GENS4001 Astronomy
Part 3
Galaxies – 1

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Astrophysics


Physics

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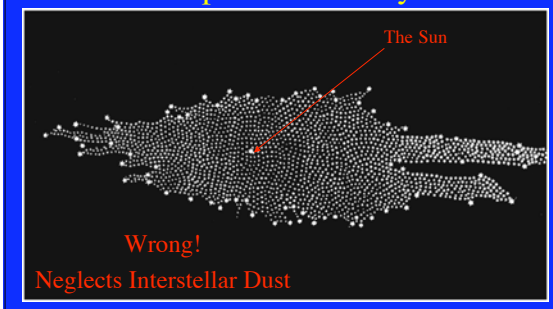
Our Galaxy – The Milky Way

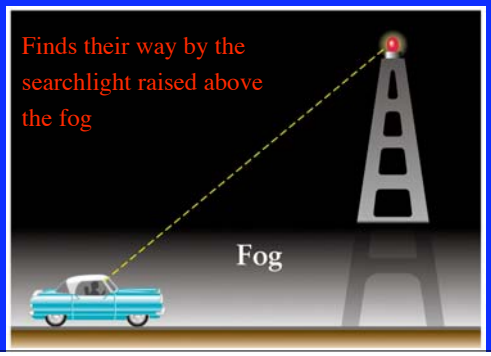
As seen from the inside.
But what does it look like from the outside?

Herschel's 18th Century Map of the Galaxy

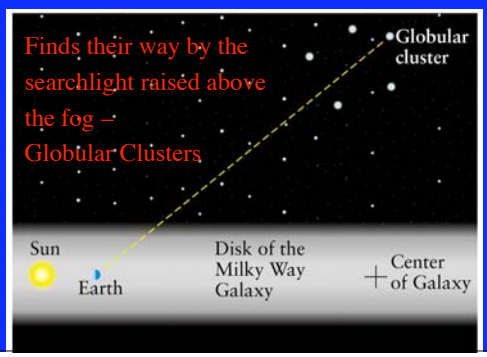


Made by counting the number of stars in every direction

A motorist lost on a foggy night



An astronomer lost in the Galaxy

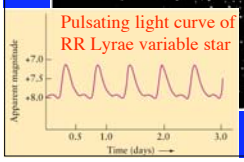


Globular Clusters – Galactic Searchlights

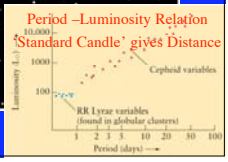
Messier 55
20,000-lyrs away

RR Lyrae Stars

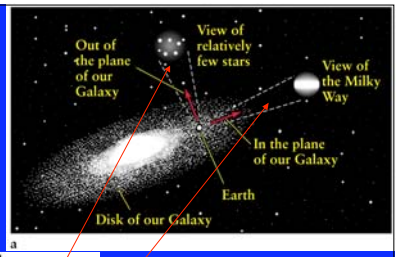
Pulsating light curve of RR Lyrae variable star

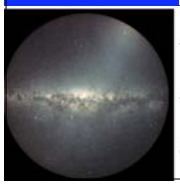


Period –Luminosity Relation
'Standard Candle' gives Distance



The distribution of Globular Clusters Shows that the Sun is not at the centre of the Galaxy





View out of the plane of our Galaxy
View in the plane of our Galaxy
View out of the plane of our Galaxy

Our View of The Milky Way

How big is the Galaxy?

Suppose the Solar System is the size of a grain of salt
(i.e. 500 Astronomical Units → 2mm)

The Sun
(Diameter 1.4 million km)

A Virus
(40 nanometres)

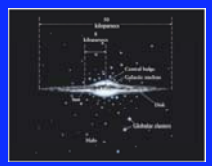
The Earth
(Diameter 13,000 km)

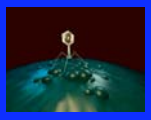
An Atom
(0.3 nanometres)

The Size of the Galaxy

A Galaxy
(100,000 light years)

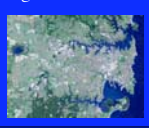
Sydney
(25 km)



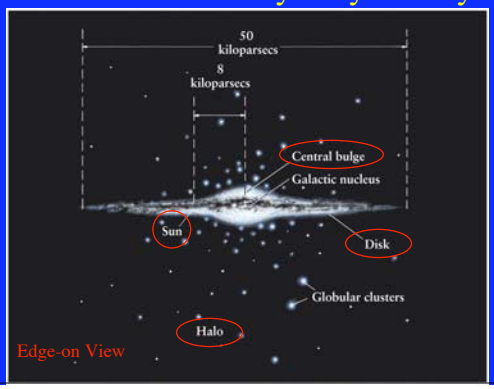


- Stars the size of Viruses
- Solar Systems the size of salt grains
- Each separated by ~1m
- 100,000 million spread over the area of Sydney, and
- Extending 250m above & below

500m



Sketch of the Milky Way Galaxy



Edge-on View

The Milky Way in the Infrared

We see through the dust to the Central Bulge!

NGC 4565
An edge-on spiral galaxy

15 million lyrs away

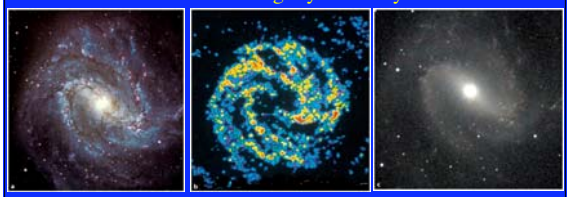
Rather like the Milky Way

Sketch of the Milky Way seen Face-on

4 Spiral Arms

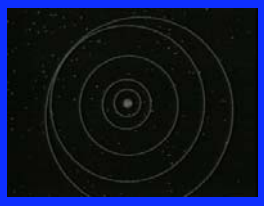
Three Views of the Spiral Galaxy Messier 83

15 million light years away



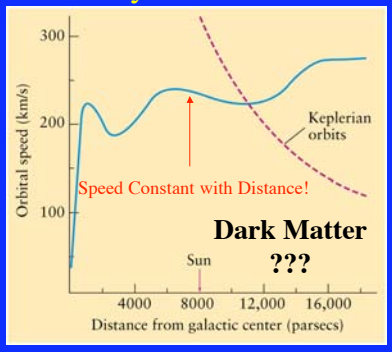
Visible Light	Radio Wavelengths	Infrared Wavelengths
• Hot, young blue stars	• Neutral hydrogen gas	• Galactic disk
• Red bubbles ionized gas	• Traces spiral arms	• Traces cool stars

Rotation in the Solar System

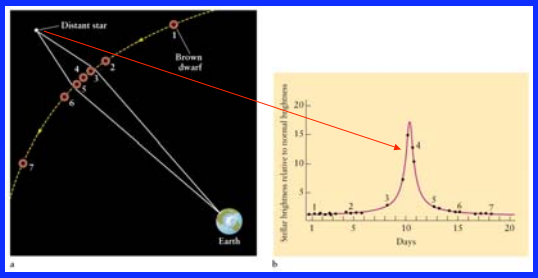


Keplerian Orbits
Speed decreases with increasing distance
$V \propto 1/\sqrt{R}$

The Galaxy's Rotation Curve



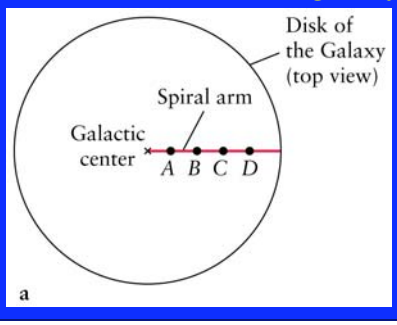
Microlensing by Dark Matter



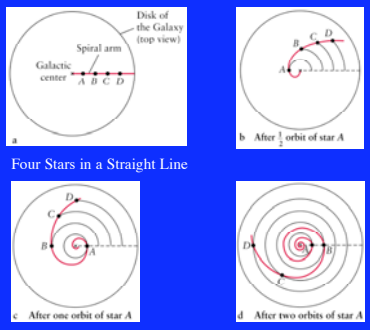
Dark object in Galactic Halo can gravitationally bend light from a distant object and magnify it

Distant object increases and decreases its intensity

How would the spiral arm look after several rotations of the galaxy?



The Winding Dilemma



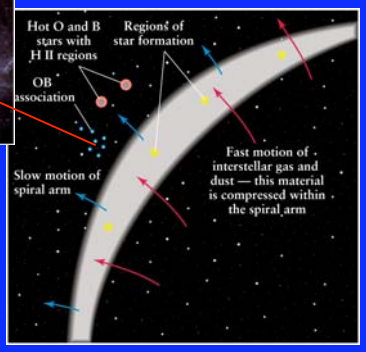
Four Stars in a Straight Line

Galaxy would 'rapidly' become wound-up!

A Density Wave on the Highway

Number of cars passing each point on the road is the same
Cars are bunched up where they move slowest ⇒ traffic jams!

The Galactic Traffic Jam



A "Compression Wave"

(rather like a sound wave)

Gas flows in, is compressed, and a portion turns into new stars

Produces the Spiral Arms and Star Formation

The Story of The Milky Way Galaxy…...