COSMOS 2□° Survey

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Abstract. The Cosmic Evolution Survey (COSMOS) will provide complete multi-wavelength imaging and spectroscopy of a 2□° equatorial field aimed at sampling the full range of cosmological environments from voids to massive clusters to understand the coupled evolution of dark matter, luminous galaxies and clusters and AGN in the epoch of maximum formation activity from $z = 0.5$ to 3. The COSMOS survey has several major primary components : 1) HST-ACS imaging covering the entire field in I-band (8100Å); 2) ground-based broadband imaging (Subaru, NOAO and CFHT) providing photometric redshifts (typical accuracy 10%); 3) low resolution optical spectra (R = 200 with VLT-VIMOS) for 90,000 galaxies with I < 25 mag. Over 60 astronomers from Europe, North America and Japan are actively involved in COSMOS multi-λ observations and science.

1 Overview

The COSMOS HST survey is the largest ACS survey ever undertaken – imaging an equatorial, 2□° field ($E_{B-V} \simeq 0.02$ mag) with single-orbit I-band exposures to a depth of 27 mag (10σ). Over 2 million galaxies (of all types) are expected with I < 27 mag (AB, 10 σ), sampling a volume in the high redshift universe approaching that sampled locally by the Sloan survey. Extensive multi-λ ground and space-based observations of this field have also been committed. Spectroscopic redshifts will be obtained for 90,000 galaxies with I < 25 mag (mostly using VLT-VIMOS) and photometric redshifts for the remainder (using Subaru, NOAO and CFHT).

2 COSMOS Science

The principle science goals for COSMOS are: quantifying large scale structure in dark matter through weak lensing and mapping the evolution of galaxies in the context of large scale structure. The expected number of objects in a 2□° field is given in Table 1. With more than 70,000 galaxies having measured redshifts (VIMOS survey) in the range $z = 0.5$ – 2 and $0.05''$ HST imaging, 7 redshift bins can be constructed, each with $> 10^4$ galaxies, to probe evolution of the morphological distribution (E, Sp, Irr, etc.) as a function of both LSS and time. Evolution of the luminosity and spatial correlation functions for type-selected galaxies will be analyzed with unprecedented statistical accuracy. The growth of galaxies, AGN and dark matter structure will be accurately traced over a period corresponding to ∼75% of the age of the universe.

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Table 1. Expected Numbers of Objects in COSMOS 2□° Field

Class	#	I_{AB} (10σ))	Reference
All objects	1.9×10^6	< 27	Metcalfe *et al.* 2001
All objects	300,000	< 25	Metcalfe *et al.* 2001
XMM-AGN	3400	27	c.f. Lockman Hole
XMM-clusters	∼120	5×10^{-17} cgs	COSMOS XMM
strong lens systems	60–80		Fassnacht *et al.* 2004
VIMOS Gal.w/ Spectra	$\sim10^5$	I≤25	Kneib *et al.*
QSOs	600(100)	24(21)	Croom *et al.* 2001
z > 4 QSOs	50	25	Cristiani *et al.* 2004
ULIRGs	3,000	26	Smail *et al.* 2002
ExtremelyRedObjects	25,000	25	Daddi 2000
LymanBreakGalaxies (z≤2)	65,000	25.5	Steidel *et al.* 2004
LymanBreakGalaxies (z∼3)	10,000	25.5	Shapley *et al.* 2001
Red high-z Galaxies (z > 2)	10,000	25.5	Labbé *et al.* 2002
SN I&II	∼100	26.5	GOODS
L,T Dwarfs	300(<200 pc)	28(4σ)	Burgasser *et al.* 2002
KuiperBeltObjects	100-250	27	Jewitt (priv. com.)

Galaxies in the early universe are built up by two major processes: dissipational collapse and merging of lower mass protogalactic and galactic components. Their intrinsic evolution is then driven by the conversion of primordial and interstellar gas into stars, with galactic merging and interactions triggering star formation and starbursts. These activities are believed to be strongly correlated and occur first in regions of the LSS with highest overdensity.

COSMOS will be fundamental to nearly every area of observational and theoretical cosmology, yielding:

• **the assembly of galaxies, clusters and dark matter on scales up to $\geq 2 \times 10^{14}$ $M_\odot$, well sampled as a function of redshift**;

• **full reconstruction of the dark matter distributions and characteristics out to z ∼1 using weak gravitational lensing**;

• **the evolution of galaxy morphology, galactic merging and star formation as a function of LSS environment and redshift**;

• **evolution of AGN and the dependence of black hole growth on galaxy morphology and environment**.