

What is Downsizing? Is it “Anti-Hierarchical”? What Causes it?

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Term Presentation

Outline

- Define terms used to describe downsizing. (dictionary.com)
- Discuss the first paper to introduce downsizing in time (Cowie et al. 1996).
- Discuss an attempt to explain observed downsizing using feedback processes (Stringer et al. 2008).

Definitions

- Hierarchy: hi·er·ar·chy (hī'ə-rär'kē, hī'rär'-) n.
pl. hi·er·ar·chies A series in which each element is graded or ranked: *put honesty first in her hierarchy of values.*
- Bottom-up: bot·tom-up (bۆt'əm-ۆp')
adj. Progressing from small or subordinate units to a larger or more important unit, as in an organization.

Courtesy: <http://dictionary.reference.com/>

Definitions (Cont'd)

- Top-down: (tɒp'daʊn) adj. Of or relating to a hierarchical structure or process that progresses from a large, basic unit to smaller, detailed subunits: *a top-down description of the department's function.*
- Downsize: daʊn·saɪz (daʊn'saɪz) v. daʊn·saɪz·ed, daʊn·saɪz·ing, daʊn·saɪz·es To make in a smaller size: *cars that were downsized during an era of high gasoline prices.*

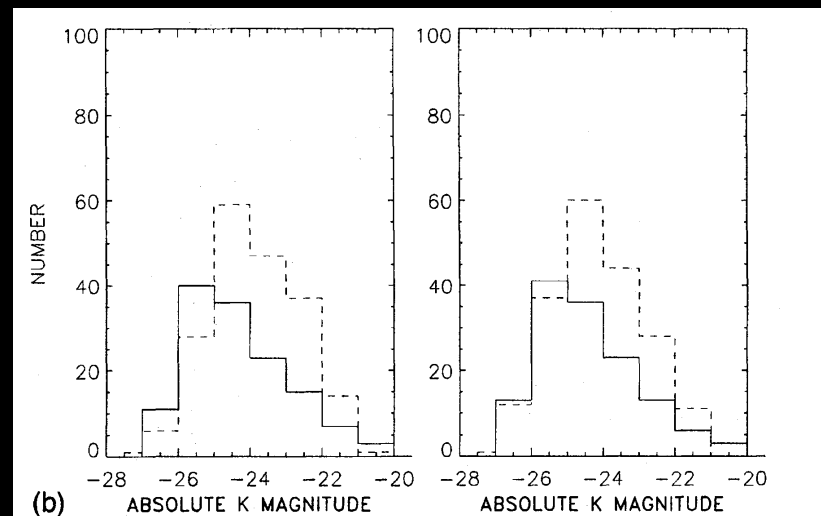
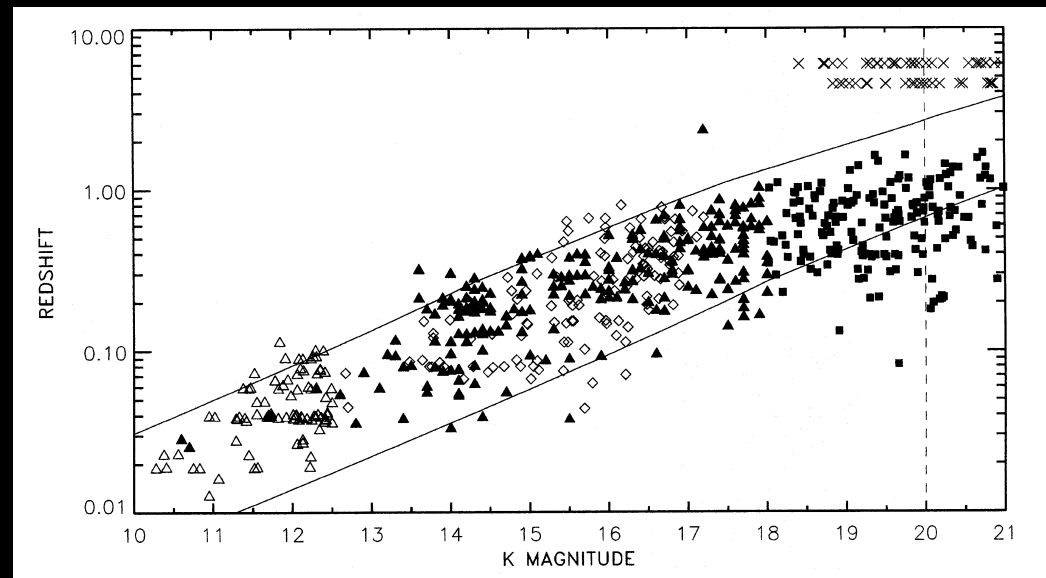
Courtesy: <http://dictionary.reference.com/>

What is Downsizing?

Cowie et al. 1996

- First use of “Downsizing” in Cowie et al. 1996
- “We shall refer to this remarkably smooth downward evolution [through redshift] in the maximum luminosity of rapidly star-forming galaxies as “downsizing”... (Cowie et al. 1996)
- Observations were done in B, I and K bands with the following selection criteria: $K < 20$, $I < 22.5$ or $B < 24.5$

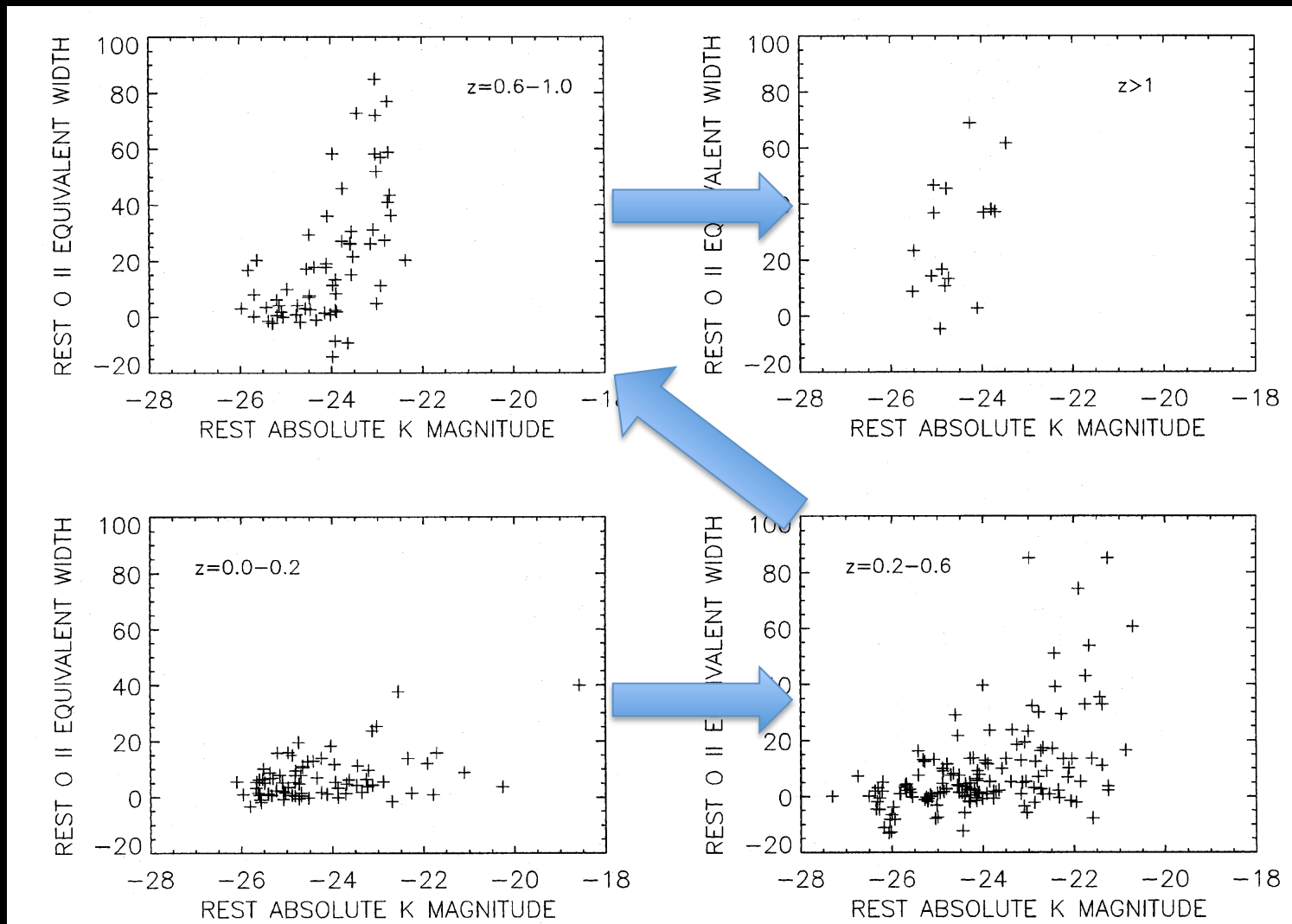
K Magnitude Redshift Relationship



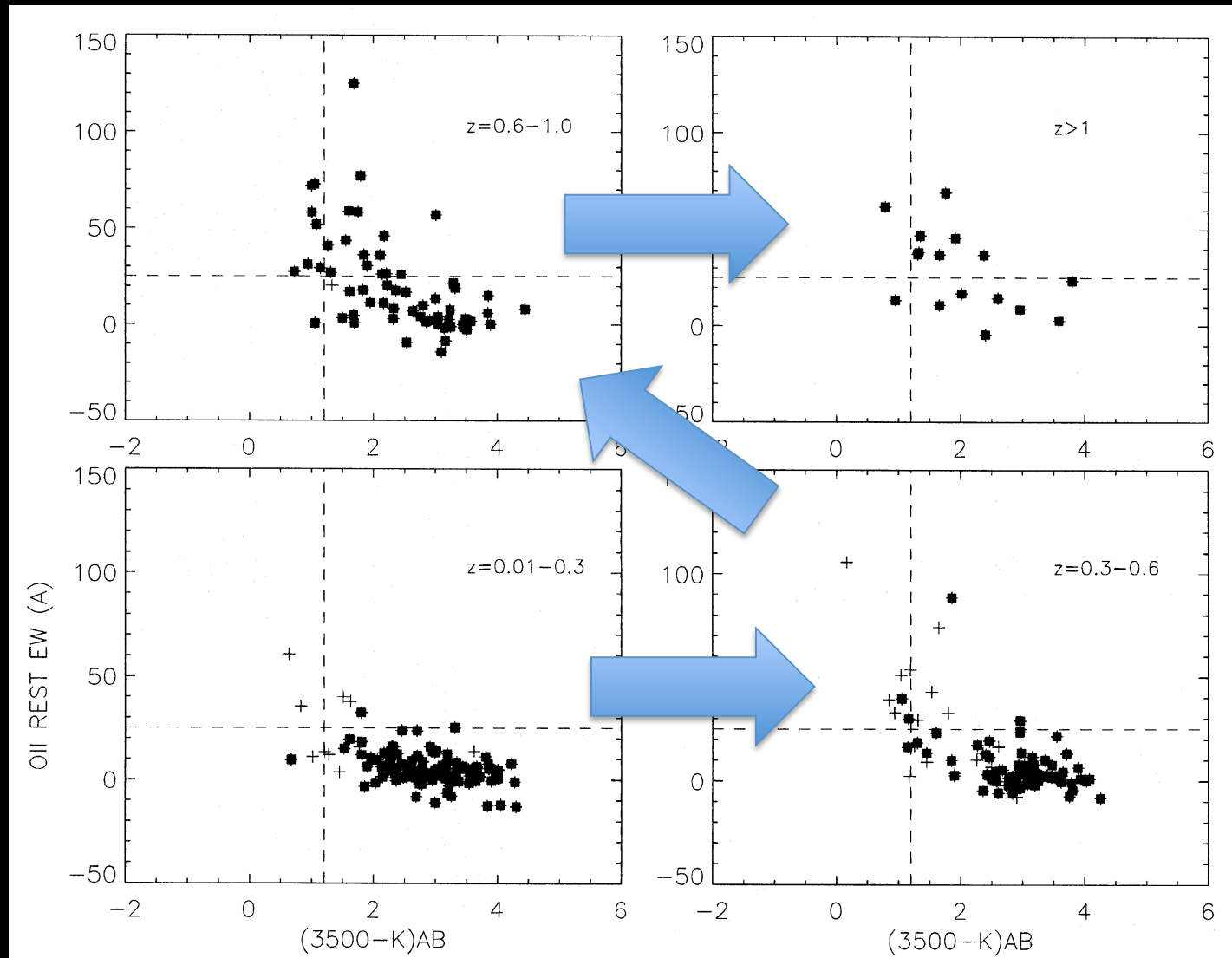
Star Formation Determination

- Using spectra they determined the $EW([OII])$. When $[OII]$ is not available in spectra, they use $EW(H\alpha)$ to find $EW([OII])$.
- $EW([OII]) \geq 25\text{\AA}$ corresponds to large SFR (Star Formation Rate) which doubles mass in less than 10^{10} yrs.
- Assigned 3500\AA magnitude to galaxies to create a color-EW diagram.

K Magnitude-EW([OII]) Diagram



(3500Å-K) Color-EW([OII]) Diagram





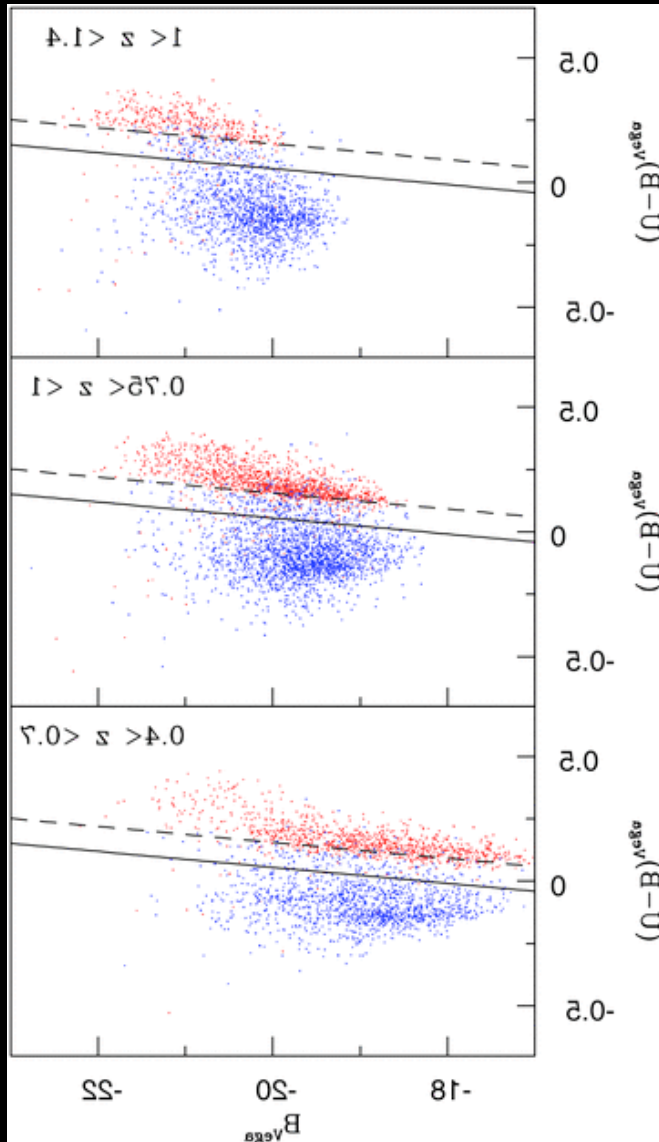
What Causes Downsizing?:
Mock Observations with the Millennium
Simulation: Cosmological Downsizing and
Intermediate-Redshift Observations

Stringer et al. 2008

Millennium Simulation Mock Catalogs

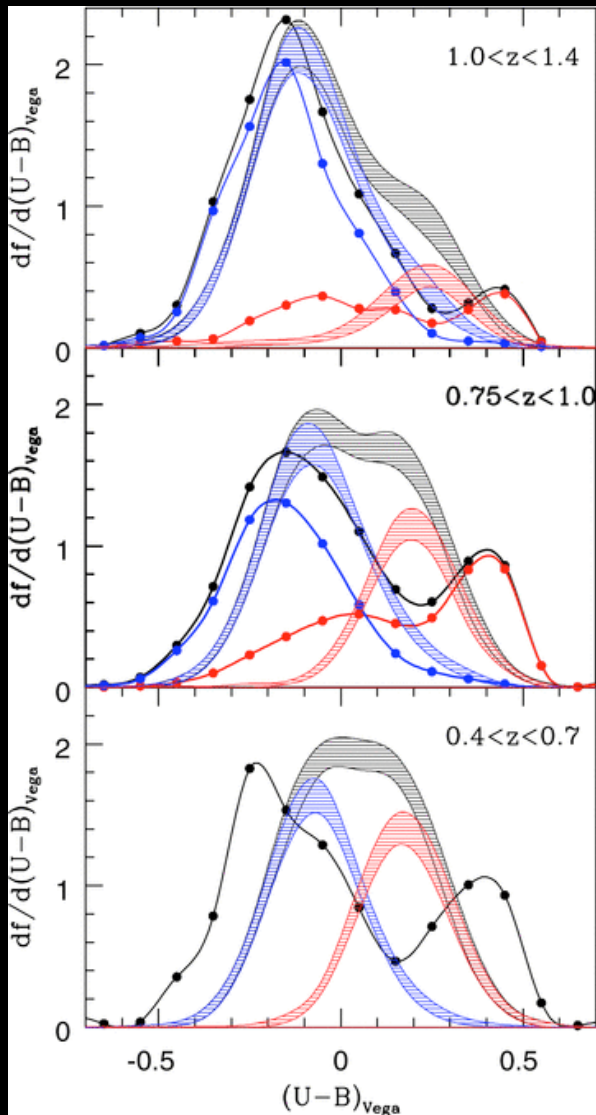
- Models are based on the dark matter halo from the Millennium Simulation.
- GALFORM semi-analytical model populates the halos.
- Models contain key feedback processes: Reheating of disk gas and AGN heating.
- Galaxies from the simulation were chosen based on a lightcone principle.

Mock Catalog Results



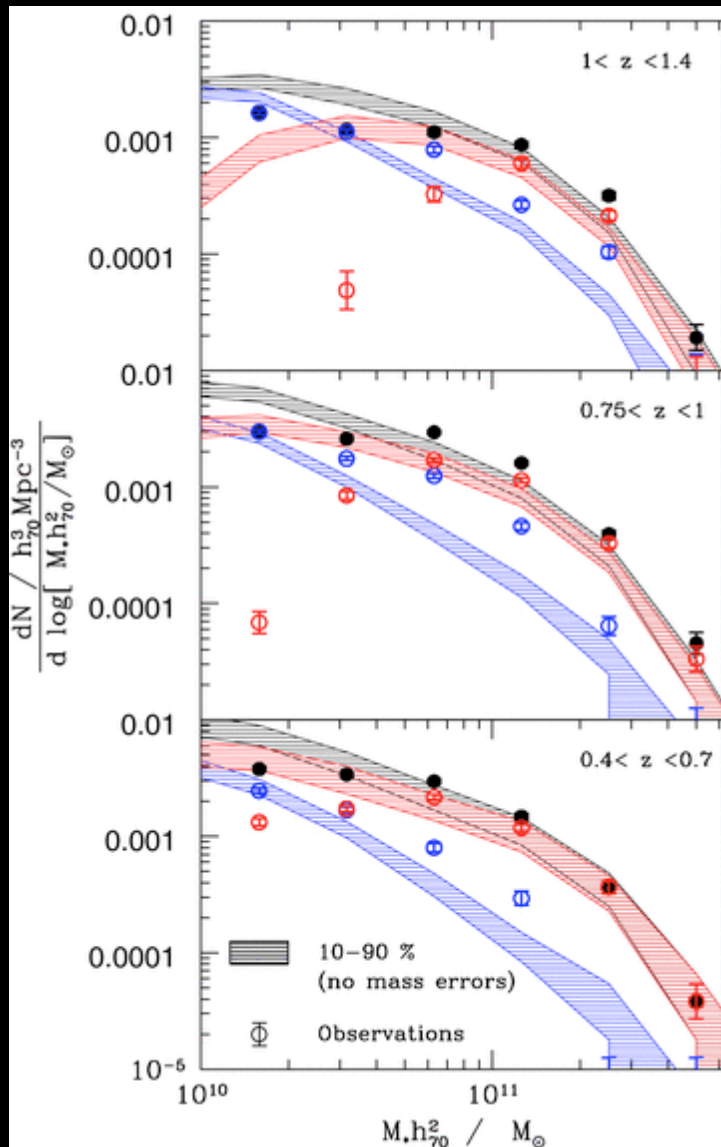
- Bimodal break down of Simulation galaxies.
- First sign of downsizing.

(U-B) Color Distribution Function



- Mock Catalogs reproduces observed downsizing effect.
- Seems to produce a descent fit to the blue galaxies component at high z .
- Failure to reproduce the color distribution for any other redshift bin and galaxy type.

Mass Distribution of Mock Catalogs



- Mock Catalogs reproduces observed downsizing effect.
- The total Mass function is correctly reproduced.
- Failure to reproduce the mass distribution of the red type galaxies at high z .
- Others have proposed solutions to explain both type of downsizing. See Cattaneo et al. 2008 and Mouri, H. & Taniguchi, Y. 2006.

Conclusions

- Downsizing has been observed and confirmed since the mid 1990's.
- There are two main types of downsizing normally considered: archeological downsizing and downsizing in time.
- Yes/No downsizing is “anti-hierarchical”, depending on how “anti-hierarchical” is defined.
- Stringer's SAM model to describe downsizing correctly predicts total mass function and shows a downsizing signature.

Thanks!!!

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