The Origin of Dwarf Galaxies, Cold Dark Matter, and Biased Galaxy Formation: 1986

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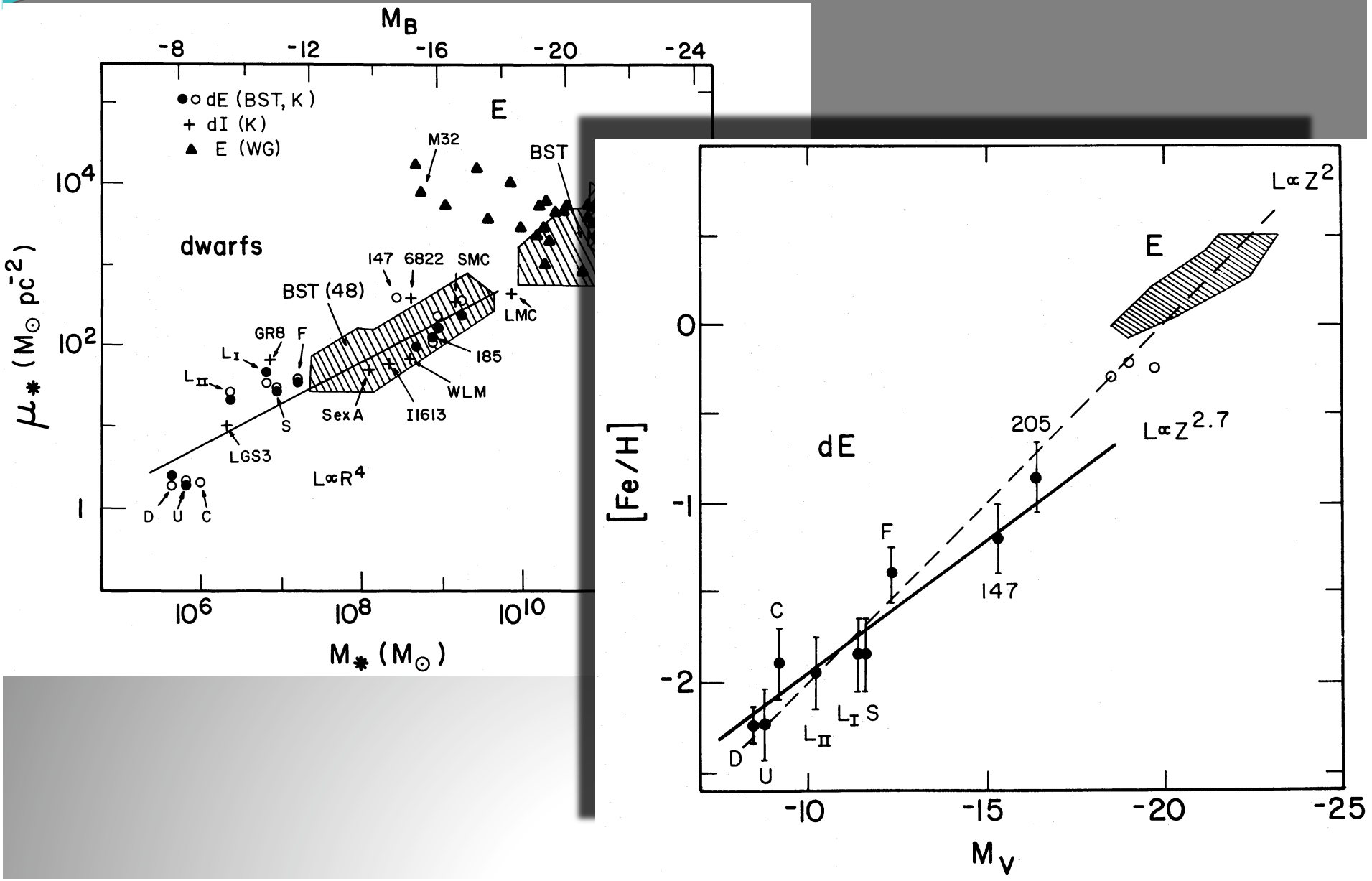
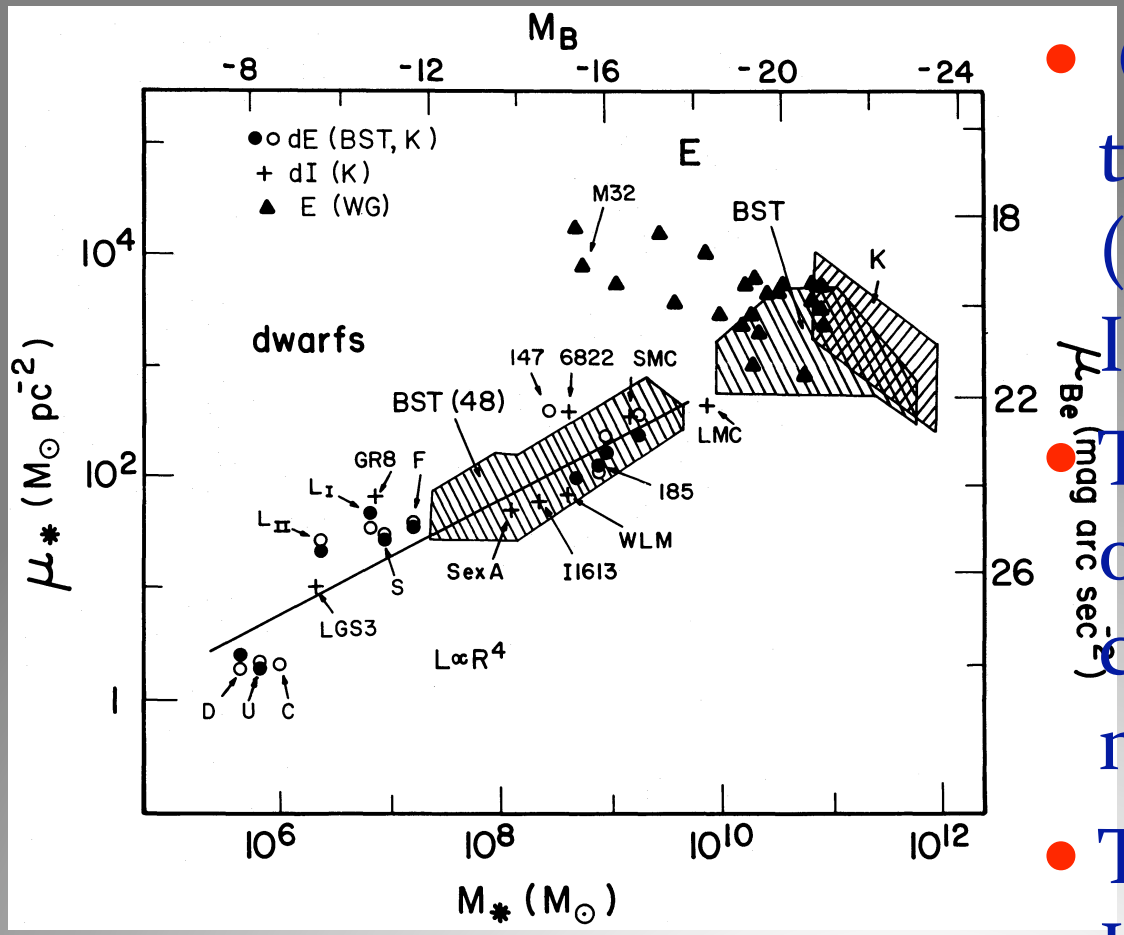
Correlations



Proposed Models

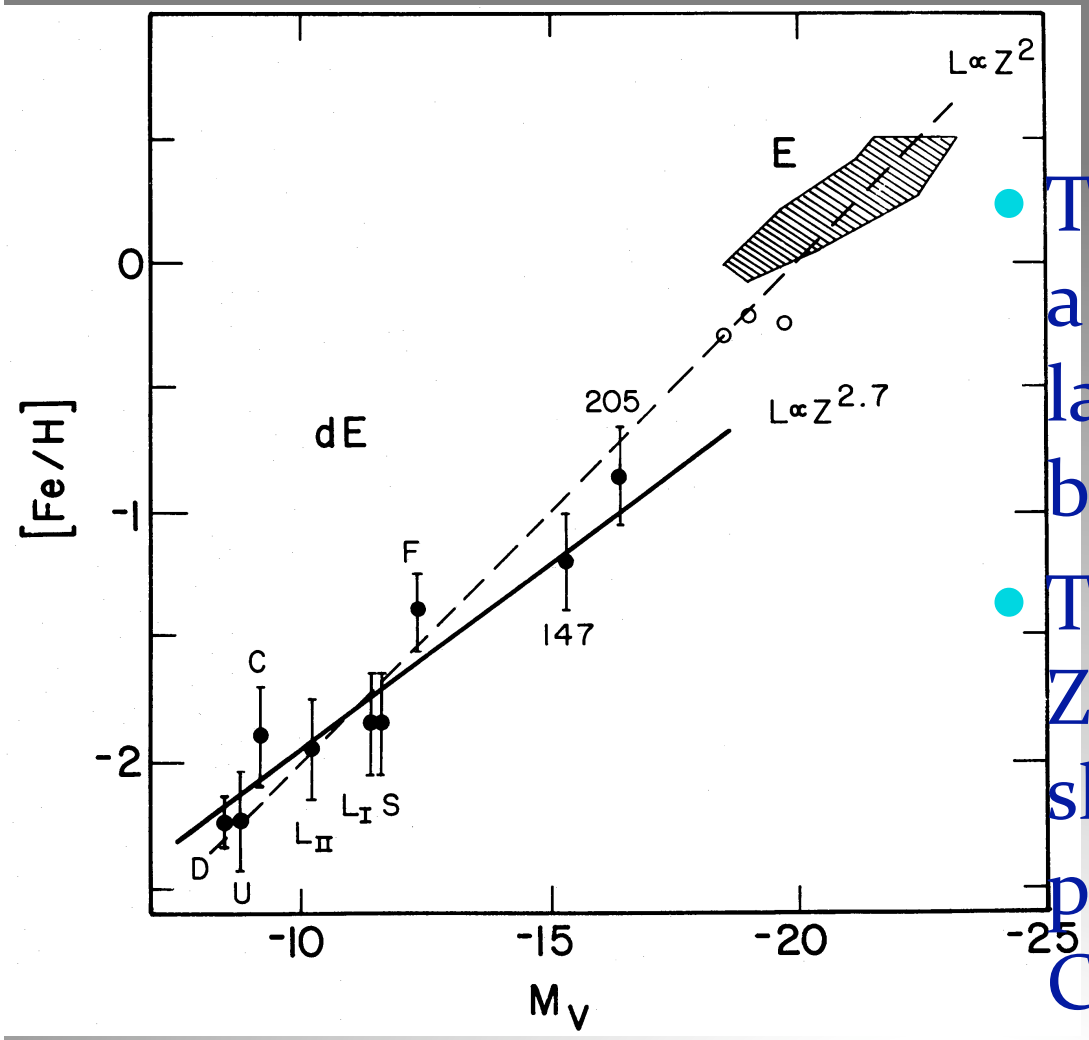
- No Gas Loss
  - Predicts a metallicity that is constant, which is wrong.
- Gas Removal in a Self-gravitating Cloud
  - Fails to reproduce simultaneous decline of metallicity and surface brightness observed in faint dwarfs.
- Gas Loss in a Dominant Halo
  - Predicts initial spectrum perturbations which correspond to CDM perturbations near 10^7 M_{\odot}

Radius vs. Luminosity



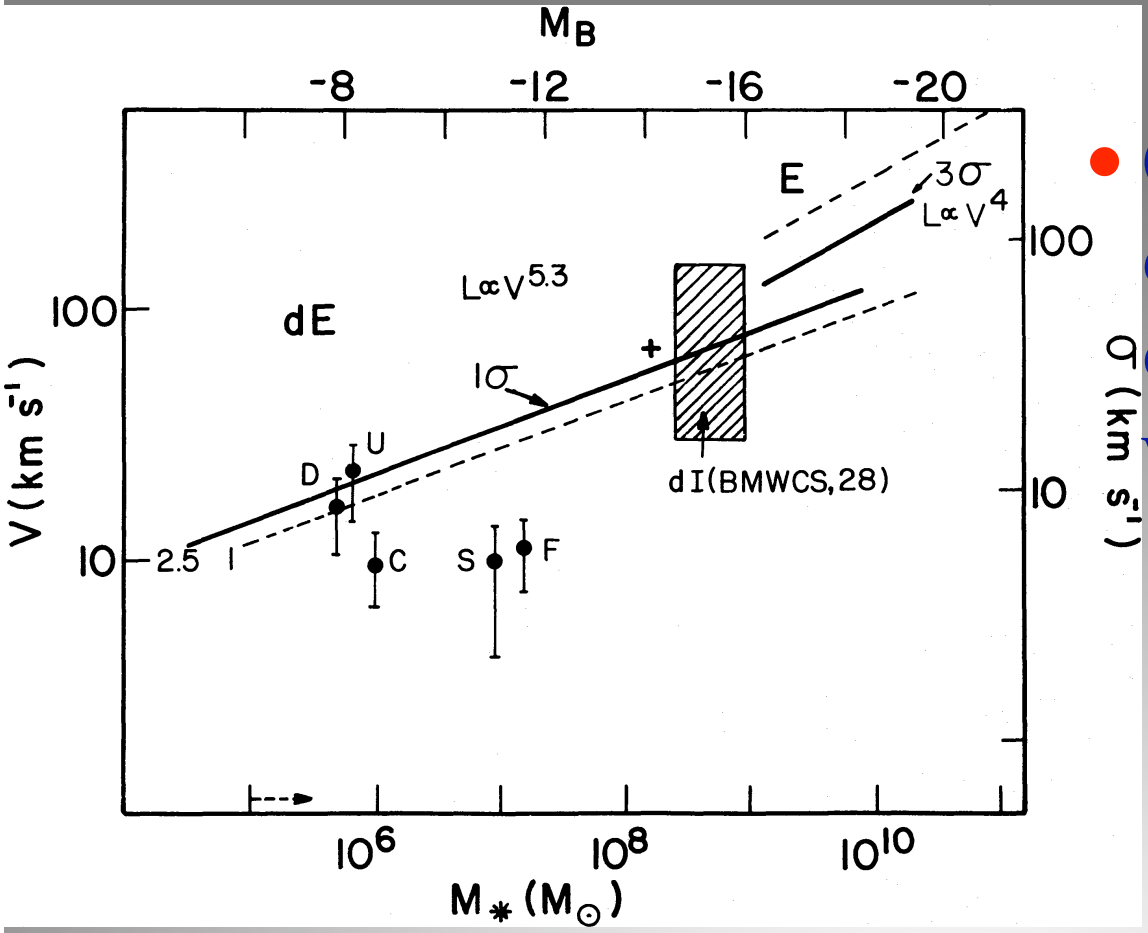
- Clear divide between the Dwarf Ellipticals (DEs) and the Dwarf Irregulars(DIs)
- The DEs and DIs obey a tight correlation over 10 magnitudes
- This is best fit by a L \propto R^4 power law

Metallicity vs. Luminosity



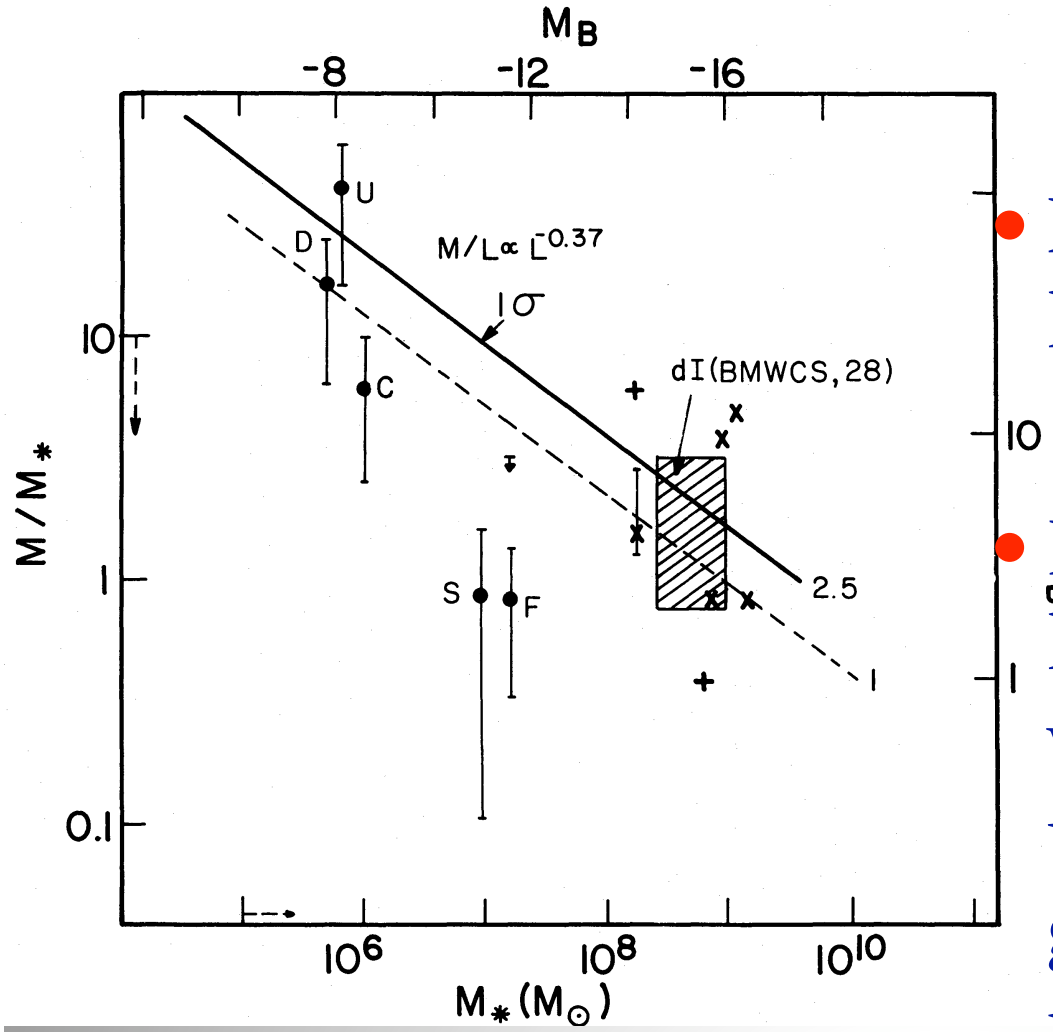
- The data are best fit by a L \propto Z^2 power law, but the Des are better fit by a Z^2.5 fit.
- The model predicts a Z^2.7 behavior. The slope is a result of the presence of halos of CDM

Velocity Dispersion vs. Luminosity



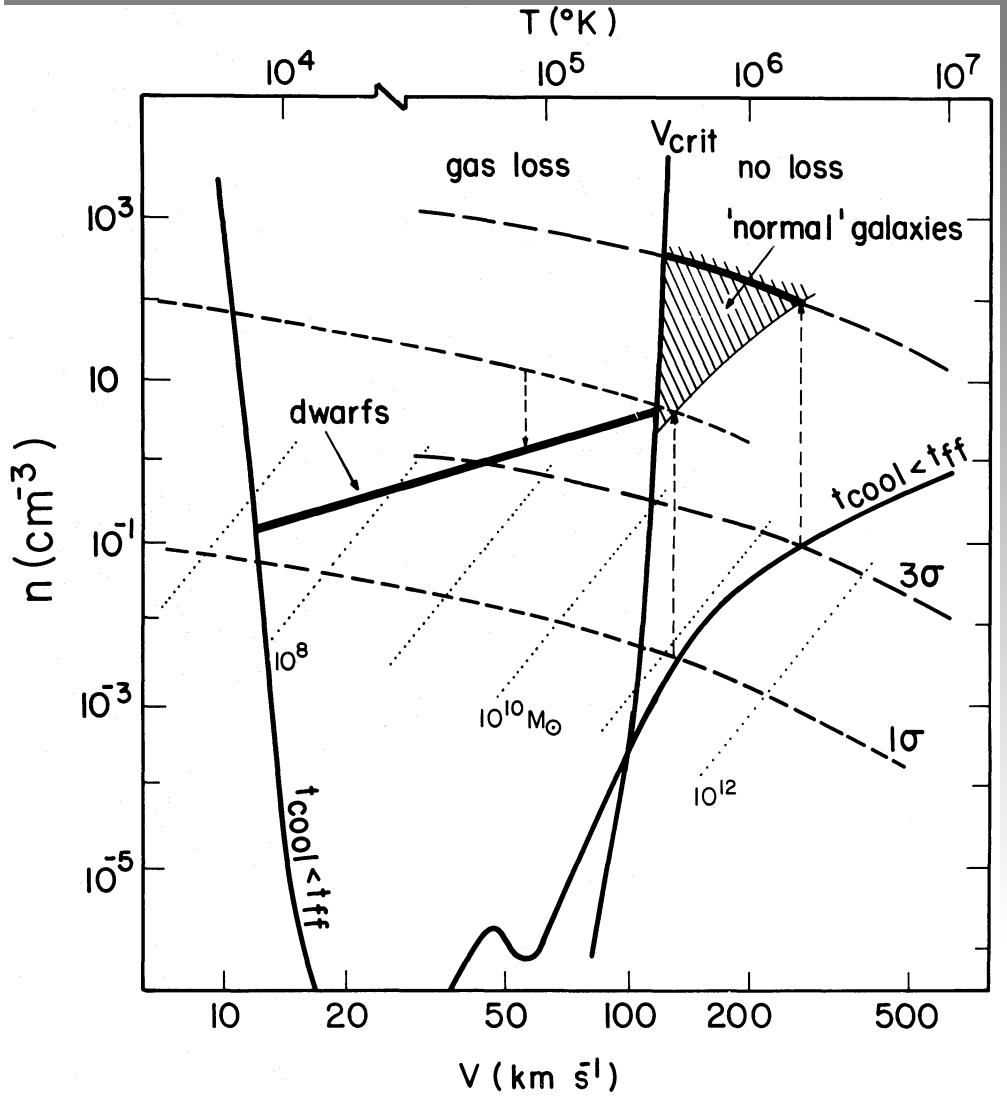
- Central velocity dispersion thought to obey L \propto V^c, with 3<c<4.

Mass to Light Ratio



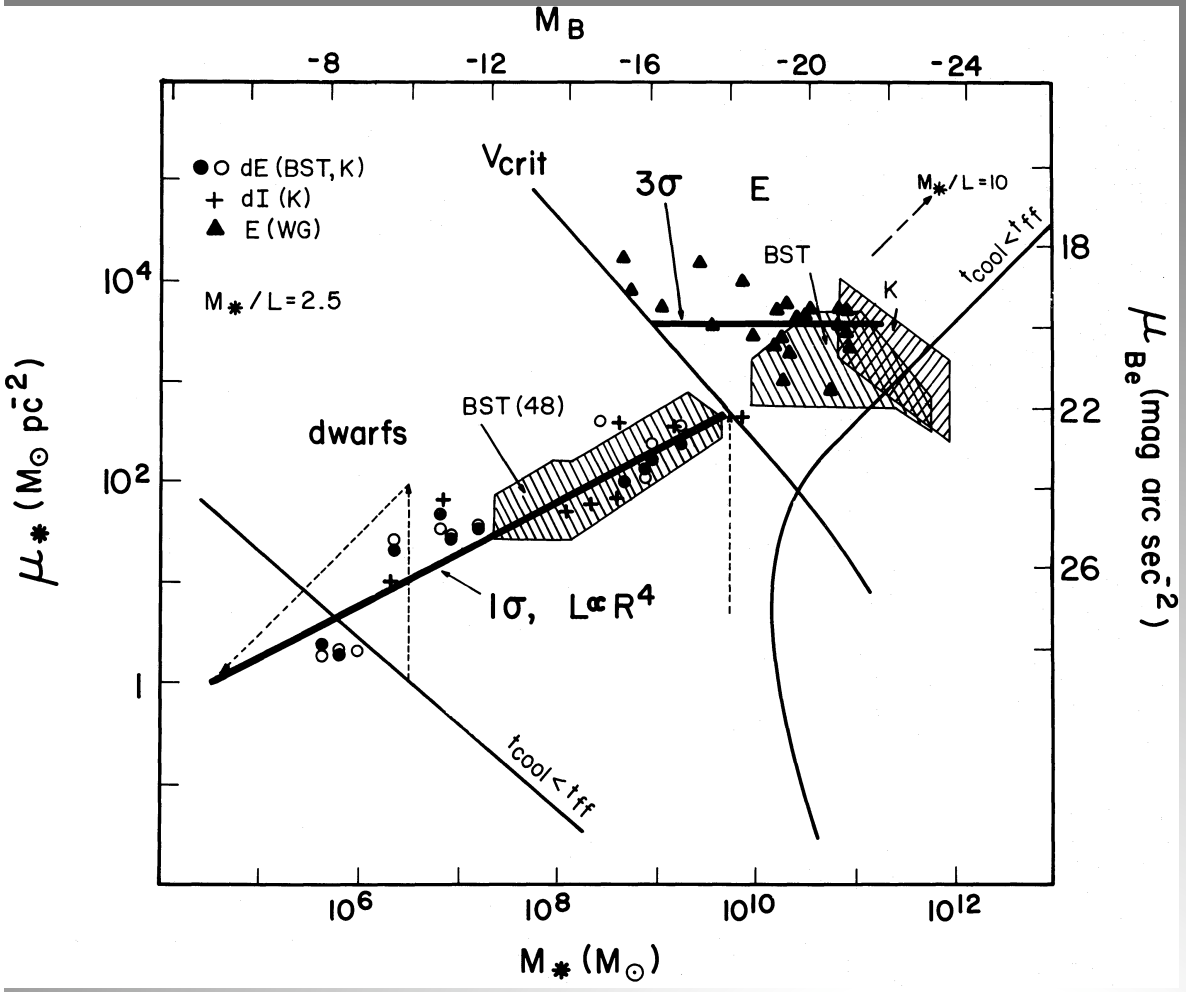
- Mass estimates have large errors
- Preliminary results here are consistent with massive halos that dominate gravitational potential.

Gas Number Density vs. Virial Velocity



- Most “Normal Galaxies” must originate from 2-3 \sigma CDM perturbations
- “Normal galaxies” Lie at larger virial velocities and higher densities
- Diffusive Dwarfs have smaller virial velocities and lower densities with a mass around 10^9 M_{\odot}.

Surface Brightness vs. Luminosity



- "Normal Galaxies" May not be that normal!

Conclusions

- Low metallicity and surface brightness observed in faint dwarfs is indicative of substantial gas mass loss.
- The model which best fit the data, is the model where gas clouds are embedded in massive halos.
- The critical virial velocity seems to point towards two classes of elliptical galaxies.
- Critical conditions for mass loss and cooling seem to point towards a bias towards dwarf galaxies.
- Dwarf irregulars may be fundamentally the same as dwarf ellipticals except their mass loss was not as complete because they may have larger DM halos.
- Dwarf galaxies may help probe large scale variations of mass distribution, and dwarf irregulars may play a key role in observations.