Galaxy Activity in SAMs

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AGN activity in theoretical models of galaxy formation

- Represents a viable “solution” for a number of long-standing problems
  - Quenching cooling flows in massive halos
  - Red colors and SFRs in local massive galaxies
  - Bright-end of luminosity function
Semi-analytical models

- “QSO”-mode
  - Bright-phase
- “Radio”-mode
  - Low-accretion Efficiency
  - Radio-jets
- We consider four models
  - Munich Wang+08
  - Somerville+08
  - Kang+08
  - MORGANA MonacoFontanotTaffoni07
QSO mode

- Munich triggered by major and minor mergers KauffmannHaehnelt00 Croton+06
- Somerville+08 triggered by major mergers Hopkins+05+07
- Kang+08 triggered by major mergers KauffmannHaehnelt00
- MORGANA associated with Eddington-limited accretion rates from a cold gas reservoir Umemura00 Granato+04
- Reservoir formed at major minor mergers and disc instabilities
**QSO mode**

- **Munich** triggered by major and minor mergers  
  KauffmannHaehnelt00 Croton+06

- **Somerville+08** triggered by major mergers  
  Hopkins+05+07

- **Kang+08** triggered by major mergers  
  KauffmannHaehnelt00

- **MORGANA** associated with Eddington-limited accretion rates from a cold gas reservoir  
  Umemura00 Granato+04

- Reservoir formed at major minor mergers and disc instabilities
Radio mode

- Munich accretion of hot gas from hidrostatic halo Croton+06
- Somerville+08 Bondi-Hoyle accretion of hot gas NulsenFabian00
- Kang+08 accretion of hot gas Kang+06
- MORGANA associated with low-accretion rates from a cold gas reservoir Umemura00 Granato+04
- All models predict the energy injected into the ICM \( L_{\text{heat}} \)
Radio mode

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- Yang+07 group catalogue
- Estimates for stellar and halo mass
- Activity Classes
  - SFG e AGN
  - HRA e LRA
Pasquali+09

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Converting Model Predictions

- **Star Forming Galaxies**
  - \( \text{SFR} = 0.5 \times 7.9 \times 10^{-42} \, L_{\text{H}\alpha} \) \text{Kennicutt98}

- **OIII line Luminosity**
  - \( \frac{L_{\text{Hard-X}}}{L_{\text{OIII}}} = 2.15 \) \text{Heckman+05 Marconi+04}

- **Radio Power**
  - \( L_{\text{kin}} = 3 \times 10^{45} \, f^{3/2} \left( L_{\text{151 MHz}} \right)^{6/7} \) \text{Willott+99}
  - \( L_{\text{kin}} = L_{\text{heat}} \) (!!!)
Result of Conversions

OIII line Luminosity

Radio Power
Central Galaxies
Central Galaxies

Somerville+08
Central Galaxies

All Models
Central Galaxies

All Models

MORGANA

f(A|M_{star})

f(A|M_{dark})

Log_{10}(M_{star}/h^2) (M_\odot)

Log_{10}(M_{dm}/h) (M_\odot)
\[ \psi = \frac{L_{\text{kin}}}{L_{\text{radio}}} \]
Satellite Galaxies
Satellite Galaxies

**MORGANA**
Bidimensional Distributions

Centrals

- > 80%
- 80%-80%
- 40%-80%
- 20%-40%
- < 20%

PO9  WDL08  MORGANA  KVB08  SHC08
Conclusions

- Model predictions are remarkably similar (despite very different assumptions for BH accretion)

- Models predict ...
  - Too many high-mass galaxies and halos host a luminous radio source
  - HRA and LRA distributions are quite different
  - AGN distributions show stronger differences among models
  - Expand M*-OIII space currently probed by observations