

Introduction

The interplay between local and global processes in galaxies

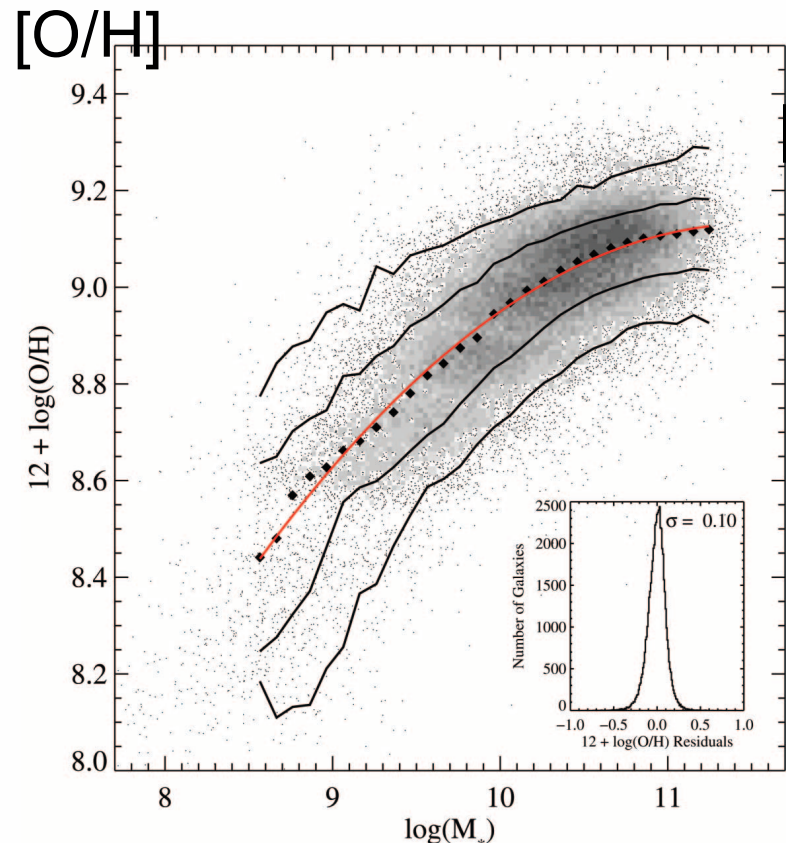
C. Jakob Walcher
Leibniz Institut für Astrophysik Potsdam (AIP)

Introduction

Why this is NOT and IFU conference!!

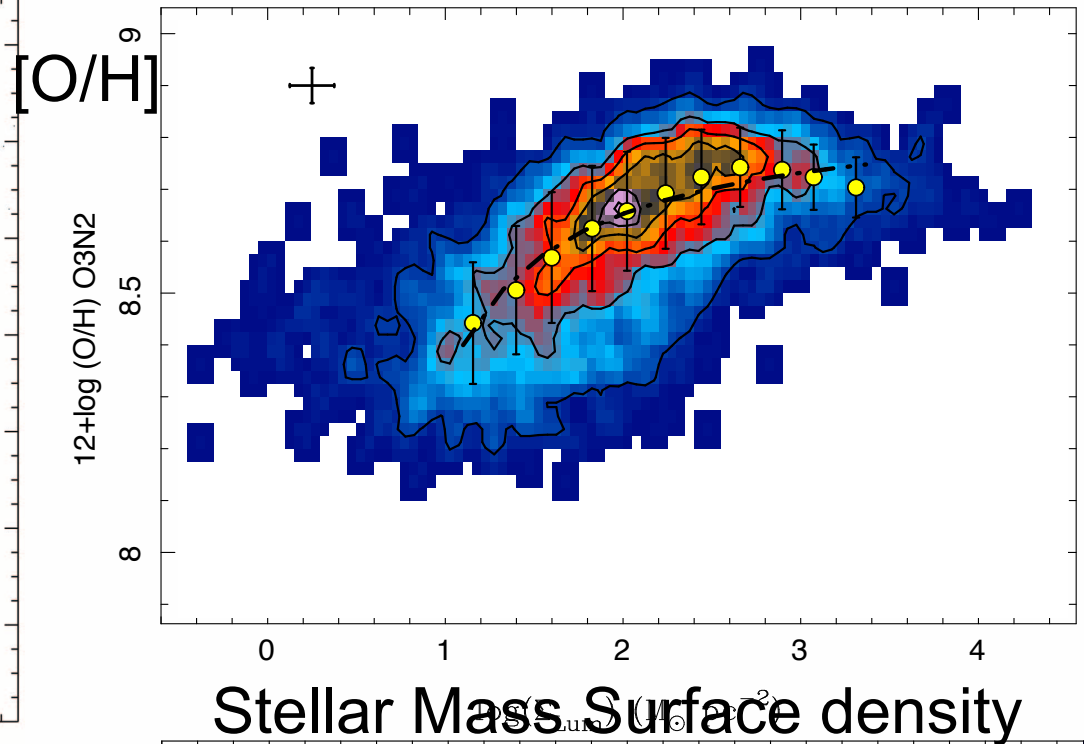
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Global M-Z $\leftrightarrow$ local Σ -Z



Stellar mass

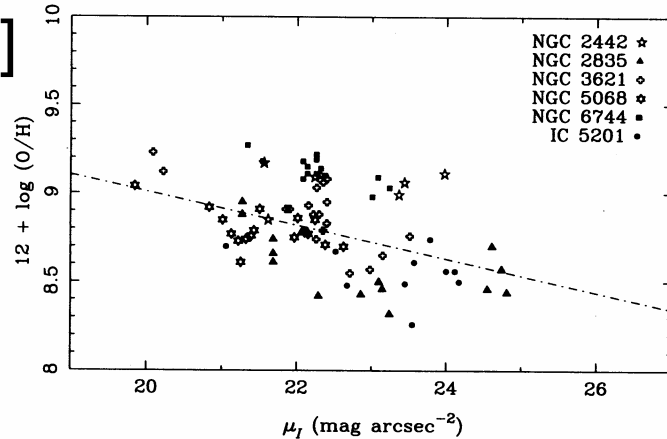
Tremonti et al., 2004



Sanchez et al., 2013

20 years ago:

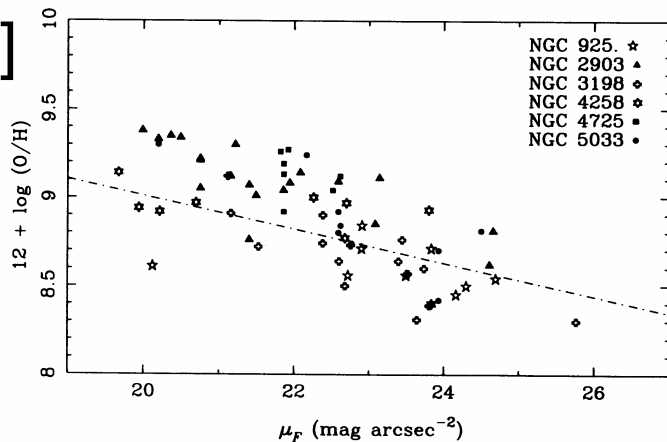
[O/H]



I am now old enough to see things rediscovered the third time.

Kennicutt 2013

[O/H]

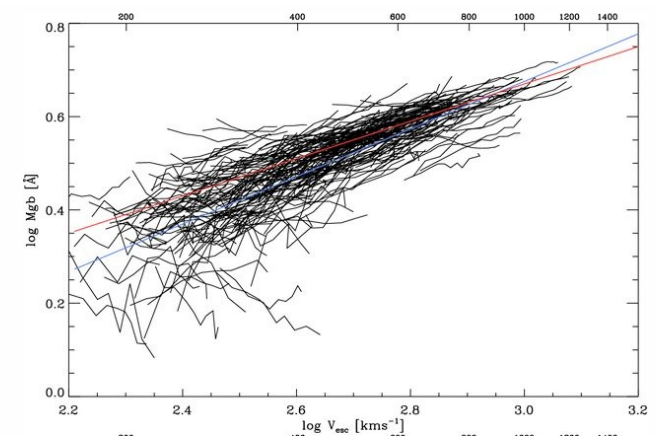


Ryder 1995

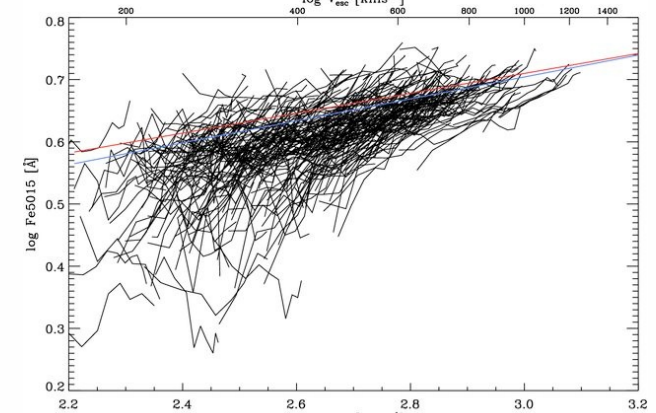
Surface brightness

Local: Escape velocity and abundances

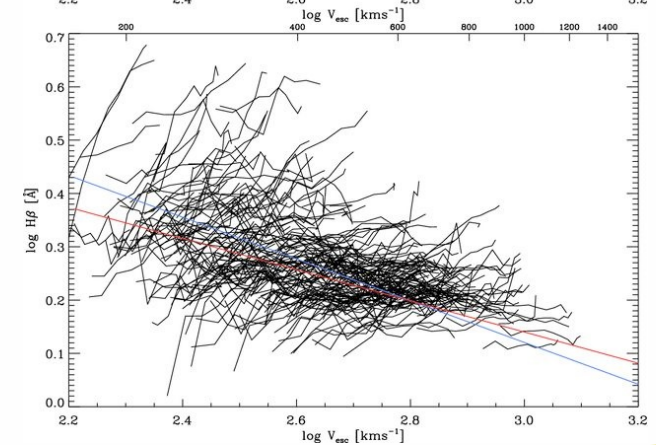
MgB



Fe5015



H β

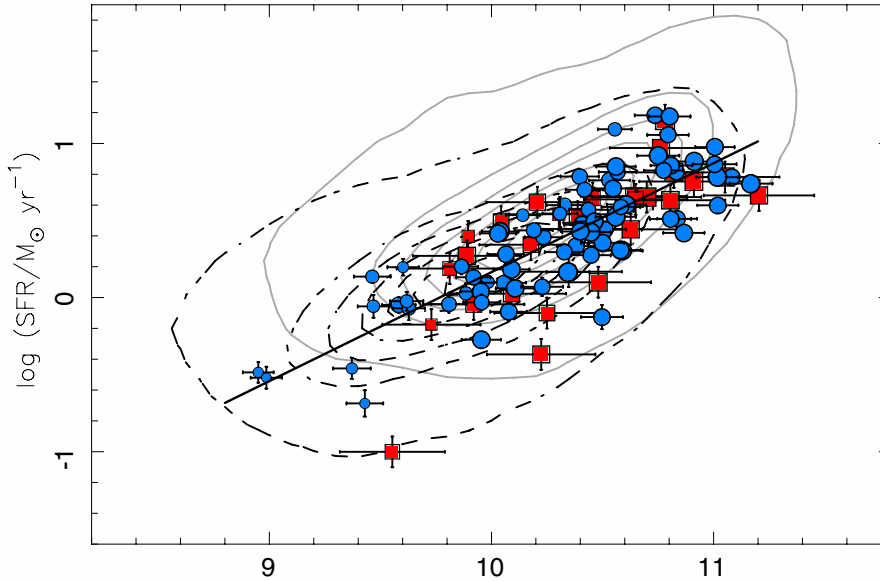


ATLAS3D, Scott et al., 2013

V_{esc}

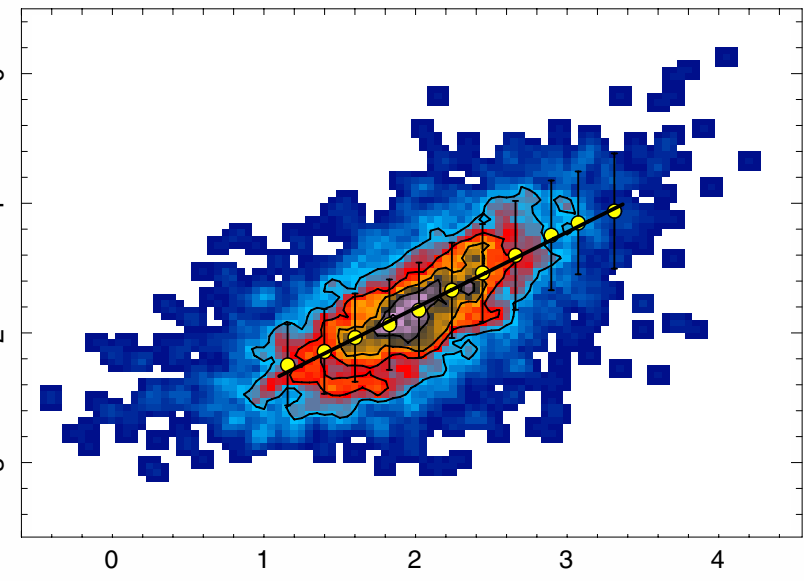
Global SF MS $\leftrightarrow$ local SF MS

Star Formation Rate



Galaxy Mass

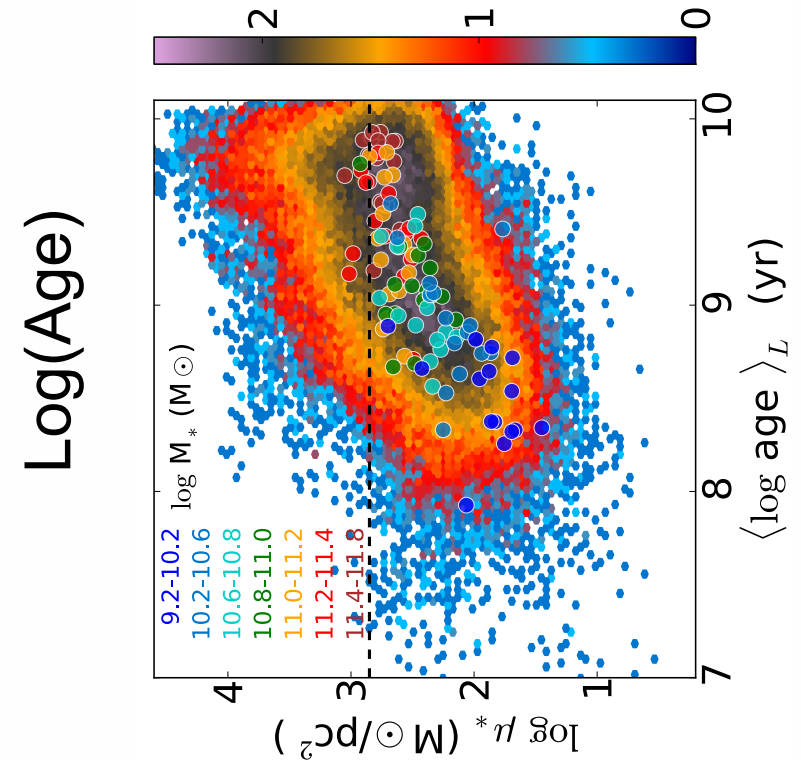
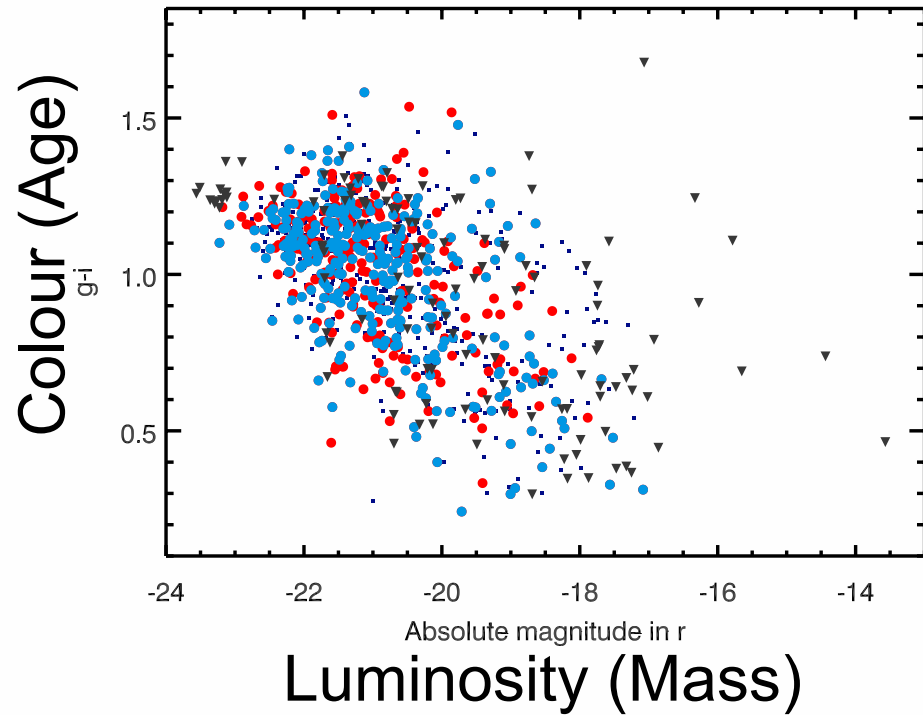
Star Formation Rate



Stellar Mass Surface Density

Sanchez et al., 2013, Cano-Diaz, et al., subm.
see also Catalan-Torecilla, et al., 2015

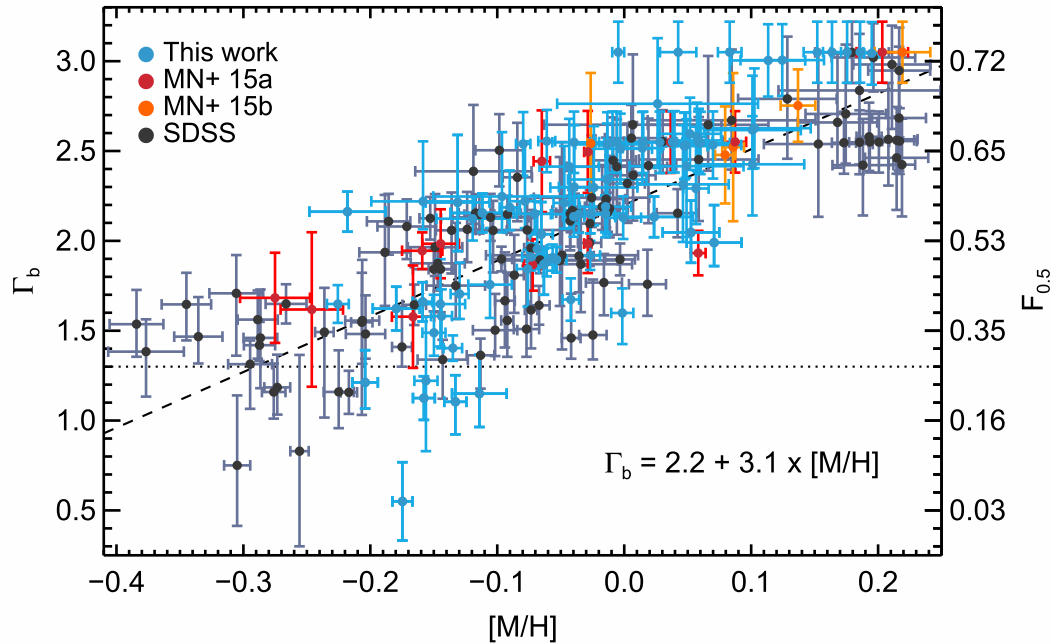
Global CMD $\leftrightarrow$ Local Σ - age



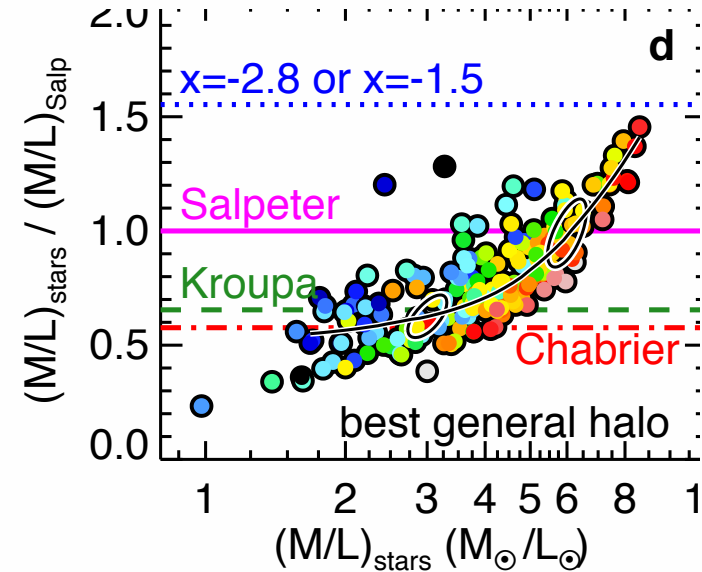
Surface mass density

Gonzalez-Delgado et al. (2014)

Local IMF-stellar metallicity

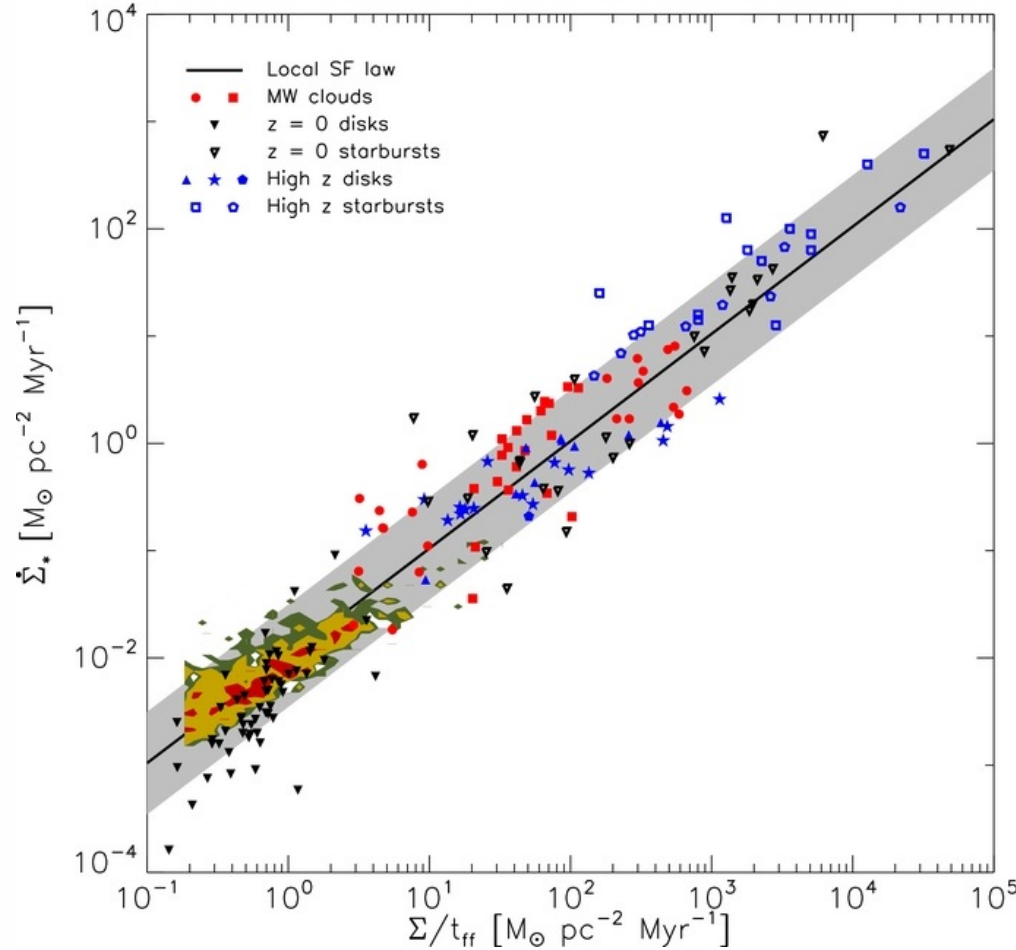


Martin-Navarro, et al., 2015



Cappellari et al., 2012

This is all well known...



Star formation law

Krumholz et al., 2012

So what do we make of this?

A nice conference

Can we do even more?

Can we use this to understand galaxy evolution?

There are a few questions that arise:

In order of increasing naivety

What is the right scale?

- 1) Galaxies are points - they are the entities we study
- 2) 1 kpc - that is the typical scale we can resolve for large samples (both obs and sim)
- 3) Probably not one scale to rule them all, but one scale for each process...

Is this emergence???

Emergence: the arising of novel and coherent structures, patterns and properties during the process of self-organization in complex systems.

Analytical expressions?

Goldstein (1999)

The ability to reduce everything to simple fundamental laws does not imply the ability to start from those laws and reconstruct the universe.

Anderson (1972)

What is the right level of complexity???

Due to the highly complex and nonlinear physical processes involved in galaxy formation numerical simulations have become the major tool for theoretical progress in this field.

Springel (2016)

But: If you built a computer the size of the universe, with every single atom in it, you could recompute the universe, but you would understand nothing!

On progress in galaxy evolution

- Use simulations to identify analytical laws
- Not to reproduce the universe
- Use observations to understand processes
- Not to study “pet objects”
- We need a revival of analytic formulations of astrophysical processes

There is more to discuss.

What does it mean to understand galaxy evolution?
→ Debate on Friday

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