

**Topics:** Milky Way kinematics and central black hole

**Reading:**

- Read secs. 2 and 7 of Ch. 19.
- Skim secs. 3 through 6 of Ch. 19.
- Look over slides posted on the website.

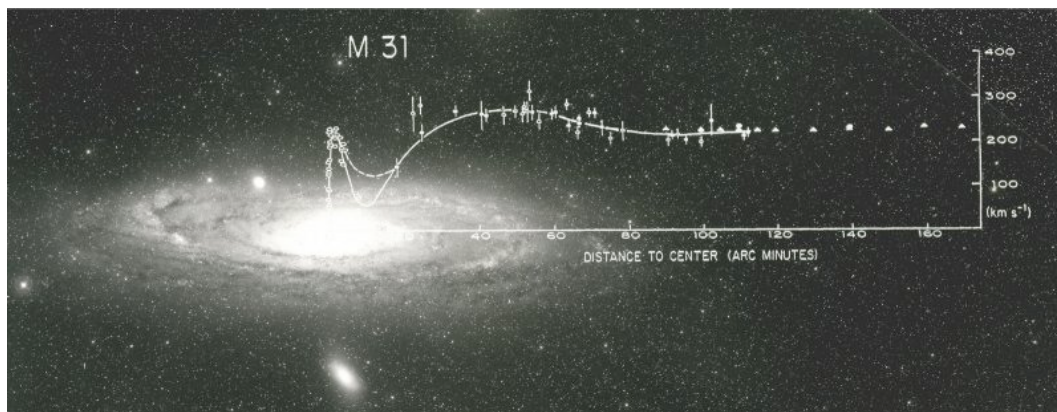
**Summary of work to submit:**

- Nothing to hand in for this class. But do look up information/images about the Galactic center on *Astronomy Picture of the Day*.

For section 2, note: Kepler's third law – very useful here, as it is for satellites, exoplanets, and binary stars, because the gas, dust, and stars in the Milky Way are all independently orbiting (in more-or-less circular orbits) the center of the Galaxy. Make sure you're very comfortable with the concept of the *rotation curve* (as shown in Fig. 19.7) and how it, plus Kepler's third law (eqn. 19.13) allows us to not just weigh the Galaxy but trace out the radial distribution of mass in the Galaxy. This is our first encounter with *dark matter*. Make sure you understand how the flat rotation curve (plus observations of how luminous matter (stars) is distributed in the Galaxy leads us to infer that our Galaxy is full of dark matter). This dark matter is not (primarily) stars, planets, or neutrinos. It appears to be a yet-to-be-directly-detected type of heavy subatomic particle.

Skim sections 3, 4, 5, and 6 – *but* note the definition of proper motion (vs. three-dimensional space motion) and the concept of the local standard of rest (in our rotating galactic disk).

Finally, read §19.7 on the nucleus (center) of our Galaxy, focusing on the evidence for a supermassive black hole (SMBH) residing there. Again go to APOD and look at a few images of the galactic center. See if you can find a time-lapse version of Fig. 19.23, showing how the stars around the SMBH move.



The Andromeda Galaxy with its rotation curve superimposed to scale. If the mass were concentrated at the center, like the starlight is, then the orbital velocity of gas clouds would fall off with distance from the center of the galaxy, just as planets' orbital velocities decrease with distance from the Sun in our solar system. This figure is courtesy V. Rubin.