

## Heber Curtis - Harlow Shapley 1920 Debate



Shapley



Curtis

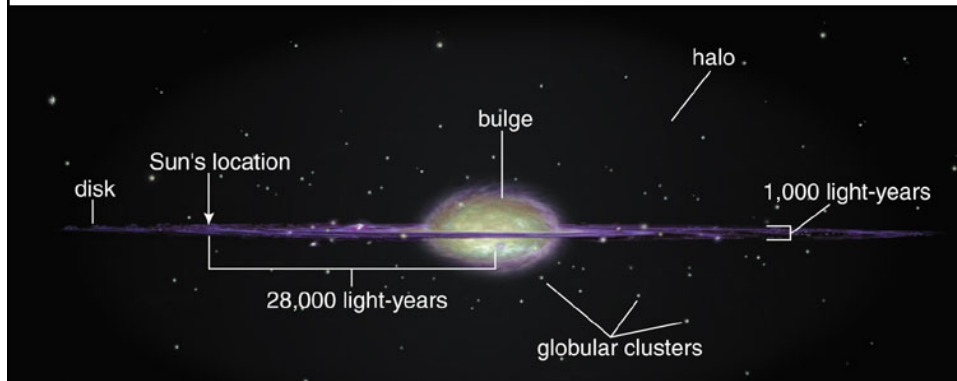
- Sun not @ center of MW
- Galaxy larger than thought from Cepheid Observations
- "Spiral Nebulae" are within the MW
- Interstellar absorption not important for distances

- Sun close to center of MW
- Cepheids not reliable distance indicator
- "Spiral Nebulae" are external galaxies
- Interstellar absorption not important for distances

## Galaxy Structure

Three major components:

- (1) Bulge – central stellar (mainly older stars)
- (2) Disk – flat rotating of stars & gas
- (3) Halo – nearly spherical of stars, DM dominated



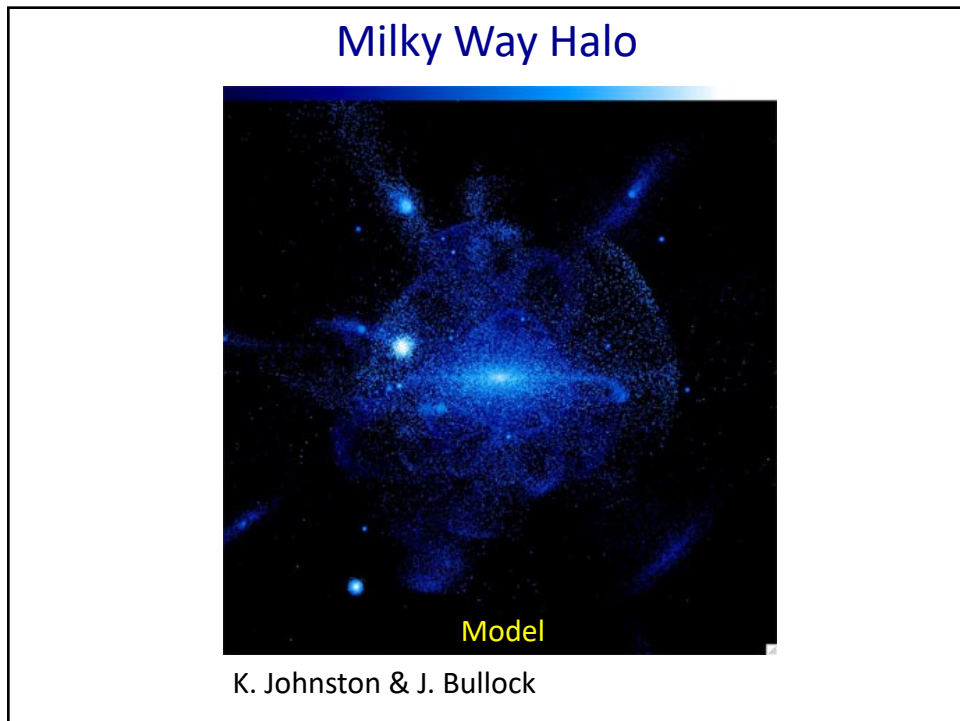
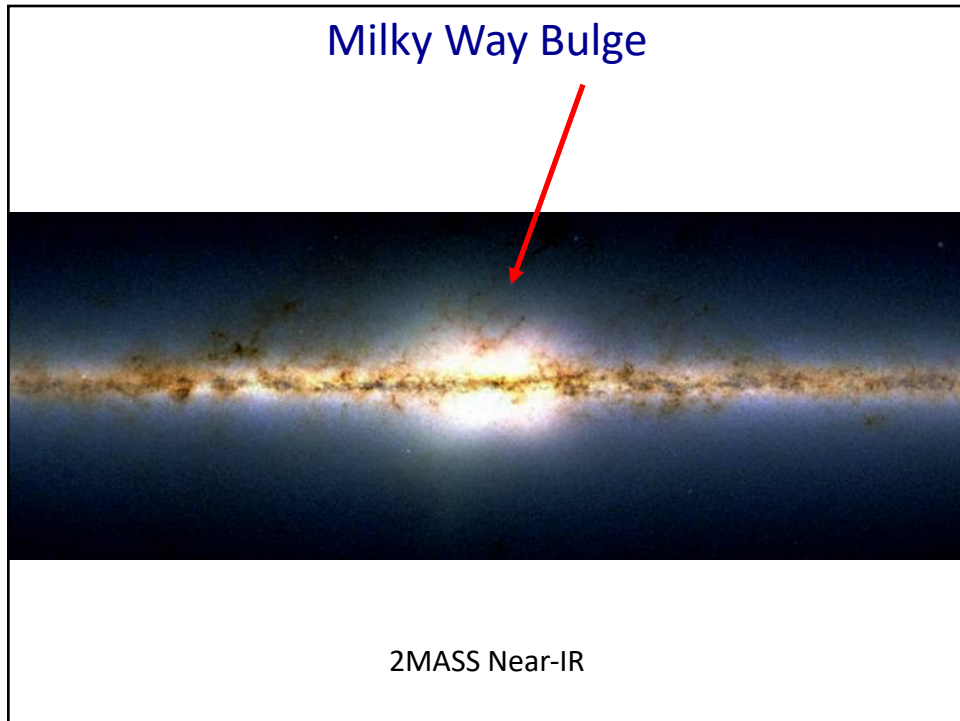
## Spirals vs. Ellipticals

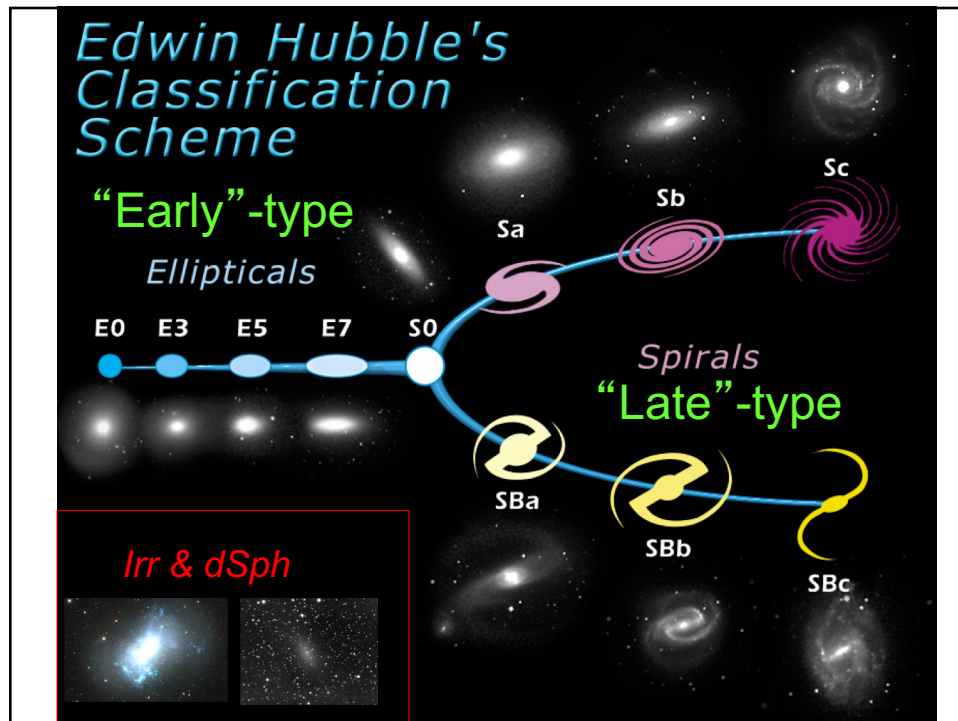


This is a face-on **Spiral Galaxy**. You can clearly see the spiral arms and a central bulge.

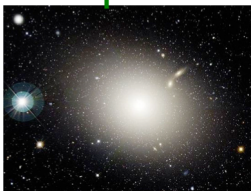



This **Elliptical Galaxy** is composed entirely of a bulge of stars. There is no disk or spiral arms.



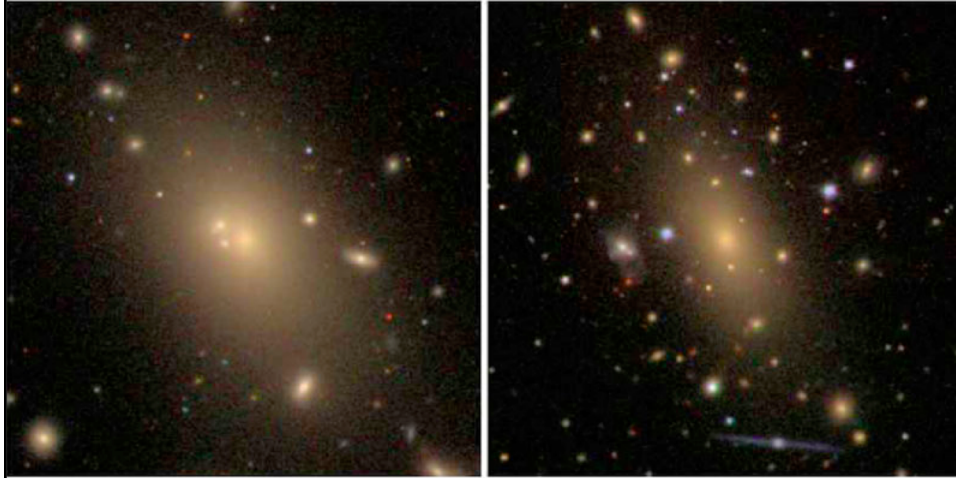


## Galaxy Types

Elliptical	Spiral
	
<ul style="list-style-type: none"> <li>• No disk</li> <li>• Redder stellar colors</li> <li>• Older stellar pop.</li> <li>• Hot ISM</li> <li>• High metal abundances</li> </ul>	<ul style="list-style-type: none"> <li>• Disk</li> <li>• Bluer stellar colors</li> <li>• Younger stellar pop.</li> <li>• Cold ISM + Hot ISM</li> <li>• Lower metal abundances</li> </ul>



## cD Galaxy – Supergiant Elliptical

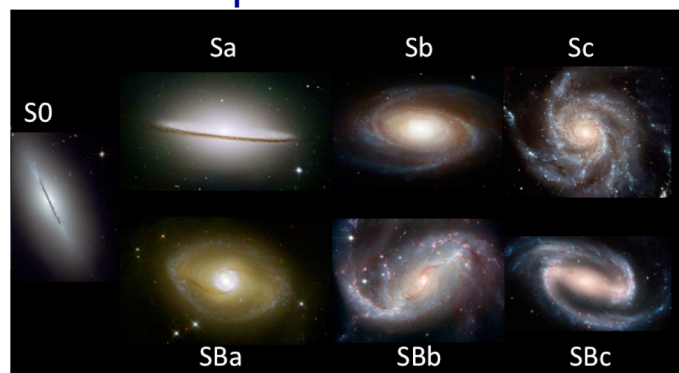


NGC 6166 cD A2199

IC 1101 cD A2029

Masses  $\sim 10^{13} - 10^{14} M_{\text{sun}}$  (MW  $\sim 10^{12}$ )

## Spiral Galaxies



- Bulge to Disk ratio decreases
- Spiral arm pitch angle opens up
- Star forming knots more prevalent

