

DWARF GALAXIES IN THE LOCAL GROUP

Almost all dSphs belong to the Milky Way or M31

dIrr galaxies have a broader distribution thru local Group

Both dIrr & dE/dSph can have very low central surface brightness

Irr galaxy ~~are~~ called dIrr at

$$L \leq 10^8 L_{\odot}$$

(LMC has $L_V = 1.7 \times 10^9 L_{\odot}$
SMC $3.4 \times 10^8 L_{\odot}$)

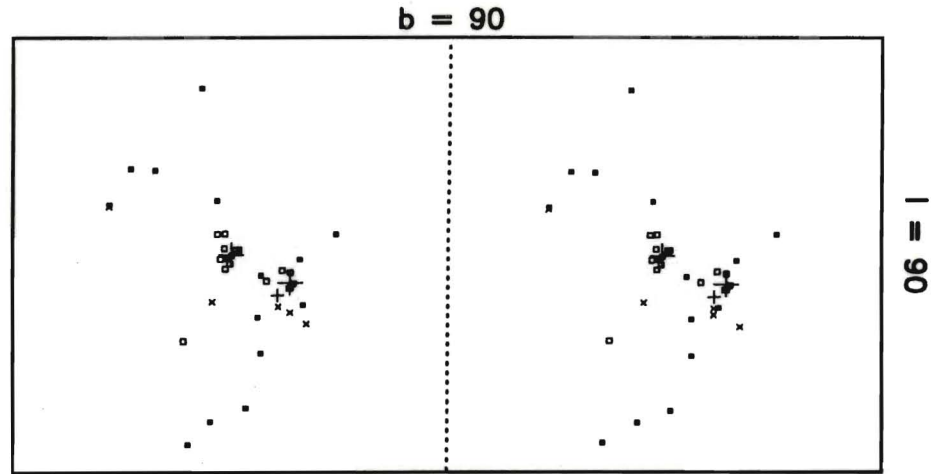
NGC 55 is located
 group. Perhaps
 history in which the
 and have "stretched
 Alternatively, this
 where the surface
 very high. NGC55

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 S

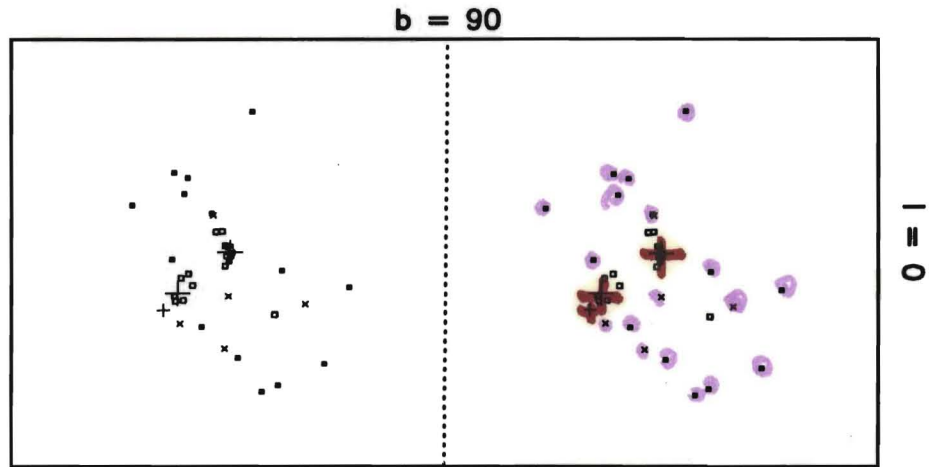
properties of Local
 many Local Group
 diameter to over 40° .
 extent of the larger
 at 1987, Bothun &
 low surface bright-
 galaxies but greatly
 theless, there have
 egrated properties
 e Vaucouleurs, and
 its remain the only
 Ables 1965, 1968,

es 1 and 2. From *top* to
 ctively. The directions
 e *top* and *right edges* of
 the Milky Way, which
 r *large cross* represents
 alaxies (see Table 1 for
 ms (denoted dIrr/dSph
 t 250 kpc apart.
 stereo pairs; the Local
 distinct structure in the
 subgroup; this is best
 The *set of three single*
 ies in the stereo pairs.
 did excessive clutter in
 stereo pair, none of the
 rious planes.

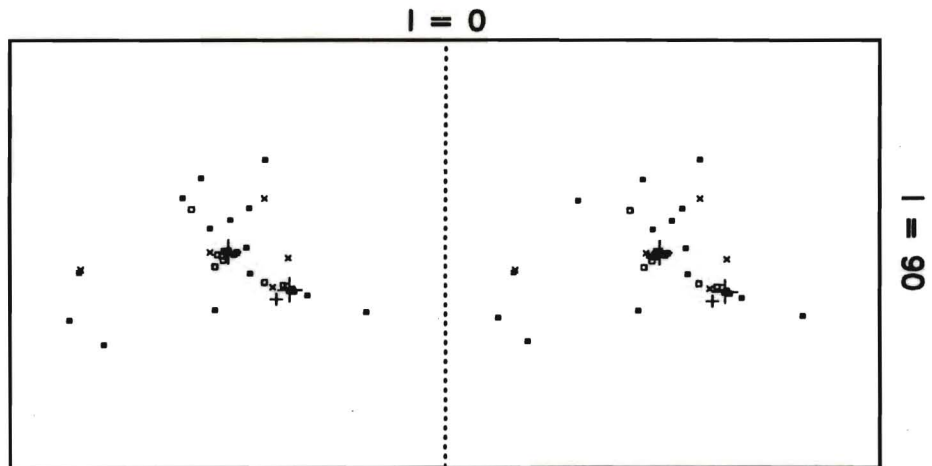
(a)



View from (l,b) = (0,0)



View from (l,b) = (90,0)



View from NGP (b = 90)

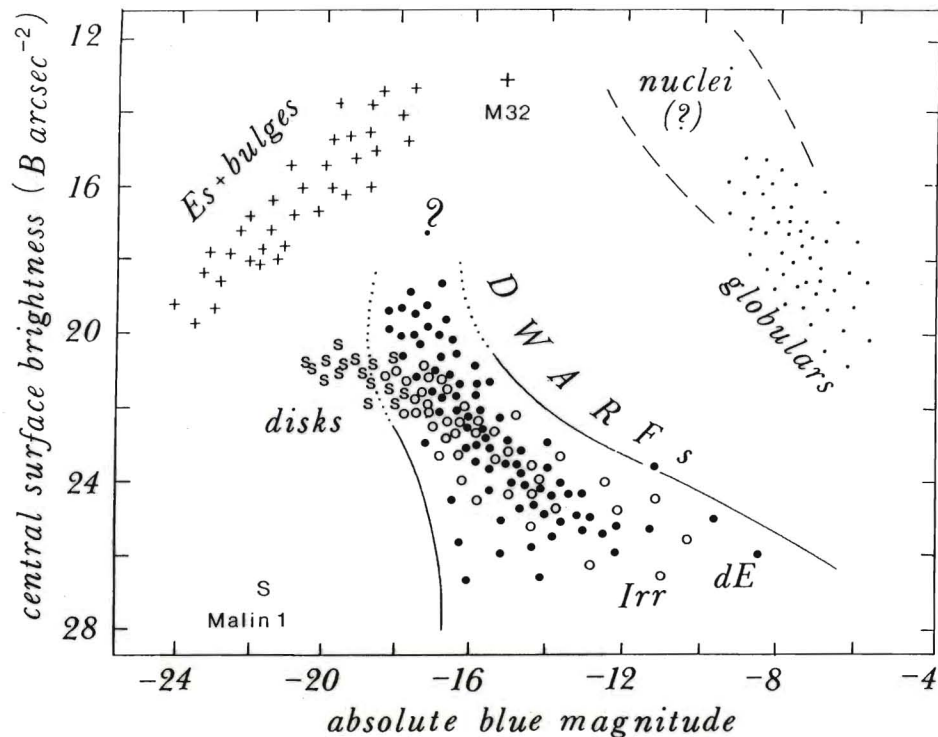


Figure 4.18 Dwarf and giant galaxies occupy different regions in a plot of absolute V -magnitude and measured central surface brightness; because of ‘seeing’, the true peak brightness may be higher. At left, luminous elliptical galaxies and the bulges of disk systems have very high surface brightness at their centers. The rightmost of the ‘dE’ points (filled circles) represent what this text calls dwarf spheroidals; open circles mark irregular and dwarf irregular galaxies. Disks of spiral galaxies are marked ‘S’. Malin 1 is a low-surface-brightness galaxy; see Section 5.1 – B. Binggeli.

a gas, we refer to disks with high values of V/σ as ‘cold’; ‘hot’ systems are those in which random motions are relatively more important, so that V/σ is low. The stronger the influence of ordered rotation, the more disklike an object must be. Within the solar system, the giant planets Jupiter and Saturn, with a ‘day’ only ten hours long, are considerably more flattened at the poles than the compact and slow-rotating Earth. We will see in Section 6.2 that not all flattened galaxies rotate fast; but strongly rotating galaxies must always be flattened.

4.4.2 Dwarf irregular galaxies

Irregular galaxies are so called because of their messy and asymmetrical appearance on the sky (see Figures 1.13 and 4.19). Starbirth occurs in disorganized patches that occupy a relatively large fraction of the disk, because the size and luminosity of star-forming regions increases only slowly with the size of the parent galaxy. Even quite small irregular galaxies can produce spectacular OB associations.

dIrr galaxies are often irregular in shape & gas-rich; lots of recent star formation

In all of the LG dIrrs we have looked carefully at, there is also a more extended, smoother distribution of older stars

Only 3 Local Group dwarfs have nuclei:

- M32 (has black hole, HSB)
- NGC 205 (tidally disrupting)
- Sgr dSph (" ")

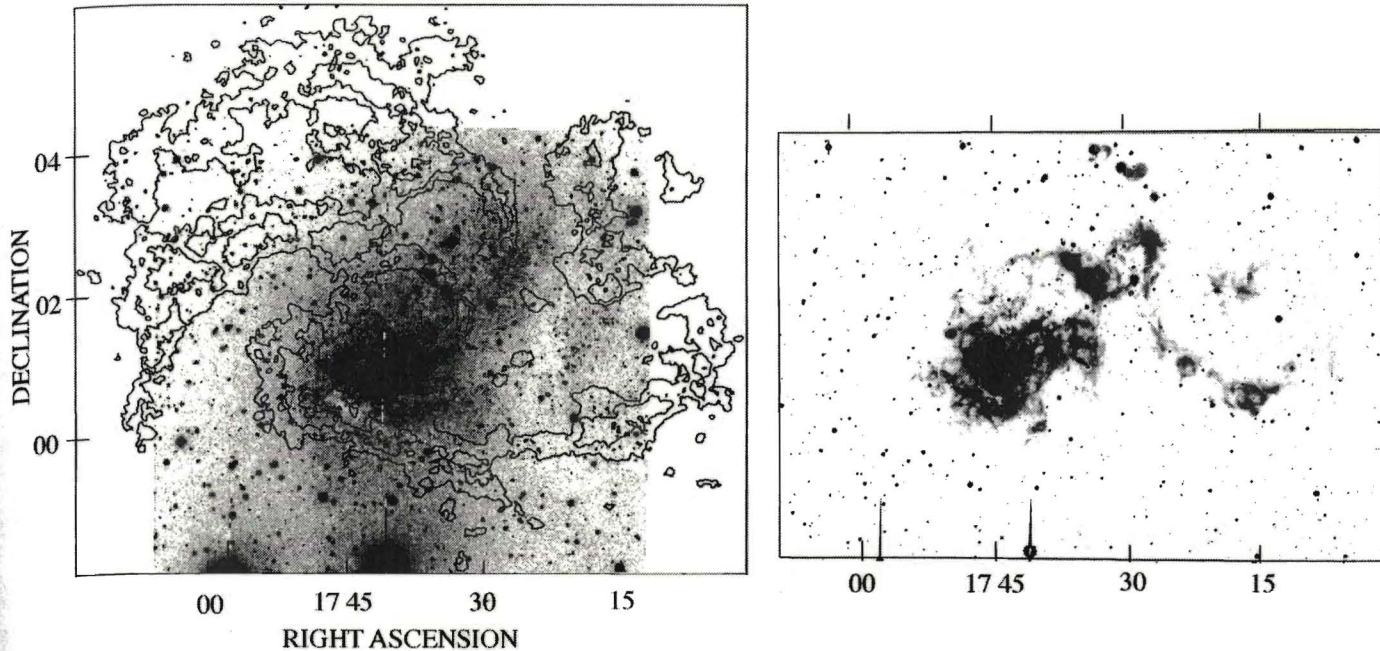


Figure 4.19 The dwarf irregular galaxy IC 10. Left, HI contours superposed on an R -band negative image; the box measures $8'$ vertically, or 19 kpc. Right, negative image showing $H\alpha$ emission from ionized gas – E. Wilcots, WIYN telescope.

$$L = 2 \times 10^8 L_{\odot}$$

We draw the line between irregular galaxies and the dwarf irregular systems at $L \sim 10^8 L_{\odot}$. Dwarf irregulars contain gas and recently formed blue stars; but in some other ways, they resemble the dwarf spheroidals. Irregular galaxies are diffuse (see Figure 5.7), and ordered rotational motion is much less important than it is in the Milky Way's disk. The stars and gas clouds have a velocity dispersion of $\sigma \sim 6\text{--}10 \text{ km s}^{-1}$, but the peak rotation speed V declines at lower luminosity; so in larger irregulars, $V/\sigma \sim 4\text{--}5$, falling to $V/\sigma \lesssim 1$ in the smallest dwarf irregulars. The proportion of metals in dwarf irregular galaxies is very low, $\lesssim 10\%$ of the solar value; the least luminous are the most metal poor. Gas in the smallest systems, such as Leo A, has only about 1/30 of the solar oxygen abundance, while the more massive galaxy NGC 6822 has about 1/10 of the solar abundance.

Dwarf irregulars tend to be brighter than the dwarf spheroidals, but this is only because of their populations of young stars. They contain relatively large amounts of gas, seen as neutral hydrogen, and the gas layer often extends well beyond the main stellar disk. Figure 4.19 shows the HI layer of IC 10; as in Figure 4.4, we see large 'holes' blown by the winds of supernovae and hot stars. Ionized gas shines brightly, showing that young stars have formed in the shells of denser gas surrounding the holes. This galaxy has little if any organized rotation.

Figure 4.20 shows the color-magnitude diagram for Sextans A; this gas-rich

Gas content :

7-50%

M_{HI} / M_{total}

dIrr

1-10%

transition
dIrr/dSph

~ 0

dSph

CO has been detected in many
LG dIrrs including very low
luminosity ones

Q How might a comparison of CO
properties in low-luminosity & high-
luminosity galaxies be interesting?