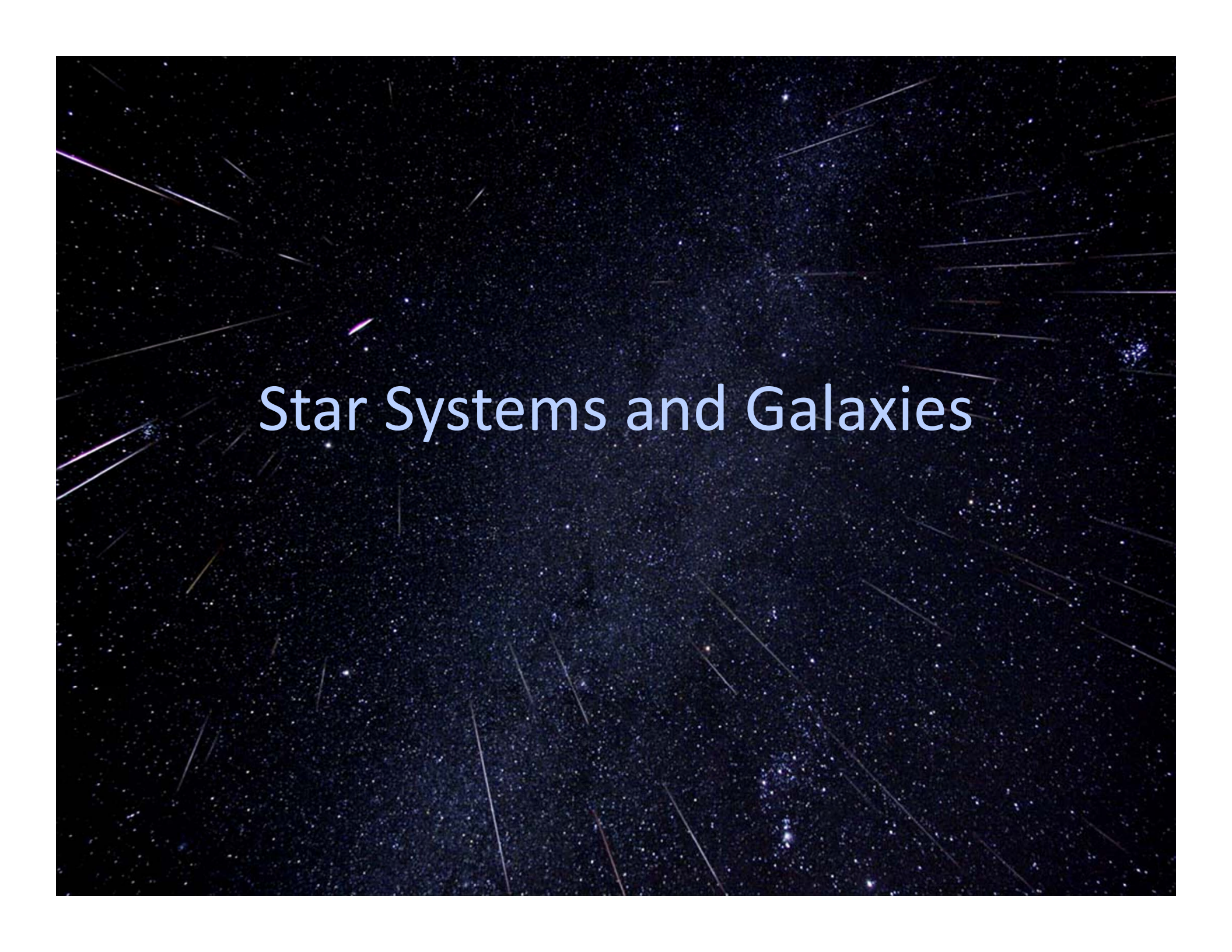


A long-exposure photograph of a starry night sky. The background is a deep black, densely populated with stars of varying brightness. Numerous bright, diagonal streaks of light, likely from meteors or satellites, are scattered across the frame, adding a sense of motion and depth. The text "Star Systems and Galaxies" is centered in a white, sans-serif font.

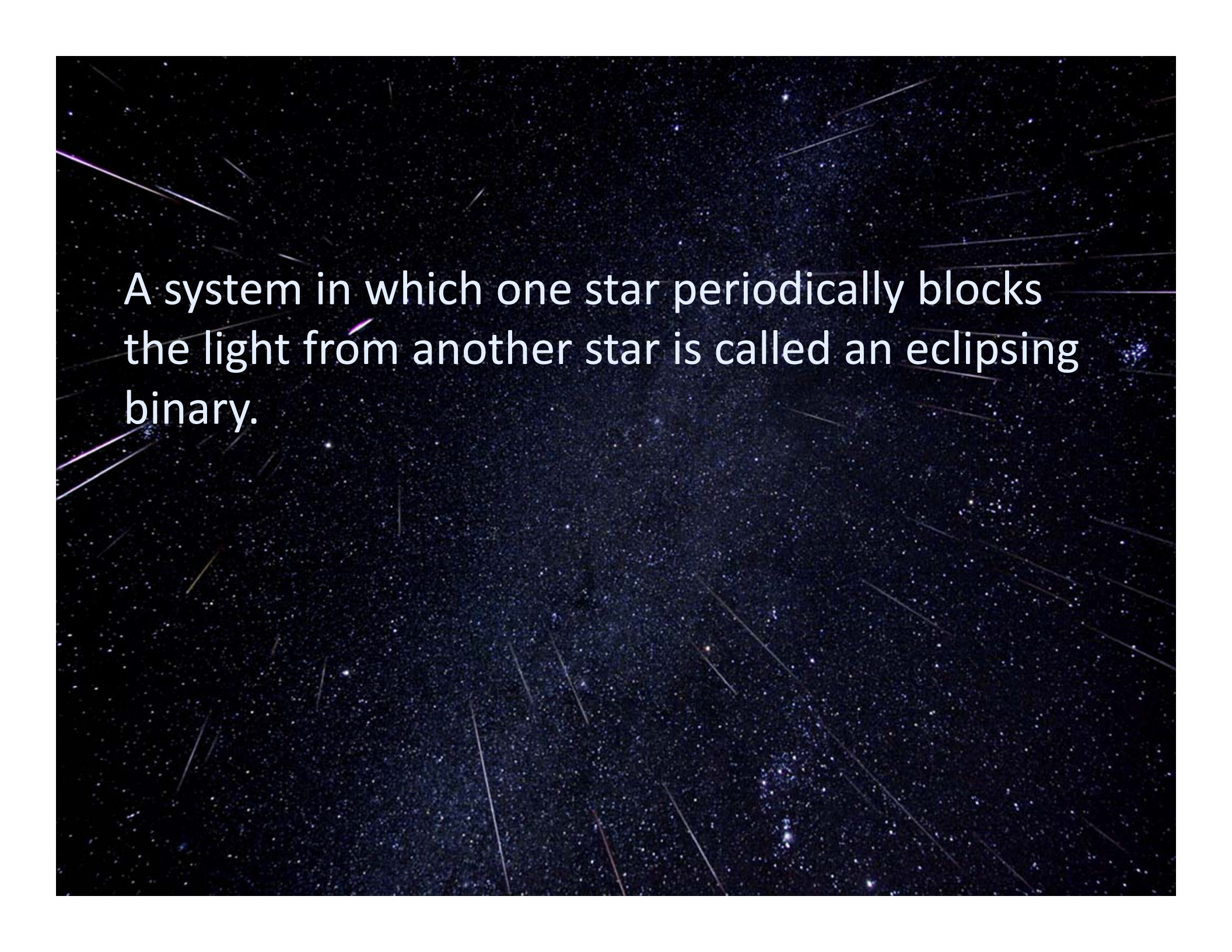
Star Systems and Galaxies

Star Systems

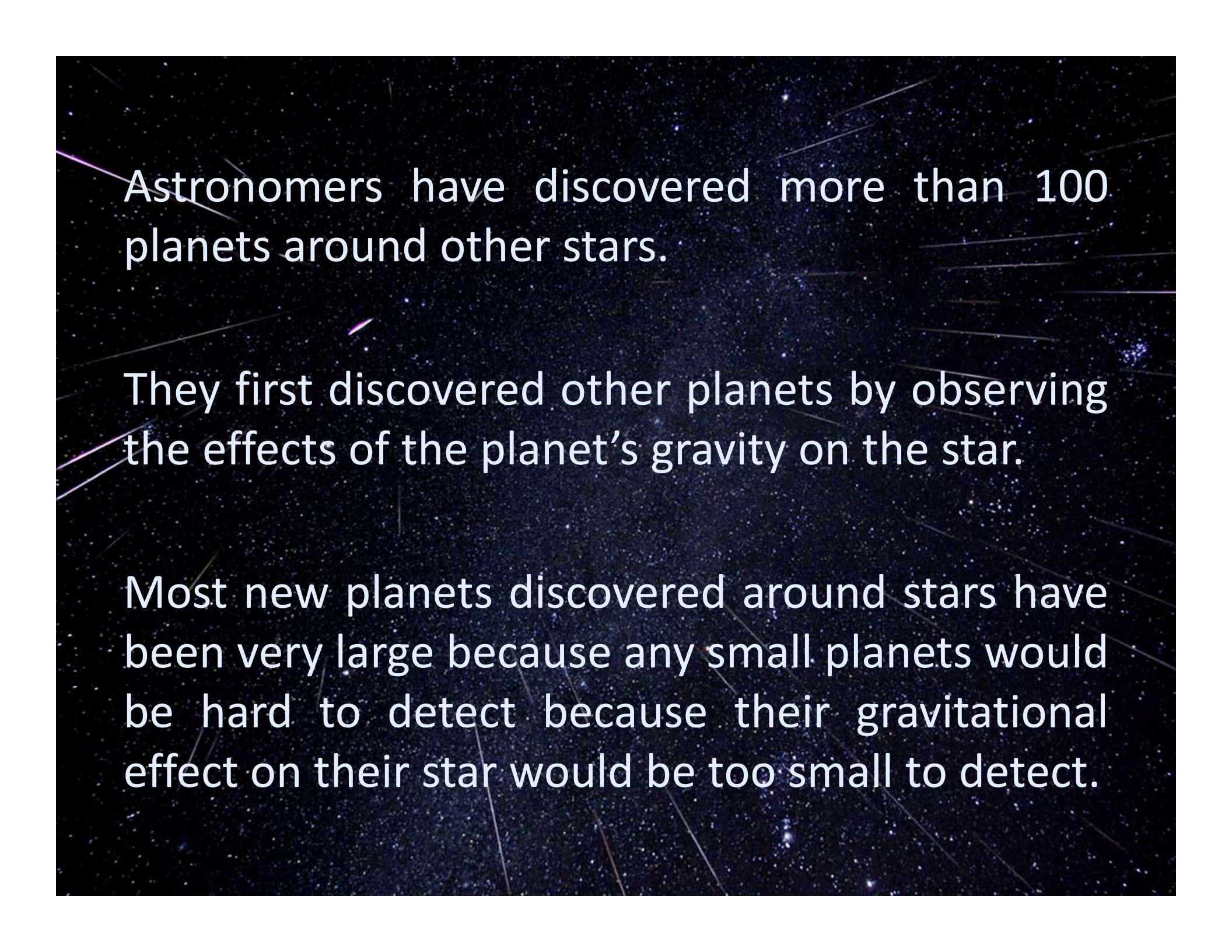
Most stars are members of groups of two or more stars, called star systems.

Star systems that have two stars are called binary stars. Sometimes the second star in a binary system cannot be seen.

Astronomers can tell there is an unseen second star in a system by observing the effects of gravity on the visible star.

A deep space photograph showing a vast field of stars against a dark cosmic background. Numerous stars of varying brightness are visible, some appearing as distinct points of light while others are blurred into streaks, likely due to the long exposure time used in the image. The stars are distributed across the entire frame, with some clusters appearing more densely packed than others. The overall color palette is dominated by deep blues and blacks, with the light from the stars providing a range of white and pale blue tones.

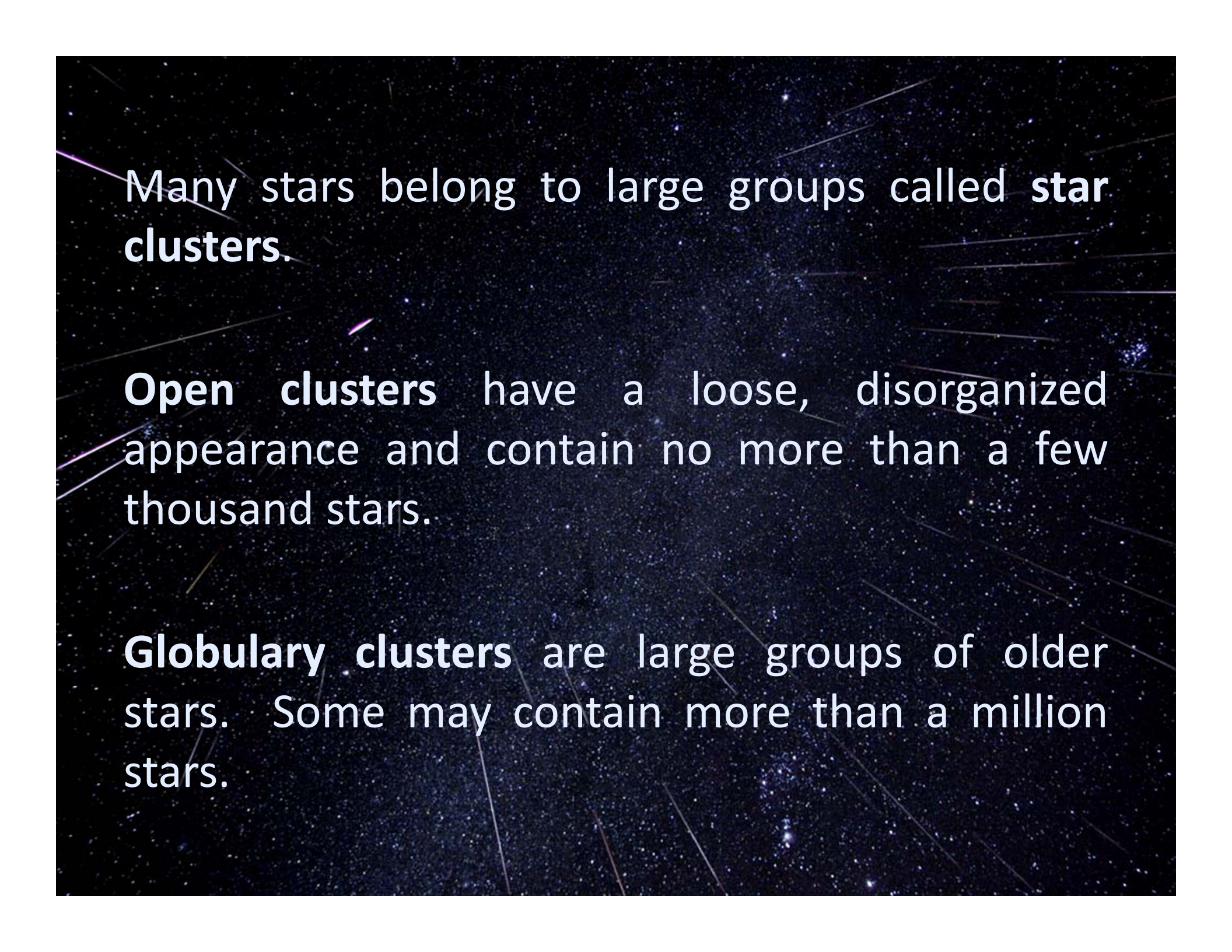
A system in which one star periodically blocks the light from another star is called an eclipsing binary.

A deep space photograph showing a dense field of stars against a dark blue and black background. A bright pink comet streak is visible on the left side, moving towards the center. The text is overlaid in white, sans-serif font.

Astronomers have discovered more than 100 planets around other stars.

They first discovered other planets by observing the effects of the planet's gravity on the star.

Most new planets discovered around stars have been very large because any small planets would be hard to detect because their gravitational effect on their star would be too small to detect.



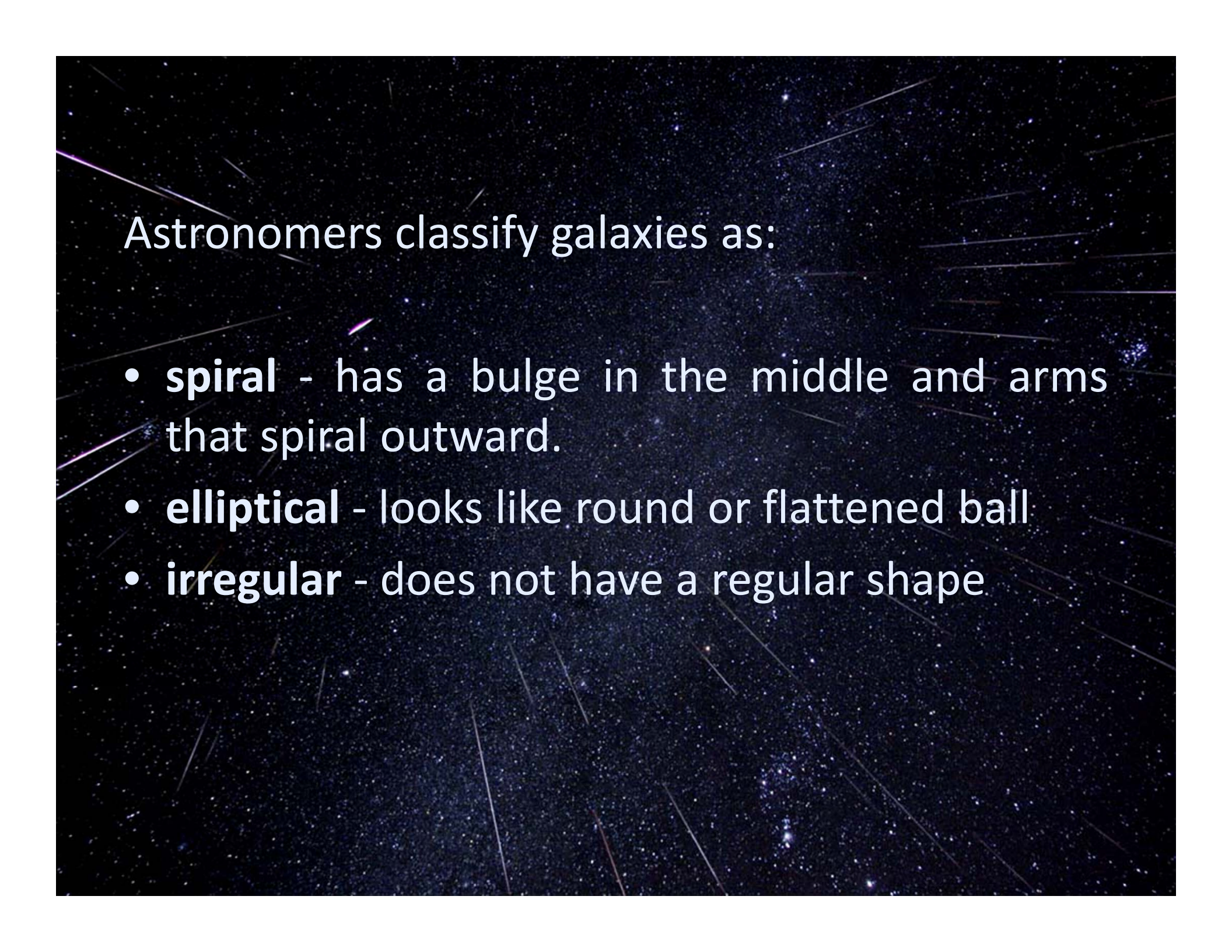
Many stars belong to large groups called **star clusters**.

Open clusters have a loose, disorganized appearance and contain no more than a few thousand stars.

Globular clusters are large groups of older stars. Some may contain more than a million stars.

Galaxies

A galaxy is a huge group of single stars, star systems, star clusters, dust, and gas bound together by gravity. There are billions of galaxies.



Astronomers classify galaxies as:

- **spiral** - has a bulge in the middle and arms that spiral outward.
- **elliptical** - looks like round or flattened ball
- **irregular** - does not have a regular shape

Spiral Galaxies

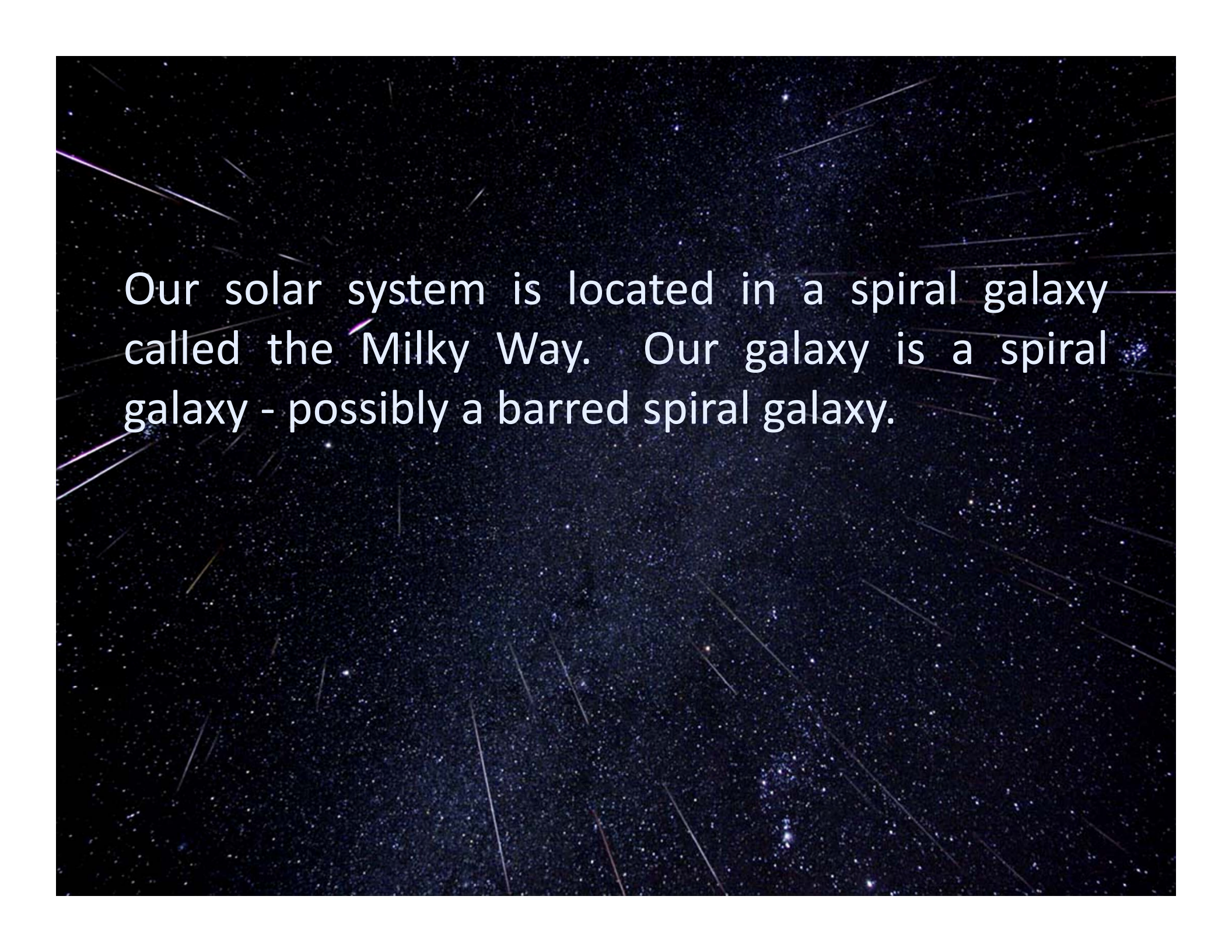
- mixture of old and new stars
- new stars form in spiral arms
- black hole in center

Elliptical Galaxies

Mostly made up of old stars

Irregular Galaxies

- Contain mostly young stars (many bright, young stars)
- Some are quasars. (A quasar is an active young galaxy with a giant black hole in the center.)

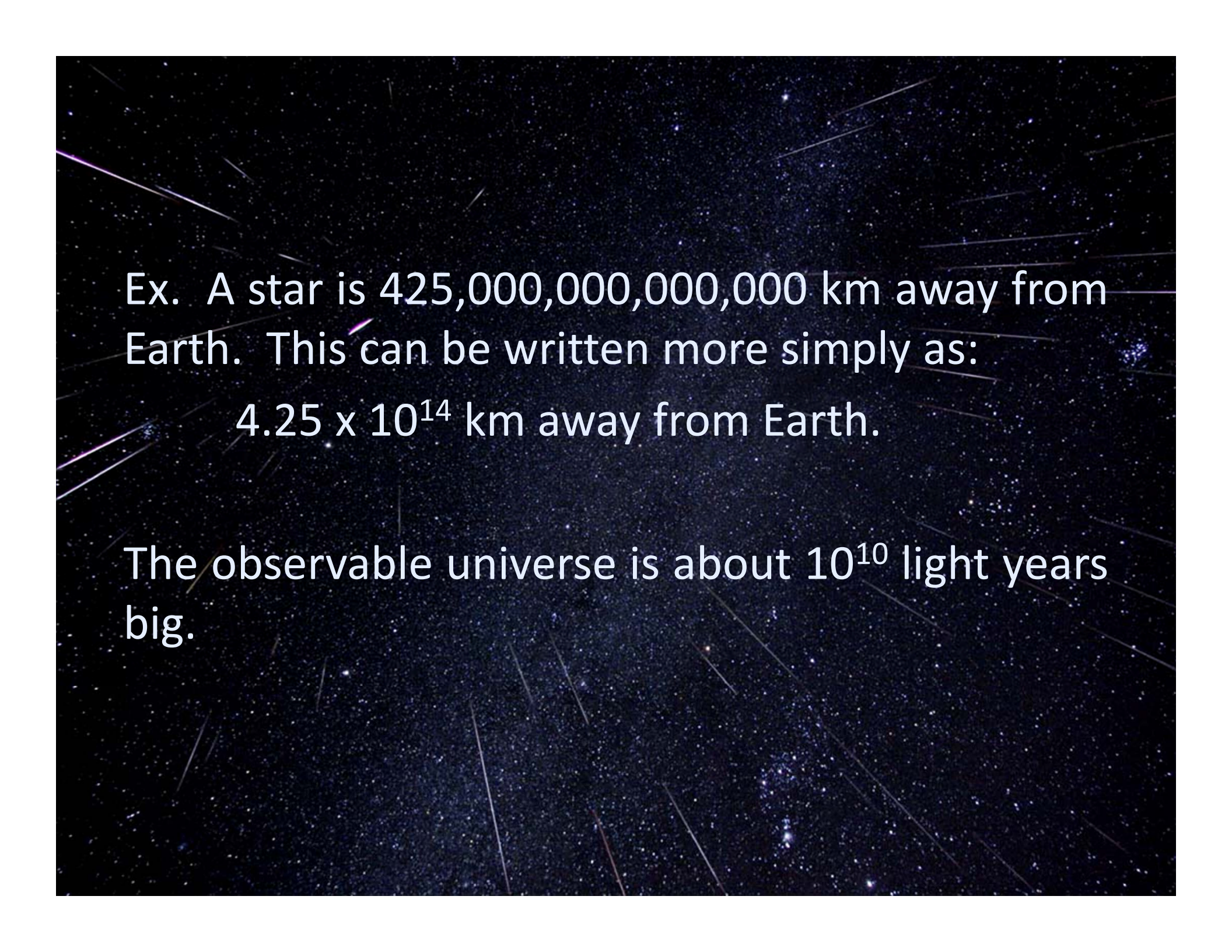
A deep-field astronomical image showing a vast expanse of space filled with numerous stars of varying brightness and colors. Several bright, thin, diagonal streaks, likely representing distant galaxies or nebulae, are visible against the dark background. The text is centered in the upper half of the image.

Our solar system is located in a spiral galaxy called the Milky Way. Our galaxy is a spiral galaxy - possibly a barred spiral galaxy.

The Universe

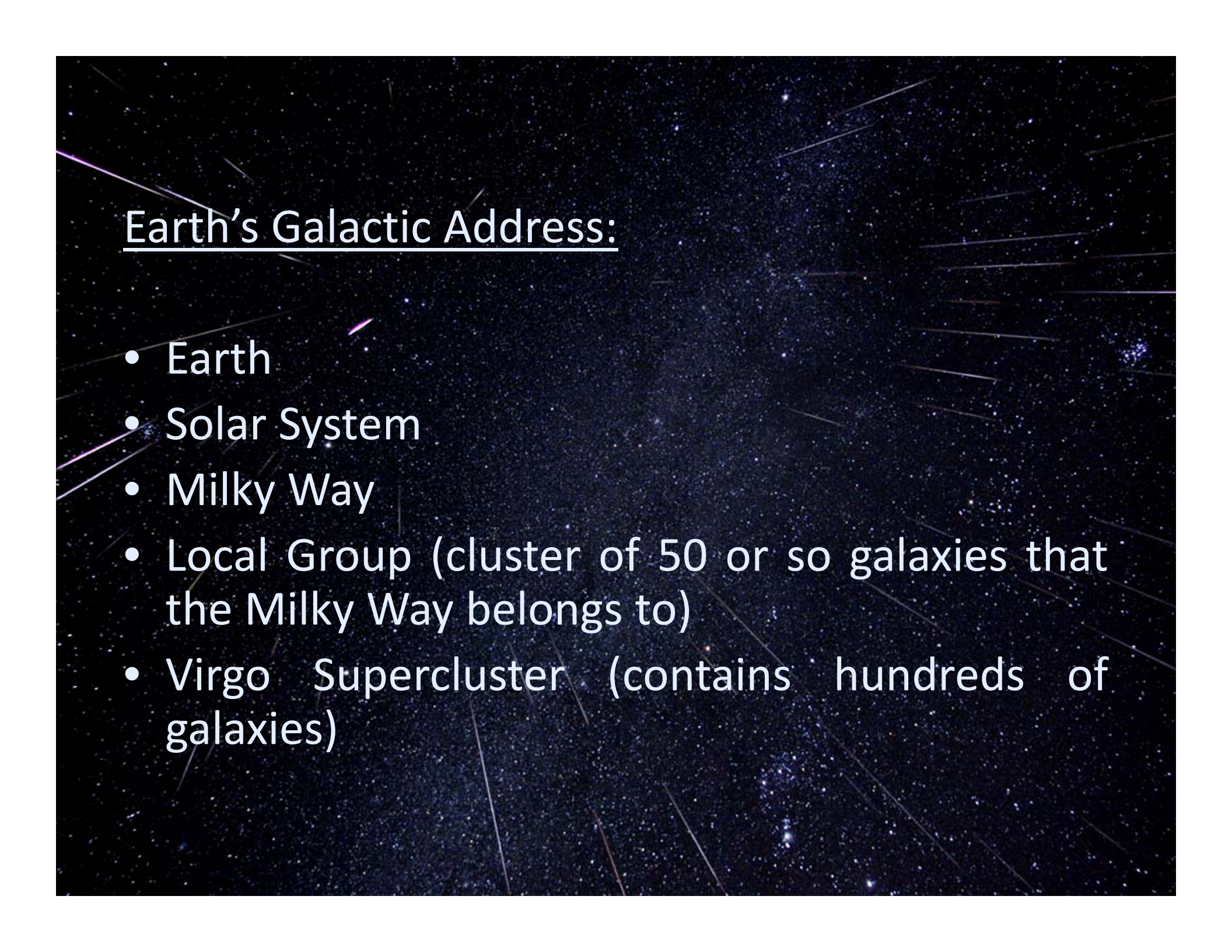
Astronomers define the universe as all of space and everything in it. Because the numbers astronomers use are so large, they use scientific notation.

Scientific notation uses powers of 10 to write very large or very small numbers.



Ex. A star is 425,000,000,000,000 km away from Earth. This can be written more simply as:
 4.25×10^{14} km away from Earth.

The observable universe is about 10^{10} light years big.



Earth's Galactic Address:

- Earth
- Solar System
- Milky Way
- Local Group (cluster of 50 or so galaxies that the Milky Way belongs to)
- Virgo Supercluster (contains hundreds of galaxies)