The density and spectral energy distributions of red galaxies at z~3.7

(Brammer & van Dokkum, ApJL, 2007)

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February 13, 2008 The first 2 billion years of galaxy formation, Aspen

Forster-Schreiber et al. (2004)



Red galaxies at z>2: DRGs

• Significant population of red z>2 galaxies missed by UV selection alone

Forster-Schreiber et al. (2004)



van Dokkum et al. (2006)



van Dokkum et al. (2006)



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• DRGs galaxies dominate M>10¹¹ M $_{\odot}$ sample at 2 < z < 3

van Dokkum et al. (2006)



• A significant fraction of K-bright galaxies are "red and dead" at $z\sim2.3$



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 Select red galaxies at z>3 with red H-K colors, analogous to the DRG, J-K, selection



- Select red galaxies at z>3 with red H-K colors, analogous to the DRG, J-K, selection
- Compare with narrower z>2 selection based on J-H
 - * Match limiting (abs) magnitude in red band
 - * Match rest-frame color selection



J-H > 0.9,	18	0.58±0.18	1.5±0.5x10 ⁻⁴
H < 23.4		arcmin ⁻²	Mpc ⁻³
H-K > 0.9, K < 24.6	23	0.74±0.19	1.2±0.4x10 ⁻⁴



		These galaxies are fairly common		
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Rest-frame SEDs



"Red" galaxies at z~3.7 have significantly bluer UV-optical colors than z~2.4

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 - Peak at $\beta = -2$, similar to UVselected galaxies (Adelberger & Steidel 2000)
- * UV selection likely more complete at z>3.5 than z~2.4

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- "Red" galaxies at z~3.7 have significantly bluer UV-optical colors than z~2.4
 - Peak at $\beta = -2$, similar to UVselected galaxies (Adelberger & Steidel 2000)
 - UV selection likely more complete at z>3.5 than z~2.4
- Color+limiting mag selection designed to select complementary samples of galaxies in two redshift bins. At higher z:
 - * Higher specific SFR?
 - * Less dust?
 - * Is z~3 an important epoch for quenching of massive galaxies??

Context: massive galaxies at z>3.7

- Unlikely that there is a significant population of "old", massive galaxies at z>4
- e.g. Mobasher et al. (2005)
 - * problem: photo-z



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- Include IRAC photometry in more careful modeling (see earlier talk by Ivo Labbe)
- Larger samples with GOODS-CDFS, UDS

- Improve photo-zs
 - * "EAZY" Brammer, van Dokkum, Coppi, et al.



Improve photo-zs, however...





- Improve photo-zs
 - * 5 Medium band NIR filters
 - * ~60 nights, Kitt Peak 4m + NEWFIRM (PI: van Dokkum; Marchesini, Brammer, Whitaker, Rudnick, Kriek, Illingworth, Quadri, Labbe, Franx, Lee)
 - * 4x30'x30', K<21.5, H<22.2, J<23.0 (Vega, 10σ)
 - * Expect $\Delta z/(1+z) \sim 0.02$ at 1.5 < z < 3.5, fewer "catastrophic" outliers

