Star Formation – HW #4

Due Friday November 2 by 6pm. Please submit in person or by email. Answer the following and how all work.

1. **To Be or Not to Be: Dense Cores and the IMF**

As we discussed in class, one theory for the IMF builds on the similarity between the IMF and CMF shape. In this problem we'll explore this idea using our previous NGC1333 $C^{18}O$(1-0) data.

a) Use the $C^{18}O$(1-0) map to identify a set of dense cores in NGC1333. There are a variety of ways to identify structures in 2D and 3D data. Pick one, make a plot showing the cores you found and explain how the method you choose works. Does the method have any free-parameters and if so, what choices did you make and why?

b) Use the relationship between column density and and intensity that we derived in HW2 to determine the masses of your cores. How does your core distribution compare to the IMF? Explain any differences or similarities.

2. **Twinkling Stars: Infrared Luminosity as a Star Formation Rate Tracer.**

We use a variety of indirect indicators to measure the star formation rate in galaxies, and one of the most common is to measure the galaxys infrared luminosity. The underlying assumptions behind this method are that (1) most of the total radiant output in the galaxy comes from young, recently formed stars, and (2) that in a sufficiently dusty galaxy most of the starlight will be absorbed by dust grains within the galaxy and then re-radiated in the infrared. We will explore how well this conversion works using the popular stellar population synthesis package Starburst99 (Leitherer et al., 1999; Vzquez & Leitherer, 2005), http://www.stsci.edu/science/starburst99/.

a) Once you have read enough of the papers to figure out what Starburst99 does, use it with the default parameters to compute the total luminosity of a stellar population in which star formation occurs continuously at a fixed rate $\dot{M}$. What is the ratio of $L_{tot}/\dot{M}$ after 10 Myr? After 100 Myr? After 1 Gyr? Compare these ratios to the conversion factor between L_{TIR} and $\dot{M}$ given in Table 1 of Kennicutt & Evans (2012).

b) Plot $L_{TOT}/\dot{M}$ as a function of time for this population. Based on this plot, how old does a stellar population have to be before L_{TIR} becomes a good tracer of the total star formation rate?

c) Try making the IMF slightly top-heavy, by removing all stars below $0.5M_{\odot}$. How much does the luminosity change for a fixed star formation rate? What do you infer from this about how sensitive this technique is to assumptions about the form of the IMF?