PROBLEM SET 9, ASTRONOMY 216

1. This problem concerns the global effect of SNR and superbubbles on the ISM. Each SNR carves out a spherical volume if the ambient density is uniform. Consider Type II SN, which occur at a rate $\sim$ 50 yr^{-1} (see class notes). The fraction of interstellar volume filled by the cavities $\sim \frac{Q}{1+Q}$, (Heiles 1987, ApJ, 315, 555), where Q is the porosity parameter,

$$Q = R_{SN} \int V_{SNR} dt \tag{1}$$

as defined in the seminal paper by Cox and Smith (1974 ApJ, 189, L105).

Neglect the clustering of SN and use the Galactic parameters in the notes. Take the ambient density $n_0 = 1$ cm^{-3}. The SNR evolution during the late stages, which includes radiation, is most accurately given by Cioffi et al (1988, ApJ, 334, 252) as discussed in the notes (see equations in the notes or the discussion in their paper). One normally assumes that the shell expands until its velocity decreases to the ambient sound velocity, say 10 km s^{-1}. After it stalls, the ambient medium penetrates at its sound velocity.

Are SN a significant influence on the ISM?

2. Now include the clustering effects; clustered SN produce superbubbles. Calculate the approximate fractional area of the disk covered by superbubbles that break out of the Galactic gaseous disk to produce chimneys.