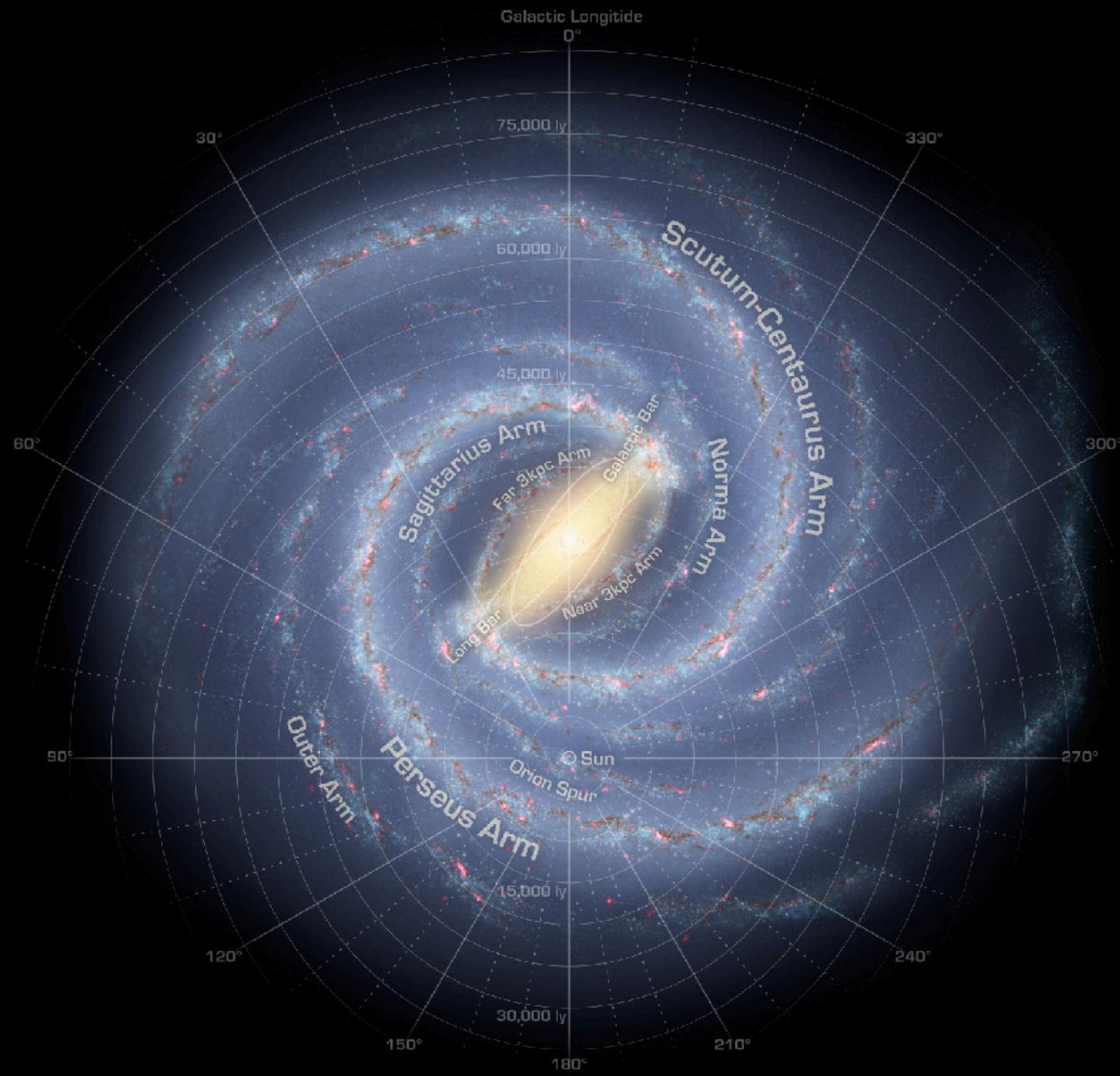
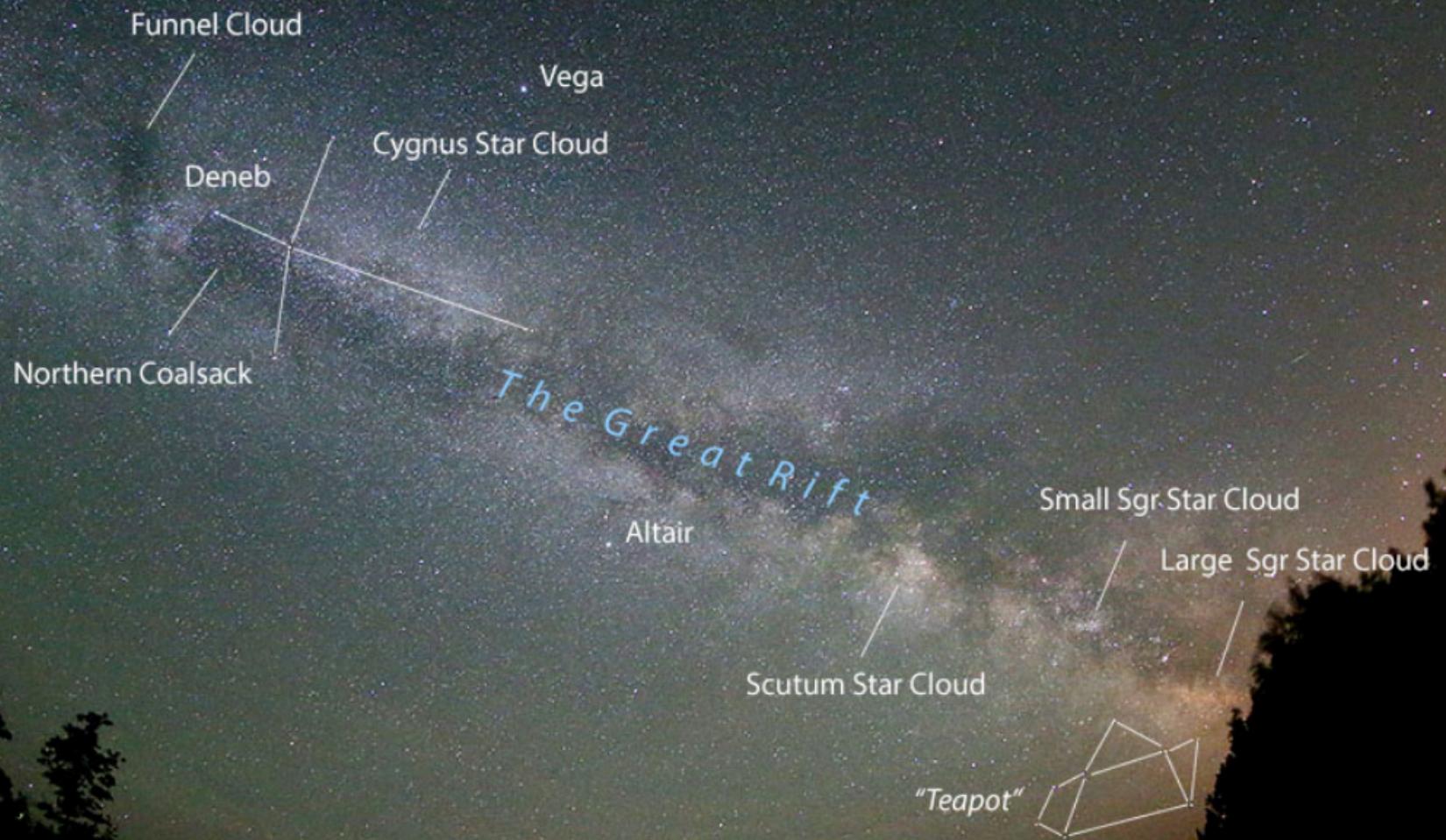


# Planets are everywhere!

- Many different detection techniques
  - Earths still challenging
  - Atmospheres very challenging
  - Many biases to larger planets, closer objects
- Planet Formation
  - Observational evidence for unseen planets
  - (seen in one case)
- Understanding planet formation:
  - Microscopic interactions on tiny scales lead to planets
  - Simulations In combination with observations





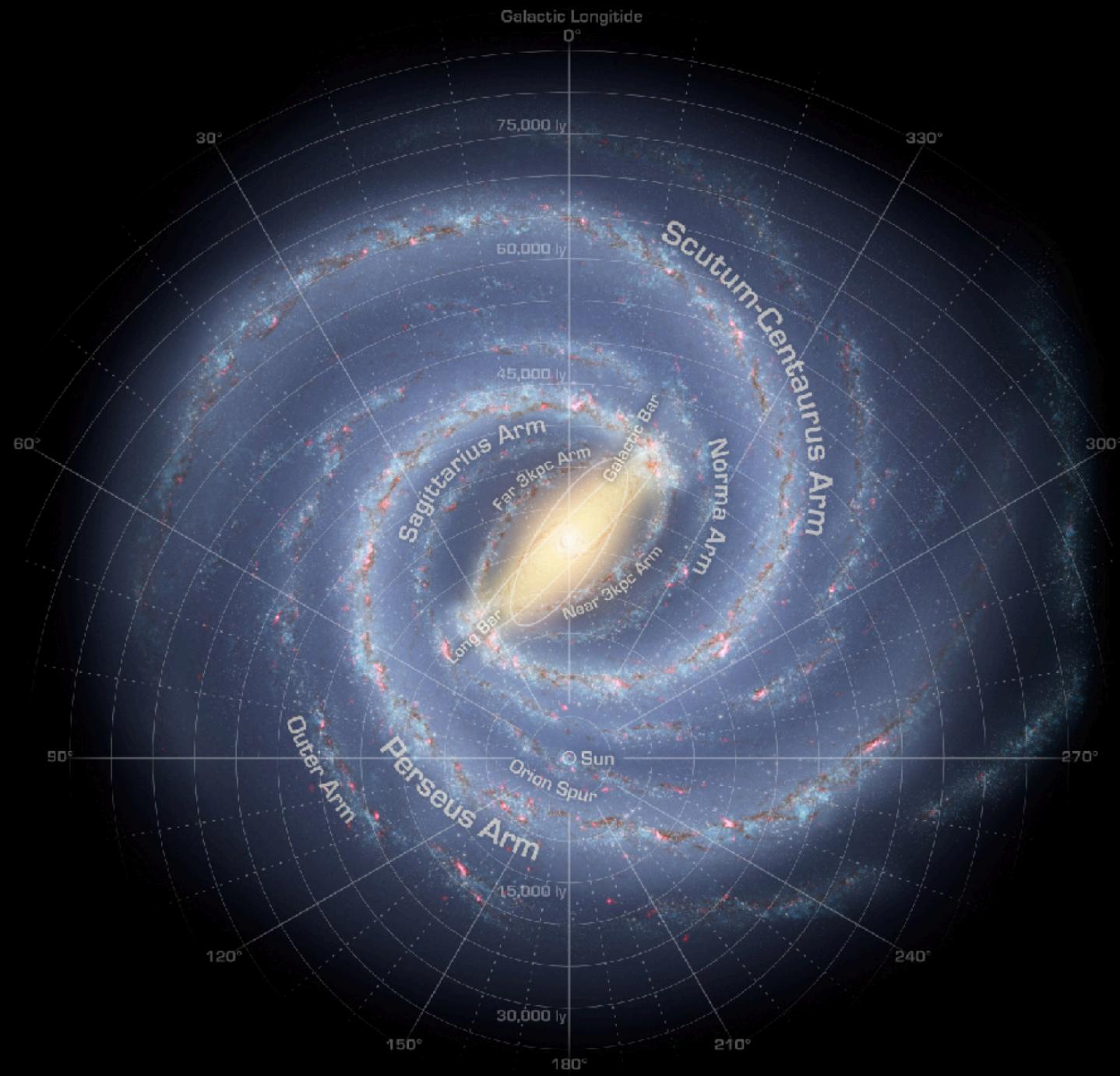


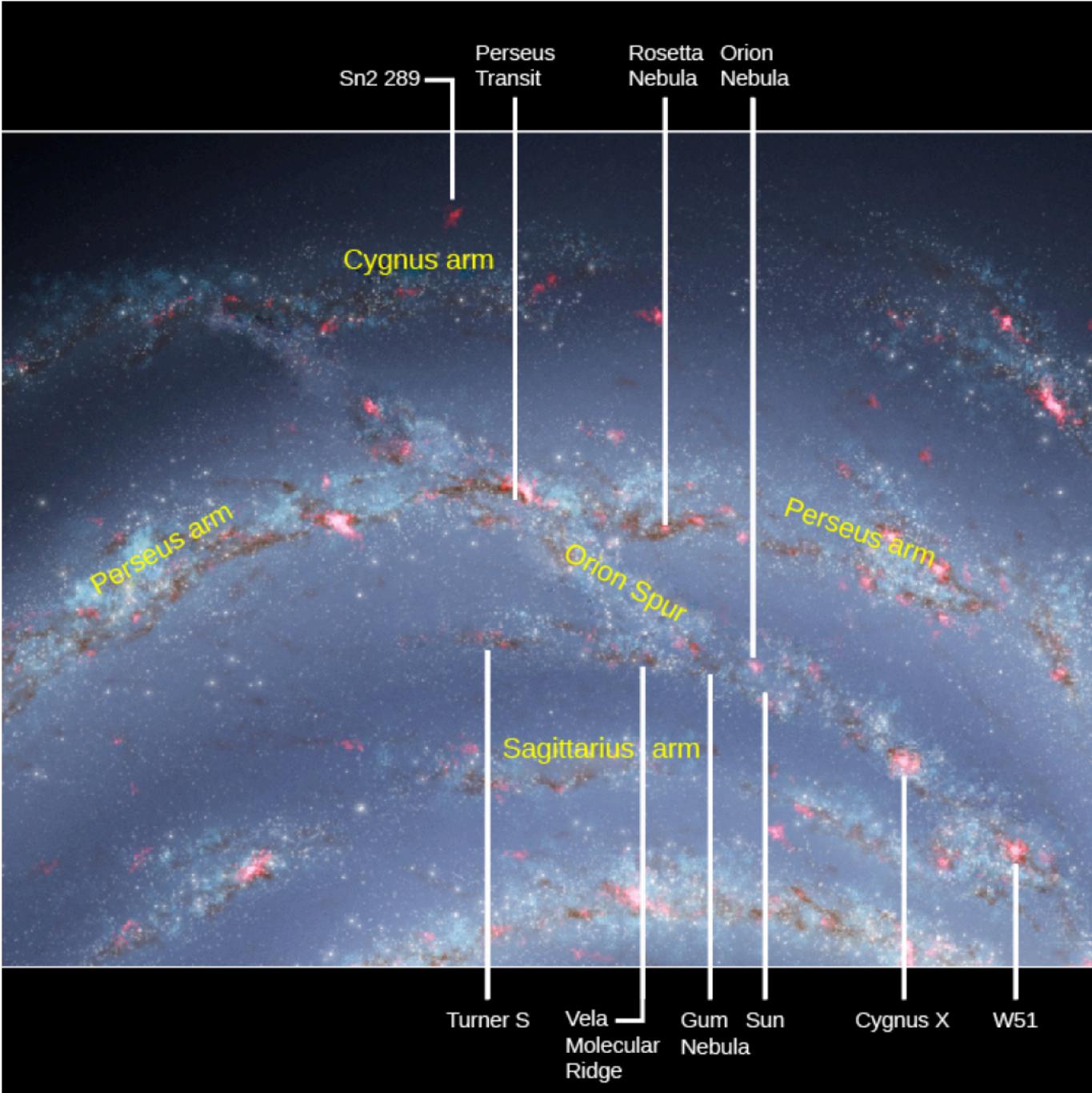
# Milky Way: keywords

- Galaxy: gravitationally bound system of stars, gas, dust, and dark matter.
  - 1000-100,000 light years in radius
  - Many kinds of shapes and sizes
- Range:  $10^8$ - $10^{14}$  stars
  - Milky Way:  $10^{11}$  stars (a large galaxy)
- Supermassive black hole
  - Milky Way:  $4 \times 10^6$  Msun (small central black hole)

# Milky Way: keywords

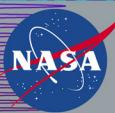
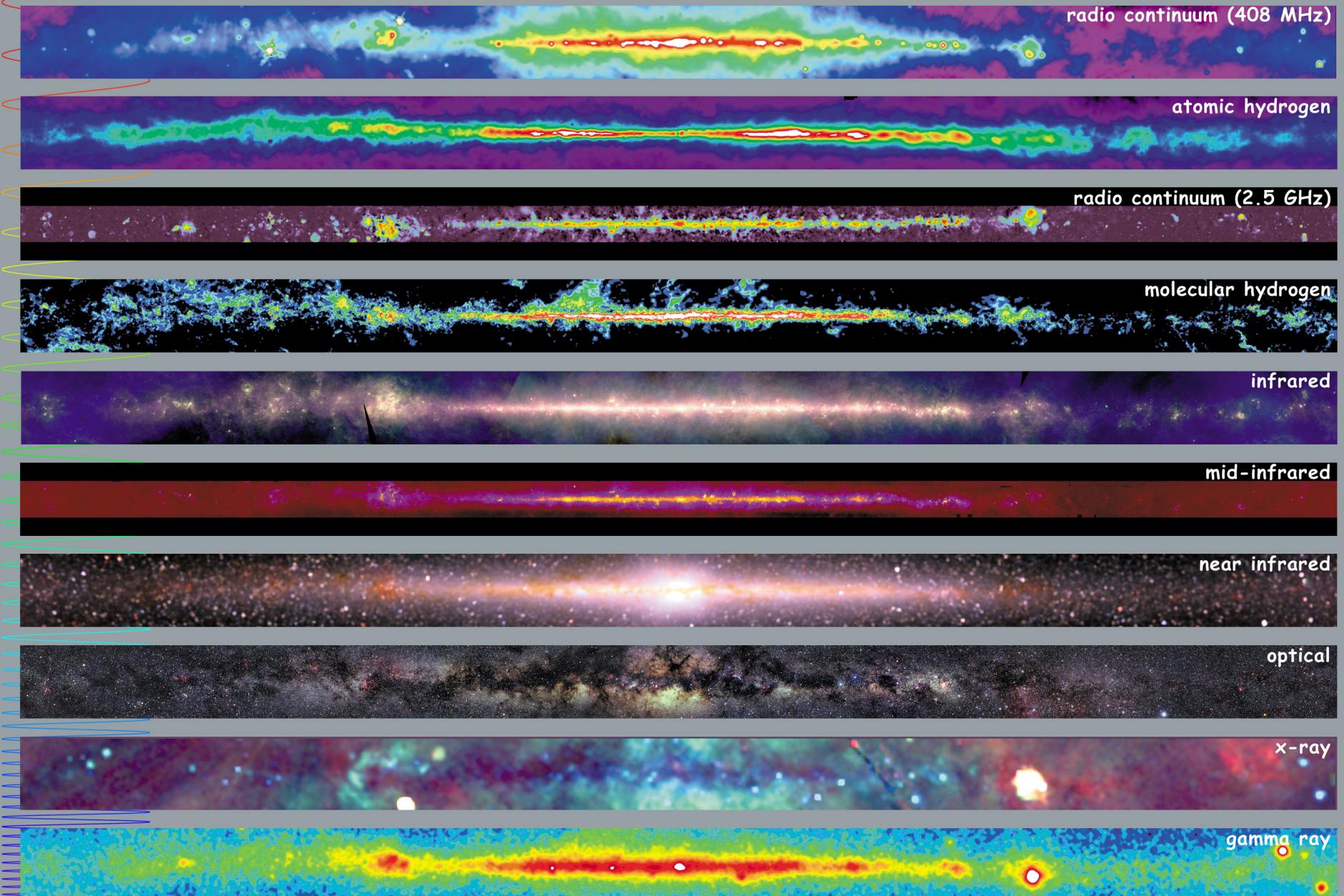
- Spiral arms: “shape” of young stars/dense gas in some galaxies
- Supermassive black hole: massive black hole at center of galaxy
- Dark Matter halo: spherical halo of dark matter around the galaxy
- Galactic rotation: rotation of stars/gas around galaxy
- Central bulge: bulge around nucleus of galaxy





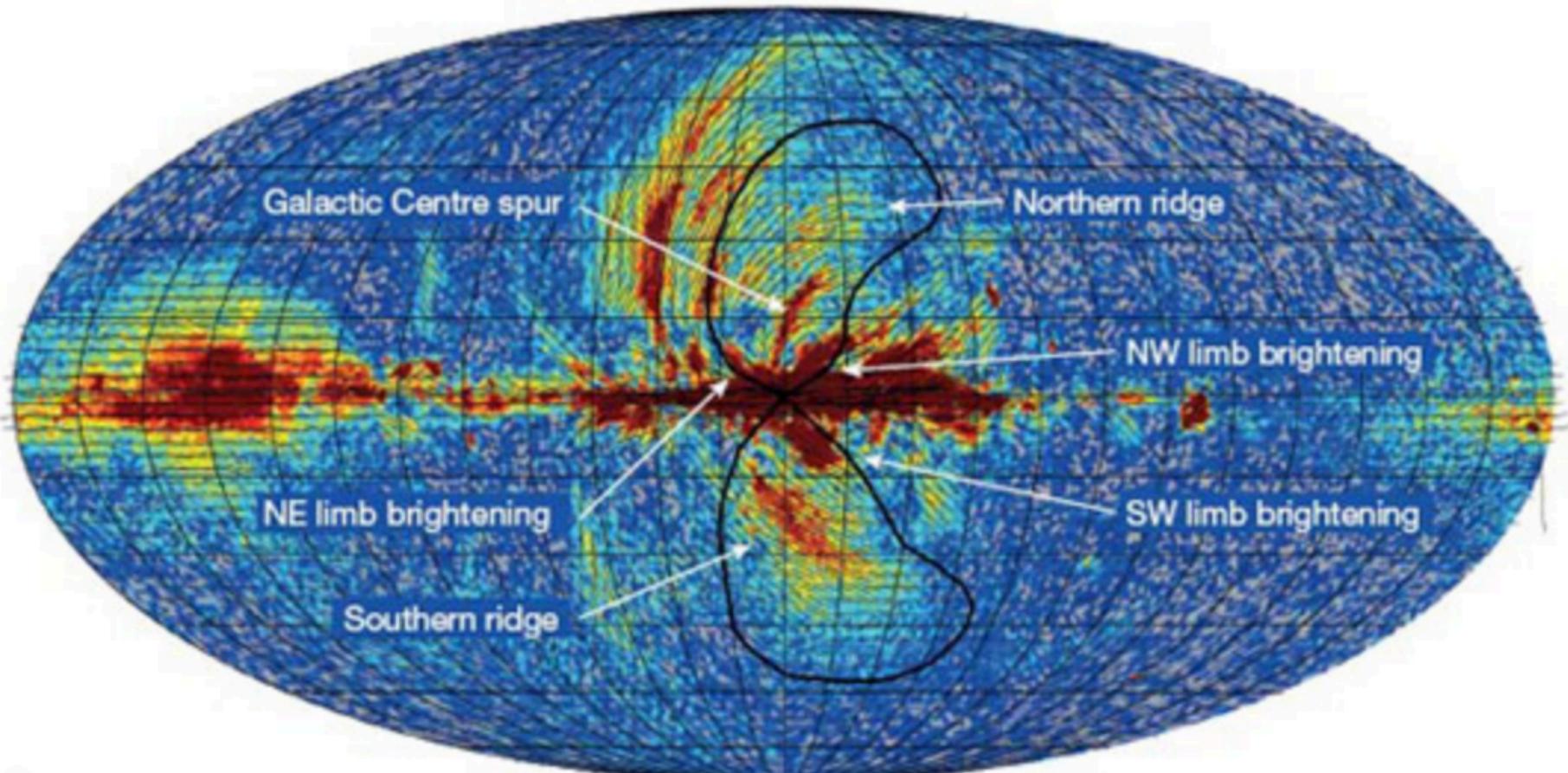
# All-sky optical map





Multiwavelength Milky Way

# Milky Way/All Sky: radio emission



# All-sky Gamma Ray emission

