Selection of Homework Questions

Next Prev Print

Topic 11: Star Formation & Starbursts

(1) Emission from Star Forming Galaxies:

a. Galaxies with high star formation rates are often conspicuous members of radio, FIR, optical emission line, UV and even X-ray surveys. Outline the various physical mechanisms that explain why vigorous star formation yields such diverse emission. Why can starburst galaxies be so much more luminous than normal galaxies, even though these normal galaxies may have a much higher mass of stars?
b. What are the various physical principles that lie behind using the luminosity of these different wavebands to yield a quantitative estimate of the star formation rate, in $M_\odot\ yr^{-1}$. Your answer should include a discussion of the various strengths and weaknesses of each method.

(2) Rates of Star Formation:

a. Star formation rates vary enormously from one galaxy to another. What are the primary and secondary factors that seem to influence the star formation rate in galaxies?
b. What factors do **not** seem to be relevant in determining the SFR?
c. During mergers, what seems to set the maximum star formation rate?

(3) Two kinds of star formation:

Compare and contrast star formation that occurs in galaxy disks with star formation that occurs in galaxy nuclei.

(4) Starbursts :

Consider the merger of two normal late type spiral galaxies each with (undisturbed) flat rotation curve ~200 km/s and disk gas fraction ~10%. Assume that over a dynamical timescale, the entire ISMs within 10 kpc of both galaxies goes to the center and undergoes a starburst with constant SFR in which 50% of the gas is converted into stars.

a. Approximately, what are the FIR and Hα luminosities of the starburst ?
b. For a Salpeter IMF [$N(M) \propto M^{-2.35}$] with upper and lower limits of 100 and 0.5 $M_\odot$ respectively, what is the supernova rate if all stars with $M > 10M_\odot$ explode ?
c. Taking the total energy release from each SN as $\sim 10^{53}$ erg with 1% energy as kinetic (99% neutrinos), how does the SN energy input compare to the net photon luminosity (as tracked by the FIR emission) ?
d. If all the SN blast energy goes into the remaining gas, what temperature is it ?
e. Would it escape from the galaxy ?
f. If each supernova injects 1 $M_\odot$ of "metals" which become mixed into the gas, what is the net metallicity of the remaining gas (recall $Z_\odot = 0.02$ = fraction of mass in metals).

(5) Superwinds:

Write a brief essay on: "Galactic Superwinds", using as source material the articles by Heckman and Strickland in the 2001 ASP conference series (or other review articles you might find on the web). Structure the essay by topic, making sure to include observational aspects; physical processes; cosmological importance. Set the level of the essay for non-specialist astronomers. Use this question to practice writing concisely and accurately -- i.e. do **not** adopt the style you might have done on previous questions, where I'm only interested in whether you know the subject. For this question, imagine you are submitting the essay as a summary article for a conference proceedings.

Home Main Index Links