The Milky Way

- The Galactic Plane
- Spiral arms
- Galactic Halo

The Galactic Plane

- In optical light the Milky Way delineates the plane of our Galaxy
- Dust lanes obscure much of the structure
- The true structure is only revealed in the near-IR where extinction is lower
- We are located about 8 kpc from the centre in a disc with a radius of about 20 kpc

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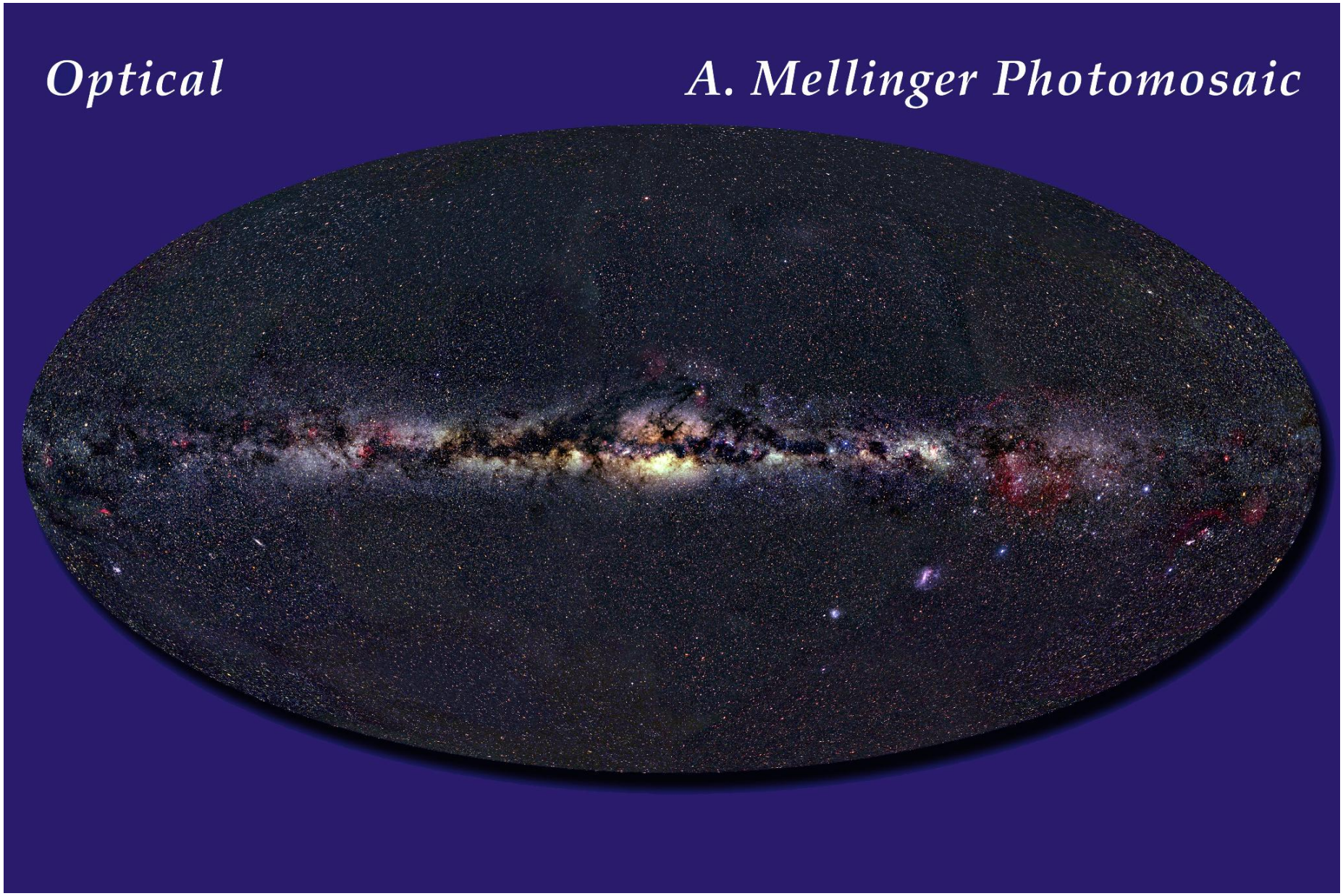

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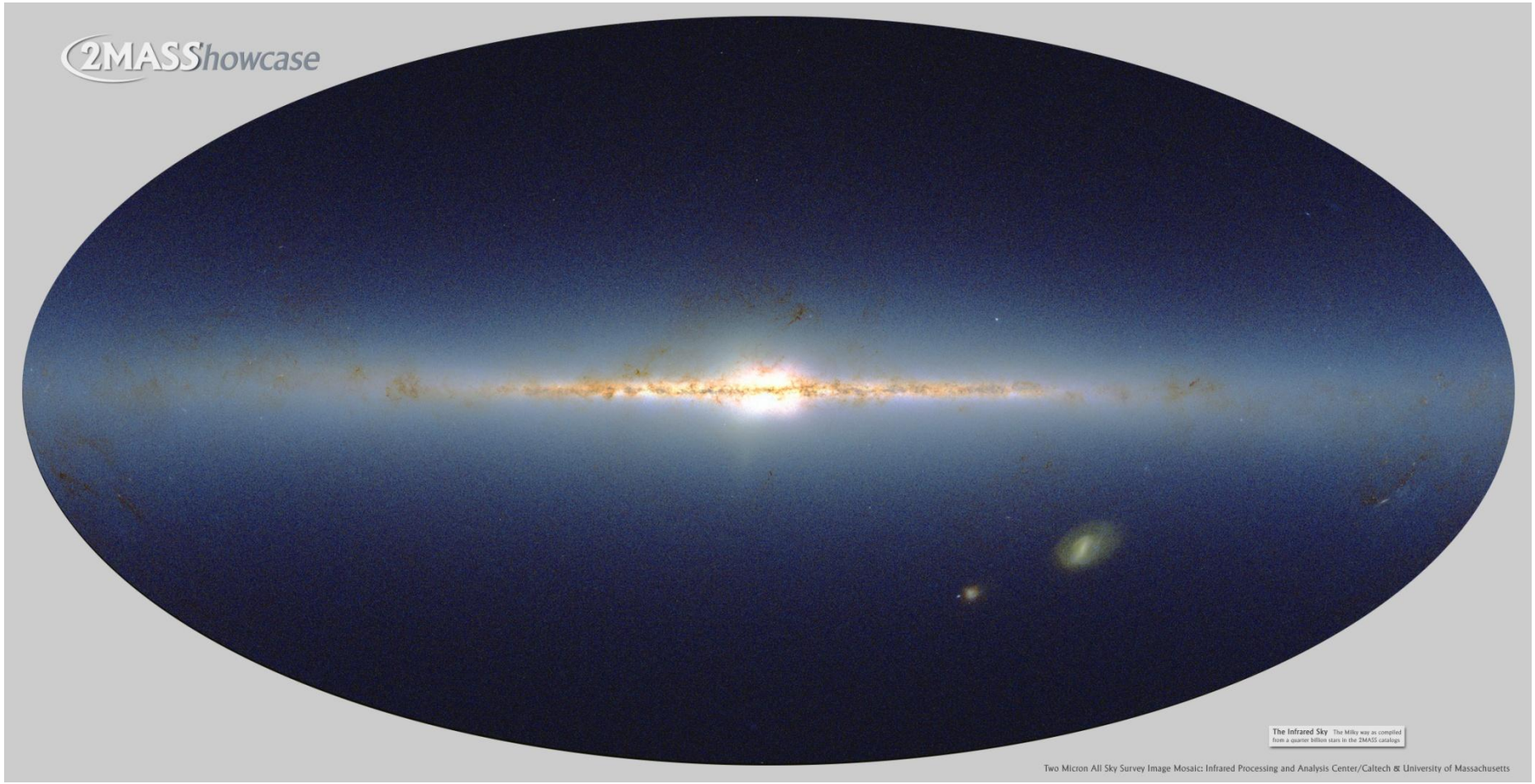
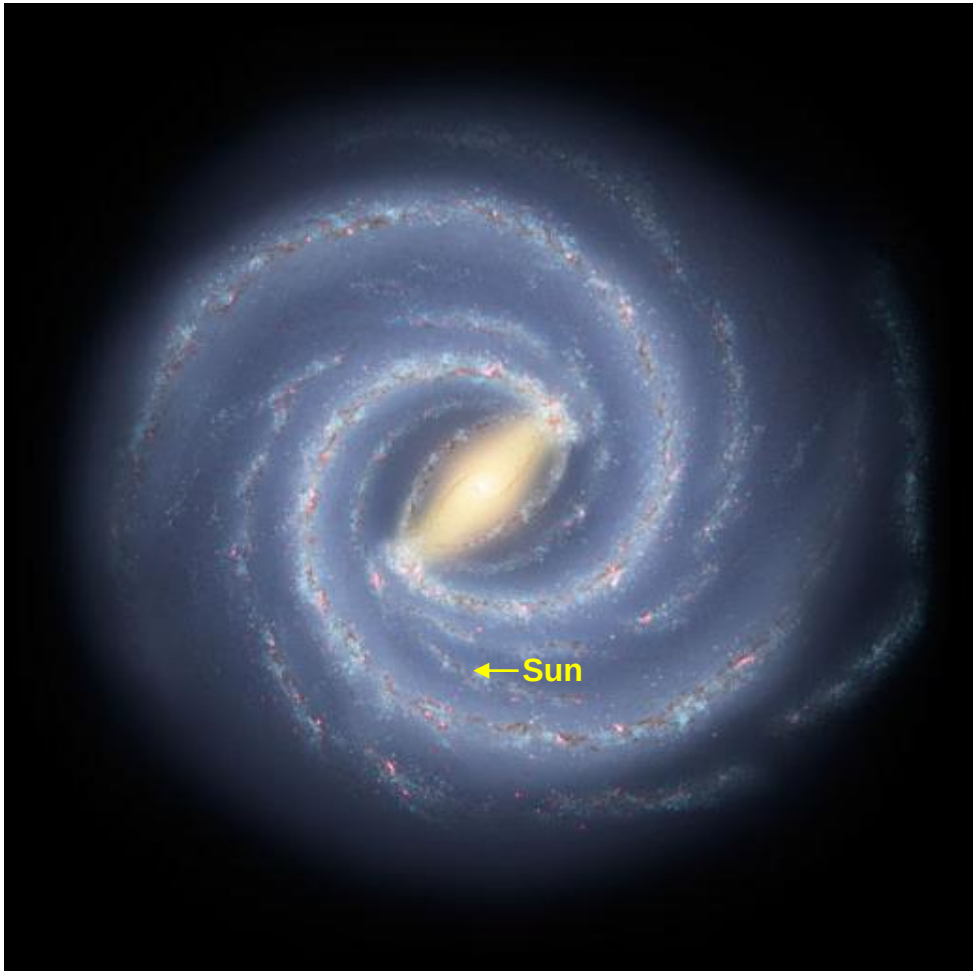
Near-infrared: 1-2 μm



Atlas Image obtained as part of the Two Micron All Sky Survey (2MASS), a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center/California Institute of Technology, funded by the National Aeronautics and Space Administration and the National Science Foundation.

The Bulge and Bar

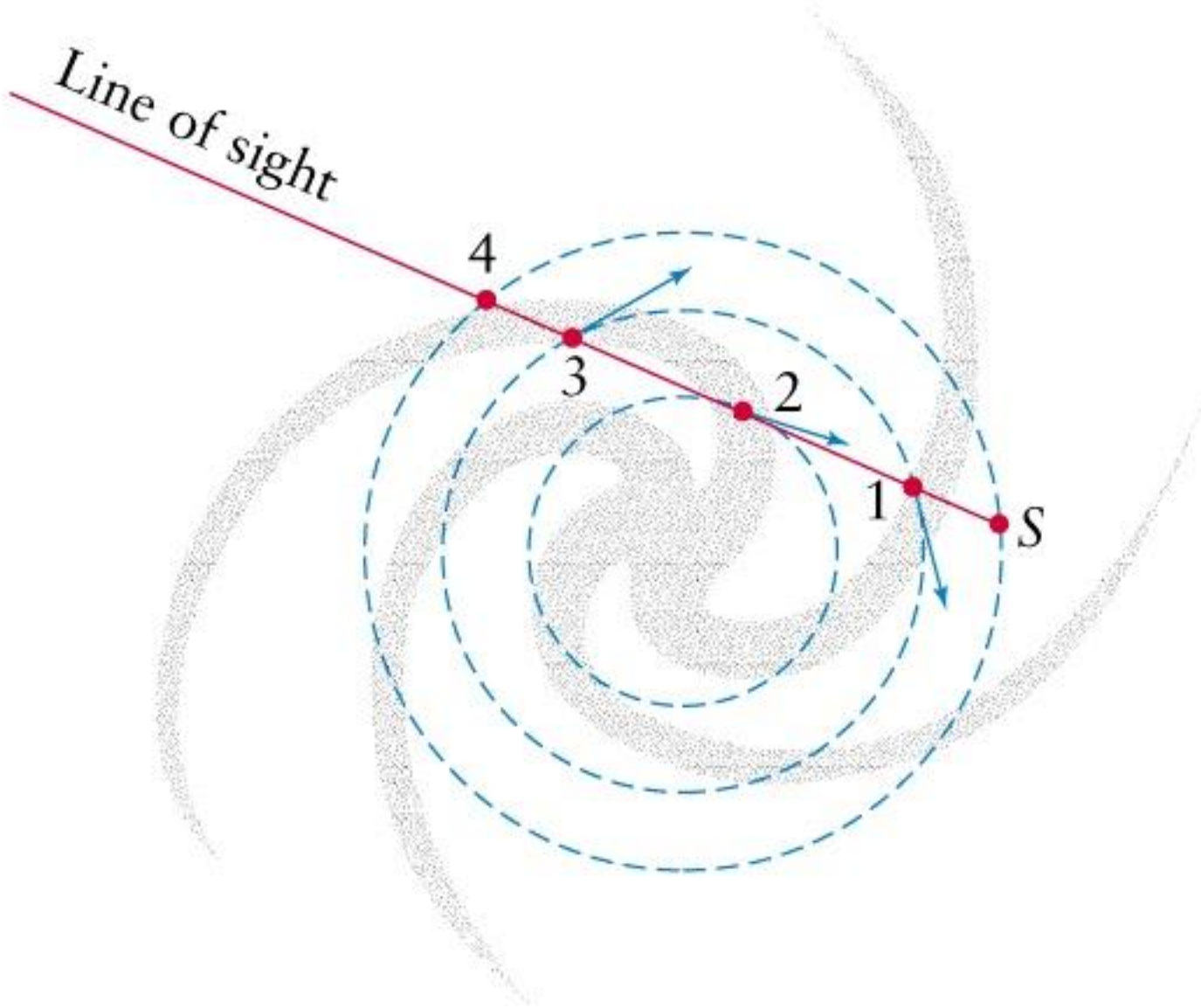
- Bulge is about 1 kpc in radius
- Bar is about 4 kpc in length



credit: NASA/JPL-Caltech

Spiral Arms

- The spiral arm structure is determined using tracers of massive star formation with known distances – usually via their Doppler shift and a rotation model
- H II regions and CO clouds are used
- Our galaxy has 4 star-forming gaseous arms and 2 stellar arms originating at each end of the bar



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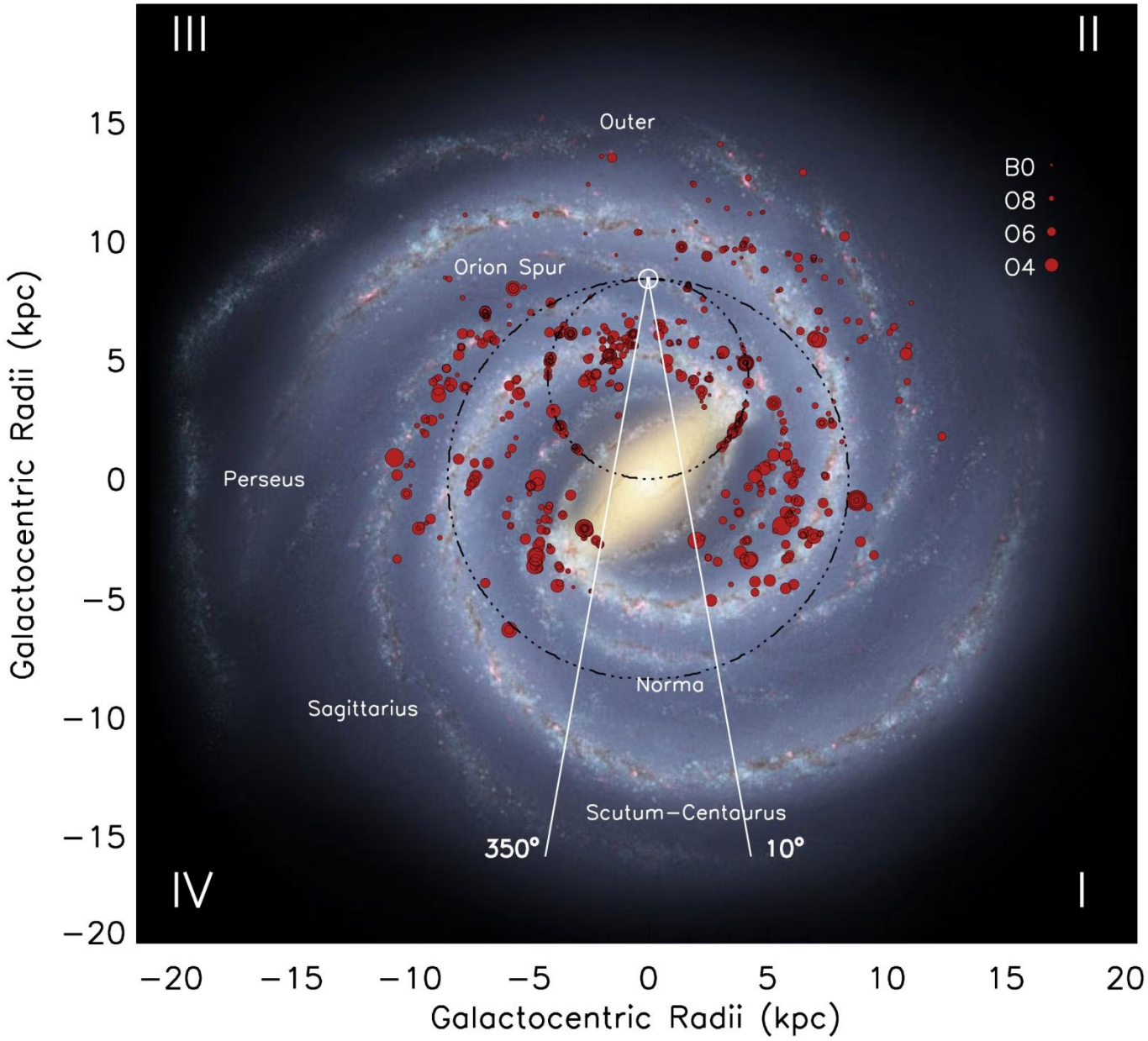


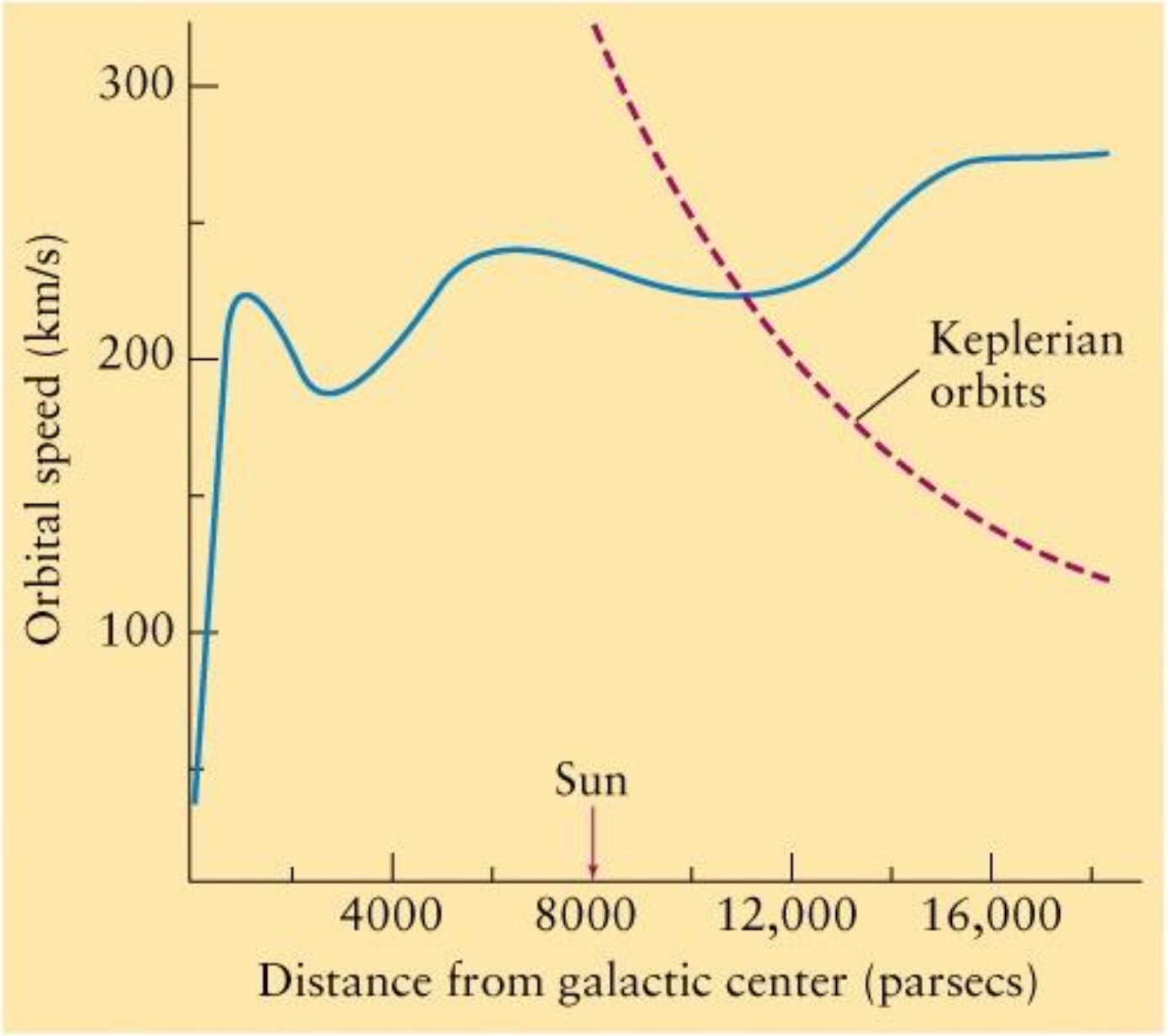
Distribution of massive star forming regions from the Red MSX Source Survey www.ast.leeds.ac.uk/RMS

Rotation of the disc

- The observed rotational velocity of the Galactic disc is approximately constant with radius

$$v \approx \text{constant} \approx 220\,\text{km}\,\text{s}^{-1}$$

- This requires differential rotation: stars closer to the centre of the galaxy orbit in a shorter time (period P α r) and overtake us, whilst we overtake stars further out



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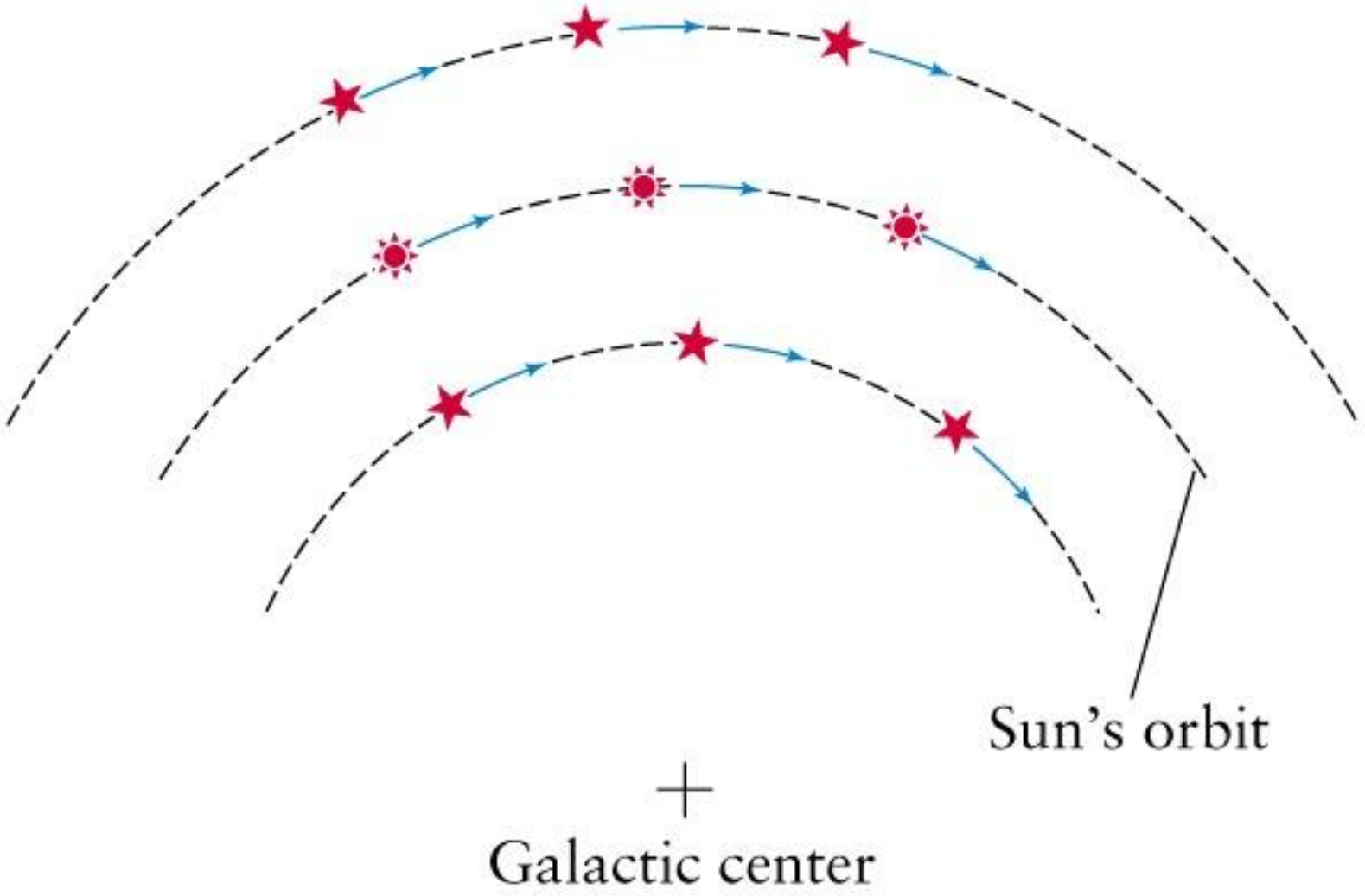

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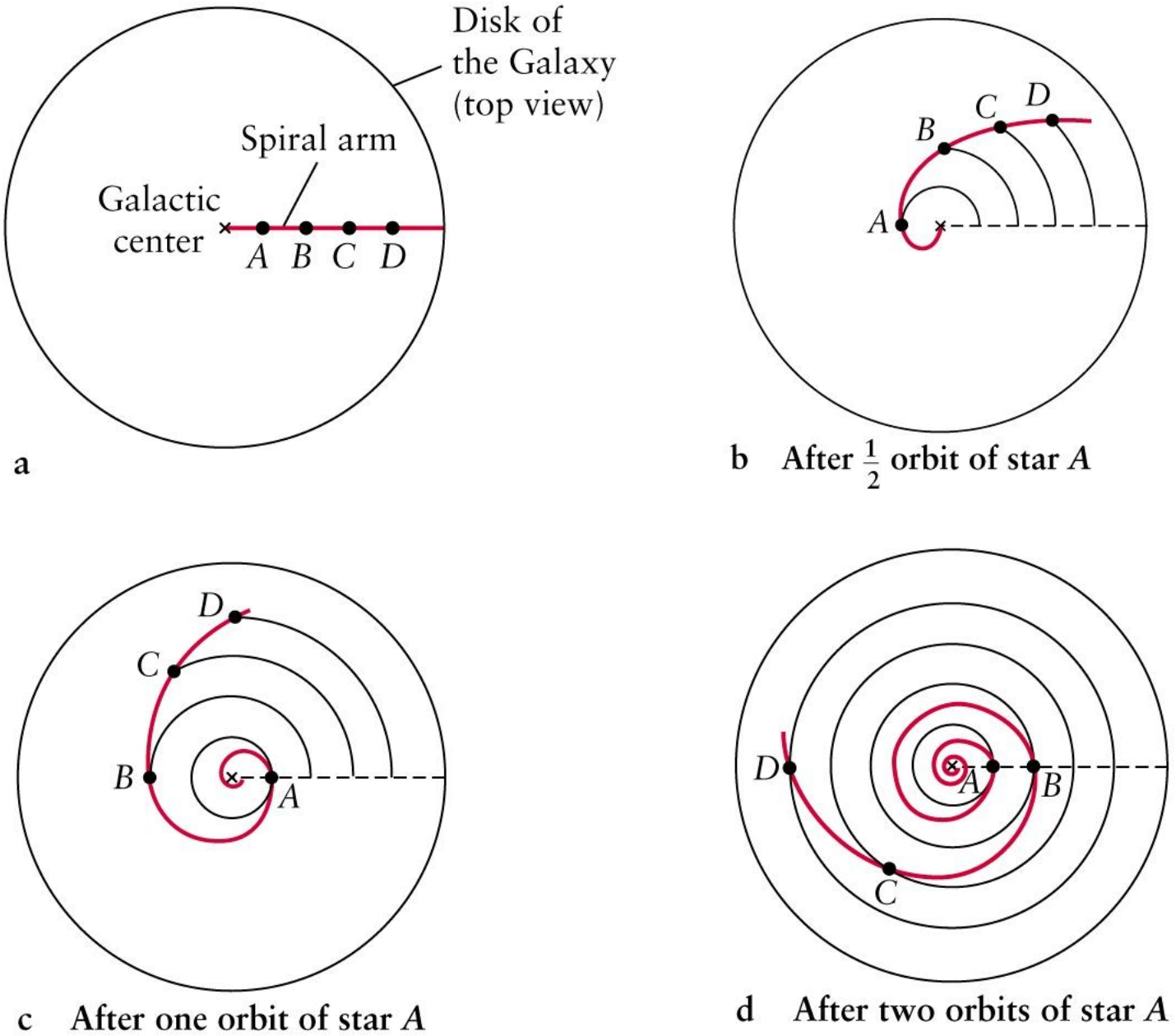
The Wind-up Problem

- If the spiral arms were a fixed pattern in the stars and gas the differential rotation would cause them to ‘wind-up’ in a few revolutions



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Density Waves

- The current model for spiral arms is that they are a density wave pattern that rotates at a slower speed than the galaxy
- Stars and gas pass in and out of the arm
- As gas gets compressed in the arm molecular clouds form with subsequent star formation
- Spiral arms usually trail the rotation

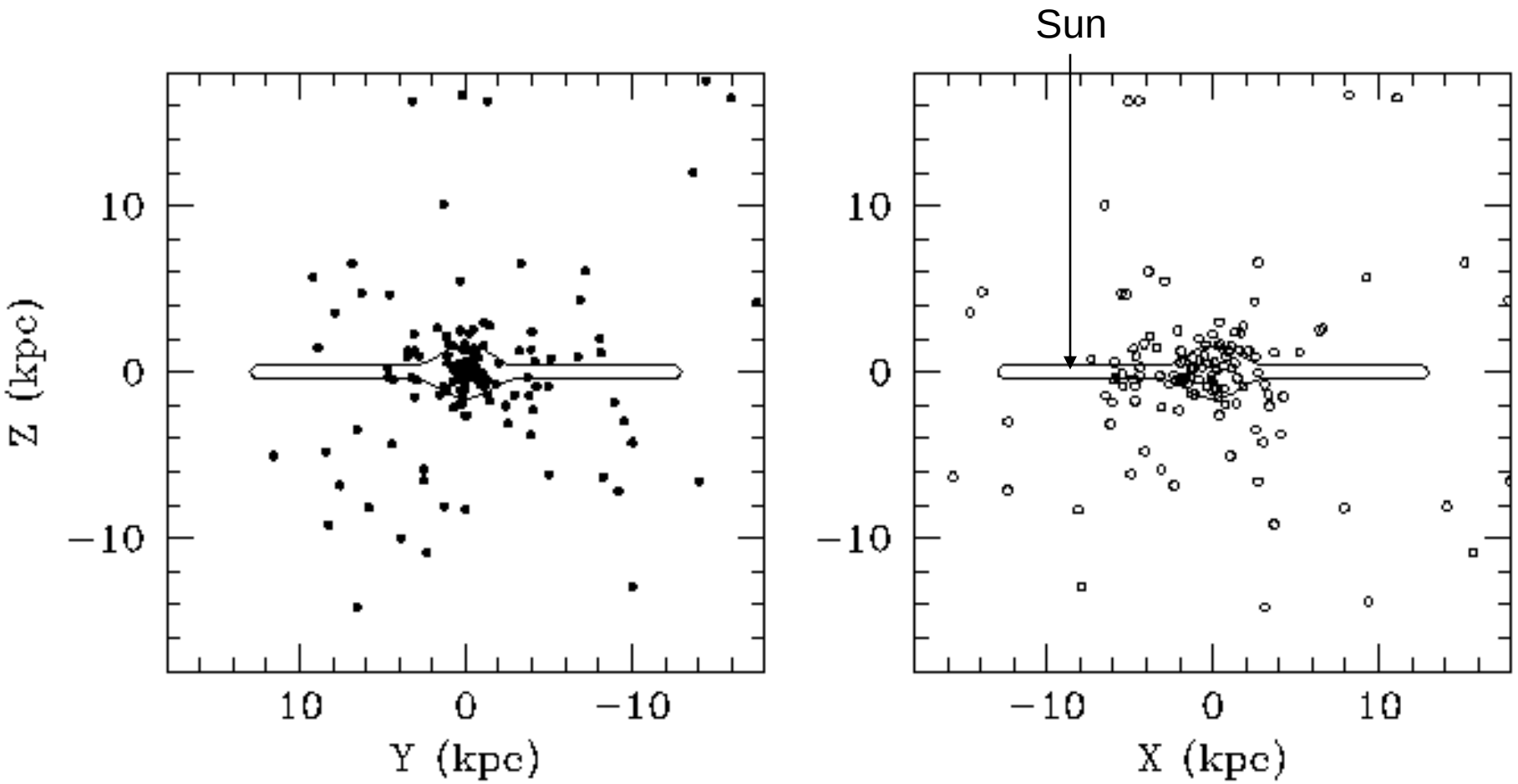
- Dust lane where material enters spiral arm, then H II regions, then blue stars

Credit: NASA and The Hubble Heritage Team (STScI/AURA)

The Galactic Halo

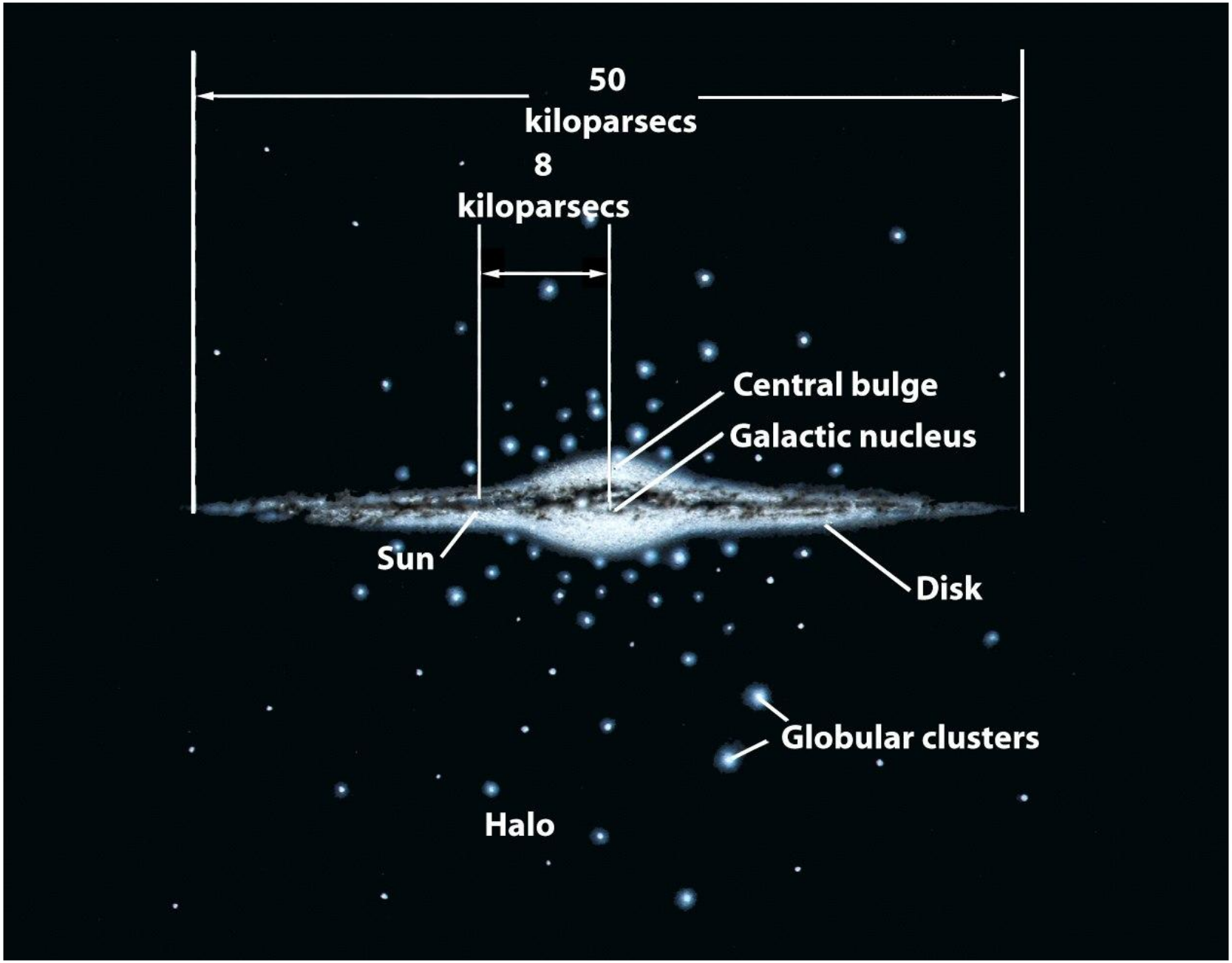
- The plane of our galaxy is surrounded by a more spherical halo of objects
- Consists of globular clusters and halo stars
- Total radius of the halo is ~ 100 kpc

Globular Cluster M80: NASA HST



Distribution of nearby globular clusters in the plane of the Galaxy

Harris, W. E. "Globular Clusters", 1999, Cambridge University Press



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Formation of the Galaxy

- Spherical halo formed first out of metal-poor material
  - One initial burst of star formation and none since
- Disc formed later
  - Continuous star formation leading to metal-rich population
- Bulge also has some metal-rich stars as a result of mergers with small galaxies

Summary

- Our Galaxy is a SBb or c
- The disc is surrounded by a spherical galactic halo
- The galactic halo is made up of Population II objects and was formed at an earlier stage than the disc