IMPLICATIONS: GHOST GALAXIES

3 – There may be a large population of dark galaxies that contain too few stars to be discovered. They may outnumber all luminous galaxies combined.

Reasons:

- Astronomers continue to discover faint galaxies. Clearly we have not found all of them. The fraction of all galaxies that have been discovered is smaller for smaller galaxies. Maybe it is much smaller than we think:
- Dwarf galaxies are <u>much</u> more numerous than giants.
- Dwarf galaxies are <u>much</u> more dominated by dark matter:

Visible body is $\sim 50\,\%$ dark in a giant galaxy (L = 1 to 10);
Visible body is $\sim 90\,\%$ dark in a medium dwarf (L = 0.01);
Visible body is $\sim 99\,\%$ dark in an extreme dwarf (L = 0.00001).

We think we understand why: smaller galaxies have a weaker gravitational hold on their contents, so the first stars that die in supernova explosions eject more gas in smaller galaxies. These explosions do not affect the dark matter. So small galaxies have less gas with which to make stars. So they have low stellar densities despite their high dark matter densities.

- Galaxies <u>do not know</u> that they must hold onto $1\,\%$ of their mass in gas to be discoverable.
- It is very plausible that the first stars in many dwarf galaxies eject so much gas
  that we cannot find the almost empty halos
  that are left.

(Luminosity L is measured in units of
the luminosity of the Milky Way.)