Primeval Starbursting Galaxies:
Presentation of “Lyman-Break Galaxies” by Mauro Giavalisco

Jean P. Walker
Rutgers University

Outline

- Context within Galaxy Formation
- History of Primeval Galaxies
- Deconstruct the Acronym: LBG
    - Lyman Break: The Lyman Break and Lyman Break Technique
    - Galaxy: Galaxies and Properties
- Conclusions

Galaxy Formation: Context

• Initial overdensities, from inflation, collapse at different times dependent on the scale of the overdensity.

• Once dark matter halos have formed, Extended-Extended Press-Schecter formalism explains the evolution of the mass function from one epoch to another.

• Dark matter halos gravitationally collapse and cool gas to form the galaxy's first stellar populations. Starburst galaxies at $z>3$ represent these first galaxies undergoing starbursts.

Theoretical History of LBGs

• During the 1960's, astrophysicists predict the sudden collapse of gas within primeval galaxies leading to a massive starburst (Eggen et al. 1962).

• Partridge & Peebles (1967) predict strong Lyα emission and lyman break in primeval galaxy spectra. Unfortunately they overestimate the extent of the galaxies thus reporting low surface brightness.

• During the mid 1970's, population synthesis models were used to predict the position of the galaxies in color-color diagrams (Meier 1976). Meier's color-color diagrams suggested the use of colors around the Lyman limit as a selection method for primeval galaxies.

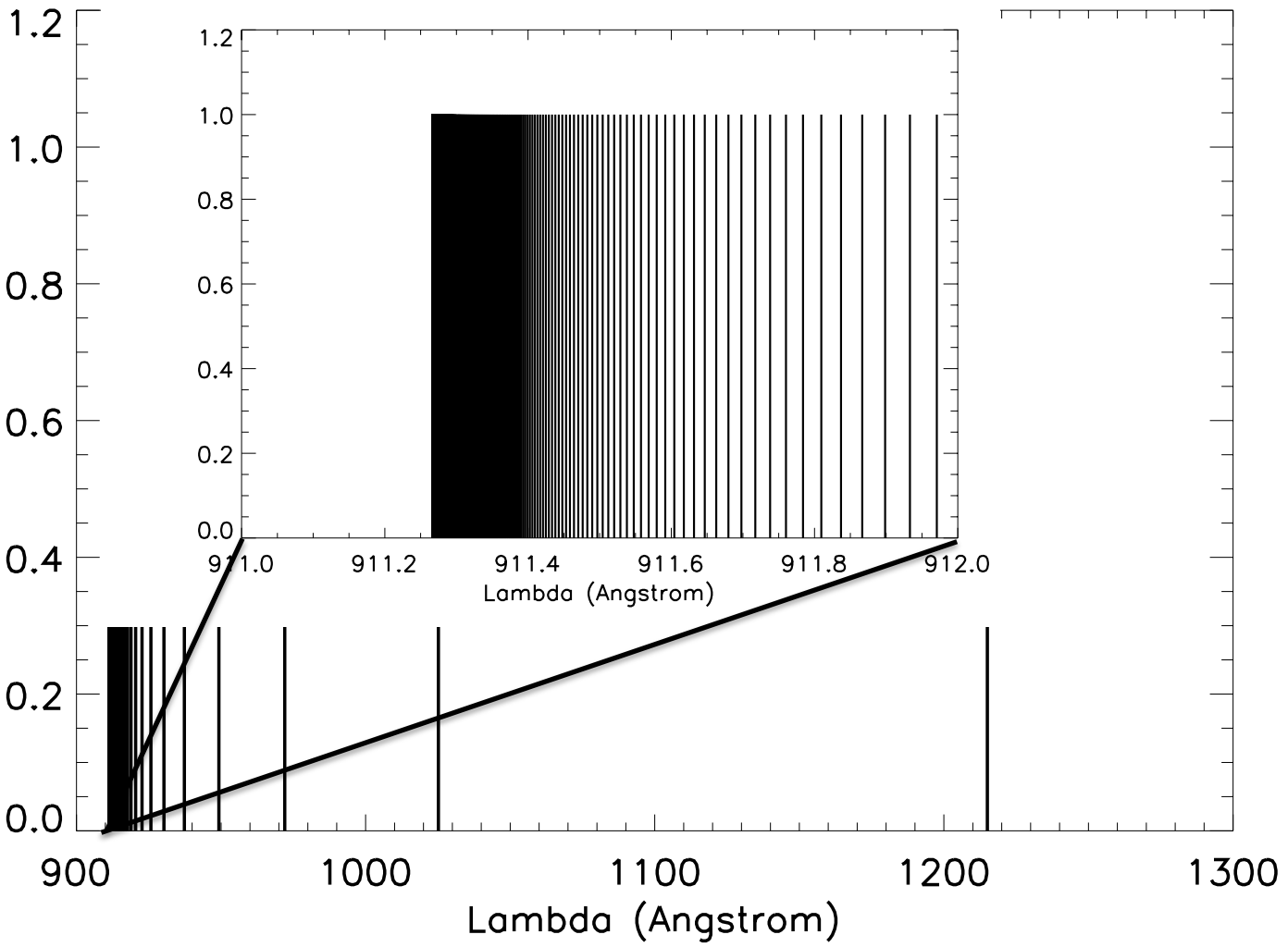
Observational History of LBGs

• The first attempts to search for Lyα emitters (LAEs) by Partridge, Davis and Wilkinson during the mid 1970's were a failure.

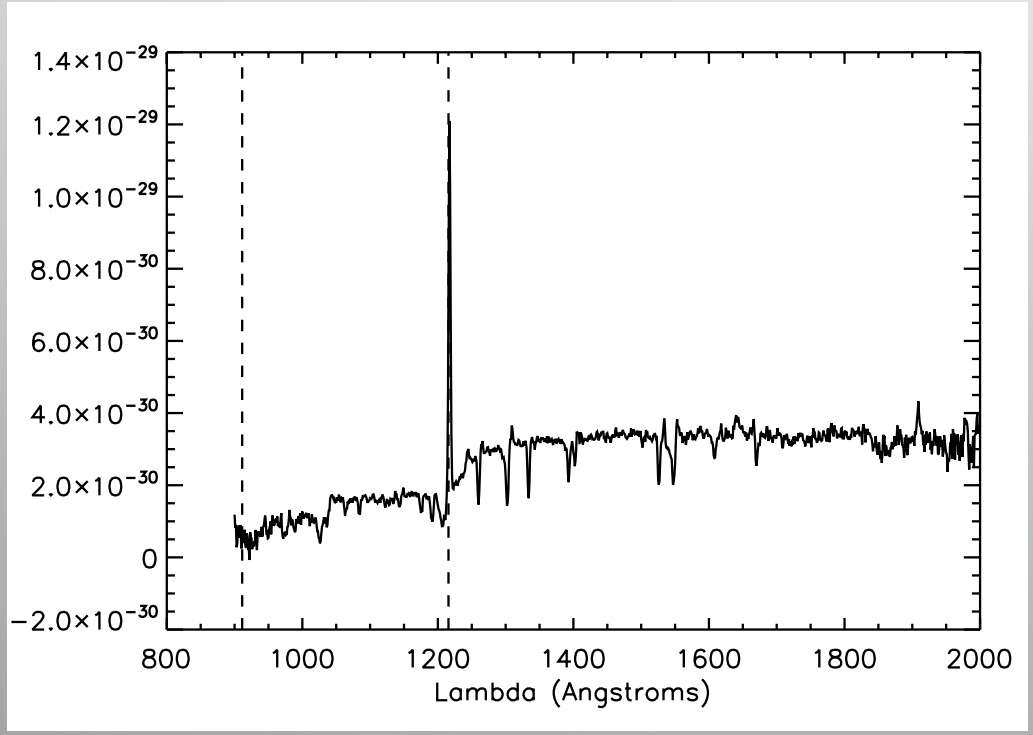
• Later surveys by Hu, Cowie , Steidel, McMahon and others detected LAEs during the mid to late 1990's and early 2000's.

• LAEs are easier to detect due to their selection criteria and large equivalent width emission line. The Lyman break technique developed during the the 1970's, allowed for the detection of LBGs in 1996 by Steidel with spectroscopic confirmation.

The Lyman Break: Quantum Mech. 101



The Lyman Break: Spectra

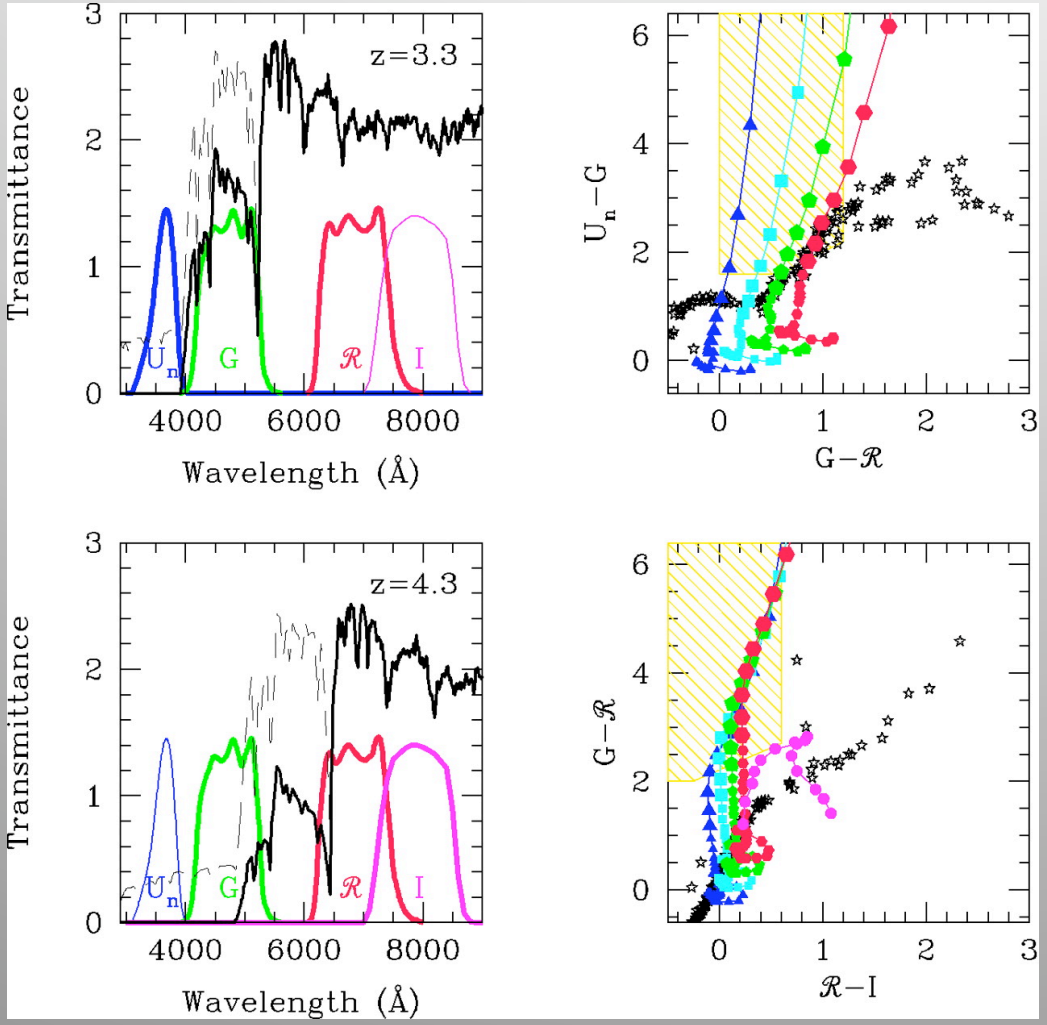


- Some LBGs do not show the Lyman limit as a strong discontinuity.

- LBG's can have Lyα emission and absorption.

- The Lyα forest is caused by intervening neutral hydrogen clouds between the observer and the LAE. It is found between the Lyman limit and Lyα line.

Lyman Break Technique



- The Lyman Break Technique (LBT) uses three filters in its simplest form.

- One filter measures the blue side of the Lyman break, the other covers the Lyα forest region, while the third is located in a non-hydrogen emission part of the spectrum.

- Differences in colors creates the positive detection regions.

Galaxies: The Nature of LBGs

• LBGs and local starburst galaxies share similarities in their spectra. They both are composed of massive O and B stars, are not dust free and have similar rest-frame Lyα equivalent width distributions ($W_{\alpha,Med}$=0).

• LBGs have been enriched by metals and have velocity dispersions consistent with outflows and supernovae winds.

• LBGs tend to have a larger luminosity and specific SFR compared to their local counterparts.

• The stellar mass are about M_*=10^10.5 M_{Sun} (Papovich et al. 2001).

Summary

• LBGs are found using the Lyman break technique which utilizes filters to measure spectral the Lyman limit photometry.

• LBGs are primeval galaxies with some metals and an ongoing young starburst. They reproduce some of the properties of local starburst galaxies.

• The Lyman break technique has allowed us to quickly find and catalog high redshift galaxies. This allows us to study the structure at high redshift and measuring cosmological properties for dark matter halos.

• High redshift LBGs allows us to study, what we believe, are the first bright galaxies during galaxy formation.