Irregular Galaxies

- Irregular Galaxies are divided into two subclasses namely Irr.1 and Irr.2. Another less prominant subclass are the Dwarf Galaxies.

    1. Irr.1 shows some spiral structure but it appears to be disrupted.Some catalogs break this sub-type down even further into those that exhibit either spiral features (Sm) - or barred spiral features (SBm) - and those that have structure, but not not structure associated with spiral galaxies such as a central bulge or arm features. These are therefore identified as "Im" irregular galaxies.
    2. Irr.2 is more disrupted than Irr. 1 and looks like they have been victims of some type of violent event which has completely disrupted their original shape.When they were formed through gravitational interaction, the tidal forces were strong enough to eliminate all identified structure of what galaxy type it may have been previously.
    3. The dwarf galaxies tend to have low metallicity and may form in a different way than normal sized Irregular galaxies. However, some galaxies currently classified as dwarf Irregulars are simply small spiral galaxies that have been distorted by a much larger nearby galaxy.Four Dwarfs are present in the local group.

- Large Megellanic Cloud and Small Megellanic cloud are the two Irregular Galaxies within the Halo of the Galaxy.

Figure 1: Comparison of Small Megellanic cloud with Globular cluster in the Halo

Spiral structure and the Winding Problem

$$t_{1/2}(w_1 - w_2) = \pi \tag{1}$$

$$t_{1/2} = \frac{P_1 P_2}{2(P_2 - P_1)} \tag{2}$$

- Observationally at r = 6 Kpc and r = 10 Kpc, $\Rightarrow V_1 = 220Kmps$
- Solving the above equation gives value of $t_{1/2} = 90$ million years
- So this time is very small compared to the age.So by this time spiral arms may no longer be distinguished.
- The formation of the spiral arms is related to Density waves passing through the disk which trigger star formation.

Surface Brightness(I)

- surface brightness of the sky is defined as the rate at which energy is reaching at unit area of the detector per unit time from a small region of 1 $(arcsec)^2$ of the sky
- Surface brightness is defined for an extended source.It is independent of the distance of the source from us
- If the size of the area considered is a square of size D, then the angular size of the object is α given by,

$$\alpha = \frac{D}{d} \tag{3}$$

$$I = \frac{L}{4\pi d^2(\alpha)^2} \tag{4}$$

$$I = \frac{L}{4\pi D^2} \tag{5}$$

- From the above equation it is evident that I is independent of the distance . Logically, this is true because as the distance increases,even though the brightness of individual stars decreases,the part of the galaxy which is visible increases this balances the value of I.
- Sky brightness sets a limit to the detection of Galaxies.The light from the moon also causes discrepancy in the brightness measured.Shown below is a table containing the lunar age and corresponding night sky brightness in different filters.

Days from new moon	U	B	V	R	I
0	22.5	22.8	21.8	20.9	19.7
3	22.3	22.5	21.6	20.8	19.6
7	21.4	21.4	20.7	20.2	19.1
10	20.4	20.3	19.6	19.2	18.2
14	19.3	19.1	18.5	18.2	17.3

Figure 2: Lunar age vs night sky brightness(magnitude)

- Airglow can be another limiting factor.It is caused due to rotational-vibrational transitions in molecules like carbon dioxide,Water molecules etc. in the atmosphere.