ASTRONOMY 8400 – SPRING 2024
Final Exam – Due April 30, 2024 at 10:30 am

1. Draw a Hubble tuning-fork diagram.
   a) Describe how morphology (visual appearance) changes with galaxy type along the sequence.
   b) List the major modifications incorporated by deVaucouleurs.
   c) Describe how at least 5 other observed properties change along the sequence or a portion of the sequence.

2. List four ways in which we can determine the masses of supermassive black holes in galaxies using resolved spectroscopy and imaging and give the advantages and disadvantages of each technique.

3. Suppose you took an image of a spiral galaxy and found that its major axis was at a position angle of 90°, and the major/minor axis ratio was 2.0. Then you took a long slit-spectrum along its entire major axis and measured radial velocities that ranged from 800 to 1000 km s^{-1}.
   a) What is the inclination angle of the galaxy?
   b) What is the galaxy's distance?
   c) What is the true maximum rotational velocity (corrected for inclination) in the rest frame of the galaxy?
   d) What is the expected maximum radial velocity at a position angle of 30°?

4. List the basic steps to generate a synthetic spectrum for a galaxy. Include the basic steps needed to create an initial mass function (IMF).

5. List the various items of observational evidence for dark matter in the Universe. How does the mass/light ratio change (quantitatively) with size scale, and what does that tell us about the distribution of dark matter?

6. Give a brief description of the following terms and give an equation when applicable. (2 pts each):
   a) Schechter luminosity function
   b) Effective radius
   c) Contributions to sky background (list)
   d) Holmberg radius
   e) Distance limit for trigonometric parallax.
   f) Distance modulus equation including corrections (for the V band)

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g) Spider diagram
h) Radius of influence for a supermassive black hole
i) Lensed objects useful for time-delay distances
j) Ways to measure star formation rate
k) Star formation “main sequence”
l) Red sequence, blue cloud
m) ULIRG
n) Sersic profile
o) Gaia
p) Moving cluster method
q) Baseline for secular parallax
r) Kinematic distance relationships for ellipticals and for spirals
s) Type of star used for Baade-Wesselink method
t) Relationship used to determine distant Cepheid distances
u) Limitations for Main-Sequence Fitting technique
v) Types of galaxies best for distances from surface brightness fluctuations
w) Supernova type Ia – physical explanation
x) Luminosity functions of these objects are used for distance determinations
y) Hubble Tension