Galactic Astrophysics Qualifying Exam (2018)

1. (a) What is the Tully-Fisher relation, and what application can it be useful for? (10%) (b) What is the Faber-Jackson relation? (5%) (c) What is the de Vaucouleurs profile and what kind of object does the profile apply to? (10%) (d) What is the exponential disk profile? (5%)
2. Please derive the tensor virial theorem for a system of collisionless particles? (20%)
3. What are constants of motion for a classical single particle? (10%) In a dynamical equilibrium, the solution of the equilibrium distribution function f(**x**, **p**) describing a system of collisionless particles must obey certain conditions involving constants of motion. What are these conditions and how do you show your results? (15%)
4. In a uniform rotating infinitesimally thin disk, what is the role of rotation in terms of the stability of the disk? (5%) What are the stability criterion of such a disk? Please derive this criterion. (15%). What is the most unstable wavenumber? (5%)