Astronomy 102 — Recitation 2

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Fall 2024

Review of lectures 2 & 3 and the book's Prologue.

Unit conversions

- 1 erg = 1 g cm^2 s^{-2}
- $1L_\odot = 3.8 \times 10^{33}$ erg/s
- 1 Watt = 10^7 erg/s

Typical Luminosities

- Normal stars: around $1L_\odot$
- Giant stars: thousands to hundreds of thousands of $L_\odot$
- Normal galaxies: $10^9 - 10^{10} L_\odot$
- Quasars: $10^{12} - 10^{13} L_\odot$

Rates

- Speed: $v = \frac{\Delta x}{\Delta t}$
- Luminosity: $L = \frac{\Delta E}{\Delta t}$

Solar-mass sized black hole

- The event horizon: a minimum radius around a black hole within which nothing can escape the black hole's gravitational force
- No thrust is required for maintaining a circular orbit around a black hole, and there is one speed corresponding to an orbit of each radius. If you are going either two fast or too slow, you will drift until you reach the correct orbit for your speed.
- To decrease your orbital radius, you must slow down. Likewise, to increase your orbital radius, you must speed up.
- As you get closer to a black hole's event horizon, your emitted pulses of laser light appear to become more and more red to those remaining in the orbiting starship — example of Doppler shift.
- The warped space around a black hole causes an orbit's circumference to become much less than $2\pi r$.
- Gravity will tug more at your feet than your head as you fall feet-first into a black hole — this differential gravitational force is known as a tidal force.

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In-class problems

1. Convert $5.9 \times 10^{35} L_\odot$ to Watts.
2. The radius of the Earth's orbit around the Sun is 1.5×10^{13} cm. What is its orbital speed (assumed constant)?
3. How long should it take to get from here to Buffalo (60 miles away) traveling at the Thruway speed limit (65 mph)?
4. What is your "luminosity" (in erg/s) if you eat 3000 calories in a day and do not gain or lose weight?
5. What would be the most exciting aspect of a journey to the center of our galaxy? What do you think would be the most dangerous aspect of visiting the black hole that you would find there? Why?