Physics 224: Paper Discussion 5
Winter 2020

Larson 1981:

- I was very surprised that their eye-fitted relations closely match the data despite the lack of statistical rigor. On the other hand, it's great that they explained the physical origin of the stellar initial mass function (IMF) and the turnover at 0.1 Msun. My question is what sets the length scale of the turbulence in molecular clouds? Why isn't there turbulence on scales of 1km, for example?

- At the end of the paper they mention the larger clouds must be created by large scale motion I'd expect that these systems are at least some what separable like different scales of waves in the ocean? Would this be true or is there a stronger feedback between these?

- On page 818 the author discusses the possibility of gravitational contraction causing unusually high velocity dispersion. Have there been any observations after this paper of regions that are known to be undergoing/have recently undergone gravitational collapse?

- For the object OMC1, the authors first explain its' scatter in Sigma as an affect of viral equilibrium "A positive correlation between velocity dispersion and mass for a given size is just what would be expected if all of the objects studied were in approximate viral equilibrium". Later, the authors suggest the scatter is signature of Gravitational Collapse. This is slightly confusing, can these two descriptions of the scatter co-exist, or are they in opposition?

- How exactly can gravitational collapse produce supersonic turbulence? Can this account for all of the supersonic turbulence observed in the molecular clouds? What other sources could there be?

- It seems that given the life time of Molecular clouds ($\sim 10^7$ years), the clouds must be continuously reforming in galaxies which exhibit star formation. Since we know of galaxies that exhibit little to no star formation, those with reasonable star formation and Starburst galaxies undergoing massive star formation, it would be reasonable to assume that the length scale of the mechanisms leading to sustained formation (or refurbishment) of molecular clouds would be at the galactic diameter length scales.

- The overall trend in velocity dispersion as a function of cloud size L is explained in the paper by a common hierarchy of interstellar motion, but they mention that the amplitude of the fluctuations varies across regions. What processes drive the amplitude differences, and are they relevant in the dynamics of the gas?

- In figure 5, Larson states column density is nearly independent of size, but then he states "the correlation could also be produced partly by observational selection effects if only a limited range of column densities can be detected by the available techniques." Have newer observations supported the data in this figure? What implications would a non-constant column density have?

- The paper mentions that the maximum lifetime of a molecular cloud is expected to be around 10^7 years. Is there a way to accurately measure the age of a molecular cloud? How short is the timescale for cloud formation to star formation compared to the total lifetime of a cloud?

Goodman, Pineda & Schnee 2009:

- Do the results of this paper retroactively void any prominent outstanding results regarding Molecular Clouds?
- Given the recommendations of the authors in section 5.4, is this the standard used today? I'm guessing by the inclusion of this paper in our discussion sessions, that it is. Does it cost more (time, money, other resources) to use one method over another? Is there an efficiency gain for using less than the optimal "holistic" approach recommended in this paper?
- There was a quick section in the paper on "How common are log-normal-like density distributions?" in which it was stated that some other studies did not find a similar distribution. The paper claimed this was from background clouds and velocity components along the line of sight. I found some more recent papers claiming a power law for column density distributions for some molecular clouds and a log-normal-like distribution for others. Could you comment on the boundaries and assumptions when determining how common log-normal-like density distributions are?
- In section 5.4 the authors discuss that using dust to estimate column density should not be done in regions where the dust to gas ratio is not well constrained. Have people attempted to use these measures of column density to instead determine the dust to gas ratio (i.e. work backwards from using the dust to gas ratio to get at the column density)?
- First off, I really enjoyed the Alien in Figure 4! In Equation 1, the additive constant is present because there needs to be a critical amount of "matter" in order to collisional excite CO. By Critical density of matter, are they making a reference to the critical density of CO or H? Additionally, one assumptions made is that the abundance of CO to H is constant. Is the abundance supposed to be constant along the line of sight? Or constant over a surface region?
- They state different cases for when to use molecular lines and when to use extinction, but for in between cases is it worth weighting these to come up with a single answer, or would this just convolute the errors?
- How consistent are the results in this paper for molecular clouds other than Perseus?
- Can current simulations provide accurate gas/dust ratios across a large dynamical range? I'm asking because we then just use this to make dust the ultimate tracer for column density. This is of course against what the paper recommends