Telescope Types

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Introduction

In the short time that I have been interested in Astronomy, one of the most frequently found articles on the Internet is a description of the different types of telescope. What I have found harder to locate is an article that attempts to explain the differences, what these differences mean and then goes on to explain which telescope is best.

This article, together with it's partner article “Telescope Basics” is an attempt at filling this void. Starting with the basics, then progressing to the various types of common telescope types and explaining how they differ by referring back to the basics, I hope to enlighten the absolute novice and to assist you in choosing your ideal telescope.

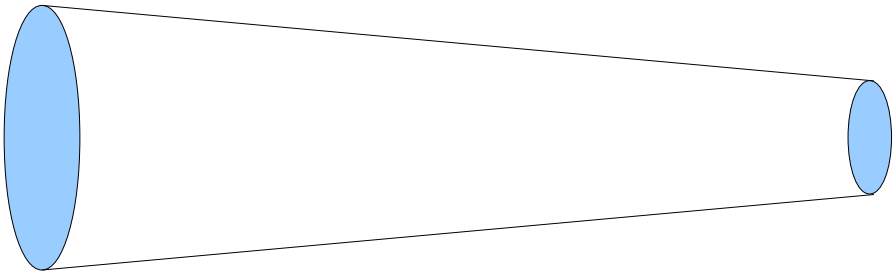
Telescope Types

There are a number of different telescope types, each have their own strengths and weaknesses. There are also telescopes which are a combination of the various types. The sections below take each of the main telescope types, explain what they are and then explains their strengths and weaknesses for visual and imaging uses.

Refractor

A refractor telescope is the typical telescope that may people think of when they think of a telescope. The thought of Galileo holding his telescope, observing the moon and the planets conjures up the same image in every one of us.

How it works



There is a large lens at the front of the telescope and a smaller lens at the rear of the telescope (eyepiece). The focal length of this type of telescope is the distance between the front lens and the rear lens. Focusing the telescope is achieved by moving the eyepiece forwards and backwards.

Refractors have the smallest Apertures and focal lengths of the telescope types. From the article on Telescope Basics, you will now know that this results in low focal lengths and low magnifications.

There are two variations of refractor, the standard refractor and the Apochromatic refractor. The difference between these two types is how it focuses the light on the eyepiece or CCD sensor.

The standard refractor does not focus each of the RED, GREEN and BLUE light to the same point, this is because the main lens (objective lens) bends each light wavelength slightly different amounts, hence the different colours do not all focus at the same point.

The Apochromatic refractor (referred to as APO for short) focuses each of the colours RED, GREEN and BLUE to the same point.

Advantages

- Small and portable.
- Large field of view
- low focal ratios

Disadvantages

- Expensive – particularly the Apochromatic variety.
- Short focal length hence low magnification.
- Small aperture – typically upto 120mm maximum

Best Uses

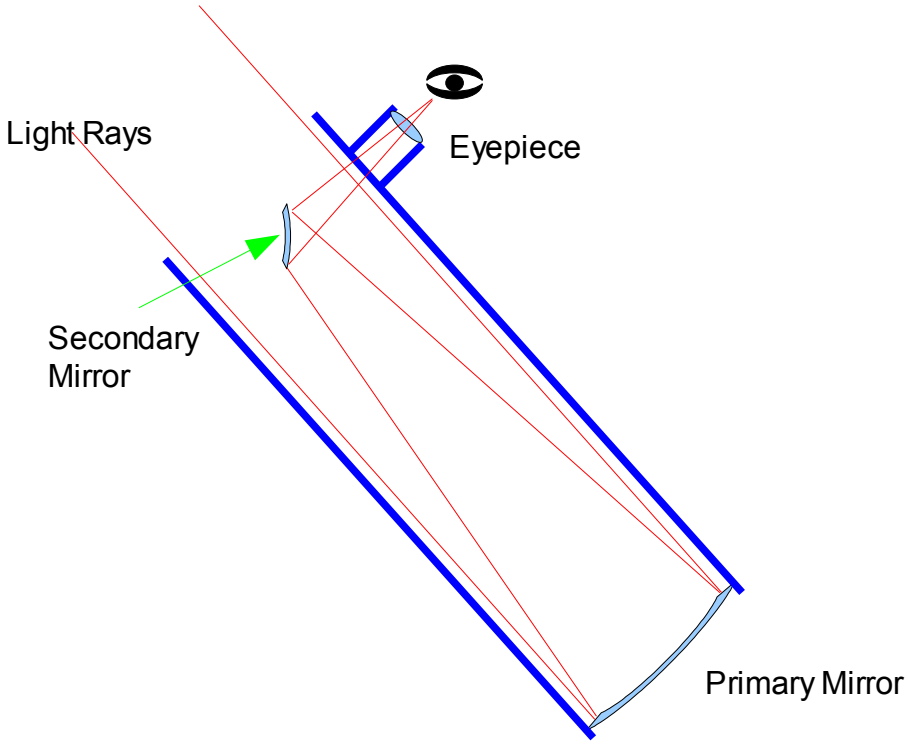
The refractor appears to be the telescope of choice for the imager, particularly the Apochromatic variety. The APO is a must for imaging. This gives a wide field of view to allow imaging of deep sky objects.

Refractors are also used for telescope guiding to ensure the telescope mount is tracking the stars accurately. For this task, you do not necessarily need the APO variety, a cheaper standard refractor would be acceptable.

Dobsonian

A dobsonian telescope is otherwise known as a light bucket. These are known for being large aperture telescopes. They are attached to simple floor standing mounts. (See a future article on telescope mounts)

How it works



The dobsonian design of telescope does not use a lens in the telescope. Instead, it uses large primary mirror that reflects the light entering the front of the telescope and directs it onto a smaller secondary mirror back at the front of the telescope.

This secondary mirror again reflects the light out to the side of the telescope where the eyepiece is located or the CCD camera. The focusing of the light is done by moving the eyepiece in or out to focus the light.

Advantages

- Low cost compared to aperture
- Large Apertures
- Low focal ratios

Disadvantages

- Not good for astrophotography since they are only Alt Az mounted.
- Large and clumbersome to move about and store.

Best Uses

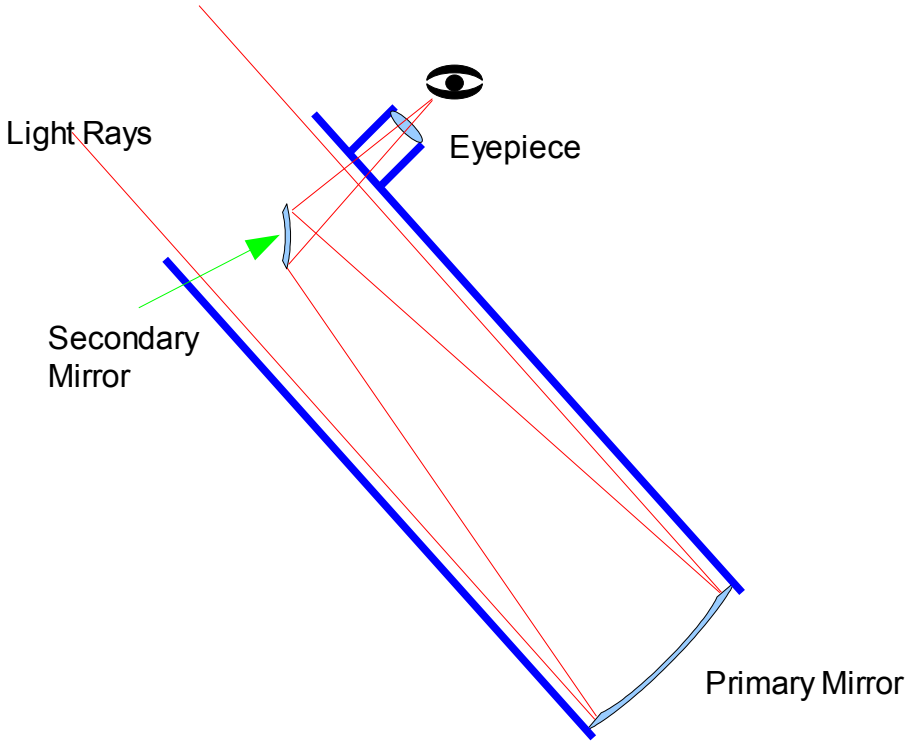
The dobsonian appears to be one of the best instrument for purely visual deep sky observing. This is mainly due to the large size of the apertures that are available which enables these instruments to collect plenty of light. It is said that the views through these instruments are quite something.

However the size of these telescopes does limit them to those who have the physical space to store them. Manufacturers have made this easier recently with the introduction of the flex-tube type of telescope. This type is a collapsible telescope, thus storage is slightly easier.

Newtonian

A Newtonian telescope is term generally given to a smaller version of the dobsonian. These are known for having good sized apertures with low focal ratios. These telescopes can be attached to both Alt Az mounts and also Equatorial mounts. (See a future article on telescope mounts)

How it works



The Newtonian design of telescope does not use a lens in the telescope. Instead, it uses large primary mirror that reflects the light entering the front of the telescope and directs it onto a smaller secondary mirror back at the front of the telescope.

This secondary mirror again reflects the light out to the side of the telescope where the eyepiece is located or the CCD camera. The focusing of the light is done by moving the eyepiece in or out to focus the light.

Advantages

- Low cost compared to aperture
- Good sized Apertures
- Low focal ratios

Disadvantages

- Tubes can be quite long (4 feet or so) and so can be problematic to store.
- Not ideal for planetary imaging since the focal length is not huge.

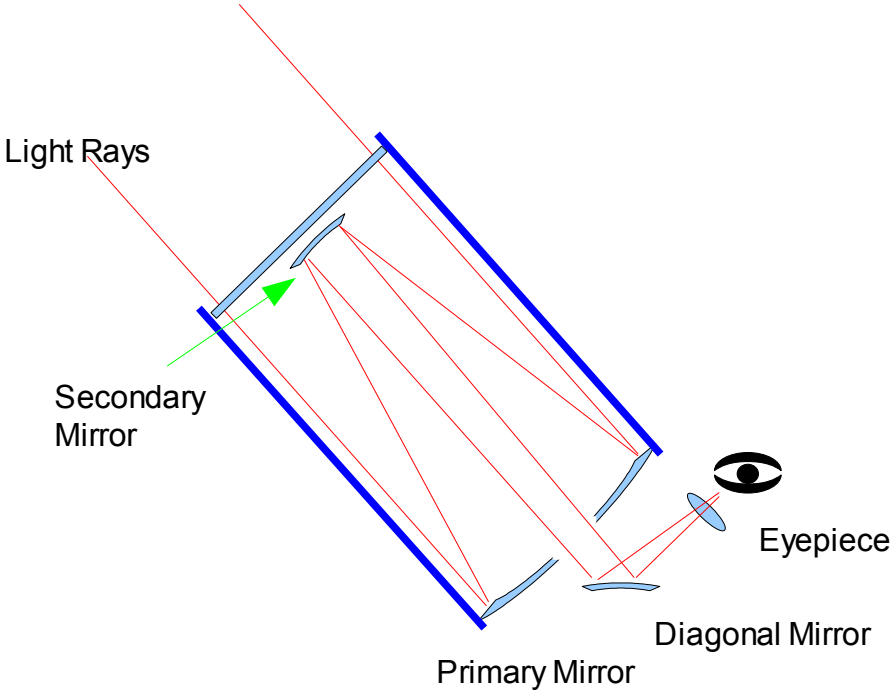
Best Uses

The Newtonian is a general all round visual and deep sky observing instrument. It can also be used for some deep sky imaging although I have heard that it can be difficult or impossible to focus these telescopes when a CCD camera is attached to the focuser.

Schmitt Casegrain

The Schmitt casegrain telescope has become a very popular type of telescope due to it's compact size and modest cost. These tend to have reasonable sized apertures and modest low focal ratios in the order of f/10. These telescopes can be attached to both Alt/Az mounts and also Equatorial mounts. (See a future article on telescope mounts). These telescopes are very popular for planetary imaging and also for deep sky imaging.

How it works



The Schmitt casegrain design of telescope does not use a lens in the telescope. Instead, it uses large primary mirror that reflects the light entering the front of the telescope and directs it onto a smaller secondary mirror back at the front of the telescope.

This secondary mirror again reflects the light back down the telescope where it passes through a hold in the primary mirror. A CCD camera can be located at this point (Prime Focus), alternatively, for visual astronomy, a diagonal mirror can be used to reflect the light at right angles towards the eyepiece. The focusing of the light is achieved by moving the primary mirror inwards or outwards.

At the front of this type of telescope is a correcting plate. This glass lens provides some correction to the light path and also helps to protect the inside of the telescope of dust. This correcting plate is made fron thin glass.

Advantages

- Large focal length
- Good sized Apertures
- Good for imaging planets due to large focal length

Disadvantages

- More expensive that dobsonian or Newtonian reflectors.
- Longer exposure times required for deep sky imaging.
- Long time to cool down to ambient temperature due to front correcting plate.
- Need to collimate telescope regularly to maintain optimum performance.
- Collimation required.

Best Uses

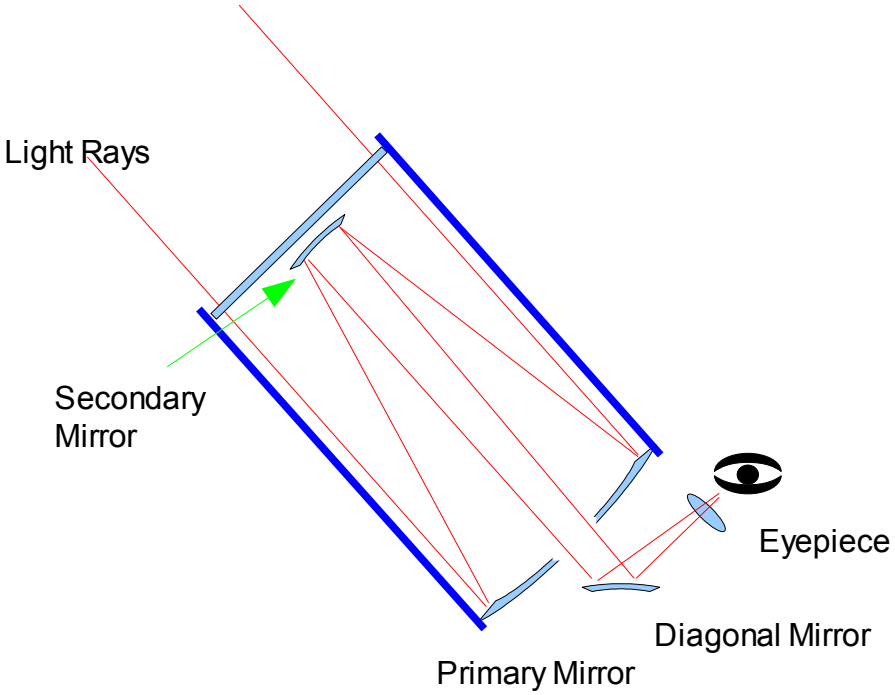
The Schmitt casegrain is a general all round visual and deep sky observing and imaging instrument. It is a very compact instrument and is easy to store. They come in a range of sizes from 5 inch upto 20 inch apertures but the cost goes up as the aperture size goes up.

These telescopes are ideal for planetary viewing or photography due to their large focal length. These telescopes are used extensively for deepsky imaging of smaller objects. They are not so good for wide field imaging since their large focal length also reduces their field of view.

Maksutov Casegrain

The Maksutov casegrain telescope has become a very popular type of telescope due to it's compact size and modest cost. These tend to have reasonable sized apertures although generally smaller than the Schmitt casegrain type, these telescopes also have higher focal ratios in the order of f/15. These telescopes can be attached to both Alt Az mounts and also Equatorial mounts. (See a future article on telescope mounts). These telescopes are very popular for planetary imaging and also for deep sky imaging.

How it works



The Maksutov casegrain design of telescope is optically very similar to the schmitt casegrain type. These do not use a lens in the telescope. Instead, it uses large primary mirror that reflects the light entering the front of the telescope and directs it onto a smaller secondary mirror back at the front of the telescope.

This secondary mirror again reflects the light back down the telescope where it passes through a hold in the primary mirror. A CCD camera can be located at this point (Prime Focus), alternatively, for visual astronomy, a diagonal mirror can be used to reflect the light at right angles towards the eyepiece. The focusing of the light is achieved by moving the primary mirror inwards or outwards.

At the front of this type of telescope is a correcting plate. This glass lens provides some correction to the light path and also helps to protect the inside of the telescope of dust. This correcting plate is made fron glass. The difference between the Maksutov and Schmitt telescope types is that this glass correcting plate in the Maksutov is thicker than that in the Schmitt casegrain telescope type.

Advantages

- Large focal length
- Good sized Apertures
- Good for imaging planets due to large focal length
- No need to collimate this telescope type.

Disadvantages

- More expensive that dobsonian or Newtonian reflectors.
- Longer exposure times required for deep sky imaging.
- Long time to cool down to ambient temperature due to front correcting plate.
- Higher focal ratio.
- Smaller apertures than Schmitt casegrain types.

Best Uses

The Maksutov casegrain is a general all round visual and deep sky observing and imaging instrument. It is a very compact instrument and is easy to store. They come in a range of sizes from 5 inch upto 8 inch apertures but the cost goes up as the aperture size goes up.

These telescopes are excellent for planetary viewing or photography due to their large focal length. These telescopes are used less extensively for deepsky imaging than their competitor. They are not so good for wide field imaging since their large focal length also reduces their field of view.