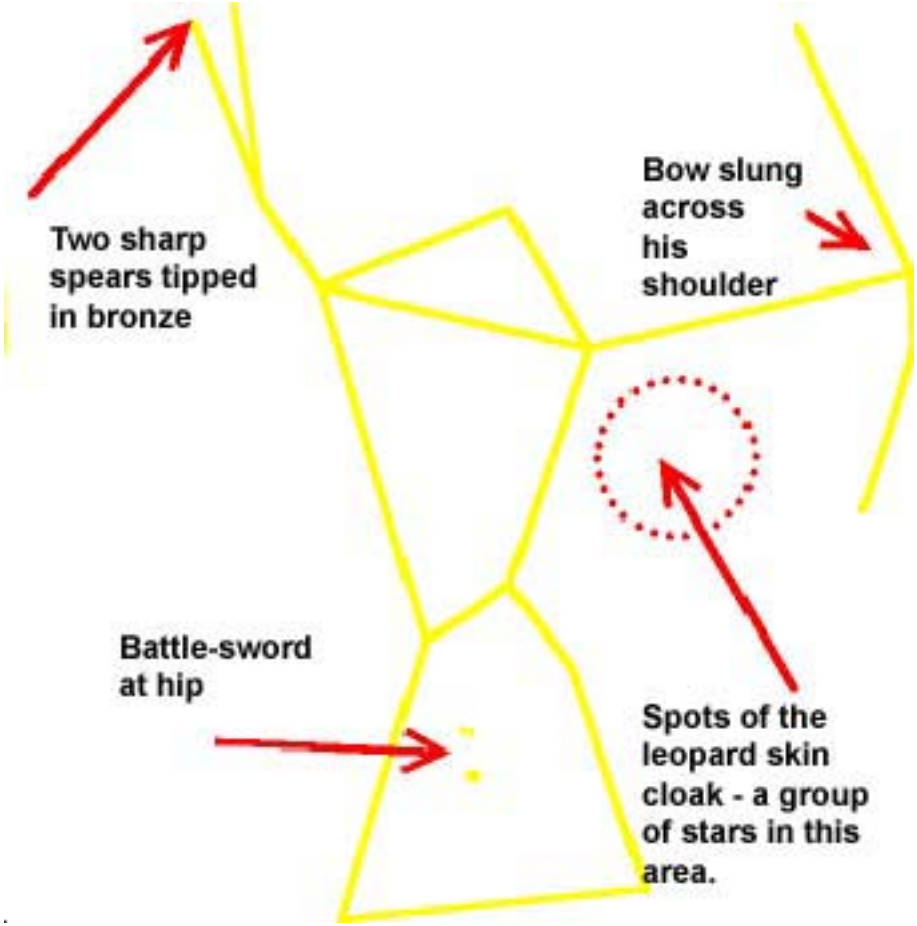
Backyard Astronomy

Navigating the Sky Reviewed …
Telescopes & Buying Guidelines.
Week 2

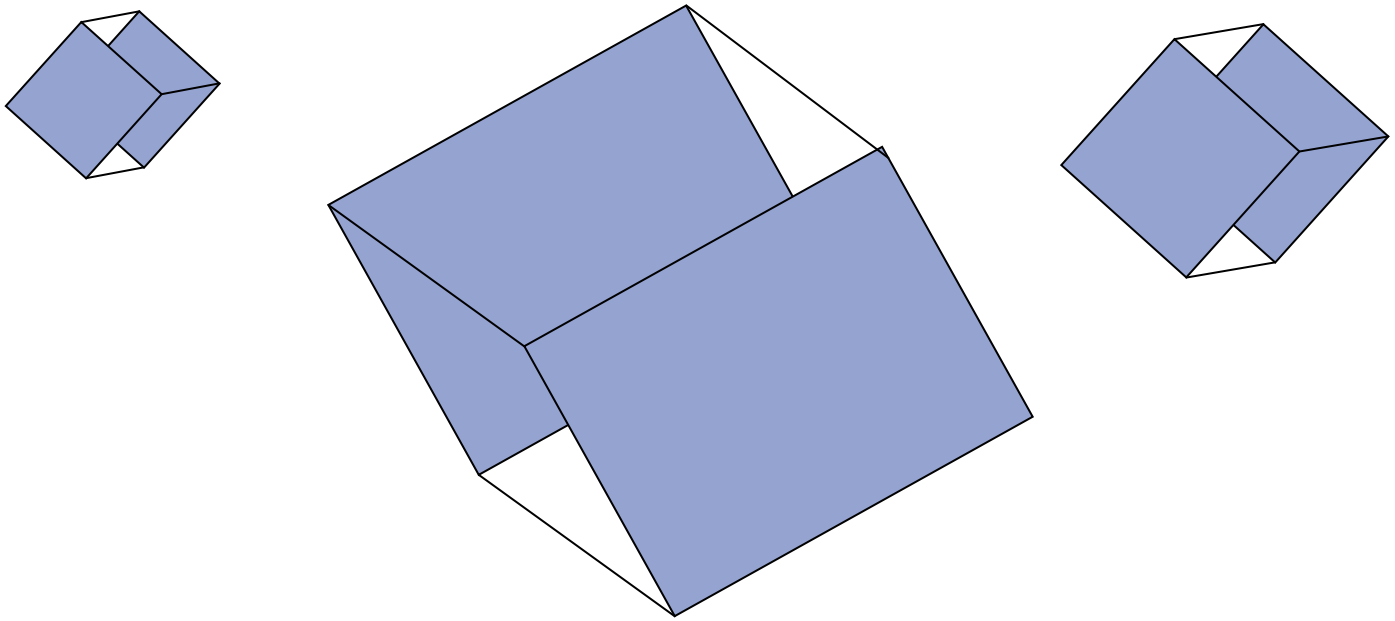
Week 2

- Review Last Week
- Quick Clarification
- 11 Steps to the Cosmos
- Messier Object tracking catalog
- Other Sky Object Catalogues
- Telescopes
  - Types
  - Options
  - Buying Considerations

Clarification on Orion Constellation



The Cosmos in 11 Steps

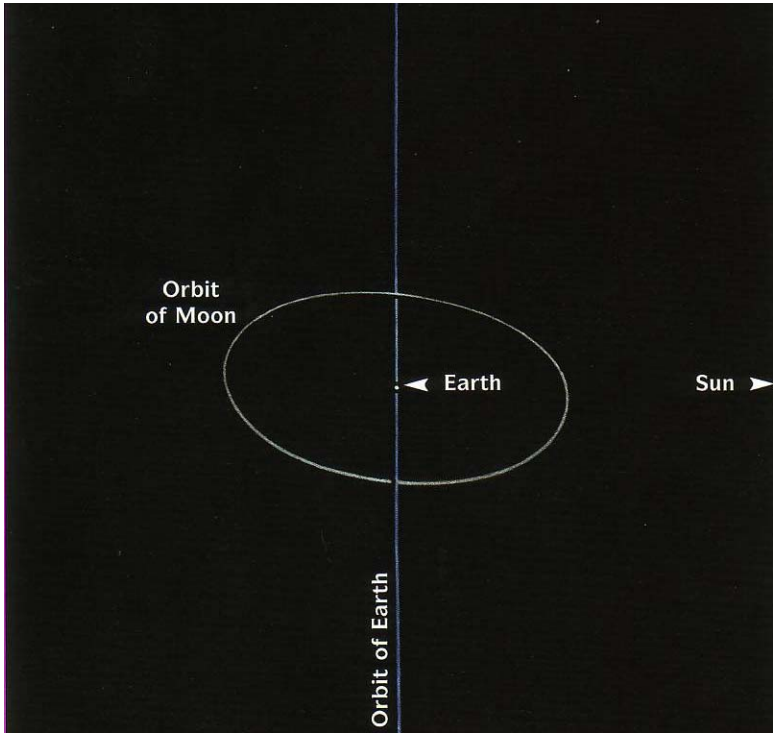


- View areas of our universe as residing in cubes… as we move out into the space, each successive cube will be 100x larger than the previous cube and containing all of the objects of the previous cube

The Cosmos in 11 Steps

Step 1: Earth is contained in a cube

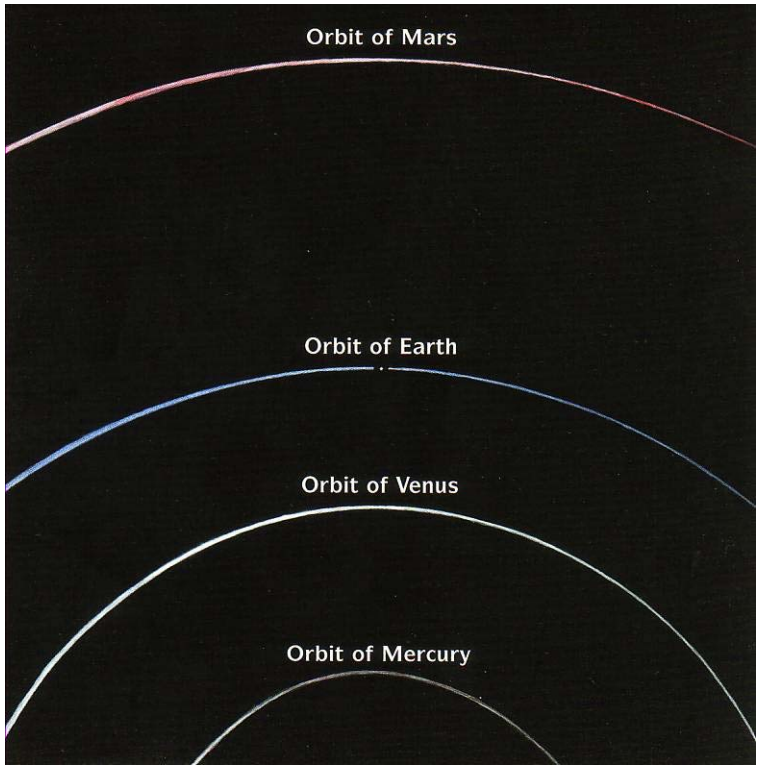
The Cosmos in 11 Steps



Step 2: 100x

Distance 2 Million Kilometers and the cube comfortable contains Earth / Moon Orbit

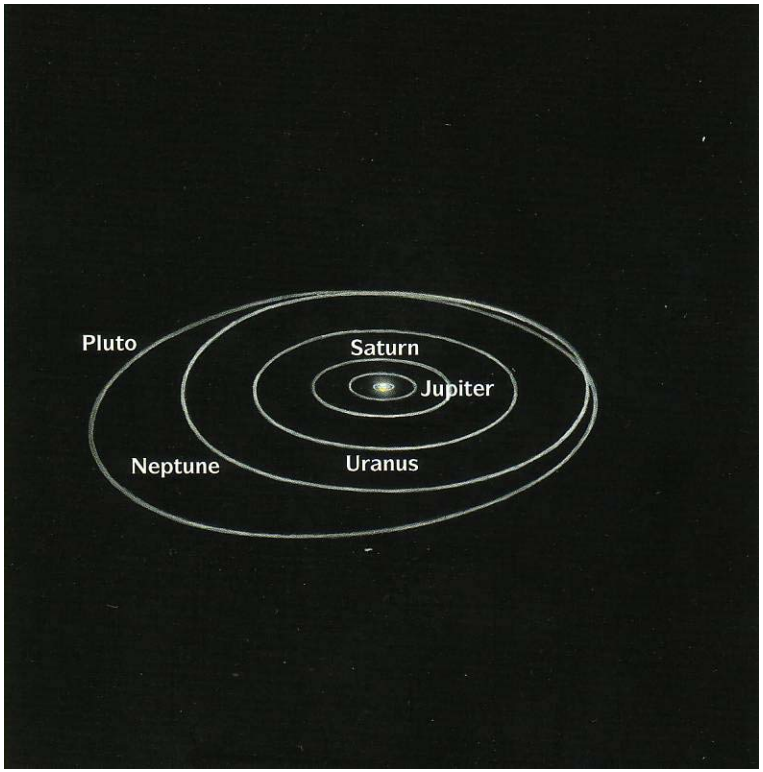
The Cosmos in 11 Steps



Step 3: 100x

Distance of cube is 200 Million Kilometers or 1.2 AU (1 AU is 150 Million Km which is the distance from earth to Sun

The Cosmos in 11 Steps



Step 4 100x

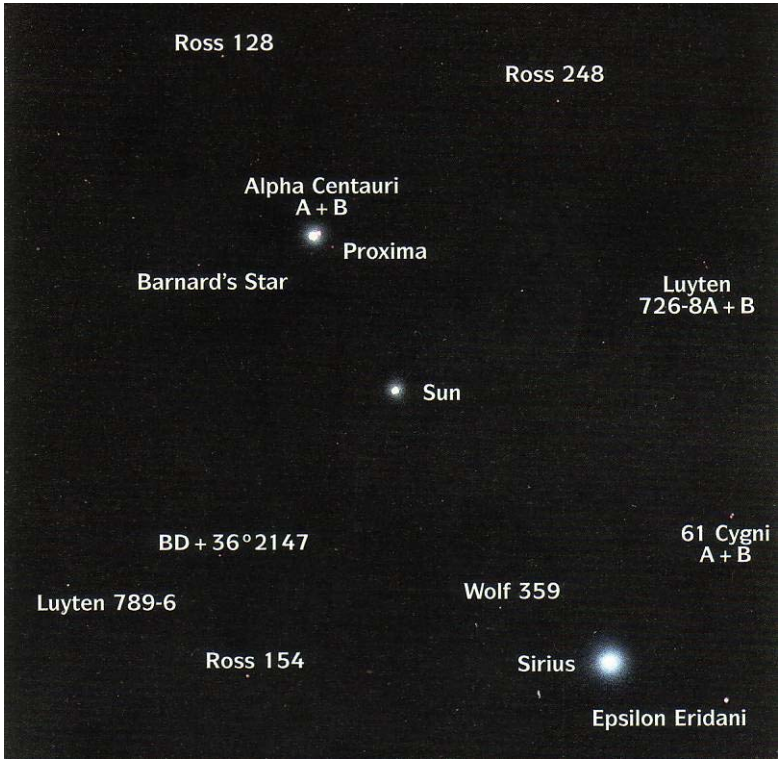
Cube encompasses the entire solar system and beyond … width of Cube is 120 Au (18 Billion Kilometers) … from the outer edge of this cube, only Jupiter & Saturn would be visible to the naked eye.

The Cosmos in 11 Steps

Step 5: 100x

12,000 Au or 1.9 Light Years … this cube is nearly all empty space… it is not a vacuum, but very close. From the edge of this cube our sun is just a very bright star. From this point out, the use of miles or kilometers for scaling is useless.

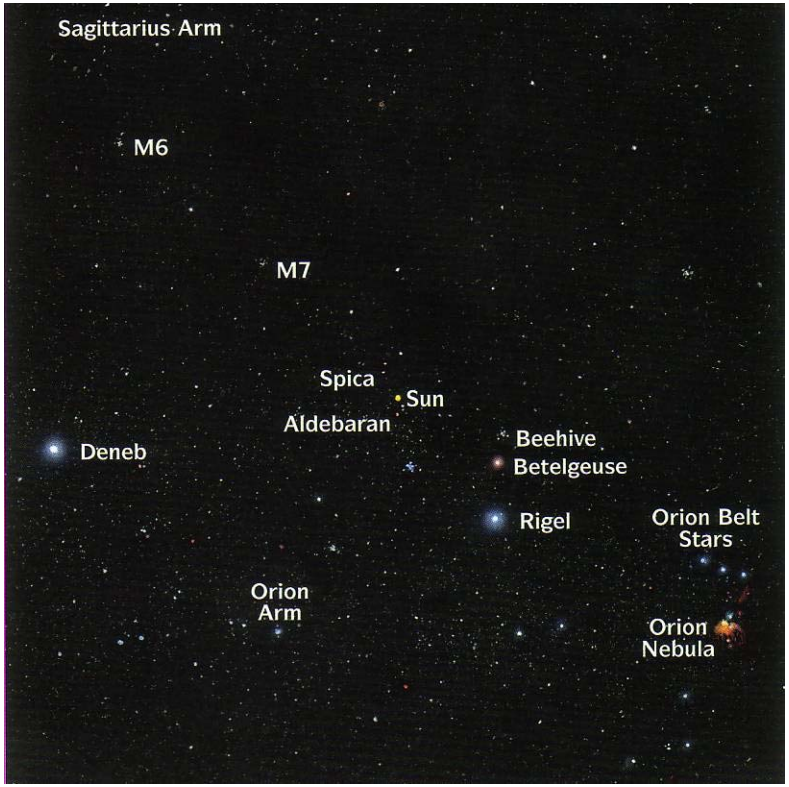
The Cosmos in 11 Steps



Step 6: 100x

1.2 Million Au wide (20 Light Years) … Our sun now takes its place as one among many … our nearest neighbor Alpha Centauri is 8000 time farther from earth than frigid Pluto … just 5% of all stars in this cube are brighter than our Sun (Sirius)

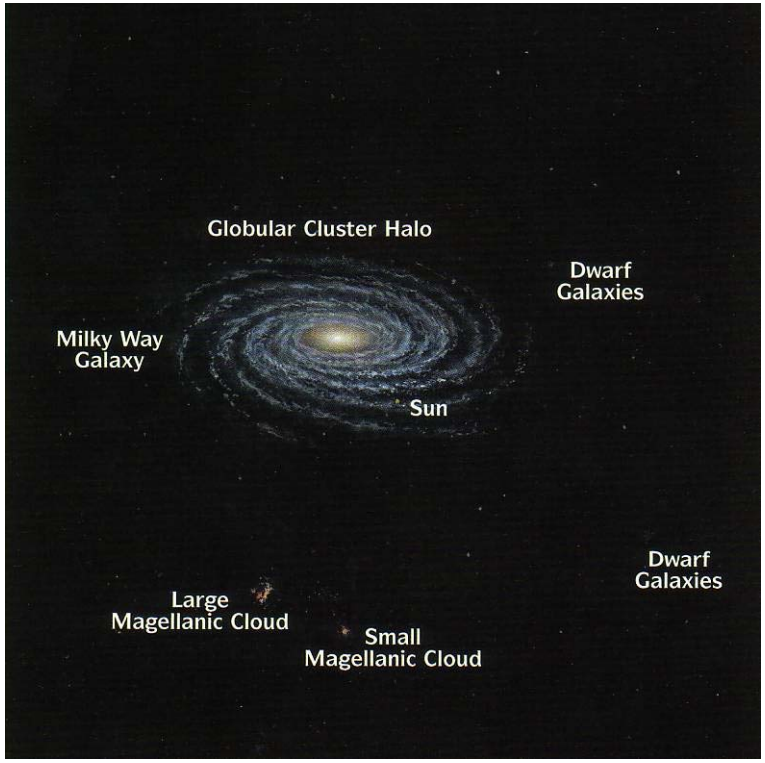
The Cosmos in 11 Steps



Step 7: 100x

The width of the this cube as grown to 2000 light years … it encloses about two million stars, several hundred times more than is visible from Earth on the clearest night. Each of theses stars are several hundred AU from each other.

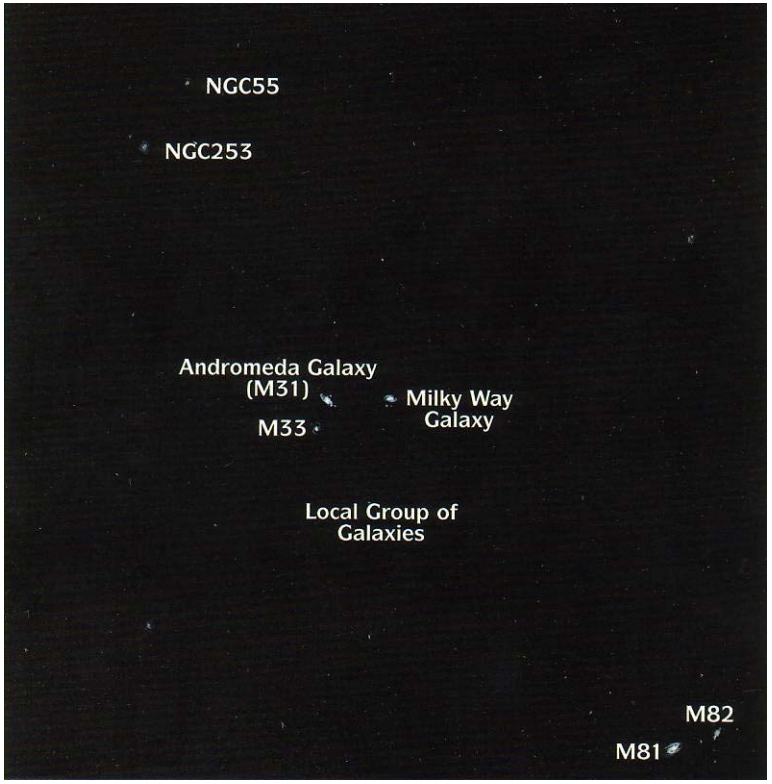
The Cosmos in 11 Steps



Step 8: 100x

The eighth cube is 200,000 light years from edge to edge… it easily spans the **Milky Way galaxy** which is 90,000 light years in diameter and 3000 light years thick.

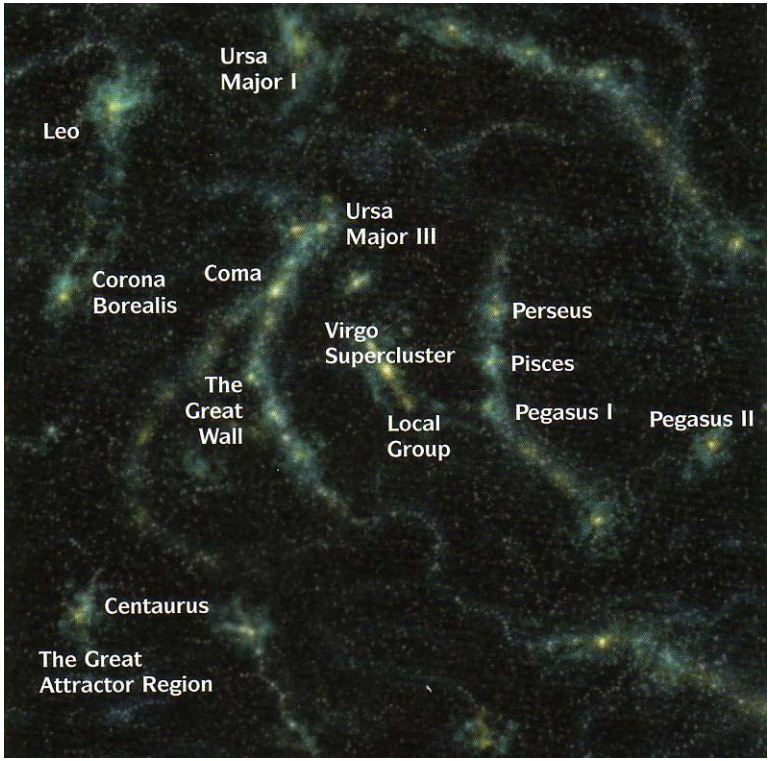
The Cosmos in 11 Steps



Step 9: 100x

The night increment in our track to edge of the universe is a cube 20 million light years on each side … our Milky Way is just one in several dozen speckling in enormous space. This group of galaxies are bound by each others gravity and are referred to as the **local group**. We are near total vacuum … 1 single atom per 1 cubic meter of space.

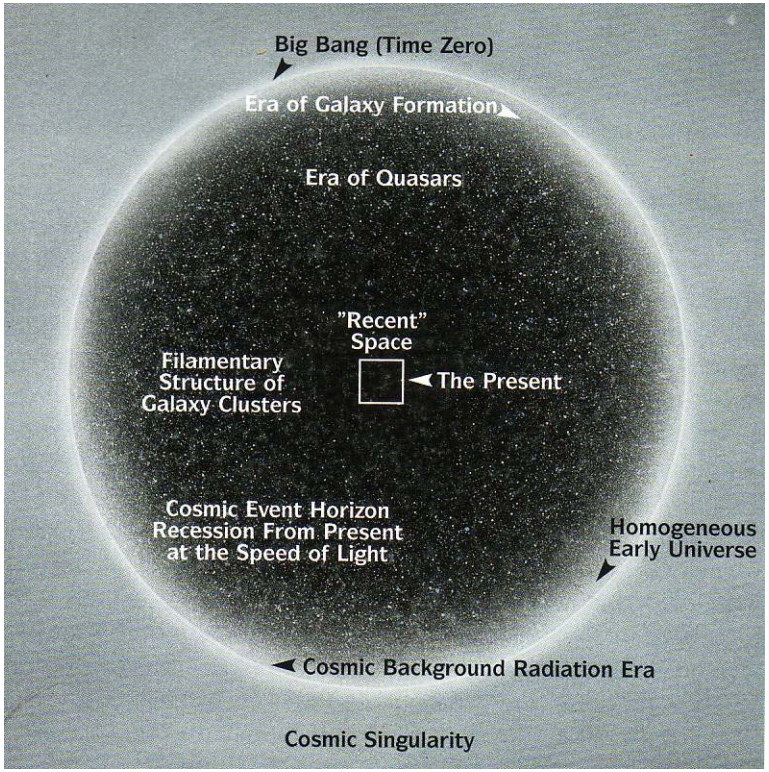
The Cosmos in 11 Steps



Step 10: 100x

Our Milky Way and its local group belong to what is a super cluster, 10s of thousands of galaxies. The super cluster we belong to is called the **Virgo super cluster**.

The Cosmos in 11 Steps



Step 11: 100x

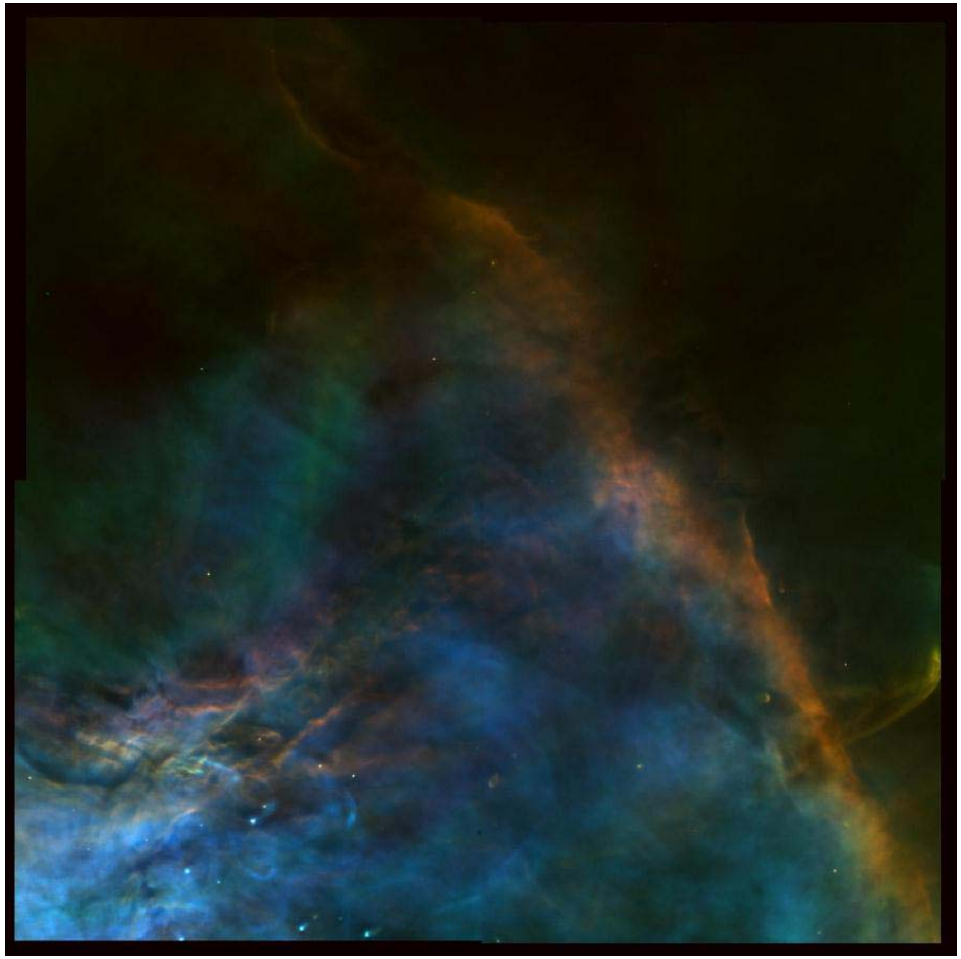
The universe is thought to be 15 billion years old … when our instruments probe the edge of the universe they find only a microwave haze thought to be remnants from the big bang explosion … when we reach out to this part of space we have literally gone back in time to the beginning of our universe.

Star Clusters

Messier Object: M80

Messier Object: M13

Nebula



Hubble Image

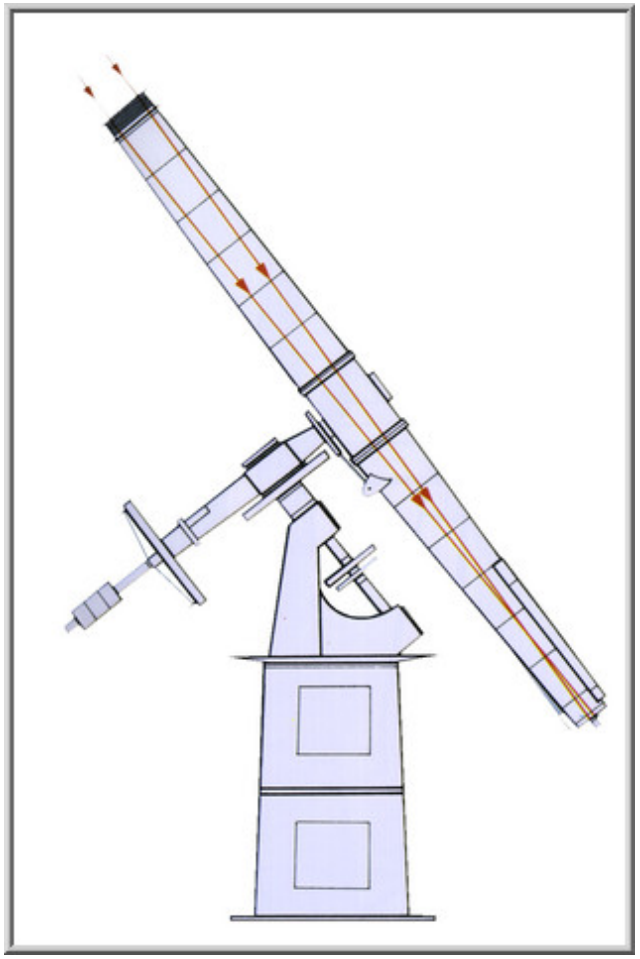
Messier Object: M42

Galaxy

Types of Telescopes

- Refractor
- Reflector
- Catadioptric Telescope

Refractor Telescope



Refractor Telescope

Refractor Telescope

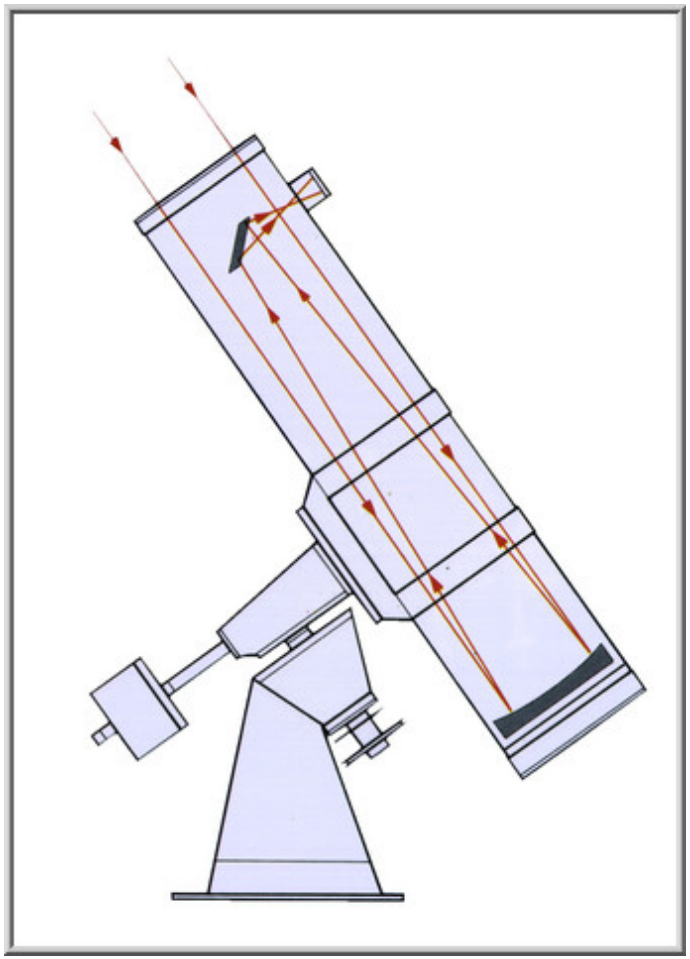
Refractor Telescope

- **Advantages**
  - Easy to use and reliable due to the simplicity of design.
  - Little or no maintenance.
  - Excellent for lunar, planetary and binary star observing especially in larger apertures.
  - Good for distant terrestrial viewing.
  - High contrast images with no secondary mirror or diagonal obstruction.
  - Color correction is good in achromatic designs and excellent in apochromatic, fluorite, and ED designs.
  - Sealed optical tube reduces image degrading air currents and protects optics.
  - Objective lens is permanently mounted and aligned.

Refractor Telescope

- **Disadvantages**
  - More expensive per inch of aperture than Newtonians or Catadioptrics.
  - Heavier, longer and bulkier than equivalent aperture Newtonians and catadioptrics.
  - The cost and bulk factors limit the practical useful maximum size objective to small apertures
  - Less suited for viewing small and faint deep sky objects such as distant galaxies and nebulae because of practical aperture limitations.
  - Focal ratios are usually long (f/11 or slower) making photography of deep sky objects more difficult.
  - Some color aberration in achromatic designs (doublet).
  - Poor reputation due to low quality imported toy telescopes; a reputation unjustified when dealing with a quality refractor from a reputable manufacturer.

Reflector Telescopes



Advantages

- Lowest cost per inch of aperture compared to refractors and Catadioptrics since mirrors can be produced at less cost than lenses in medium to large apertures.
- Reasonably compact and portable up to focal lengths of 1000mm.
- Excellent for faint deep sky objects such as remote galaxies, nebulae and star clusters due to the generally fast focal ratios (f/4 to f/8).

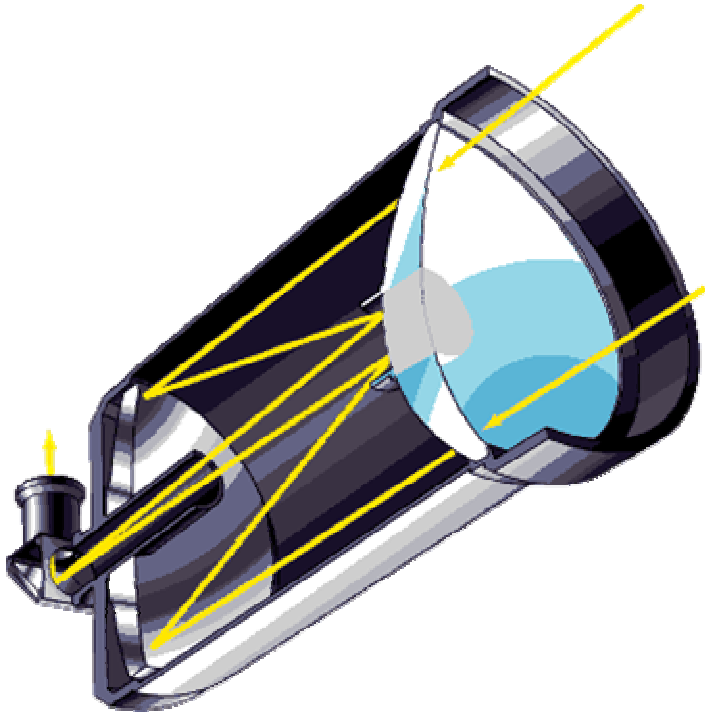
Advantages

- Reasonably good for lunar and planetary work.
- Good for deep sky astrophotography (but not as convenient and more difficult to use than Catadioptrics).
- Low in optical aberrations and deliver very bright images.

Disadvantages

- Generally not suited for terrestrial applications.
- Slight light loss due to secondary (diagonal) obstruction when compared with refractors.

Catadioptric Telescope



1. Light Collecting Lens
2. Primary Mirror
3. Secondary Correction Lens / Mirror

Catadioptric Telescope

Catadioptric Telescope

Advantages

- Best all-around, all-purpose telescope design. Combines the optical advantages of both lenses and mirrors while canceling their disadvantages.
- Excellent optics with razor sharp images over a wide field.
- Excellent for deep sky observing or astrophotography with fast films or CCD's.
- Very good for lunar, planetary and binary star observing or photography.

Catadioptric Telescope

Advantages (continued)

- Closed tube design reduces image degrading air currents.
- Most are extremely compact and portable.
- Easy to use.
- Durable and virtually maintenance free.
- Large apertures at reasonable prices and less expensive than equivalent aperture refractors.
- Most versatile type of telescope.
- More accessories available than with other types of telescopes.
- Best near focus capability of any type telescope.

Catadioptric Telescope

Disadvantages

- More expensive than Newtonians of equal aperture.
- It is not what people expect a telescope to look like.
- Slight light loss due to secondary mirror obstruction compared to refractors

Power & Magnification Myth

- **One of the least important factors in purchasing a telescope is the power**
  - Power, or magnification, of a telescope is actually a relationship between two independent optical systems – (1) the telescope itself, and (2) the eyepiece (ocular) you are using

Power & Magnification Myth

- **To determine power, divide the focal length of the telescope (in mm) by the focal length of the eyepiece (in mm). By exchanging an eyepiece of one focal length for another, you can increase or decrease the power of the telescope.**
  - For example, a 30mm eyepiece used on the C8 (2032mm) telescope would yield a power of 68x (2032/30 = 68) and a 10mm eyepiece used on the same instrument would yield a power of 203x (2032/10 = 203).
  - Since eyepieces are interchangeable, a telescope can be used at a variety of powers for different applications.

Power & Magnification Myth

- **There are practical upper and lower limits of power for telescopes. These are determined by the laws of optics and the nature of the human eye. As a rule of thumb, the maximum usable power is equal to 60 times the aperture of the telescope (in inches) under ideal conditions.**
  - Powers higher than this usually give you a dim, lower contrast image. For example, the maximum power on a 60mm telescope (2.4" aperture) is 142x. As power increases from this point, the sharpness and detail seen will be diminished. The higher powers are mainly used for lunar, planetary, and binary star observations.

Power & Magnification Myth

- **Do not believe manufacturers who advertise a 375 or 750 power telescope which is only 60mm in aperture (maximum power is 142x), as this is false and misleading.**

Power & Magnification Myth

- **Most of your observing will be done with lower powers (6 to 25 times the aperture of the telescope [in inches]). With these lower powers, the images will be much brighter and crisper, providing more enjoyment and satisfaction with the wider fields of view.**

Power & Magnification Myth

- **There is also a lower limit of power which is between 3 to 4 times the aperture of the telescope at night.**

So if Power of the scope isn't the most important, then what is?

- Since the distance of a celestial object generally corresponds to its brightness, the telescope with the largest aperture (size of the main mirror or lens) will not only allow you to see the faintest objects but also the most distant objects.
  - For example, through a 60mm refracting telescope you can see the bright center of the Andromeda galaxy which is more than 2 million light years away.
  - With an 8" (200mm) telescope or larger, you can see the spiral arms of the much fainter Whirlpool galaxy, which is 35 million light years away!

Buying Considerations more important than Power

- Quality of Optics
  - Telescope Optics
  - *Eye Piece Optics
- Quality of Stand / Tripod
  - Eliminating as much vibration as possible will improve your experience
- Aperture (how much light can scope collect)
- Viewing Conditions

Shopping for a Scope

- Use the Internet as much as possible
- Manufacturer Websites are useful
  - www.Meade.com
  - www.Celestron.com
  - Orion – www.telescope.com
- Search out Web Reviews
  - www.Amazon.com
  - www.Google.com
- Used Scopes can be great buys
  - www.Ebay.com
  - www.astromart.com