PART I

Galaxy Formation Models

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PART I: Building synthetic universes
PART II: The parameters of galaxy formation
PART III: The universe in the cloud
The basics of how galaxies are built and evolve
The uses and limitations of semi-analytic galaxy models
The challenge of data access and delivery
Galaxy formation primer
The skeleton

The flesh
1. The skeleton: N-body simulations

2. The flesh: interwoven analytic models of the physics of galaxy formation
2dF Galaxy Redshift Survey

3° slice
62559 galaxies
220929 total
cluster

milky-way

Wechsler et al. 2002
1. The skeleton: N-body simulations

2. The flesh: interwoven analytic models of the physics of galaxy formation
Galaxies, why we care ...

- highly non-linear evolution
- home of internal phenomena
- shaped by external influences
Star formation

Kennicutt 1998
Supernova feedback

Martin 1999
Satellite galaxies

Galaxy C153 in Cluster Abell 2125

NASA, W. Keel (University of Alabama), F. Owen (National Radio Astronomy Observatory), M. Ledlow (Gemini Observatory) and D. Wang (University of Massachusetts)

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Morphological evolution

NGC 2207 & IC 2163
... and assembly

Seyfert’s Sextet
... and death

M87 (Virgo cluster)
Black holes

Haring & Rix 2005

NGC 6240
AGN jets

M87
(Virgo cluster)
AGN bubbles
iPad
Schmidt law star formation
SFR dependent SN winds
satellite gas stripping
morphological transformation
assembly through mergers
starbursts through mergers
Magorrian relation BH growth
jet & bubble AGN feedback

Croton et al. 2006
Remember:

Numerical Simulation  +  Analytic Simulation
$z = 0$ galaxy light
Galaxy spatial and luminosity distributions

- clustering -

- luminosity function -
Galaxy colour distribution

Croton et al. 2006

Baldry et al. 2005

Distribution of galaxies, $V_{\text{survey}}/V_{\text{max}}$ corrected, density contours on a log scale.
Physical consequences

AGN ($\propto m_{BH} \sigma^3$)

SN ($\propto SFR$)
Our model is only as good as the questions we ask.

For systems with infinite levels of complexity, our model can never be "correct".
...and the story continues in the next lecture with “Model parameterisation”...