

Galaxies near and far

Bob Fosbury and friends ...

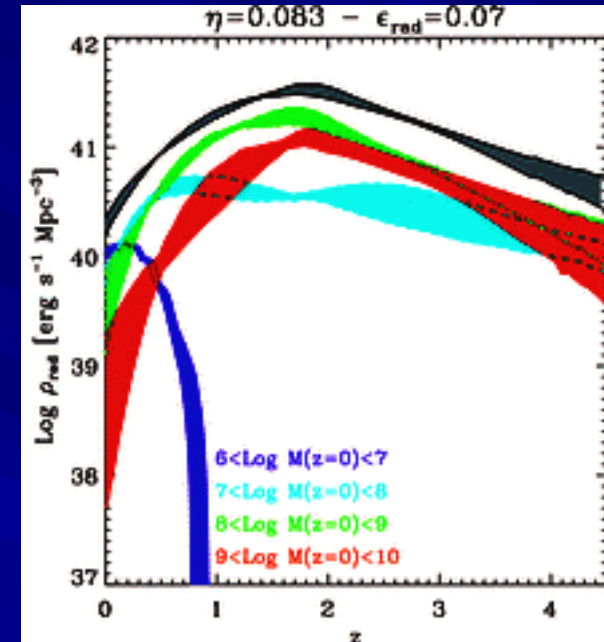
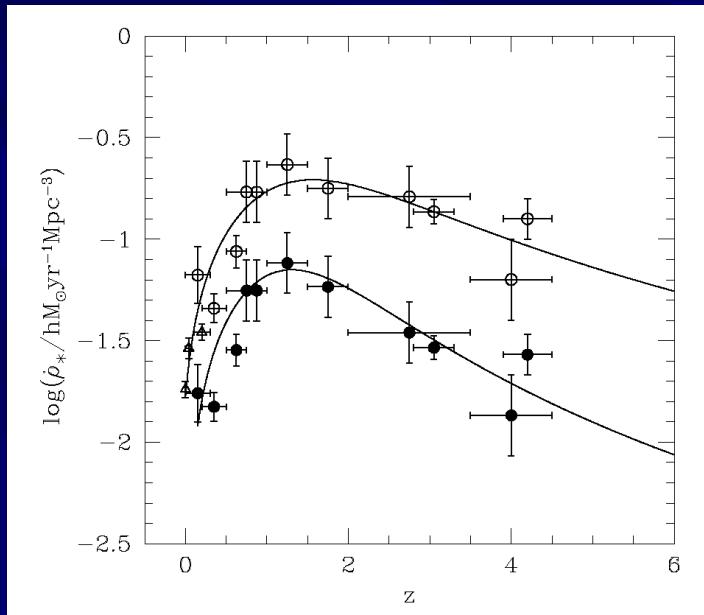
Late type stars near and far

Bob Fosbury and Hagai Netzer



Herstmonceux castle, Sussex

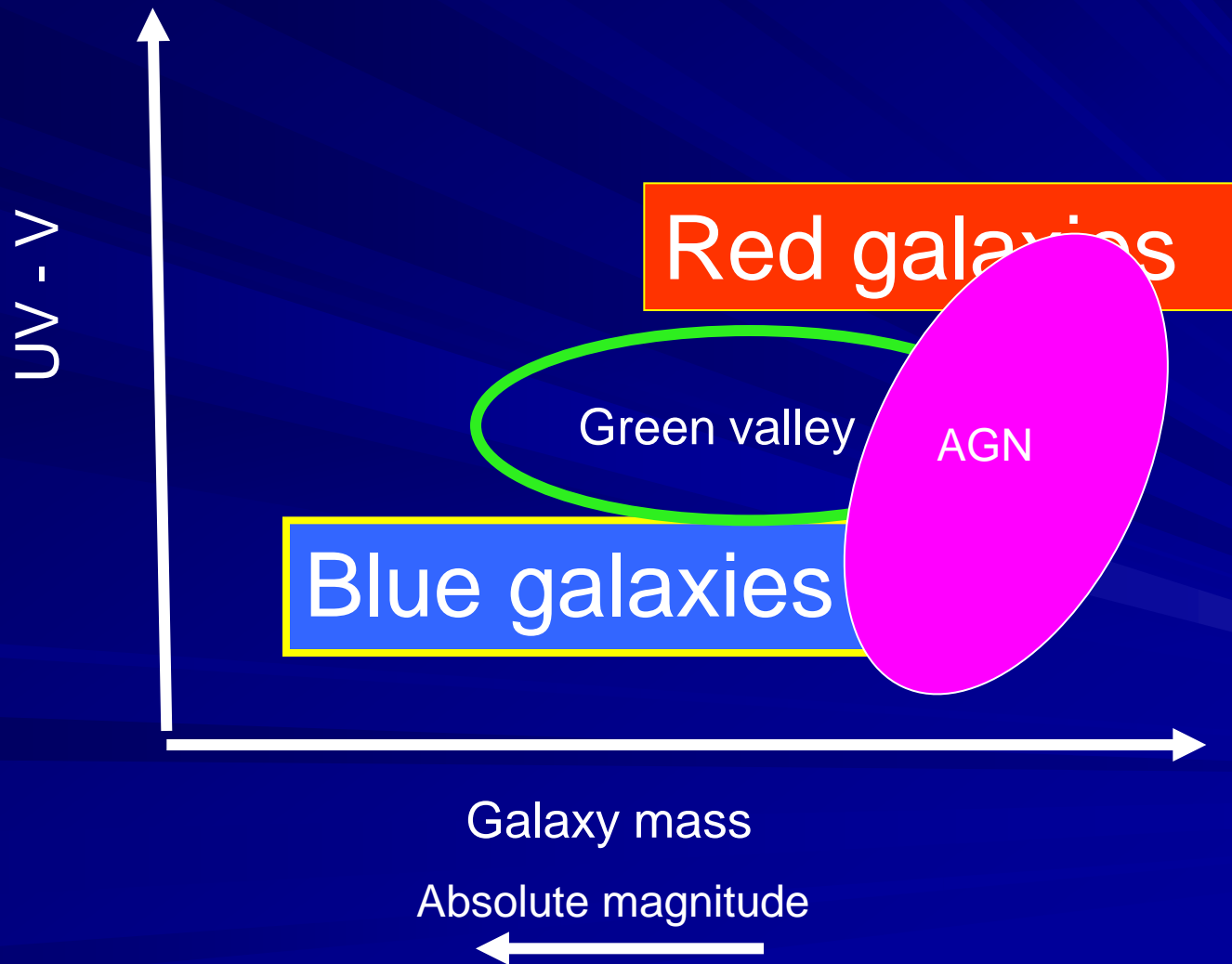
Parallel cosmological evolution of AGN and their host galaxies



Hagai Netzer
School of Physics and Astronomy
Tel Aviv University

Collaborator: Benny Trakhtenbrot

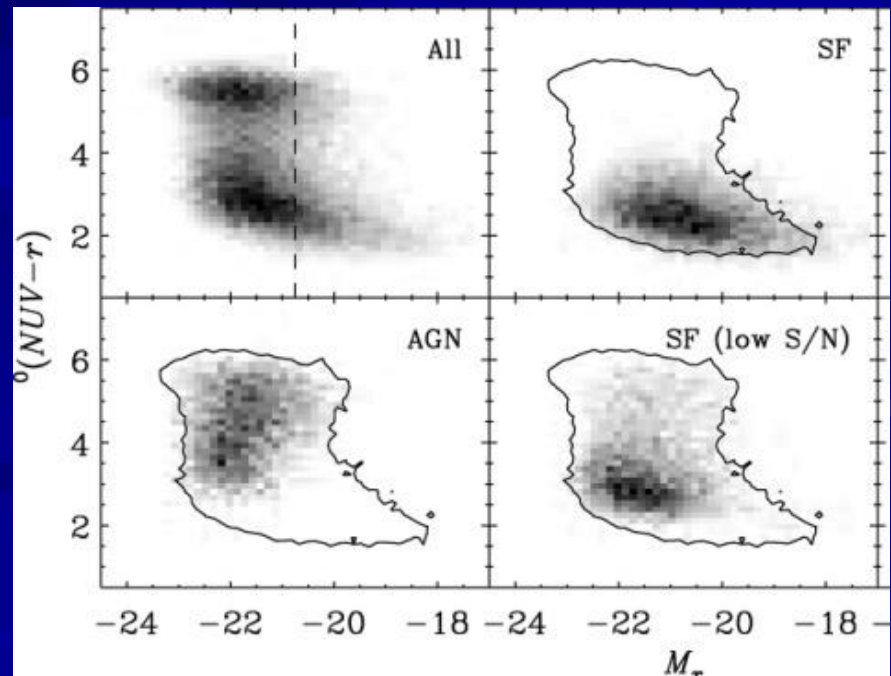
Red and blue galaxies and AGN



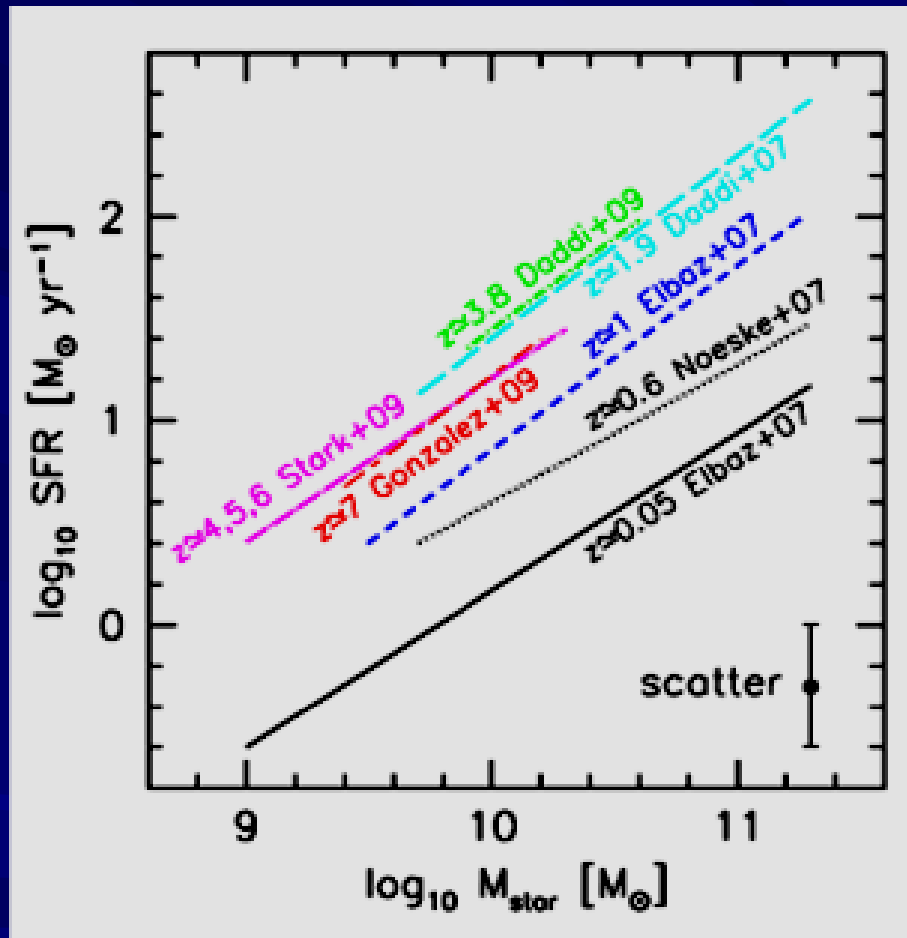
Measuring star formation rate (SFR) in blue and red galaxies

- Balmer emission lines (not in AGN)
- Mid-IR emission (not in AGN)
- The D_n4000 method (OK for type-II AGN)
- UV continuum (not in AGN)
- Far-IR emission (OK for all AGN)

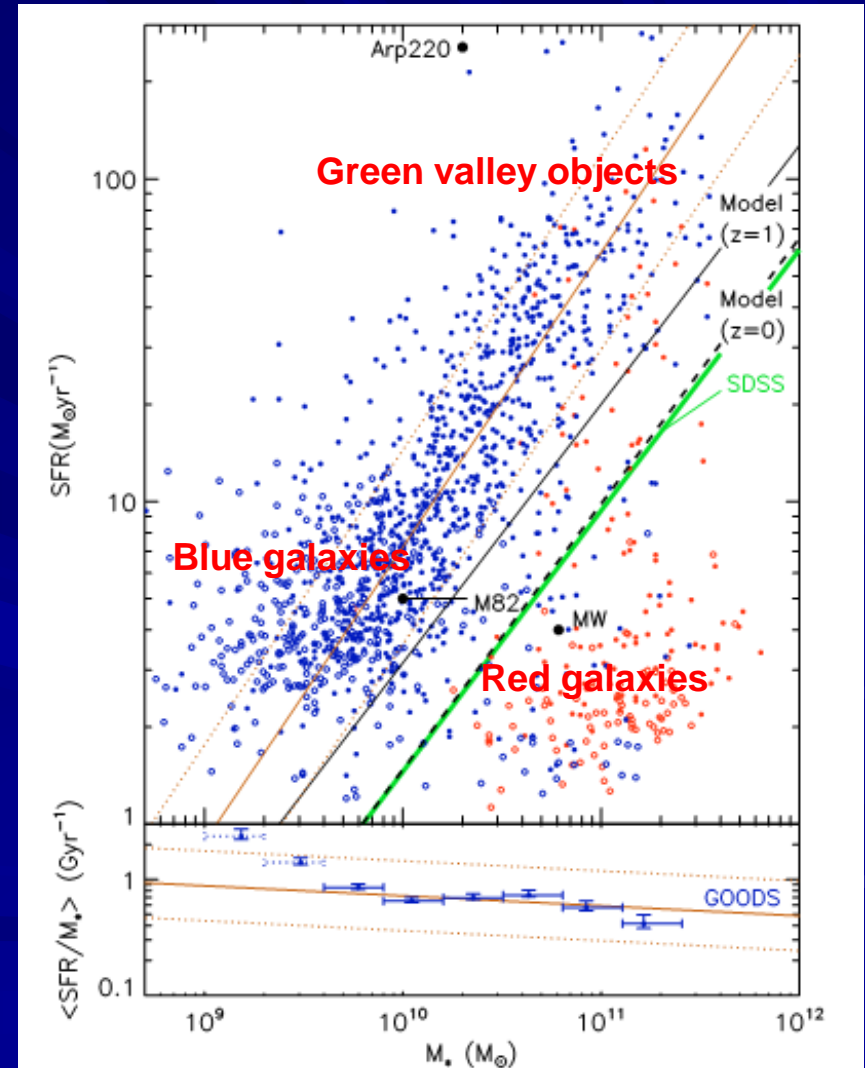
Salim et al. 2007



The SF sequence



Dutton et al. 2009



Elbaz et al. 2007

Measuring BH growth

$$L = \eta \frac{dm}{dt} c^2$$

$$\frac{dm}{dt} = \lambda M_{BH}$$

$$\frac{dm}{dt} = \text{const.}$$

$$\frac{dm}{dt} = \alpha[SFR]$$

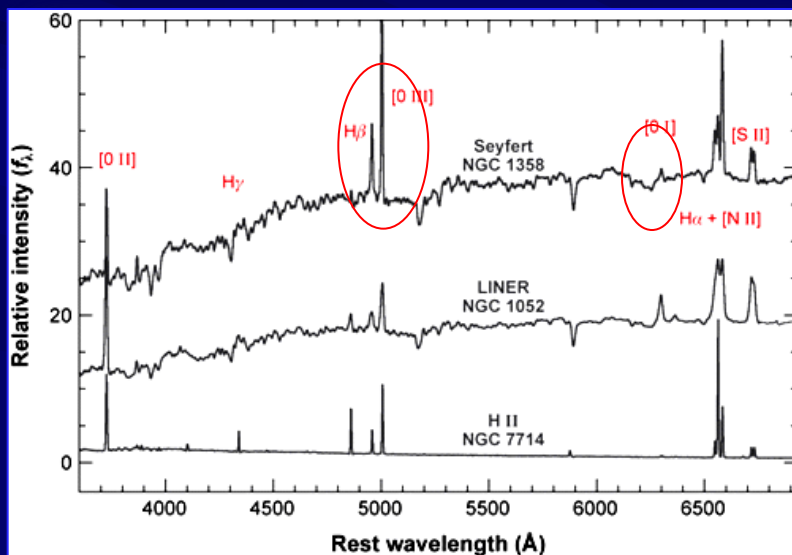
$$\frac{dm}{dt} = \lambda M_{BH} \Rightarrow$$

$$M_{BH} = M_{seed} \exp(t / t_{grow})$$

$$t_{grow} = 4 \times 10^8 \frac{\eta / (1 - \eta)}{L / L_{Edd}} \ln \frac{M_{BH}}{M_{seed}} \text{ years}$$

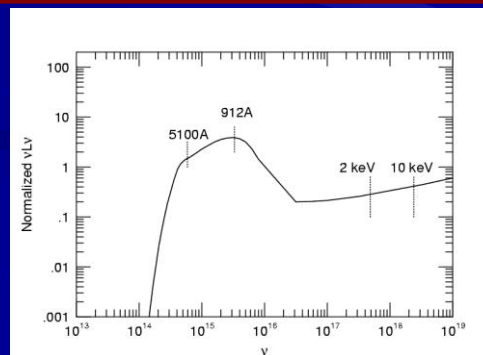
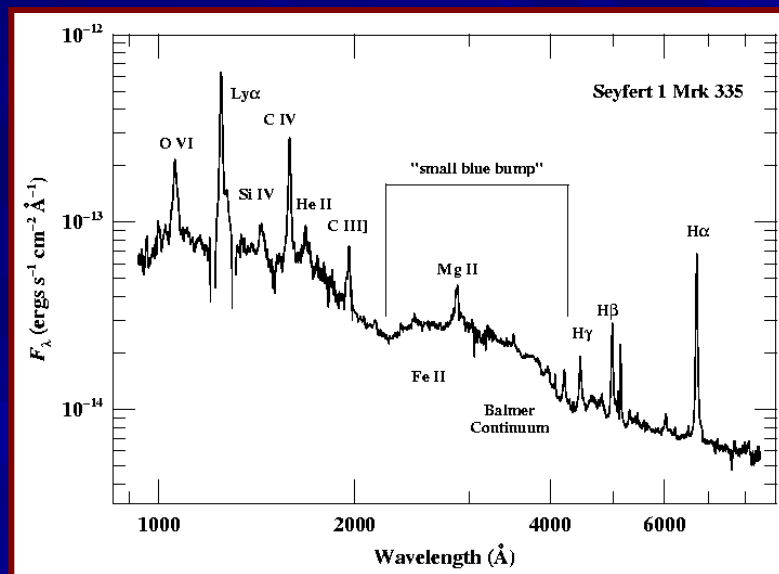
Measuring AGN luminosity

Type-II AGN

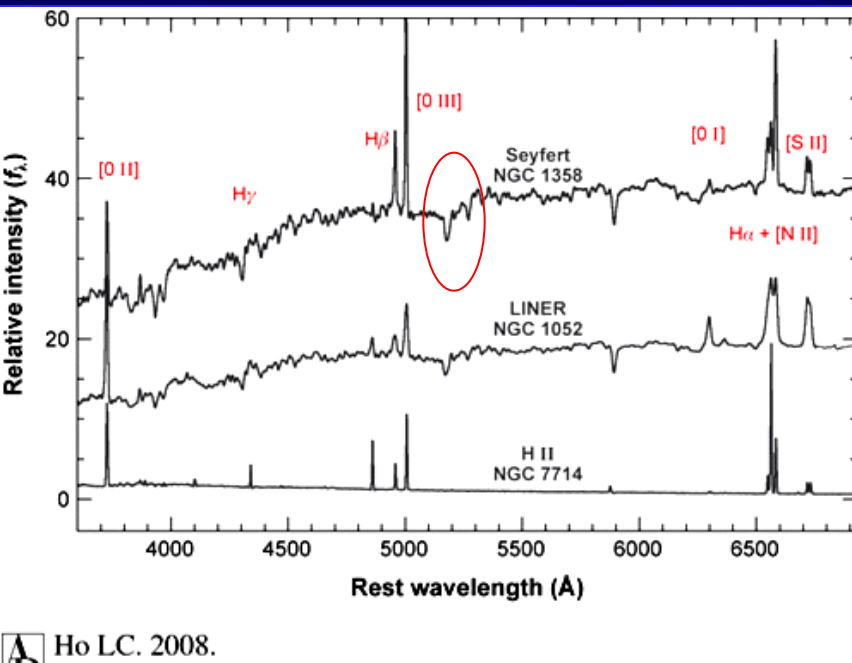


Ho LC. 2008.

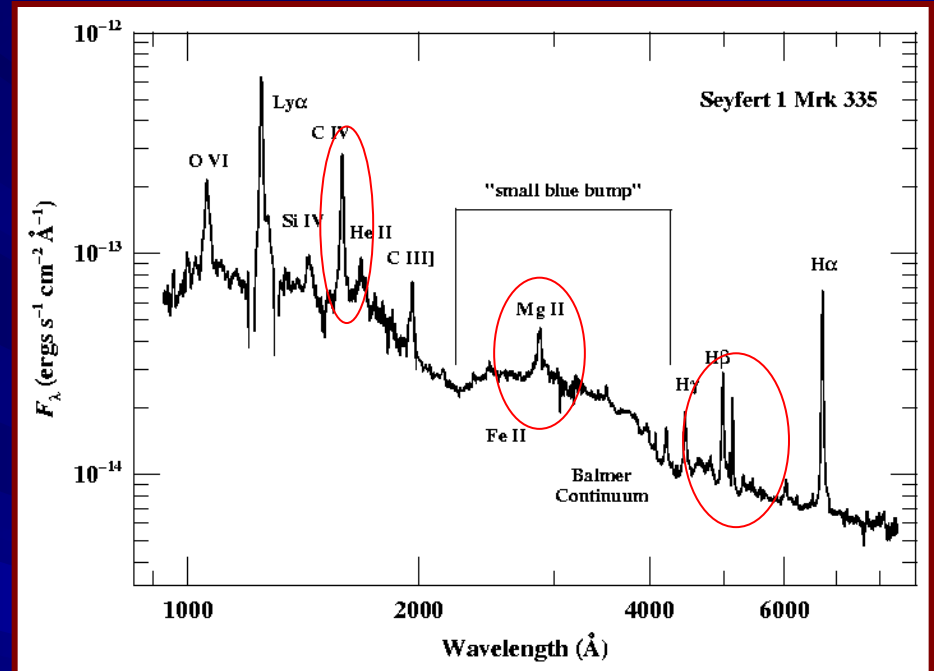
Type-I AGN



Measuring BH mass in AGN

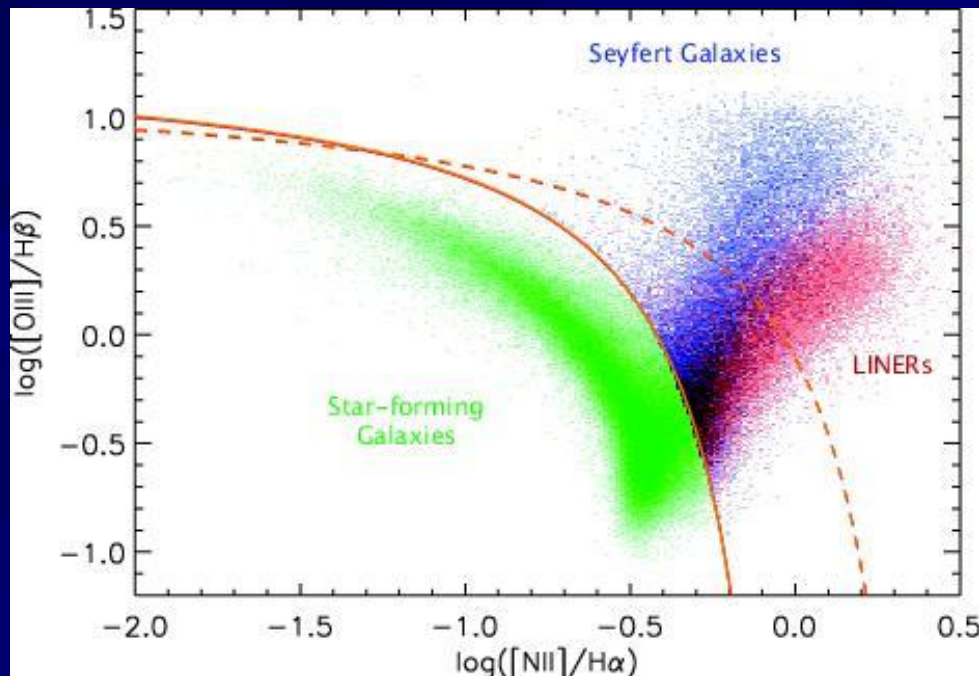


BH mass from the M - σ^* relationship
at $z=0$

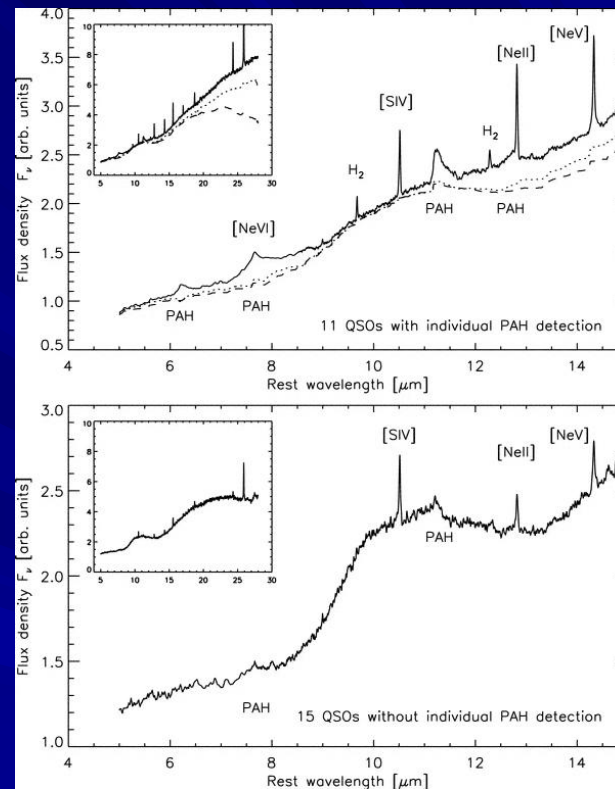


BH mass from reverberation mapping
at all z

Measuring SFR in AGN

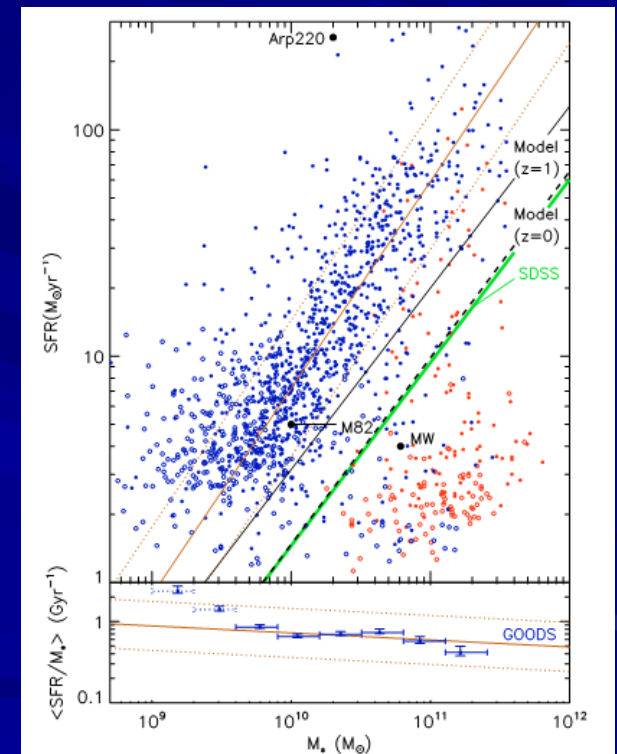
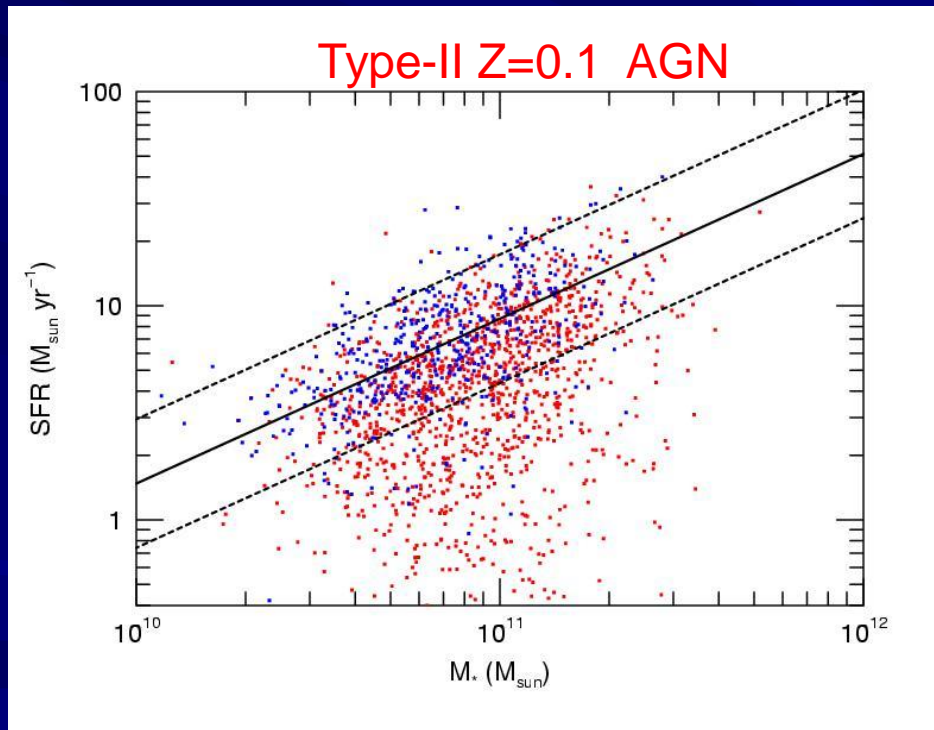


Type-II AGN:
The D4000 method
The UV method



Type-I AGN:
From L(FIR)
From L(PAH)

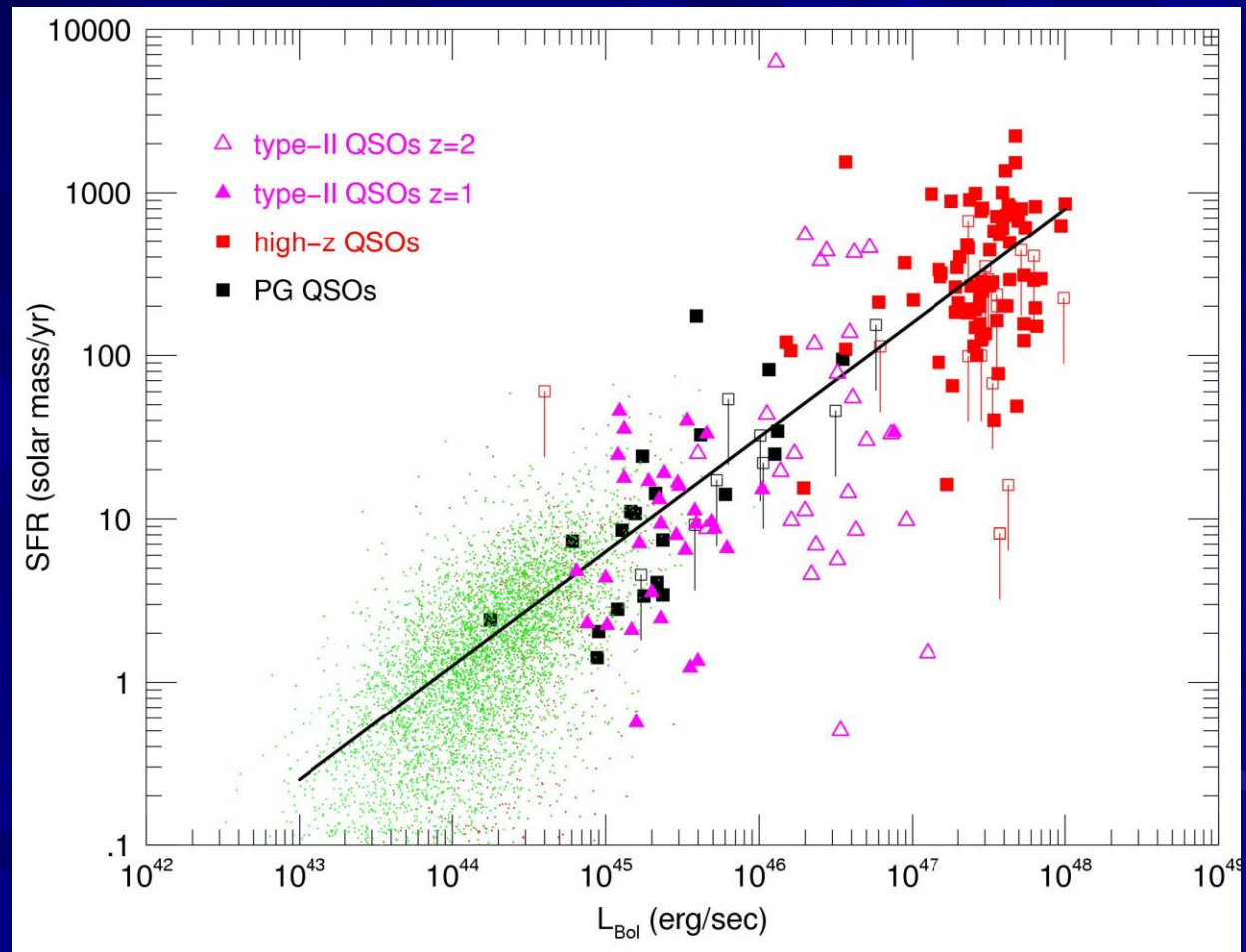
The SF sequence of $z=0.1$ AGN



SFR vs. L_{AGN} in AGN dominated sources

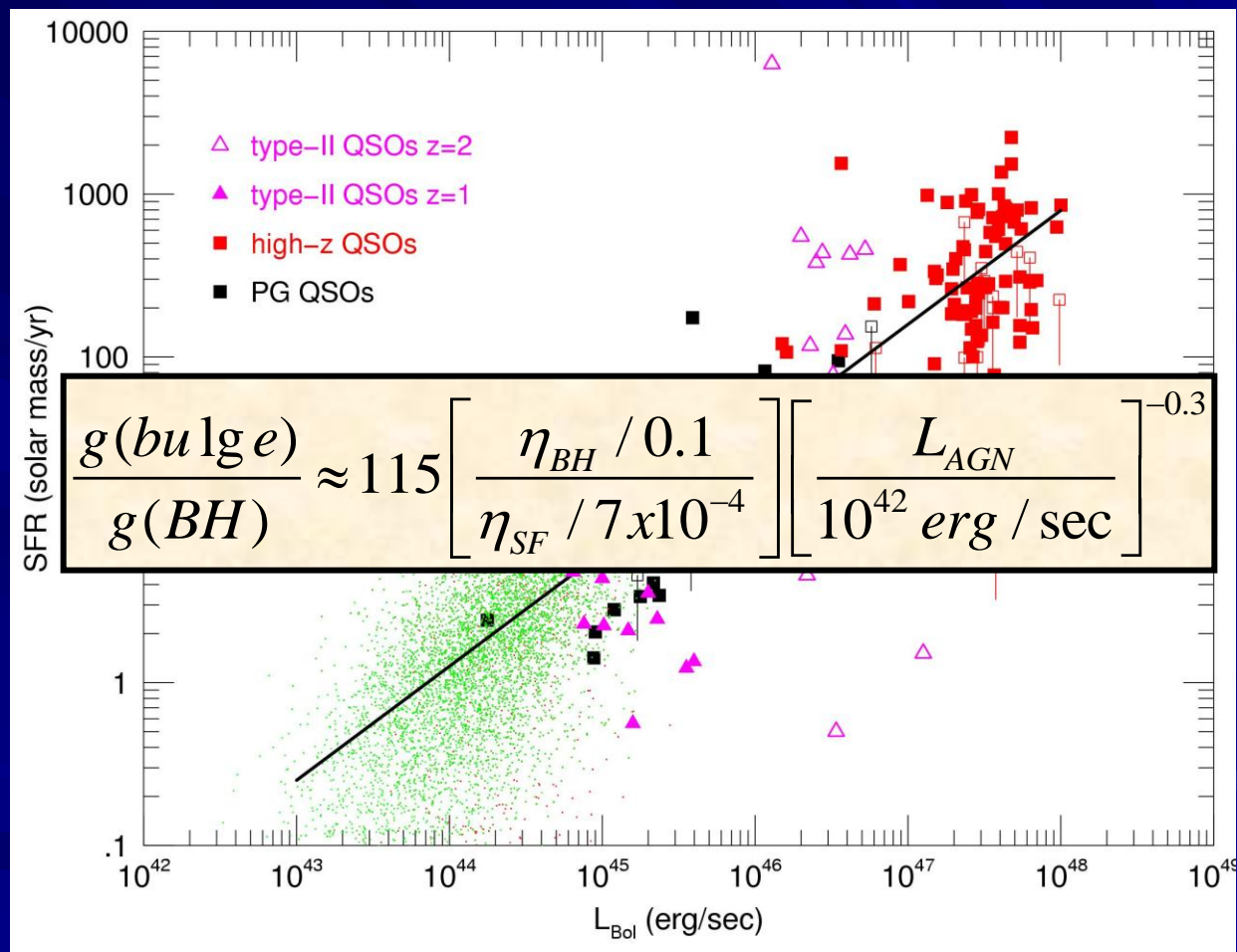
SF at low-z
From D_{4000}

SF at high-z
From $L(\text{FIR})$



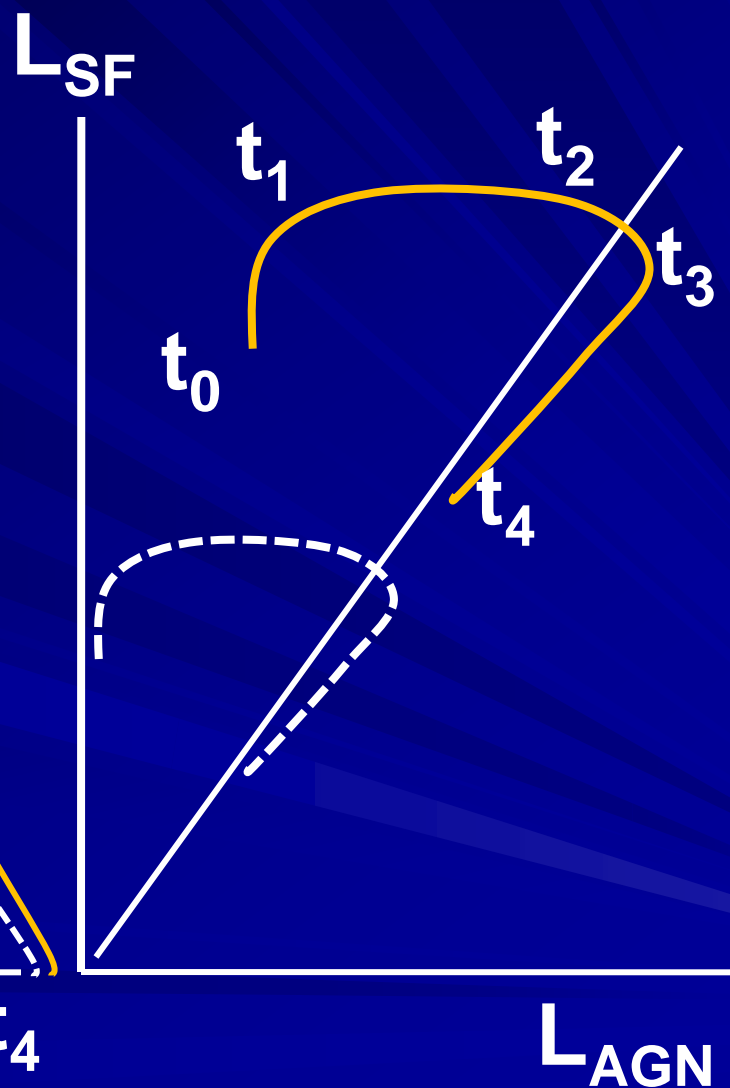
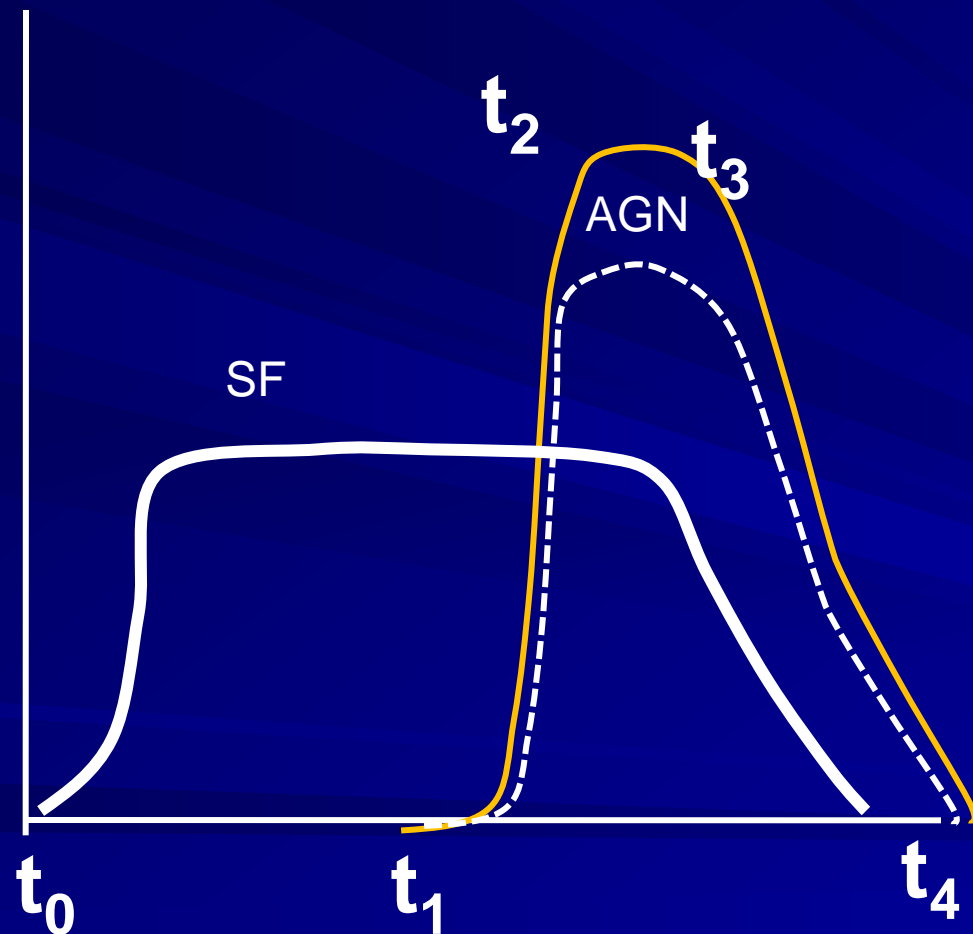
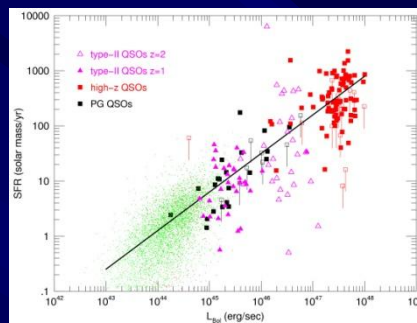
Netzer 2009

BH and bulge growth

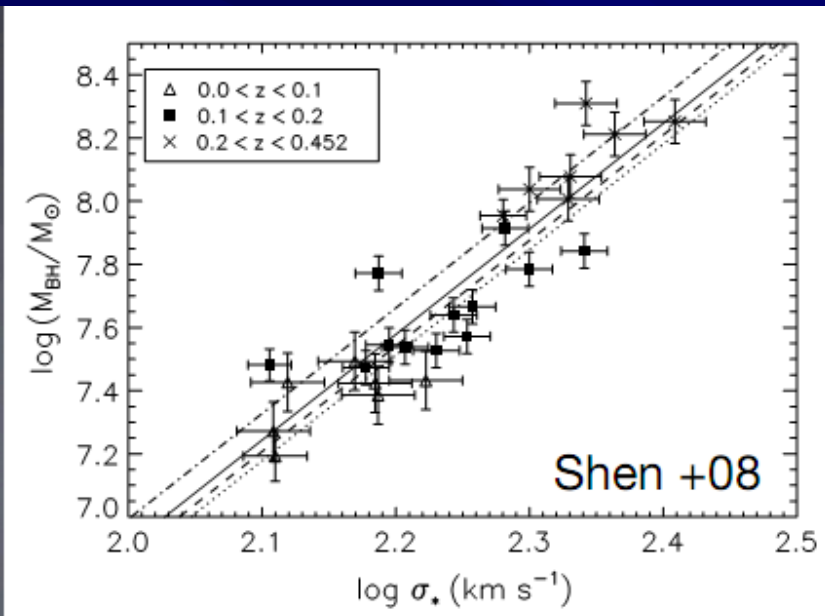


Netzer 2009

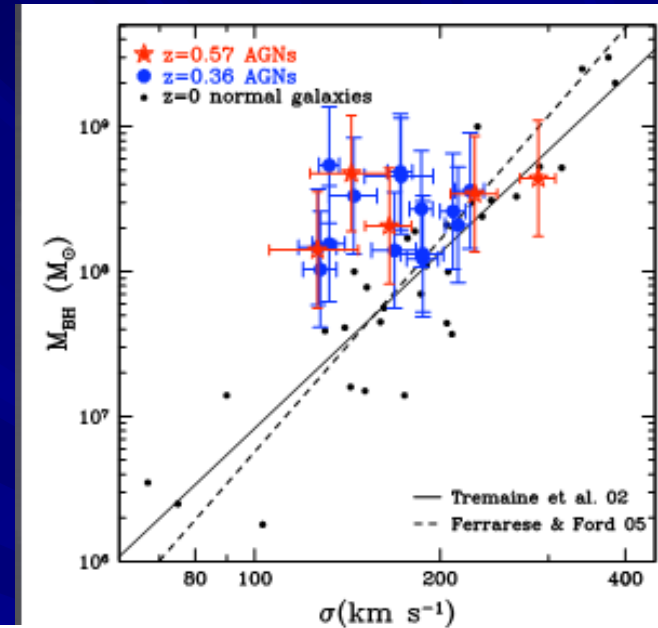
L_{AGN}
 L_{SF}



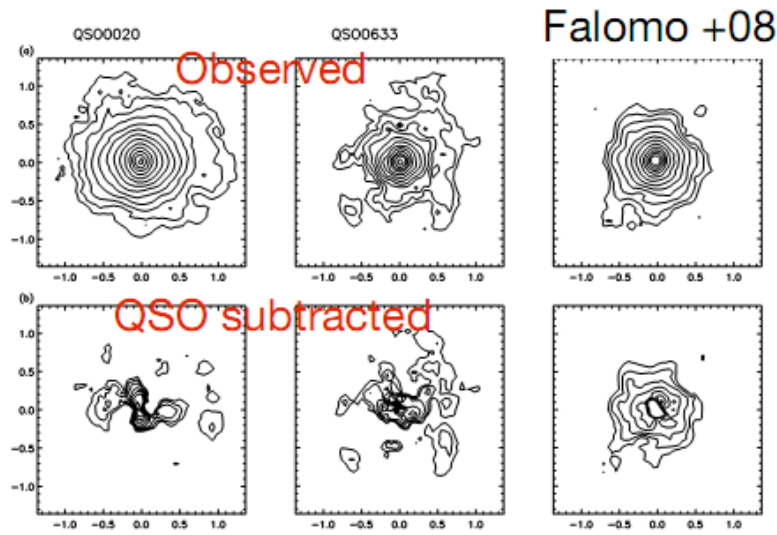
Comparing BH mass and stellar mass at all z



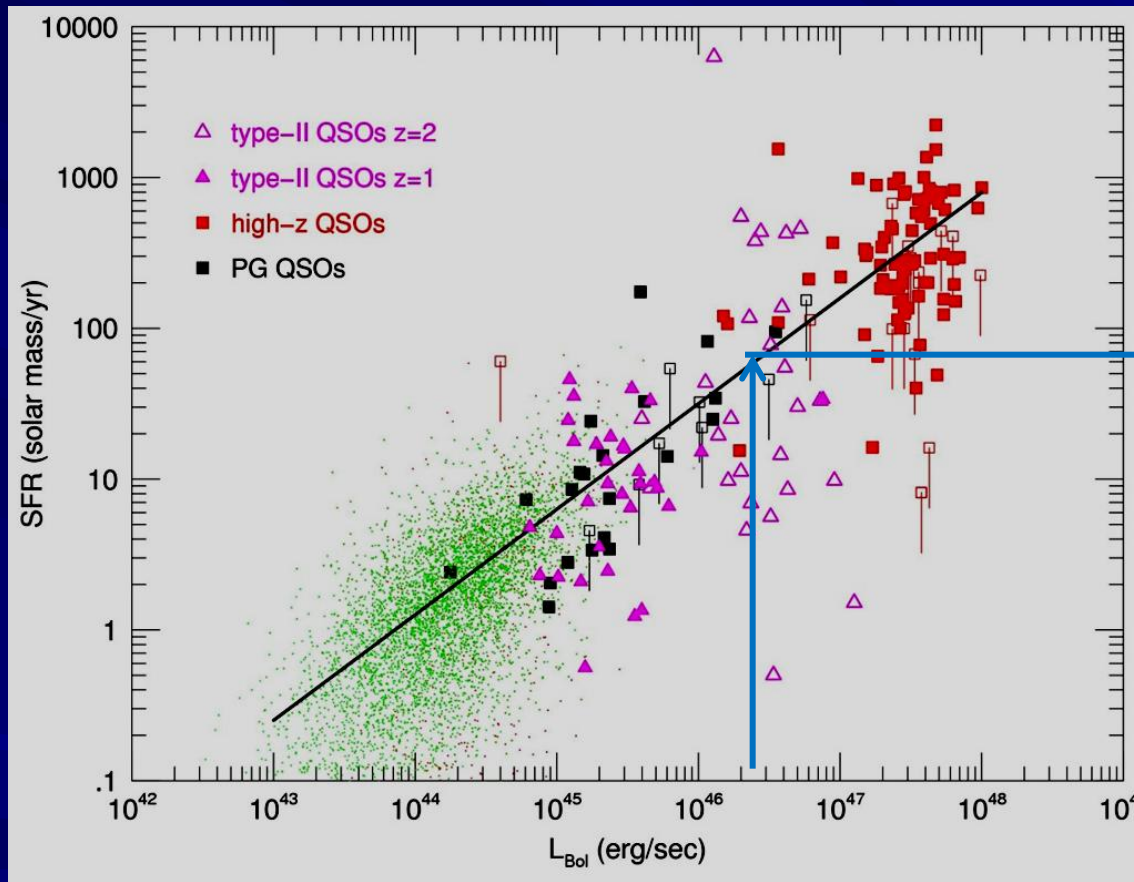
Shen et al. 2008



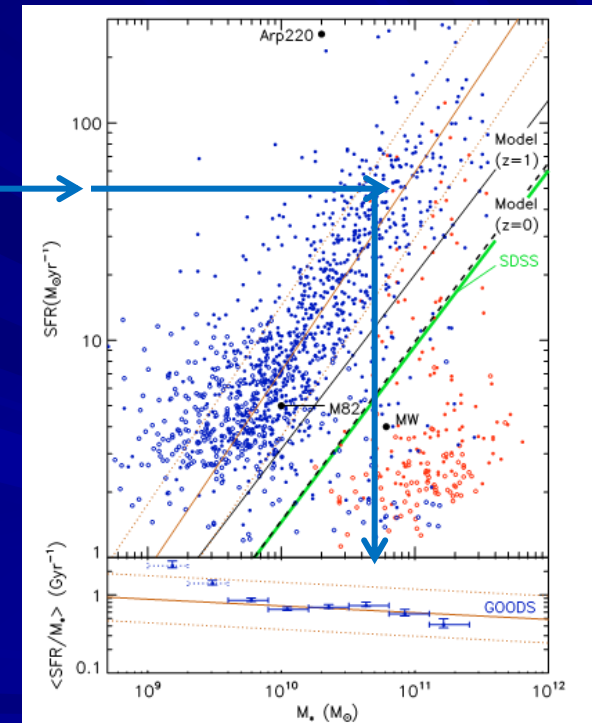
Woo et al. 2006



Measuring stellar mass in AGN dominated systems: A new method

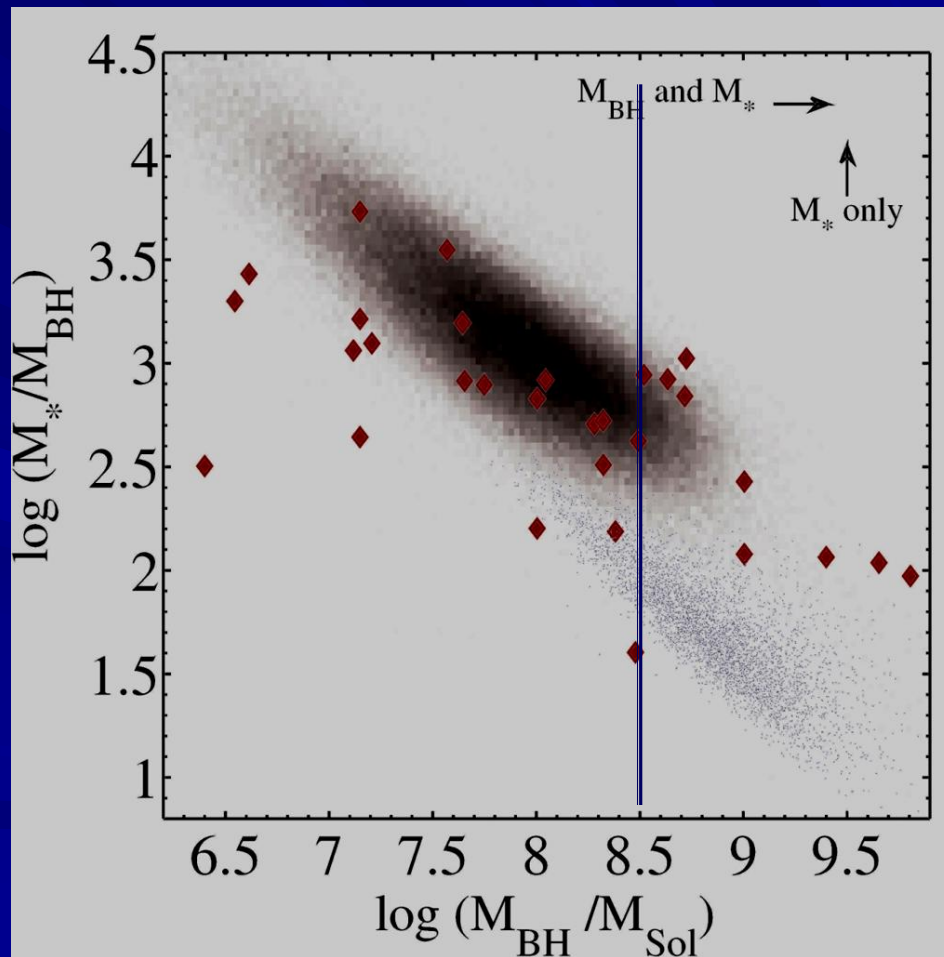
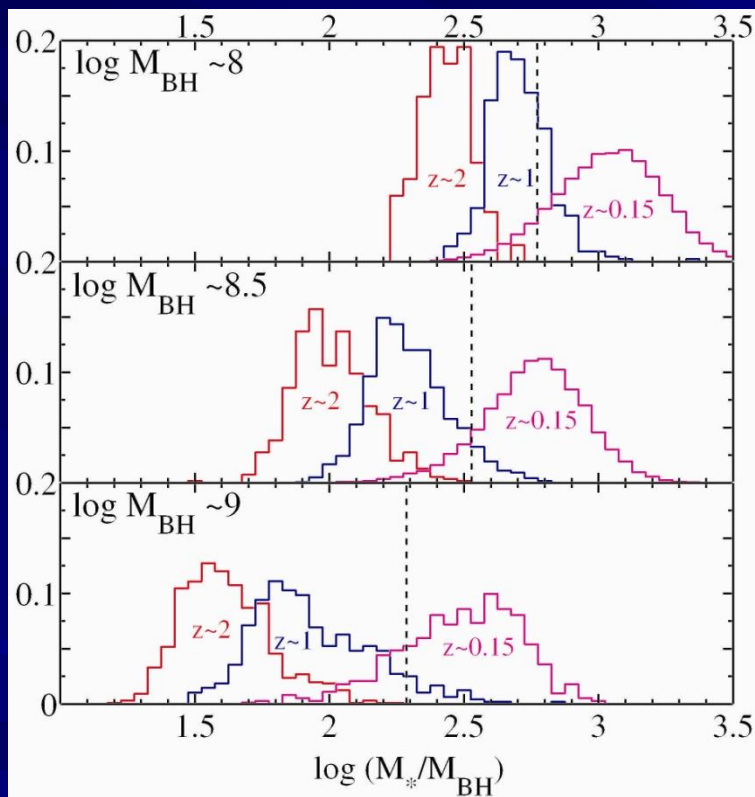


Netzer 2009



Trakhtenbrot and Netzer 2010

$M_{\text{bulge}}/M_{\text{BH}}$: Low and high redshift comparison



Co-evolution of AGN and SF galaxies

- Star formation and stellar mass
 - Red and blue galaxies
 - AGN and the “green valley”
 - The “SF sequence”
- Black hole growth and star formation rate
 - How to measure BH growth
 - SFR in AGN hosts
- BH and galaxy growth through time
 - A new method to estimate $M_{\text{bulge}}/M_{\text{BH}}$
 - BH mass and accretion rate at $z > 2$

The equation of time 1975-2011

