Is black hole growth a universal process?

Exploring selection effects in measurements of Eddington ratios and host galaxies of AGN

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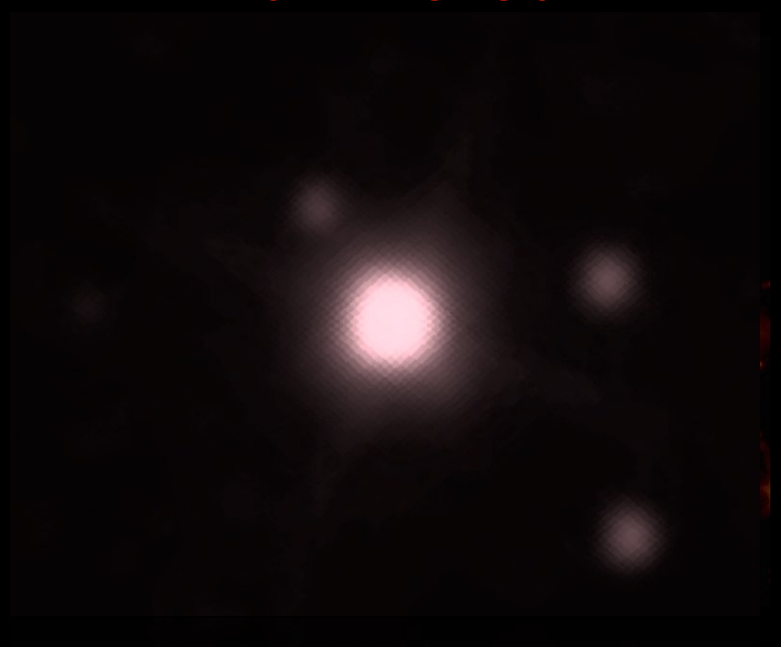
In collaboration with Ryan Hickox, Simon Mutch, Darren Croton, Andrew Ptak, Michael DiPompeo

Sloan Digital Sky Survey Fly-through
Miguel Aragon (JHU), Mark Subbarao (Adler P.), Alex Szalay (JHU)

Observational Difficulties

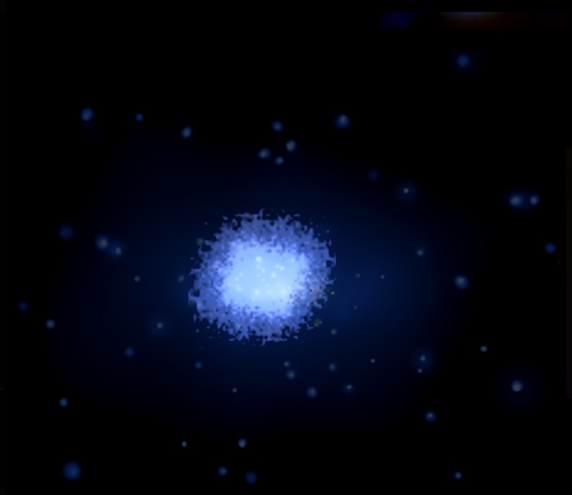
Dilution by host galaxy light

mid-infrared



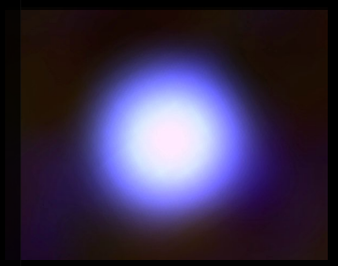
optical

soft X-rays



< 10 keV

hard X-rays



> 10 keV

(e.g. Hopkins et al. 2009, Trump et al. 2016, Jones et al. 2016)

Images courtesy SSC/WISE/HST/CXC/Swift

Observational Difficulties

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< 10 keV

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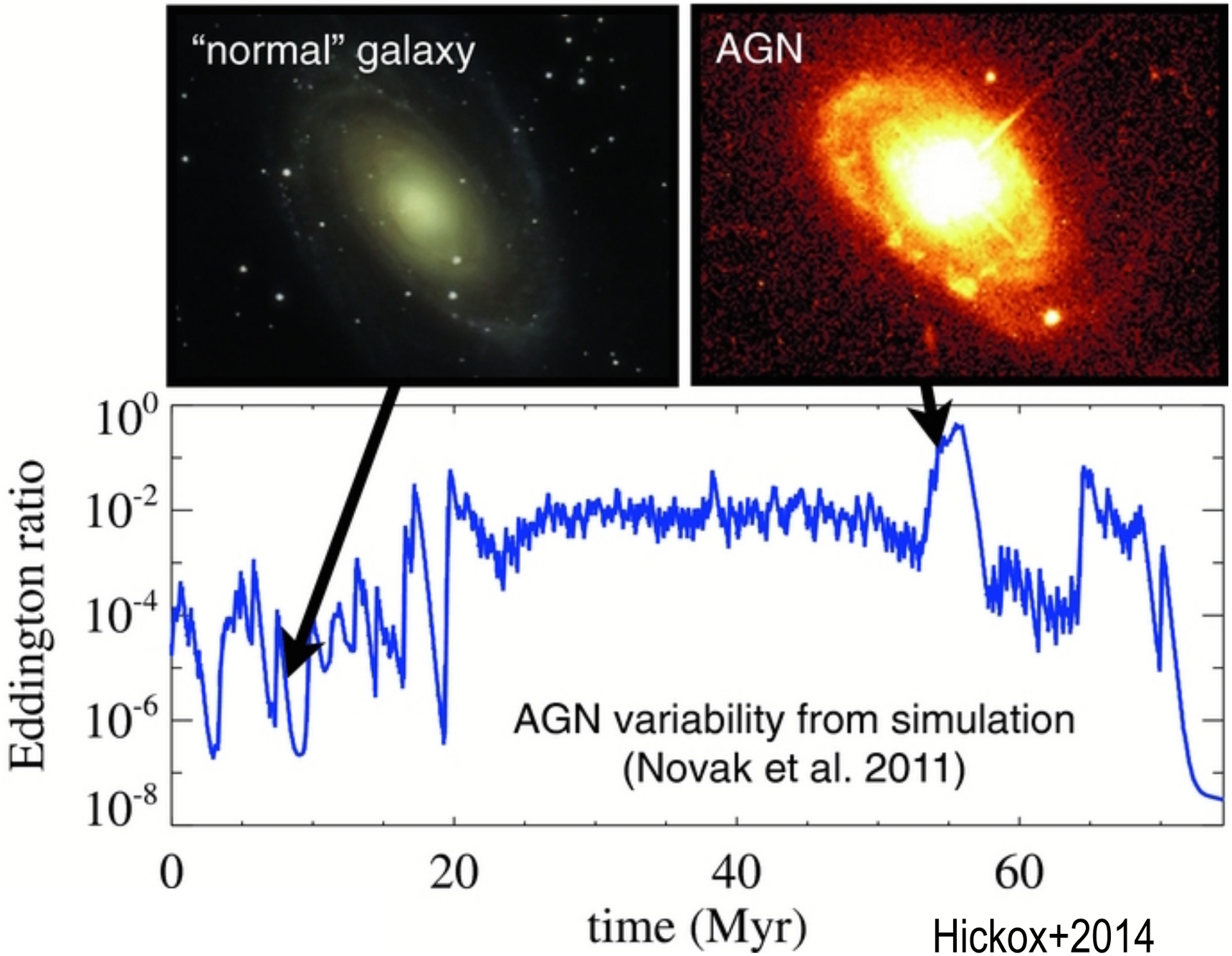
Images courtesy SSC/WISE/HST/CXC/Swift

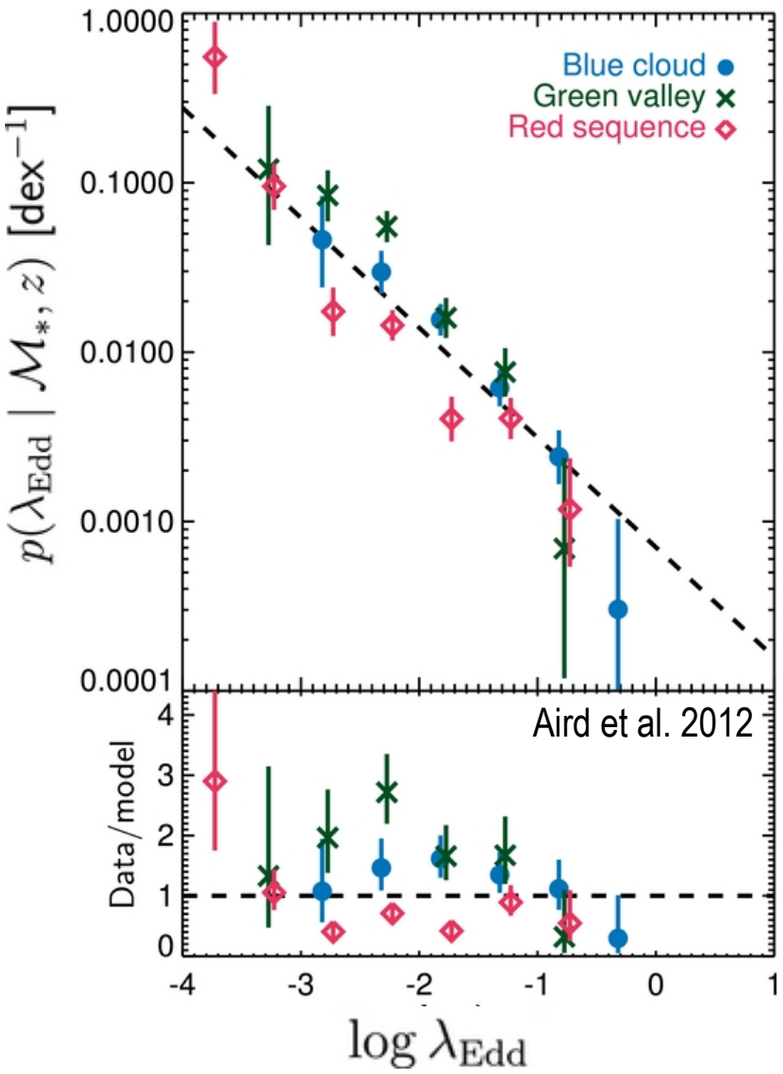
Introduction to the Eddington Ratio Distribution



Hickox+2014
(See also e.g., Schawinski+2010d)

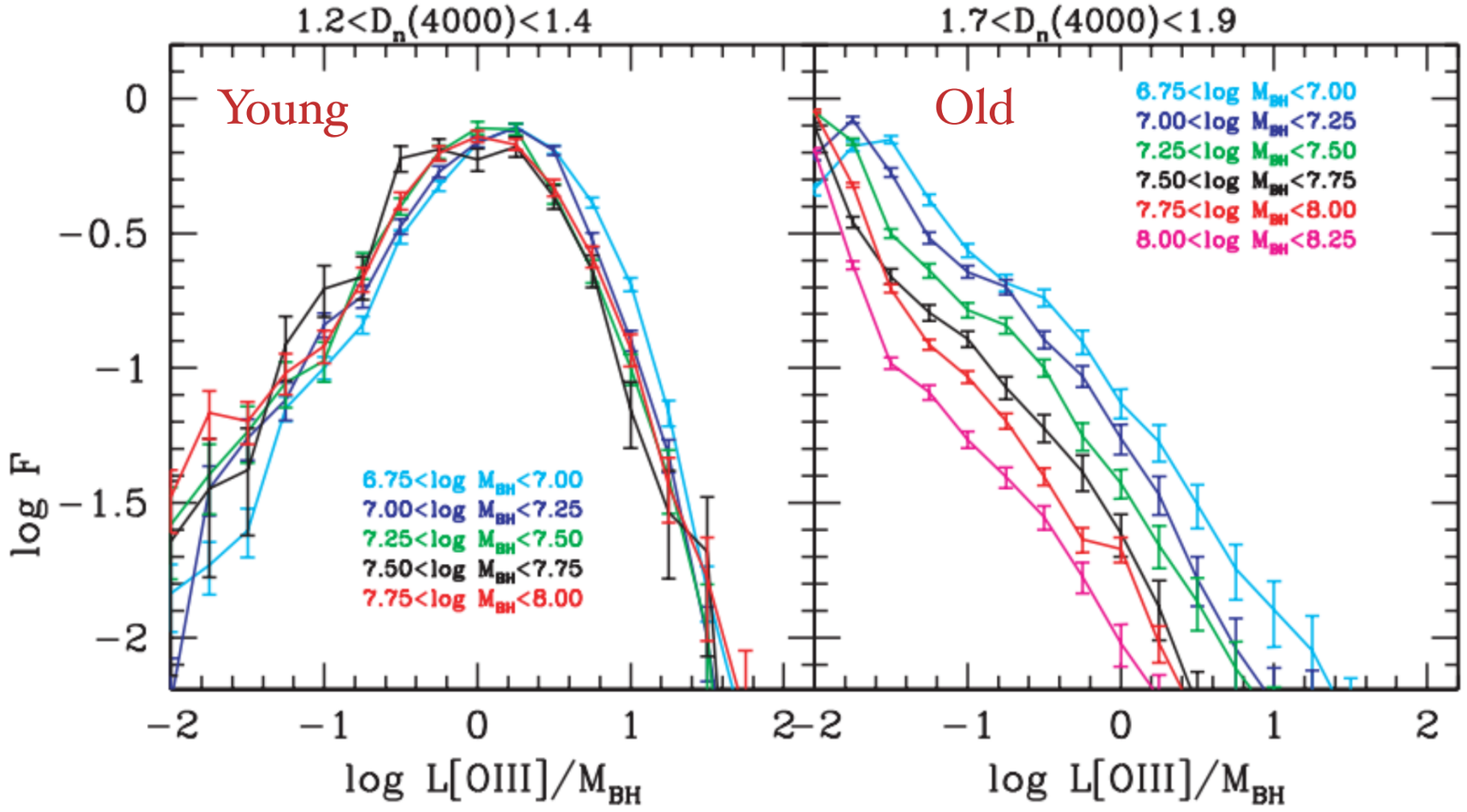
Determining the Eddington Ratio Distribution

Power Law



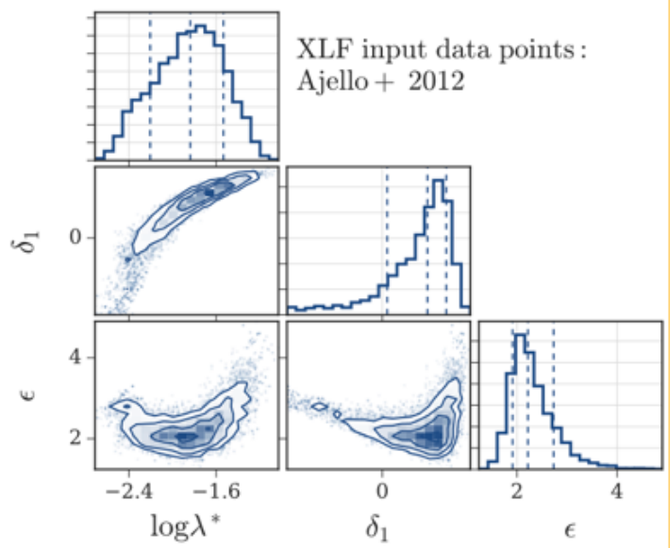
Lognormal

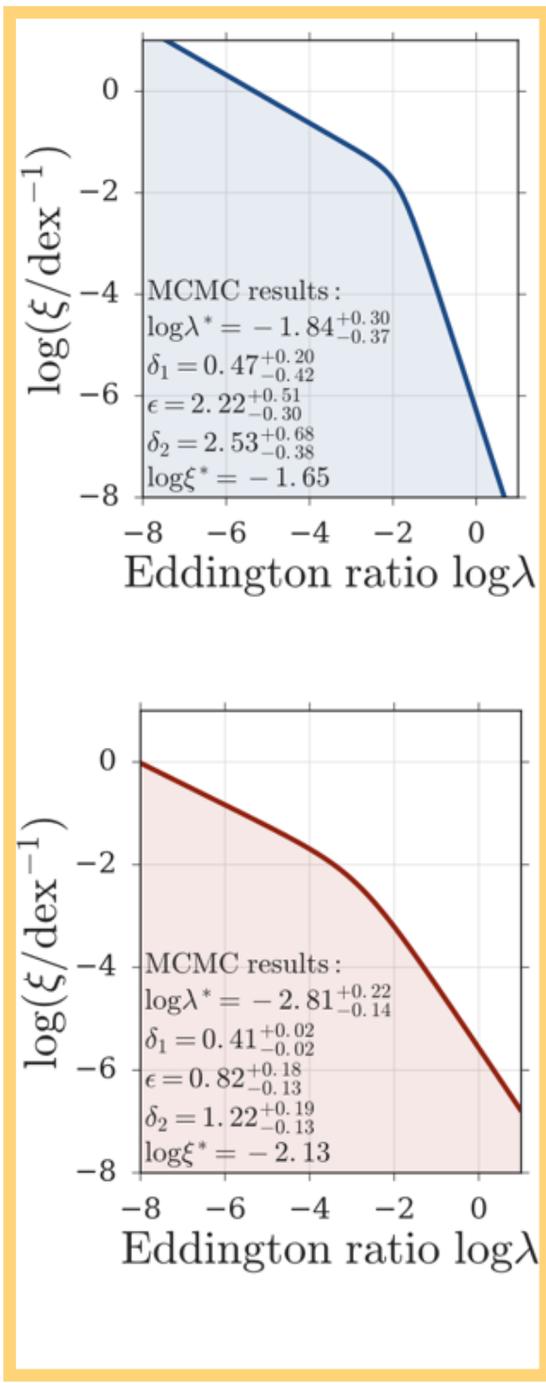
Power Law

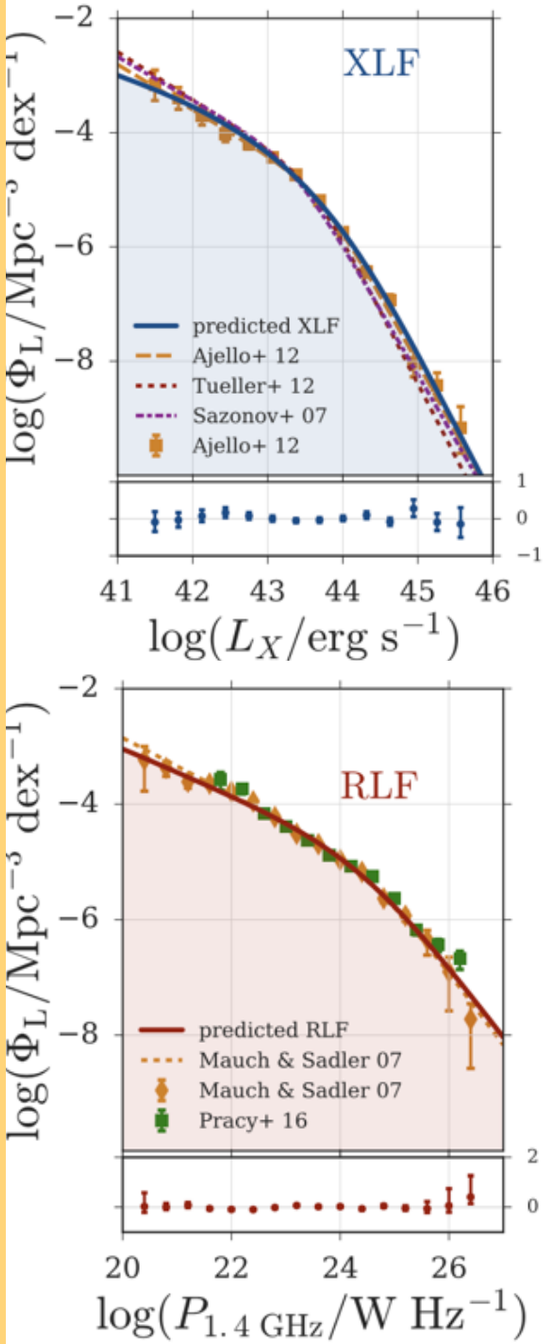


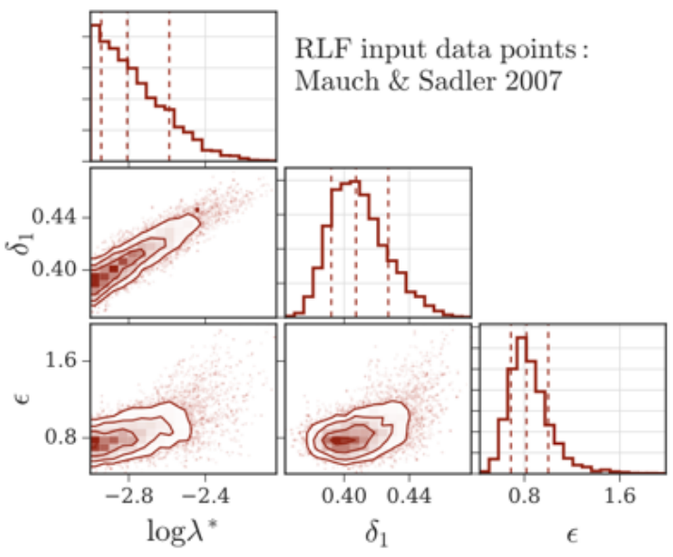
Kauffmann & Heckman+2009

Determining the Eddington Ratio Distribution







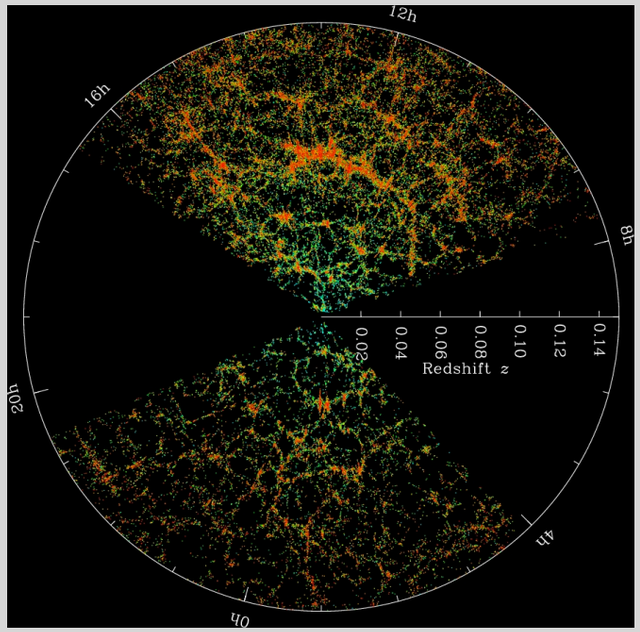


(largely) Mass Independent ERDF

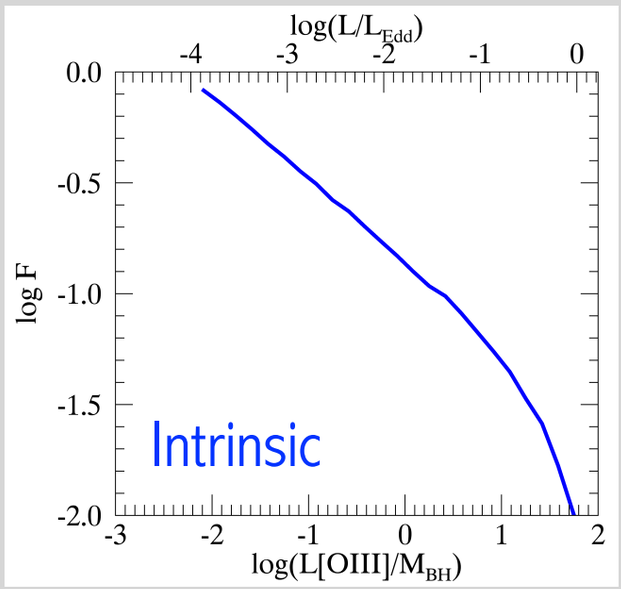
Weigel+2017, submitted

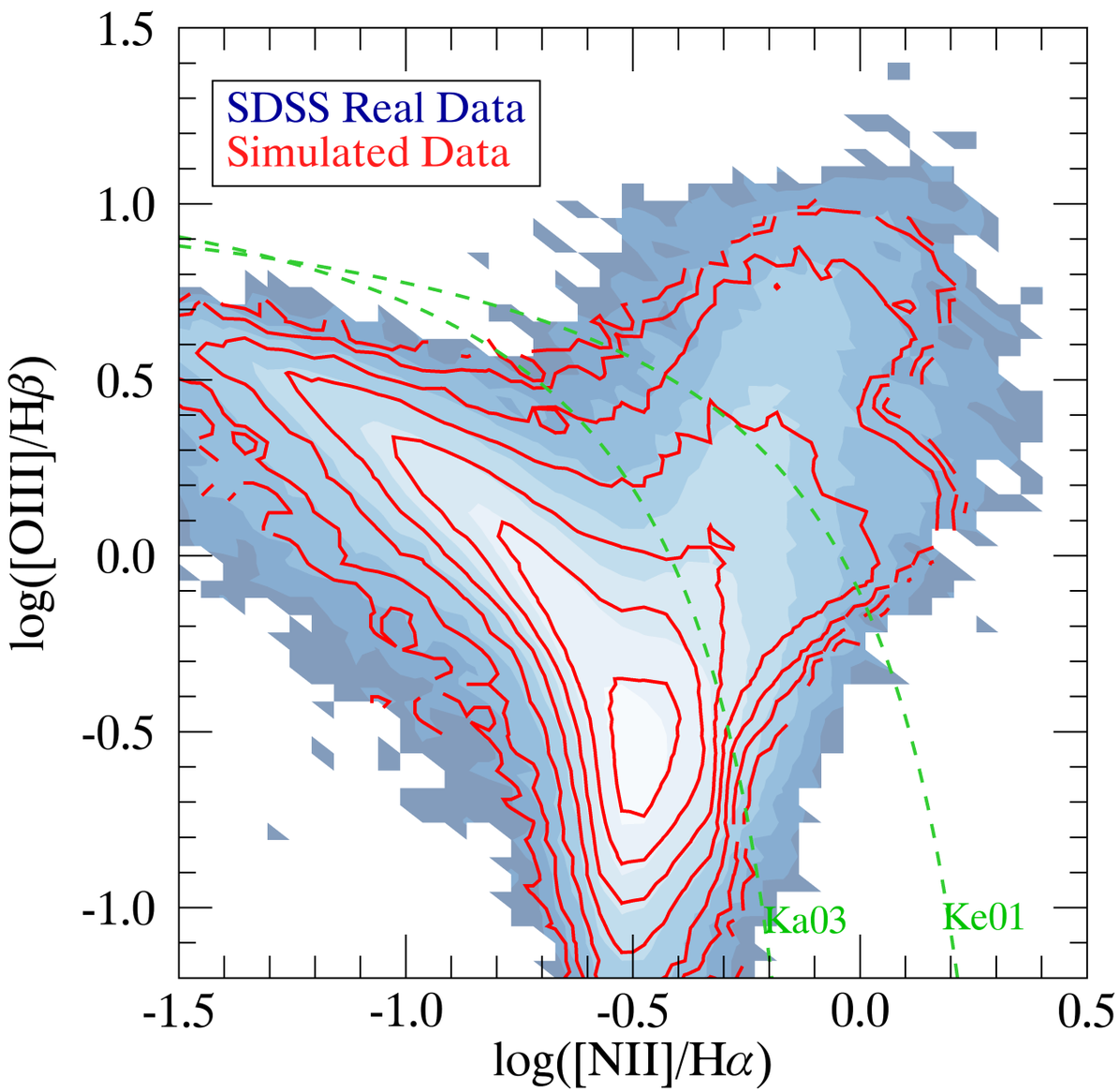
Building a Simulated Sample of Galaxies with AGN

SDSS Star Forming Galaxies



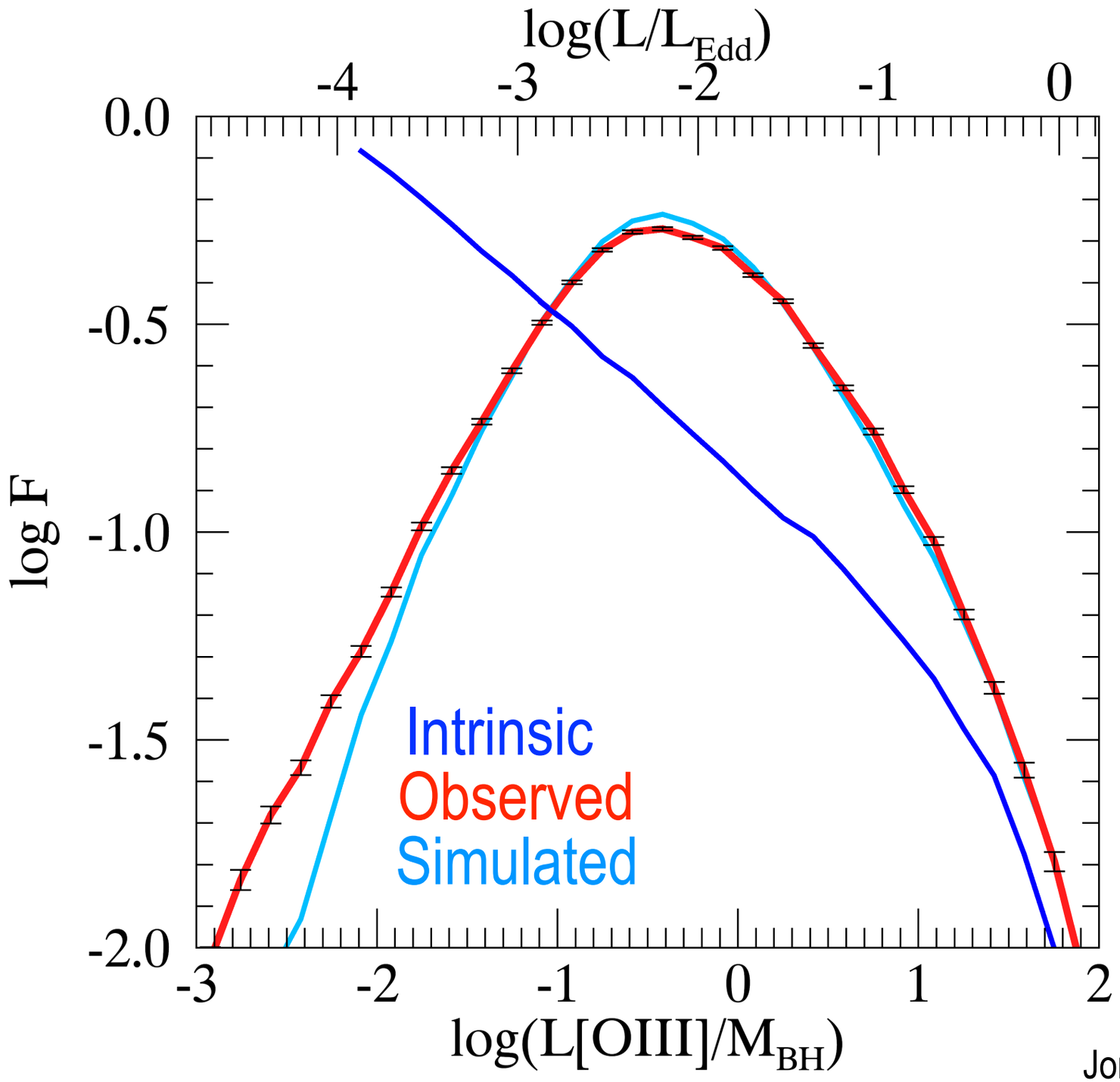
AGN Accretion Rate





Jones et al 2016, ApJ 826,12

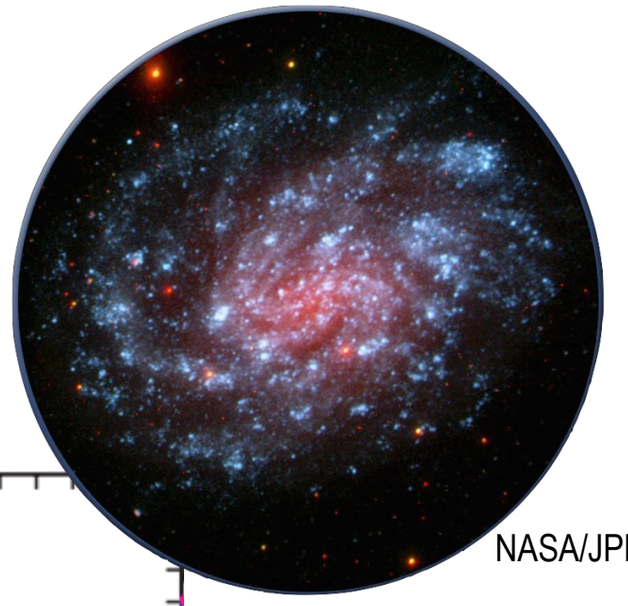
Testing the Simulated Sample



Jones et al 2016, ApJ 826,12

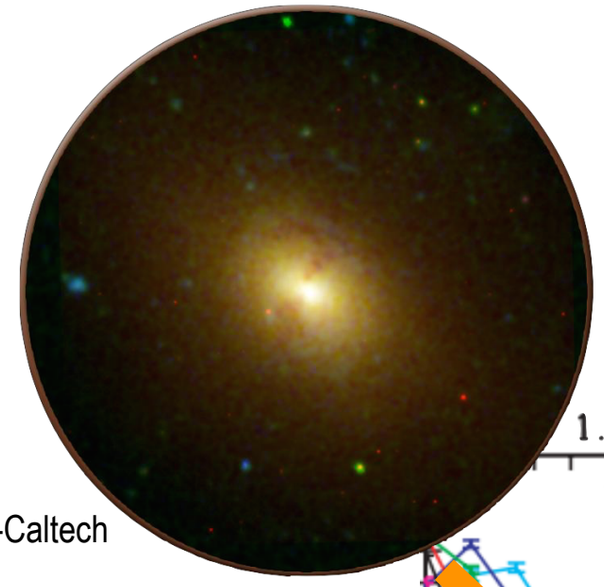
A Summary of the Optical

Young Galaxies



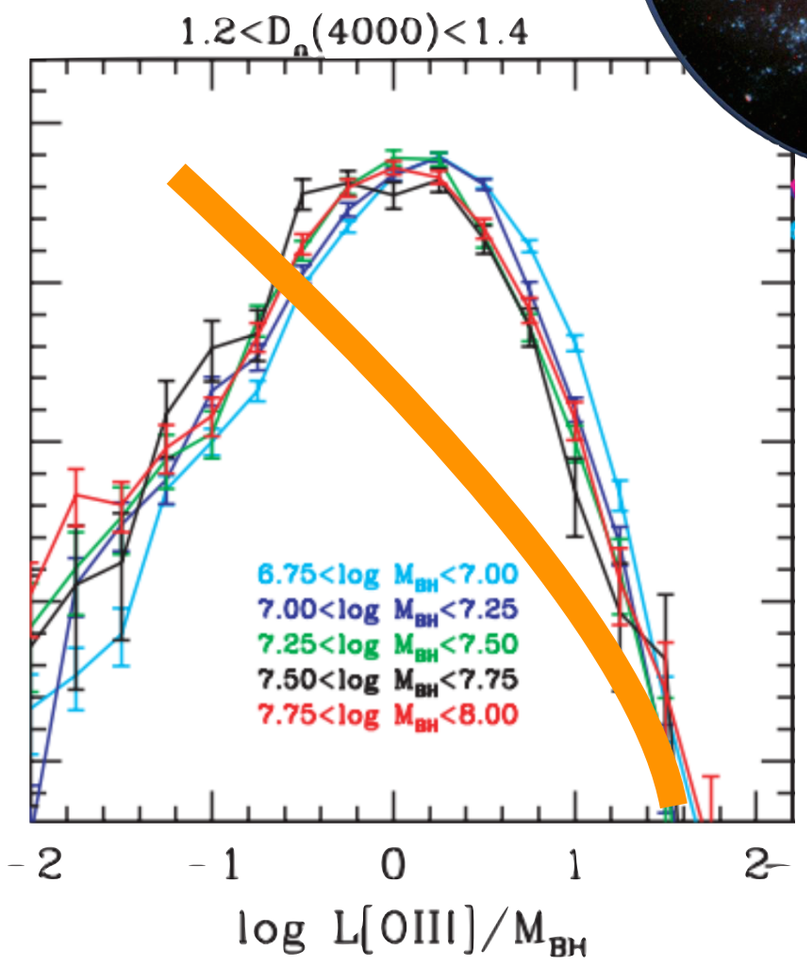
NGC 300

NASA/JPL-Caltech

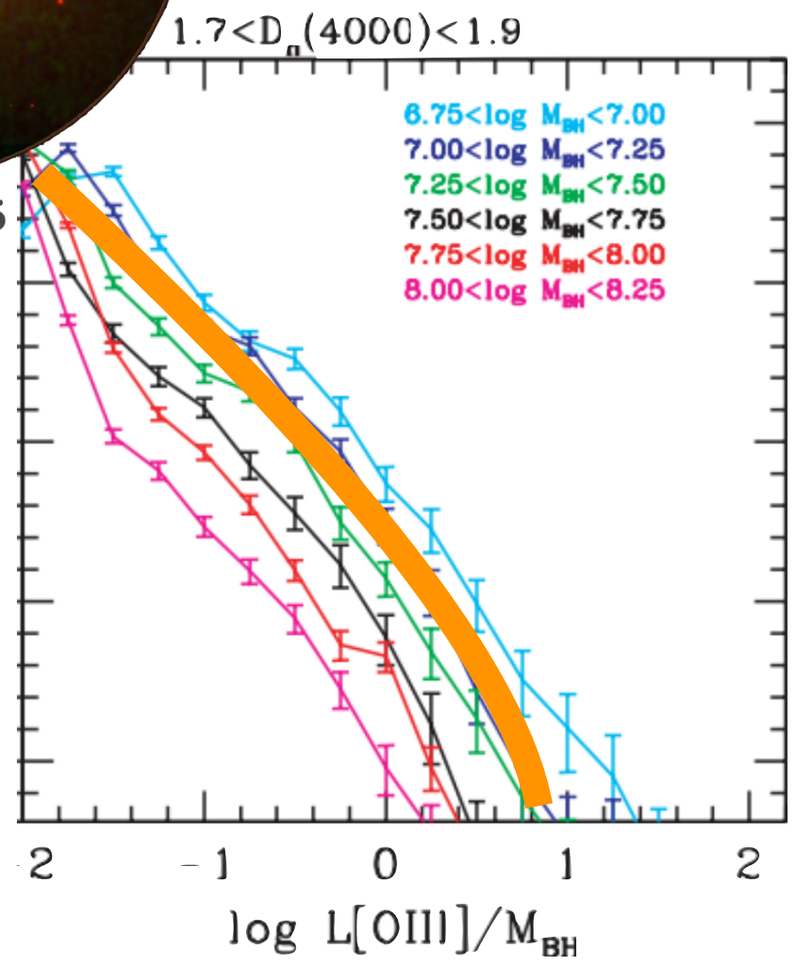


NGC 1316

Older Galaxies



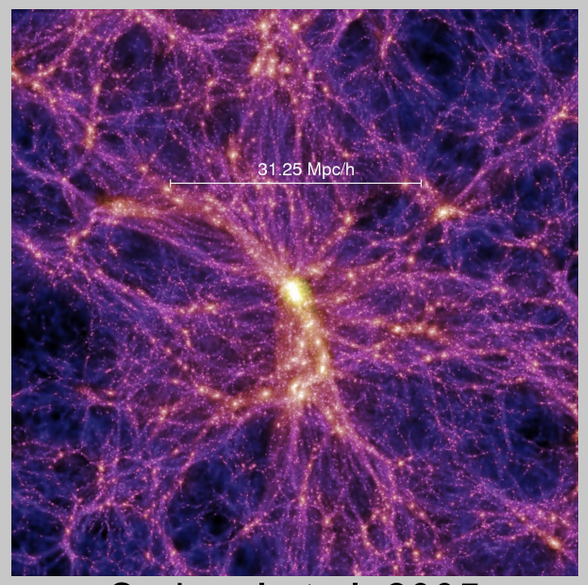
Universal Power Law



Jones et al 2016, ApJ 826,12

A Simple Model of Galaxy Formation and AGN Accretion

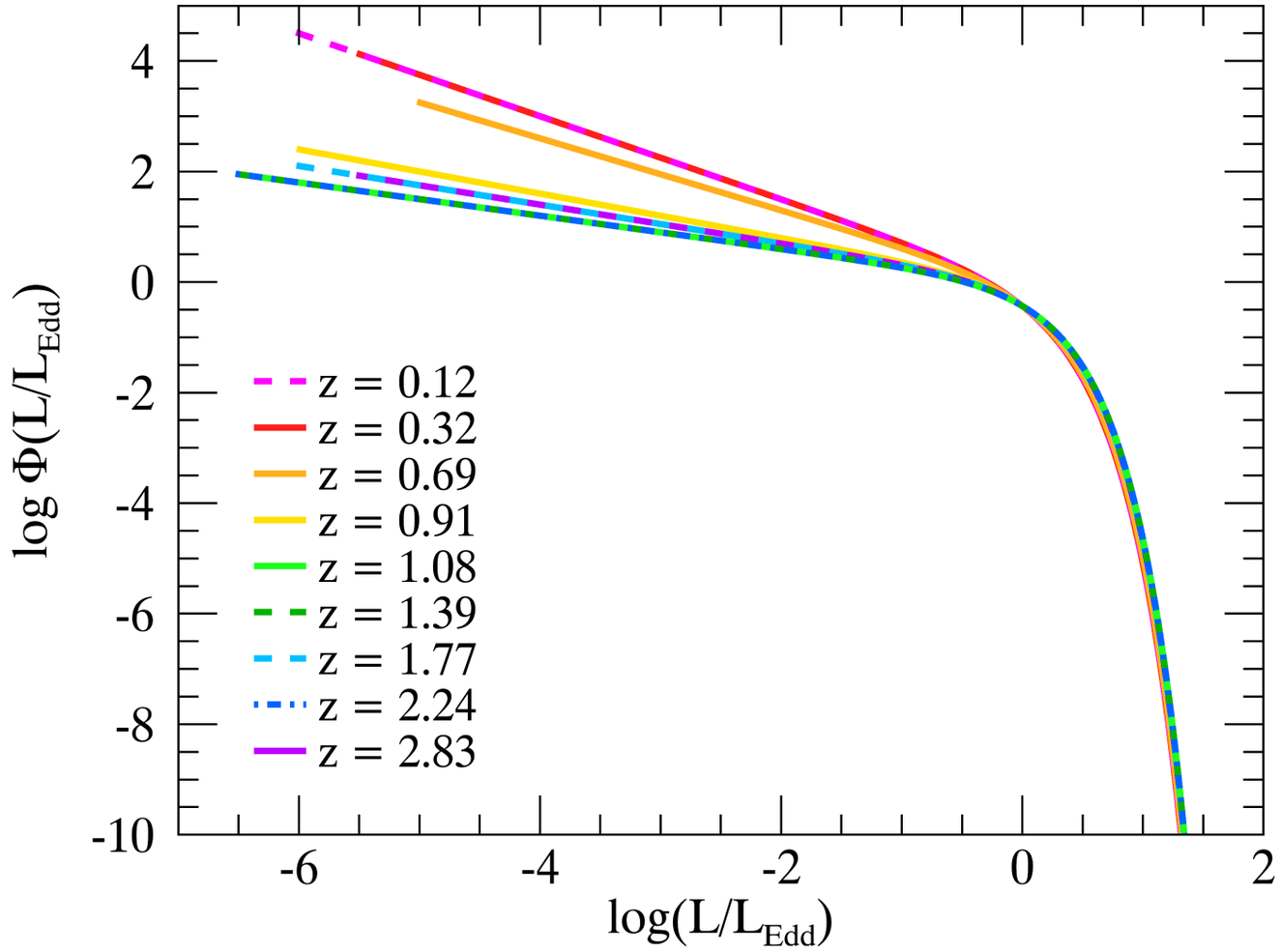
Galaxies



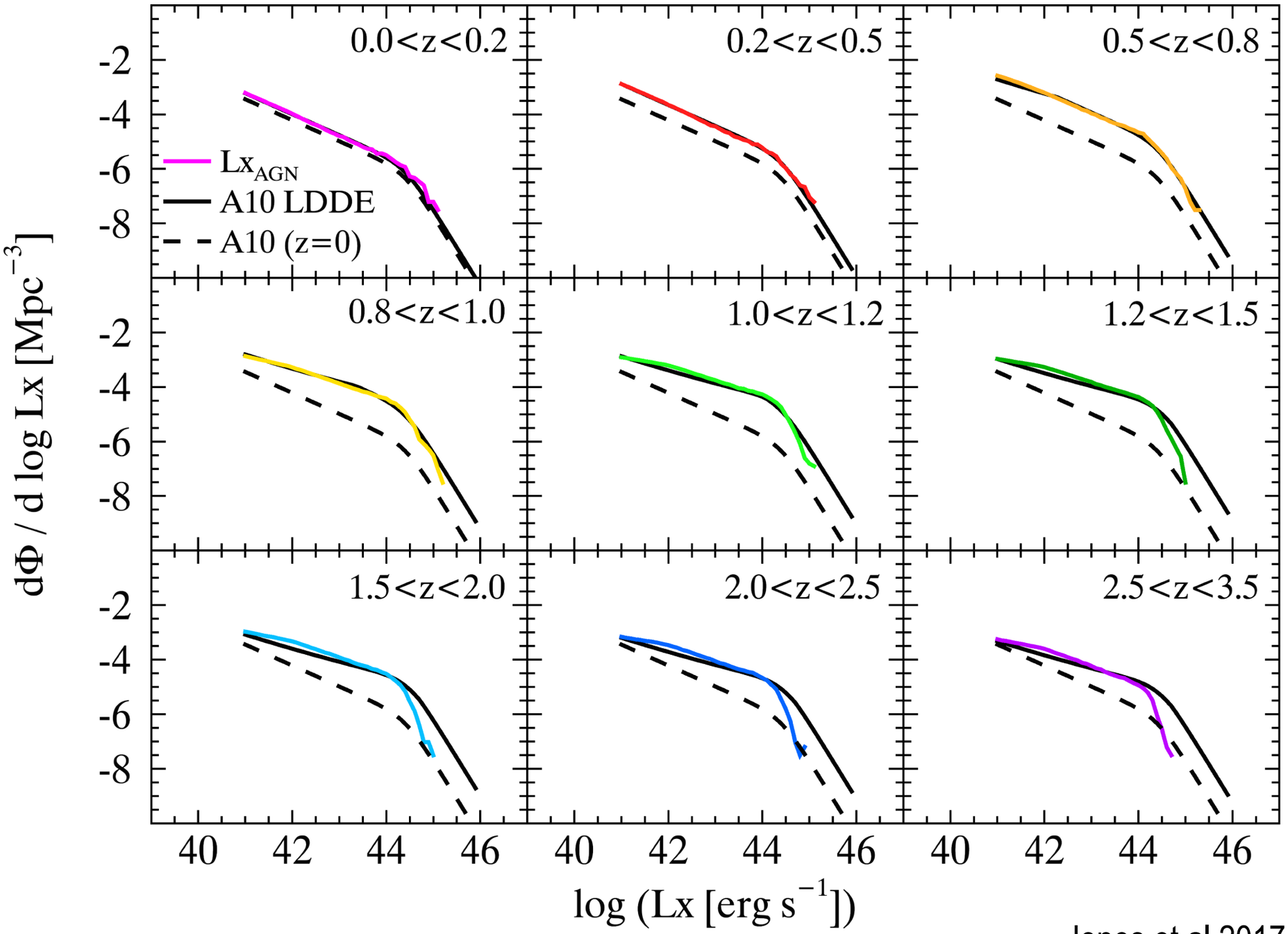
Springel et al. 2005

Mutch et al 2013, MNRAS 435, 2445

AGN

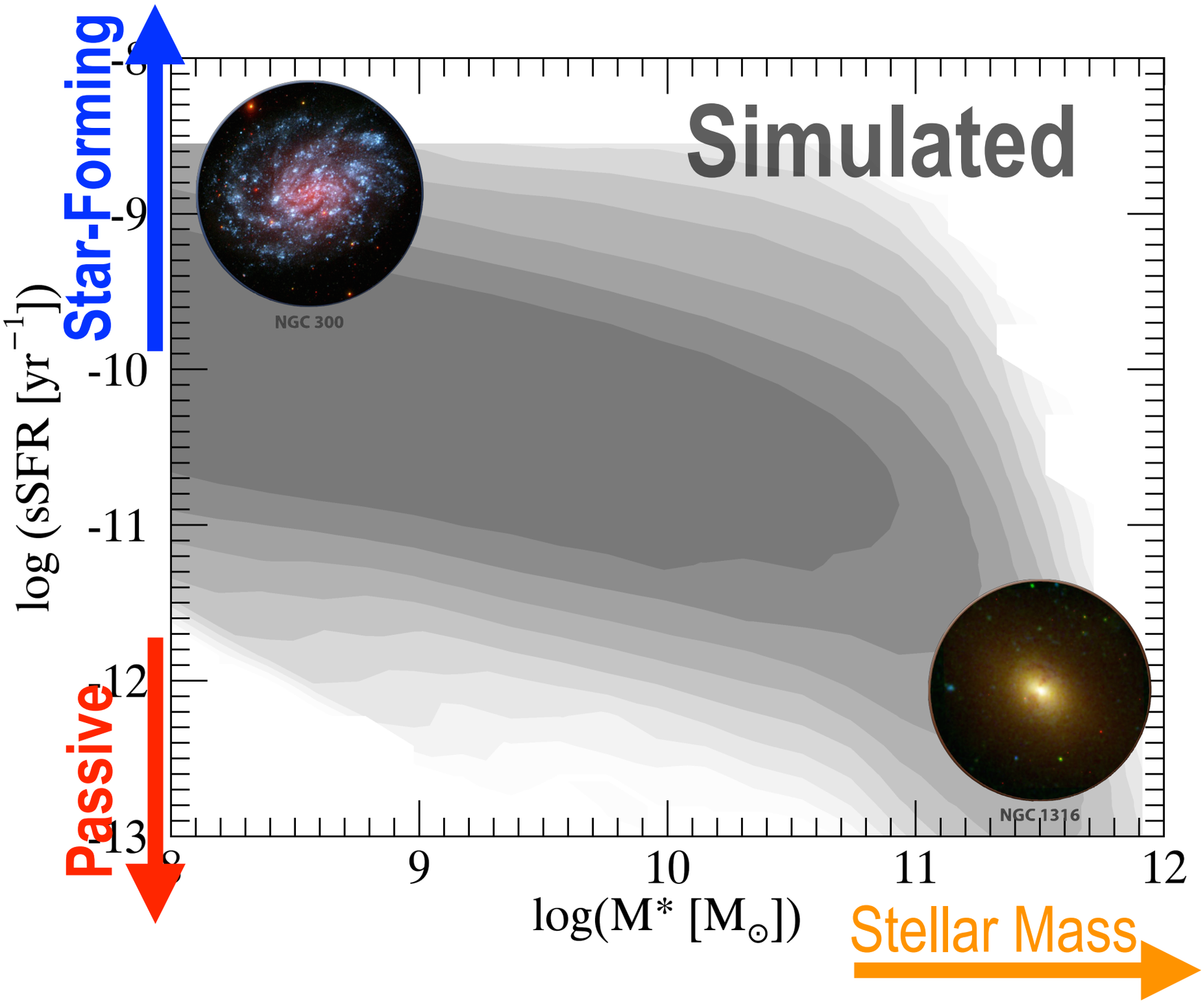


Evolution of the AGN XLF

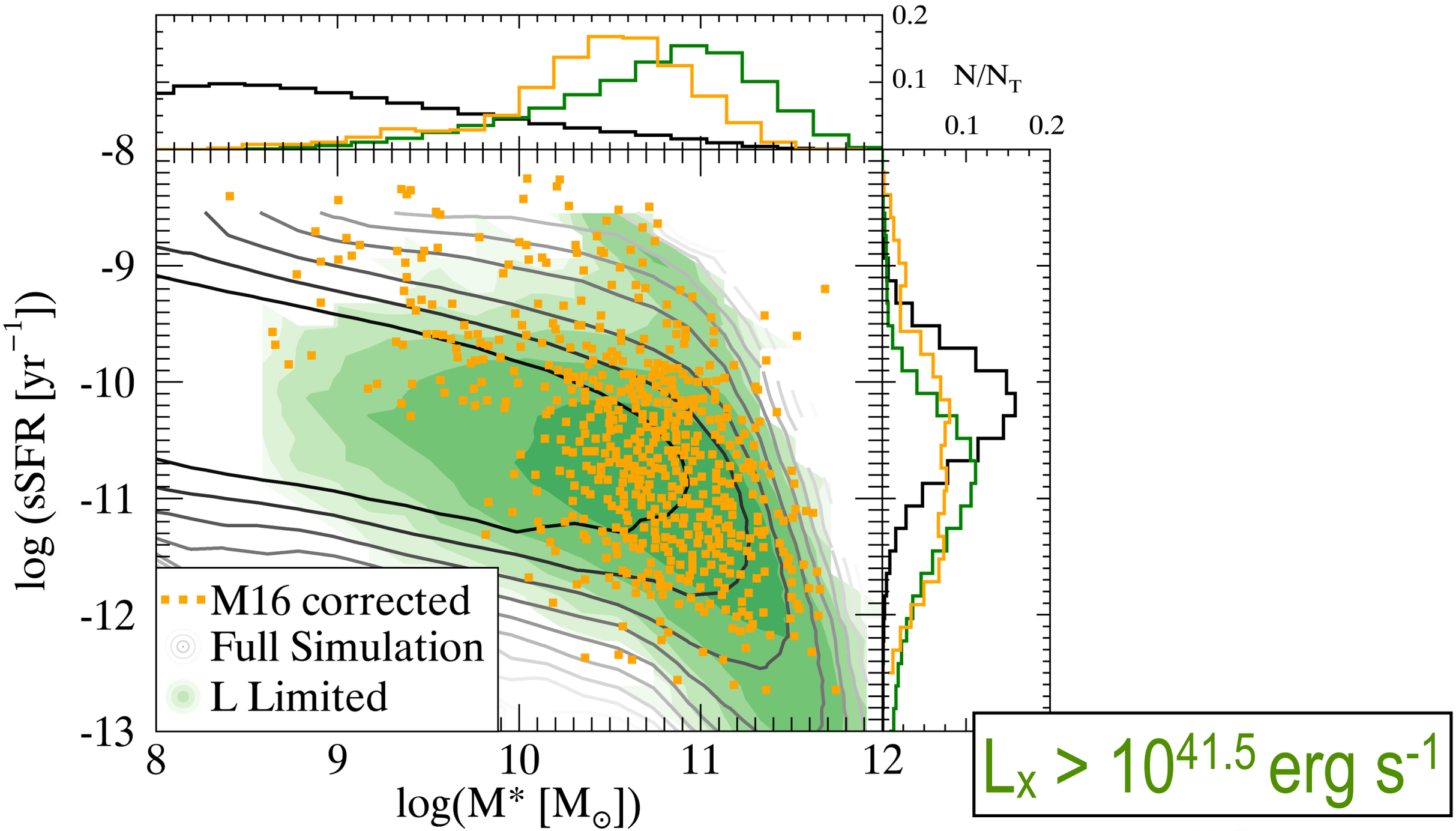


Jones et al 2017, Accepted to ApJ

sSFR-M*

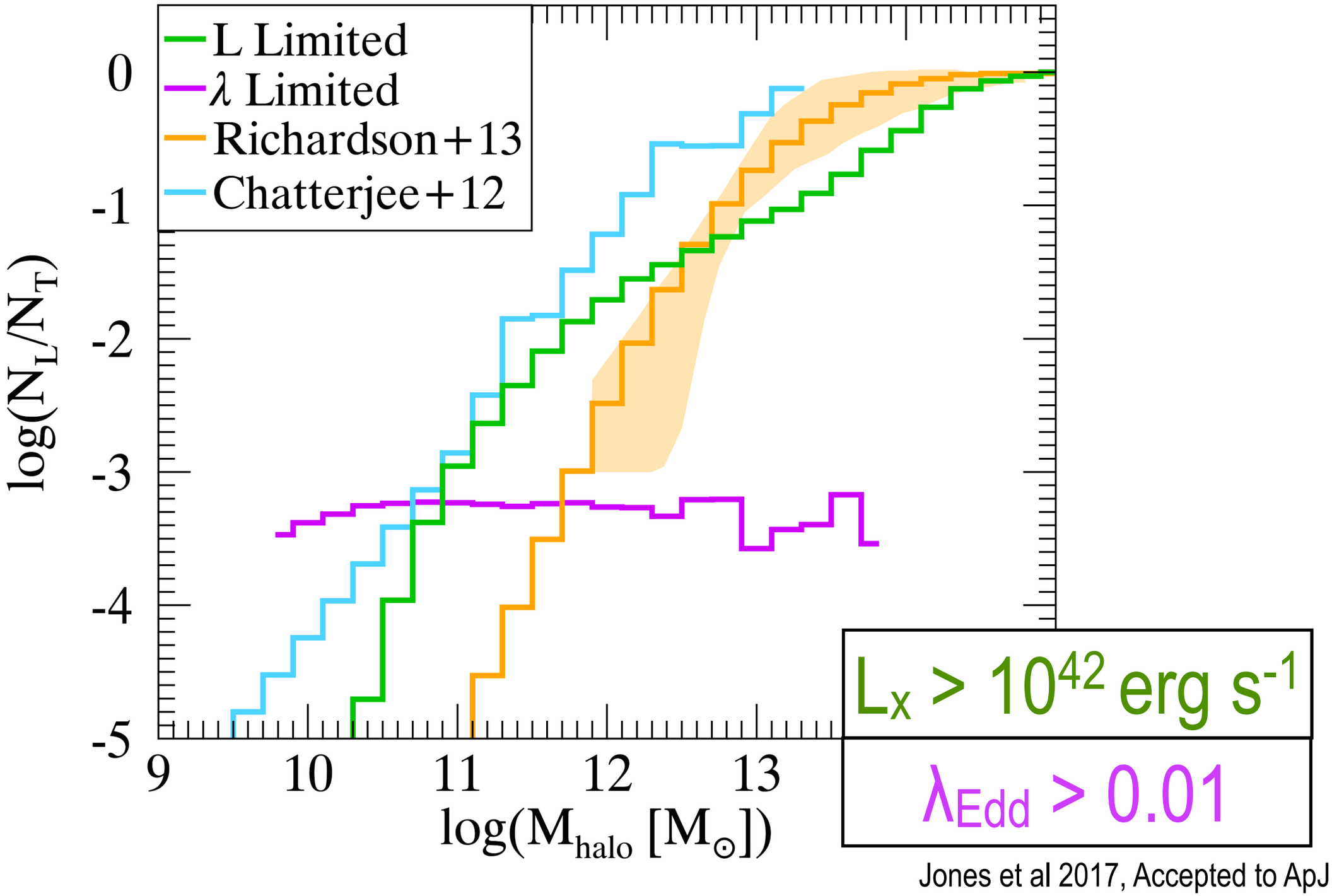

Simulated
Star-Forming
Passive
NGC 300
NGC 1316
log (sSFR [yr^{-1}])
-9
-10
-11
-12
-13
8
9
10
11
12
log(M* [M$_\odot$])
Stellar Mass

How Do Imposed Thresholds Influence Observations?



Jones et al 2017, Accepted to ApJ

Halo Occupation Distributions



Jones et al 2017, Accepted to ApJ

A Simple Conclusion for a Simple Model

A simple, **universal** broad Eddington ratio distribution is consistent with a range of optical and X-ray observables.

Jones et al 2016, ApJ 826,12

Jones et al 2017, Accepted to ApJ

What's Next?

1. Multi-wavelength SEDs for the full simulated AGN population

2. Investigating additional selection effects (e.g., mass limits, obscuration, flux limits, color cuts, etc.)

3. Exploring the synthesis of the X-ray Background