UVOT Observations of the Chandra Deep Field-South aka: The UVOT Deep Field

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Hoversten et al. 2009, ApJ, 705, 1462

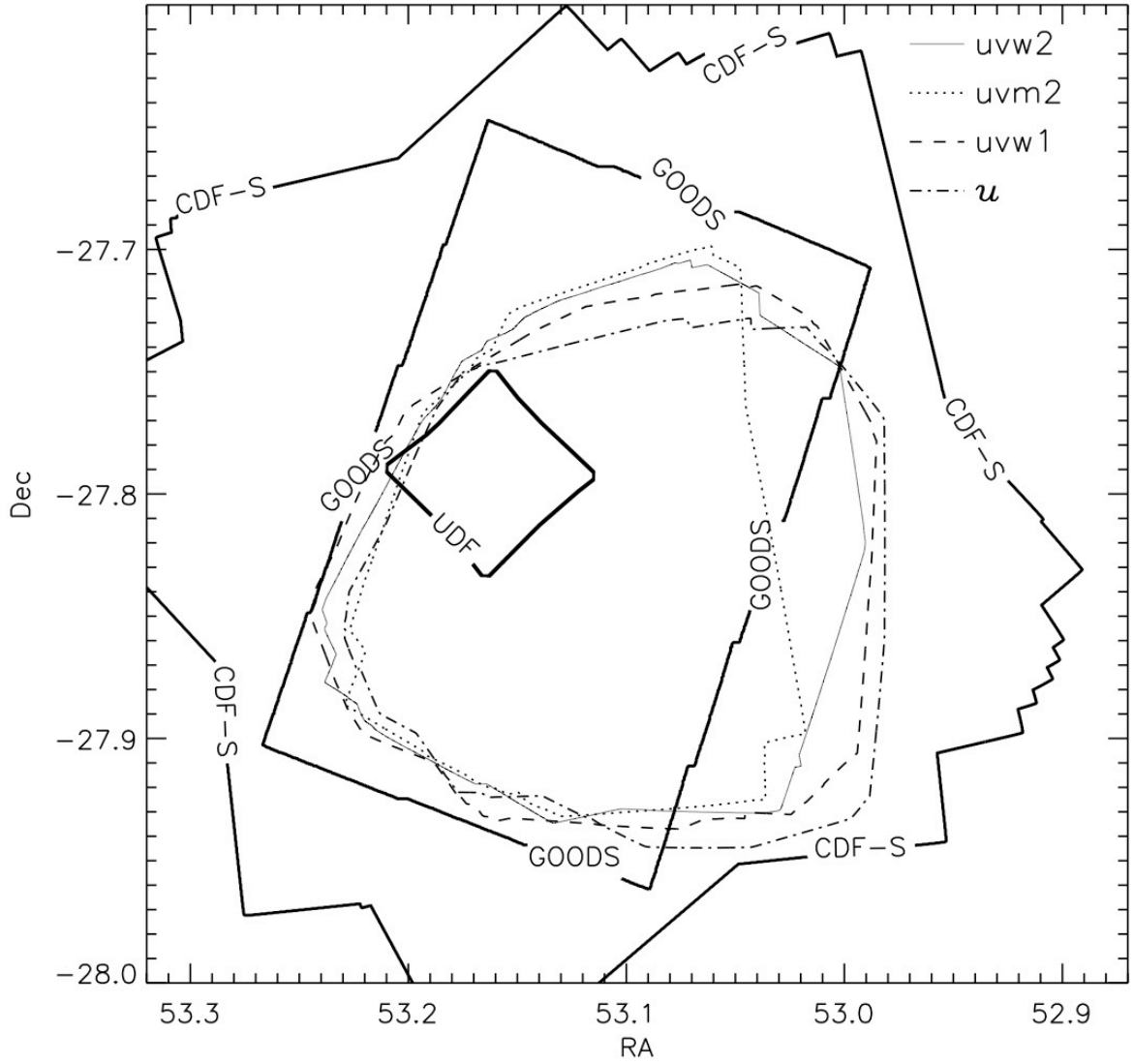
Motivation

- Rest-frame UV light directly traces star formation in galaxies.
- UVOT occupies a unique niche in FOV & response & PSF.
- Deep UV observations will enable a number of science projects aimed at tracing the evolution of star formation in galaxies.
- Request approved by Neil Gehrels (Swift PI) for 75 ks each in w2 (1928 Å), m2 (2246 Å), w1 (2600 Å), and u (3645 Å) as a Swift Key Project.
- Observing plan was for a few ks per day to avoid disrupting normal Swift operations.
- Data taken in 1x1 (unbinned, 0.5 arcsec per pixel) mode for best possible resolution.
- CDF-S was good, cold fill-in target in Fall 2007
  - Able to get more than 75 ks per filter
  - Complete observations in only a few months

Why the Chandra Deep Field-South?

- Lots of multi-wavelength data:
  - CDF-S (Giaconni et al.), 1 Ms, Chandra/ACIS, now 2 Ms (Luo et al., PI Brandt)
  - Hubble Ultra Deep Field: HST/ACS (B,V, I, z)
  - GOODS (Great Observatories Origins Deep Survey): HST/ACS (B,V,I,z)
  - GEMS (Galaxy Evolution from Morphology & SEDs): HST/ACS (V & z)
  - Ground based imaging (U,B,V,R,I,z,J,K)
  - Ground based follow-up spectroscopy
  - Spitzer IRAC (van Dokkum et al.) + MIPS (GTO)

Why the Chandra Deep Field-South?



UVOT Deep Field Observation

Chandra Deep Field -- South

UVOT w2, m2, w1

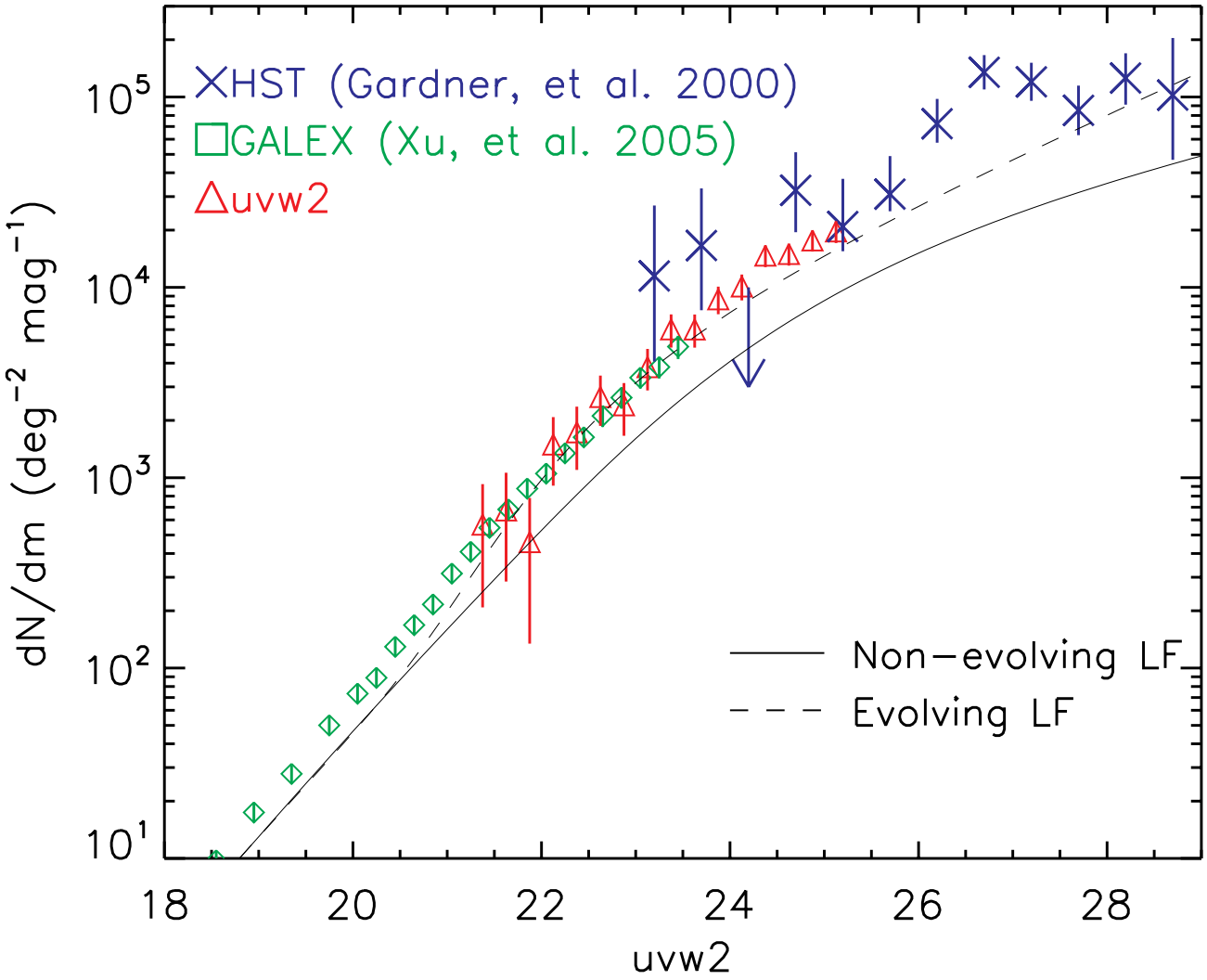
w2 = 145 ks (blue)
m2 = 136 ks (green)
w1 = 158 ks (red)
u = 124 ks

Total = 563 ks

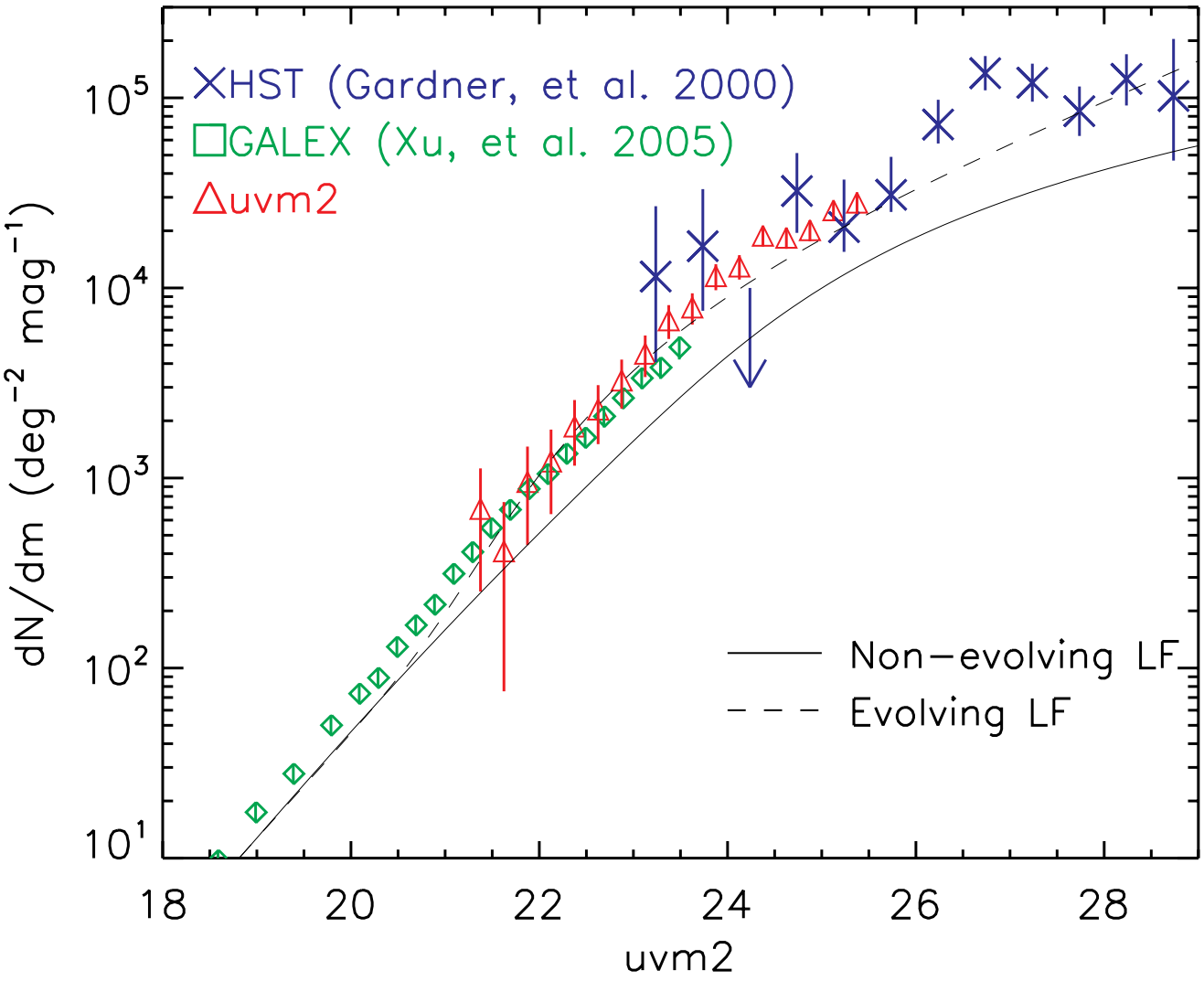
In regions with 100ks per filter:
2118 with u < 26 and 1637 with u < 24.5

UVOT Deep Field Observation

UV Galaxy Number Density



UV Galaxy Number Density



Galaxy Evolution Models

- UVOT number counts reach fainter magnitudes than GALEX, lower error-bars than HST number counts – probe the "knee" in the number count distribution.
- Models: start with nearby GALEX NUV galaxy LF from Wyder et al. (2005), correct for shift to UVOT filters.
- Assume star-forming galaxy template with $A_V = 1$ and Calzetti extinction law.
- Compute no-evolution and evolution model
  - Evolutionary model used LF parameters calculated by Arnouts et al (2005) at 1500Å – primarily luminosity evolution: ΔM^*~-2.0 mag from z=0 to ~1
  - Our number counts are consistent with these evolutionary parameters.
- UVOT number counts can be used as constraints for more sophisticated galaxy evolution models.

Future Projects

- SED fitting of UVOT + optical + IR data will provide sample of ~1000 star-forming galaxies out to z~1 with:
  - Photometric redshift
  - Stellar mass
  - Star formation rate
  - Extinction
- FUV & NUV luminosity functions of vs. redshift (and galaxy type) --> star formation rate density.
- Study the star formation and extinction properties of galaxies as a function of stellar mass, redshift, etc.
- Sample of z~1 to 1.5 Lyman Break Galaxies --> study evolution of star-forming galaxies from z~3 to z~1.
- Other UVOT deep fields, particularly serendipitous GRB follow-up fields.
- Anything else?