2017 Midterm Review

Galaxy classification – BM Ch 4.1
- Hubble and other classification systems
- Trends of physical (gas content, star formation) and morphological galaxy properties along Hubble sequence

Photometric Properties of Ellipticals – BM 4.2-4.3, SG 6.1
- Surface Brightness profile for E's – DeVaucouleurs ($R^{1/4}$), Sersic
- Centers of Ellipticals (core/coreless)
- Triaxiality – Disky/boxy isophotes and relation to other physical properties

Photometric Properties of Spirals – BM 4.4, SG 5.1
- Surface Brightness profile for disks - exponential
- vertical distribution – scale height

Ellipticals – stellar pops and ISM - BM 4.3, 8.3, 11.1, 11.2, SG 6.3
- Trends with luminosity, color, metallicity, gas content, X-ray/radio emission
- Kinematics – how do we measure velocity dispersion and rotational velocity
- Typical values for V_{rot} and sigma
- Faber-Jackson ($L \sim sigma^4$)
- Fundamental plane and how it relates to VT

Spirals – ISM, structure and Kinematics - BM 8.2, 11.3, SG 5.2-5.3
- Gas content/distribution, velocity maps, rotation curves
- MW and the Sun's LSR (know V_o and R_o)
- Typical values for V_{rot} and sigma
- Tully-Fisher ($L \sim V_{max}^4$)
- $M(R) = \frac{V^2(R)R}{G} \rightarrow \rho(R) = \frac{V^2}{4\pi G R^2}$
- Metallicity in disks (compared to closed-box chemical evolution model)
- Spiral structure - density waves, kinematic spiral

Potential Theory and Orbits - BT 2.0-2.2, 3.0-3.4, SG 3
- Gravitational potentials – Poisson's equation $\nabla^2\Phi(R,z) = 4\pi G\rho(R,z) = \frac{\partial^2\Phi}{\partial z^2} + \frac{1}{R}\frac{\partial}{\partial R}\left[R\frac{\partial\Phi}{\partial R}\right]$
- Spherical potentials and orbits – rosettes
  - Integrals of motion – conservation of energy and momentum
  - Two extreme potentials $\Phi = -\frac{GM}{R} \qquad \Phi = \frac{1}{2}\Omega^2 R^2 + const$
- Axisymmetric potentials and orbits $\Phi_{eff} = \Phi(R,z) + \frac{L^2}{2R^2}$
- Nearly Circular Orbits – epicycle approximation
- Crossing time/Relaxation time $t_r = \frac{V_v^2}{\Delta V^2} t_c \simeq \frac{N}{8lnN} t_c$
- Collisionless Boltzman Equation

Example question:

What is the fundamental plane? How does it relate to the virial theorem and what does this relation tell us about the type of galaxies that lie in the fundamental plane?

Draw a typical rotation curve for a spiral galaxy. Derive the density distribution required to produce this rotation curve at large radii. How does this indicate the presence of dark matter?

Calculate the mass interior to the Sun's orbit using accepted values for V_o and R_o.