A Century of Cosmology

Booklet of Programme & Abstracts

Isola di San Servolo

Venice (Italy)

August 2007

Contents

Forewords

A golden age of knowledge and discovery in Astrophysics and Cosmology has been brought by recent advancements in instrumentation and detectors. The advent in the 90's of 10-meter class telescopes, near-infrared detectors, wide field cameras, the Hubble Space Telescope, and space-based observatories for the X-ray and the microwave background radiation, has produced an impressive body of knowledge in observational cosmology. We are now on the verge of delineating, if not completing, the mosaic that begins at the epoch when the Universe exited the Dark Ages to form stars, ionize gas, and seed metals and dust. We may be able to finally understand how the present Universe came about.Galaxies are being observed up to $z \sim 7$ probing the Universe when it had? experienced only 5% of its lifetime. Structures extending over hundreds of Mpc are being discovered by present-day wide and deep surveys carried out with the largest ground-based telescopes reaching fluxes up to 100,000 times fainter then those reached in the 70s.

The meeting aims at summarizing current knowledge in cosmology and discussing some of the milestones of the last decade. The focus will be on the fundamental questions that are still unsolved. The role that the next generation instruments will play in this field will be addressed briefly, touching in this way upon past, present, and future, as witnessed by some of the key players. This conference aims at becoming a meeting point between the scientists that led the field a few decades ago and those leading it now, to set guidelines for the younger scientists that will lead it in the future.

Scientific Organizing Committee

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Scientific Programme

SUNDAY, AUGUST 26, 2007

18.00–20.00		**WELCOME RECEPTION**

MONDAY, AUGUST 27, 2007

08.00 – 09.00		Reception
09.00 – 09.10	**G. Chincarini**	*Welcome*
09.10 – 09.50	**C. Cesarsky**	*Large Ground based facilities and Cosmology*

Session 1: **COMPACT MATTER IN THE UNIVERSE**

Morning		*(Chairman: P.J.E. Peebles)*
09.50–10.30	**R. Sunyaev**	*The Richness and Beauty of the Physics of Cosmological Recombination*
10.30–10.55		**Coffee Break**
		From first stars to massive black holes
10.55–11.20	**R. Maiolino**	*The evolution of the mass-metallicity relation at high-z*
11.20–11.45	**A. Bunker**	*Star formation in the first billion year - Implications for reionization*
11.45–12.10	**R.I. Thompson**	*NICMOS measurements of the near-IR background*
12.10–12.35	**D. Stark**	*New constraints on star formation at* $z > 7$
12.35–14.00		**Lunch**

Afternoon		**Quest for reionization** *(Chairman: P. Madau)*
14.00–14.40	**X. Fan**	*Observing the re-ionization epoch: what it is telling us*
14.40–15.05	**E. Dwek**	*The evolution of metals and dust in the high-redshift universe ($z > 6$)*
15.05–15.30	**M. Trenti**	*The very first PopIII stars and their relation with bright $z \sim 6$ QSOs*
15.30–16.20		**POSTER SESSION**
		Coffee Break
16.20–17.45	**D. Calzetti**	*Measuring Star Formation in Local and Distant Galaxies*
16.45–17.10	**S. Gallerani**	*Was the universe neutral beyond redshift six?*
17.10–17.50	**W.R. Forman**	*Shocks, bubbles, and filaments: the interaction of supermassive black holes with gas rich environments*

TUESDAY, AUGUST 28, 2007

Session 2: **EVOLUTION IN THE UNIVERSE**

Morning		**The LSS of the Universe** *(Chairman: W. Freedmann)*
09.00–09.40	**P.J.E. Peebles**	*Successes and challenges for the standard cosmology*
09.40–10.20	**M. Pettini**	*Lyman Break Galaxies: a Ten Year Perspective*
10.20–10.45		**Coffee Break**
10.45–11.10	**D. Koo**	*The latest results from the DEEP and AEGIS surveys*
11.10–11.35	**K.I. Caputi**	*The optical spectral evolution of mid-IR galaxies in the COSMOS field*
11.35–12.00	**P. Tozzi**	*Tracing distribution and evolution of metals in the intracluster medium*
12.00–12.25	**M. Colless**	*Cosmology from large scale galaxy surveys*
12.25–12.50	**A. Fontana**	*The origin of massive galaxies*
12.50–14.30		**Lunch**
Afternoon		**Metals and dust in the Universe** *(Chairman: W.R. Forman)*
14.30–15.10	**J.X. Prochaska**	*Probing the IGM and ISM at High z with Gamma-Ray Bursts*
15.10–15.35	**R. Salvaterra**	*The GRB luminosity function in the light of the SWIFT 2-year data*
15.35–16.00	**R. Giovanelli**	*ALFALFA: HI Cosmology in the Local Universe*
16.00–16.50		**POSTER SESSION**
		Coffee Break
16.50–17.15	**M.P. Haynes**	*ALFALFA: the search for (almost) dark galaxies and their space distribution*
17.15–17.55	**M. Tarenghi**	*The new cosmology with ALMA*

WEDNESDAY, AUGUST 29, 2007

Session 2: **EVOLUTION IN THE UNIVERSE**

Morning		**Evolution of galaxies** *(Chairman: P. Saracco)*
09.00–09.40	**O. Le Fèvre**	*Galaxy evolution from the VIMOS VLT Deep Survey*
09.40–10.00	**D. Marchesini**	*Assessing the predictive power of galaxy formation models: a comparison of predicted and observed rest-frame optical luminosity functions at* $2 < z < 3.3$
10.00–10.20	**R. Bowens**	*Galaxy buildup in the first 2 Gyr: evolution of the UV LF from* $z \sim 8$ *to* $z \sim 4$
10.20–10.50		**Coffee Break**
10.50–11.10	**A. Fernández-Soto**	*First results from ALHAMBRA: A deep, wide-area photometric redshift survey*
11.10–11.30	**M. Magliocchetti**	*Clustering properties and masses of starforming galaxies at* $z \sim 2$*: the Spitzer view*
11.30–11.50	**M. Vaccari**	*The FIR & sub-mm view on galaxies: from Spitzer & SCUBA to Herschel & SCUBA2*
11.50–12.10	**M. Cirasuolo**	*The mass assembly history of massive galaxies*
12.10–12.30	**B. Garilli**	*The assembly of stellar mass in galaxies during the last 10 Gyr: VVDS results*
12.30–12.50	**M. Huertas-Company**	*Morphology of* $z \sim 1$ *galaxies from deep K-band AO imaging in the COSMOS field*
	Free Afternoon	

THURSDAY, AUGUST 30, 2007

Session 2: **EVOLUTION IN THE UNIVERSE**

Morning		**From dark halos to galaxies** *(Chairman: J. Mather)*
09.00–09.40	**J. Ostriker**	*The role of simulations in cosmology*
09.40–10.20	**J. Dunlop**	*Galaxy formation and evolution: the far-IR/sub-mm view*
10.20–10.45		**Coffee Break**
10.45–11.20	**P. Madau**	*Galaxy formation and dark matter substructure*
11.20–11.40	**M. Giavalisco**	*Multi-wavelength observations of galaxies at* $z \geq 2$
11.40–11.55	**E. Stanway** (on behalf of **L. Douglas**)	*Large scale structure in the first billion years*
11.55–12.10	**S. Cristiani**	*The CODEX-Espresso experiment: cosmic dynamics, fundamental physics, planets and much more...*
12.10–12.50	**M.J. Rees**	*Growth and consequences of black holes beyond* $z = 6$
13.00–14.30		**Lunch**
Afternoon		**Cosmological parameters** *(Chairman: R. Ruffini)*
14.30–15.10	**A.G. Riess**	*A Brief History of Cosmic Expansion and Acceleration*
15.10–15.30	**W. Freedmann**	*The Carnegie Supernova Project*
15.30–15.45	**C. Grillo**	*Cosmological parameters from strong gravitational lensing and stellar dynamics in elliptical galaxies*
15.45–16.10	**M. Davis**	*Cosmological constraints from DEEP2 galaxy groups*
16.10–16.40		**Coffee Break**

SHORT TALK SESSION

16.40–16.50	**S. Salimbeni**	*The red and blue galaxy luminosity function in the GOODS field: evidence for an excess of red dwarf*
16.50–17.00	**A. Pollo**	*The VIRMOS-VLT Deep Survey: 10 billion years of evolution of the large scale structure*
17.00–17.00	**E. Mikheeva**	*A solution of the cusp problem in relaxed halos*
17.10–17.20	**V. Strokov**	*On the lagrangian theory of cosmological density perturbations*
17.20–17.30	**E.R. Stanway**	*Spectroscopy of galaxies at* $z = 6$ *and above: cosmological implications*
17.30–17.40	**M. McQuinn**	*Studying reionization with Ly*α *emission*
17.40–17.45	**1st Ranked Poster**	
17.45–17.50	**2nd Ranked Poster**	
17.50–17.55	**3rd Ranked Poster**	

20.00 **SOCIAL DINNER**

FRIDAY, AUGUST 31, 2007

Session 3: **THE DARK UNIVERSE** *(Chairman: TBD)*

Morning		**Constraints from the CMB** *(Chairman: R. Sunyaev)*
09.00–09.40	**J. Mather**	*Prospects for Future Cosmology*
09.40–10.20	**P. De Bernardis**	*From Boomerang to B-Pol*
10.20–10.45	**G. Smoot**	*The Cosmic Microwave Background Radiation Anisotropies: Their Discovery and Utilization*
10.45–11.00		**DISCUSSION**
11.00–11.30		**Coffee Break**
11.30–11.45	**A. Kurek**	*Chasing Lambda*
11.45–12.00	**F. Frontera**	*The cosmic X-ray background level at its emission peak*
12.00–12.15	**D. Samtleben**	*Measuring the CMB radiation polarization with QUIET*
12.15–12.30	**D. Cline**	*The role of dark matter in the cosmos*
12.30–12.55	**M. Bersanelli**	*Present and (near) future of CMB observations from space*
12.55–14.30		**Lunch**
Afternoon		**Dark matter and dark energy** *Chairman: M. Pettini*
14.30–15.00	**B. Sadoulet**	*Dark Matter: at the brink of a discovery?*
15.00–15.15	**M. Lattanzi**	*Massive neutrinos and inos and the upper cutoff to the fractal structure of the Universe*
15.10–15.30	**H. Hoekstra**	*Cosmic shear results fro the CFHT Legacy Survey*
15.30–15.45	**L. Guzzo**	*Measuring dark matter and dark energy from redshift-space distortions at $z = 1$: early results from the VVDS-wide survey*
15.45–16.15		**Coffee Break**
16.15–16.55	**S. Perlmutter**	*Observationalist optimism for progress on Dark Energy*
16.55–17.25	**V. Lukash**	*Cosmological model: from initial conditions to structure formation*
17.25–18.05	**G. Efstathiou**	*Starting now what would I plan knowing where we are?*

August, 27th, 2007

Welcome

Guido Chincarini 10′

1

Large Ground based facilities and Cosmology

40′ Catherine Cesarsky

2

The Richness and Beauty of the Physics of Cosmological Reionization

Rashid Sunyaev

40′

Session 1

3

The evolution of the mass-metallicity relation at high-z

R. Maiolino

25′
Session 1
4

I will present initial results from an ongoing ESO large program (AMAZE) aimed at investigating the mass-metallicity relation at $z > 3$. The observations consists of deep, near-IR integral field spectra of a sample of 35 galaxies at $3 < z < 5$, whose stellar masses are accurately determined through Spitzer observations. These data allow us to determine the gas metallicity of these galaxies. By combining these results with surveys at lower redshift we can determine the evolution of the mass-metallicity relation over the redshift range $0 < z < 5$. In some objects the integral field spectra allow us to spatially resolve the gas metallicity, thus providing additional information on the evolution of the galaxy metallicity gradients. I will show preliminary results which clearly illustrate a mass-dependent evolution of the average metallicity in galaxies. I will compare our findings with recent models of chemical evolution, thus providing constraints on galaxy evolutionary scenarios.

Star Formation in the First Billion Year - Implications for Reionization

A. Bunker, E. Stanway, L. Eyles, R. Ellis, M. Lacy, R. McMahon, K. Chiu

We have discovered a population of star-forming galaxies at $z \sim 6$ through HST imaging (including the Hubble Ultra Deep Field), and confirmed many of these spectroscopically with the Keck and Gemini telescopes. While the volume-averaged star formation rate in the observed $z \sim 6$ galaxies appears to provide insufficient UV flux to reionize the Universe at this redshift, we have evidence from Spitzer imaging that some of these galaxies harbour older, massive stellar populations which may have been pivotal in reionizing the Universe at $z \sim 10$.

25′
Session 1
5

NICMOS Measurements of the Near Infrared Background

Rodger I. Thompson, Daniel Eisenstein, Xiaohui Fan, Marcia Rieke and Robert C. Kennicutt

NICMOS images in the Hubble Ultra Deep Field at 1.1 and 1.6 microns provide a very accurate measurement of the near infrared background. We find a background of $7-10$ nW/m^2/sr in both bands, all of which is from resolved galaxies in the redshift range from $0-7$. This is 10 times less than earlier claims for an background excess at 1.6 microns. We have also performed a fluctuation anlysis on both images and find that the fluctuations are consistent with previous results at this wavelength and are entirely accounted for by the resolved galaxies, with a peak power at redshifts between 0.5 and 1.5. Extrapolation to 3.6 and 4.5 μm agrees with the recent fluctuation anlysis of deep Spitzer fields. In short the near infrared background has been completely resolved and consists primarily of galaxies of very moderate redshift. There is no evidence for a large population of very high redshift, possibly Pop. III, galaxies above that required to reionize the universe.

25′
Session 1
6

New Constraints on Star Formation at $z > 7$

Daniel Stark

The first constraints are now emerging on the abundance of star-forming galaxies at $7 < z < 10$. I will discuss new results from two surveys for gravitationally-lensed galaxies at $z > 7$: 1) a Keck near-infrared spectroscopic survey for $z \sim 8-10$ Lyman-alpha emitters (LAEs) toward intermediate-redshift galaxy clusters, and 2) a deep near-infrared Hubble Space Telescope survey of galaxy clusters for magnified Lyman-break galaxies (LBGs) at $z \sim 7-10$. These surveys have uncovered a surprisingly large abundance of candidate star-forming galaxies at very early times in cosmic history. Such a large abundance is only explicable if the initial mass function is top-heavy or if the observations are probing an overdensity in the underlying dark matter mass distribution. I will detail follow-up spectroscopic efforts to confirm that this population is indeed at $z > 7$ and will discuss implications for reionization.

$25'$
Session 1
7

Observing the re-ionization epoch: what it is telling us

40′
Session 1
8

Xiaohui Fan

The Evolution of Metals and Dust in the high-Redshift Universe $(z > 6)$

Eli Dwek

Dusty hyperluminous galaxies in the early universe provide unique environments for studying the role of massive stars in the formation and destruction of dust. At redshifts above ~ 6, when the universe was less than ~ 1 Gyr old, dust could have only condensed in the explosive ejecta of Type II supernovae (SNe), since most of the progenitors of the AGB stars, the major alternative source of interstellar dust, did not have time to evolve off the main sequence. I will present analytical models for the evolution of the gas, dust, and metals in high redshift galaxies, with a special application to SDSS J1148+5251, a hyperluminous quasar at $z = 6.4$. I will also discuss possible star formation scenarios consistent with observational constraints on the dust and gas content of this object.

25′
Session 1
9

The very first PopIII stars and their relation with bright $z \sim 6$ quasars

M. Trenti & M. Stiavelli

We discuss the link between dark matter halos hosting the first PopIII stars formed at redshift $z > 40$ and the rare, massive, halos that are generally considered to host bright $z \sim 6$ quasars. We show that within the typical volume occupied by one bright high-z QSO the remnants of the first several thousands PopIII stars formed do not end up in the most massive halos at $z \sim 6$, but rather live in a large variety of environments. The black hole seeds planted by these very first PopIII stars can easily grow to $M > 10^{9.5} M_{\odot}$ by $z = 6$ assuming Eddington accretion with radiative efficiency ~ 0.1. Therefore quenching of the accretion is crucial to avoid an overabundance of supermassive black holes. We implement a simple feedback model for the growth of the seeds planted by PopIII stars and obtain a $z \sim 6$ BH mass function consistent with the observed QSO luminosity function.

25′
Session 1
10

Measuring Star Formation in Local and Distant Galaxies

Daniela Calzetti

I review measurements of star formation for galaxies in the local and medium/high redshift Universe, from the ultravilet to the far infrared. Recent facilities (e.g., Spitzer, GALEX) and surveys (e.g., SDSS) have made available large samples of homogeneously observed and processed data on galaxies. These are gold mines for testing the strenghts and limitations of commonly used tracers of star formation rates.

25′
Session 1
11

Was the Universe neutral beyond redshift six?

S. Gallerani, A. Ferrara, X. Fan, T. Roy Choudhury

Important informations on the cosmic reionization are hidden in QSO spectra. I present results obtained from the analysis of the transmitted flux in a sample of 17 QSOs spectra at $5.7 < z_{\rm em} < 6.4$. I study separately the narrow transmission windows (peaks) and the wide dark portions (gaps) in the observed absorption spectra. I compare the statistics of these spectral features with Lya forest simulations. From the theoretical point of view, I consider two different reionization models: a Late Reionization model, in which the universe reionizes at $z = 6$, and an Early Reionization Model, in which the IGM is highly ionized at even higher redshifts. By using the gap statistics, I measure the neutral hydrogen fraction at $z \sim 6$, a crucial epoch to discriminate different reionization scenarios. Moreover, I find that the observed widths of the peaks are systematically larger than simulated ones. I discuss the possible reasons for this intriguing discrepancy.

25′
Session 1
12

Shocks, Bubbles, and Filaments: the Interaction of Supermassive Black Holes with Gas Rich Environments

William R. Forman

We discuss the interaction of supermassive black holes with cluster and early type galaxy environments. Hot gas, the dominant baryonic component in clusters but also found in early type galaxy coroane, provides a record of activity of AGN/supermassive black holes within hot gas rich systems.

For clusters, the hot gas shows evidence of shocks and buoyant bubbles of relativistic plasma, both produced by supermassive black hole outbursts. In addition, filamentary structures seen in the X-ray gas distribution show a complex relation between the AGN produced plasma and the thermal gas. We focus on the Chandra observation of M87 and other clusters that show evidence for outbursts with energies up to 10^{62} ergs.

Observations from a survey of 160 "normal" early type galaxies also will be presented. Chandra images of these galaxies show the presence of nuclear emission, jets, cavities and buoyant bubbles in their hot coronae, similar to those found in clusters. For those galaxies with luminous gaseous coronae, 30% show cavities from which we compute outburst energies of 10^{55} to 10^{59} ergs and outburst ages of $1 - 100$ million years. We detect weak active nuclei (luminosities from 10^{38} to 10^{41} ergs/sec) in 80% of the galaxy sample.

We compare the effects of outbursts on hot coronae and the growth of the black holes in systems from galaxies to rich clusters.

$40'$
Session 1
13

August, 28th, 2007

Successes and challenges for the standard cosmology

P. James E. Peebles

Recent advances in the cosmological tests show that the ΛCDM model almost certainly gives a good description of cosmic evolution on the scale of the Hubble length. But is the physics of this model, with its enigmatic dark sector, better than the simplest approximation we can get away with at the present level of the evidence? We have a valuable test from observations of the evolution of cosmic structure on the scales of galaxies and smaller, though that requires separation of the complexities of strongly nonlinear processes from any possible anomalies within the ΛCDM cosmology. I offer a list of observational issues that may allow this separation, offering extensions of the cosmological tests to smaller scales.

40′
Session 2
1

Lyman Break Galaxies: a Ten Year Perspective

Max Pettini

40′
Session 2
2

I will review what we have learnt over the last decade about star-forming galaxies at redshifts $z = 1.5 - 5$, focusing on their most important physical properties and on what they tell us about the progress of galaxy formation from about one billion years after the Big Bang. I will conclude with a brief look forward to some of the questions which will be addressed with forthcoming instrumentation.

The latest results from the DEEP and AEGIS surveys

David Koo

25′

Session 2

3

The optical spectral evolution of mid-IR galaxies in the COSMOS field

K.I. Caputi et al.

The large area and multiwavelength coverage of the COSMOS field makes it uniquely suitable for the study of galaxy evolution up to high redshifts. In particular, the zCOSMOS survey is enabling us to conduct a systematic study of the optical spectra of thousands of Spitzer/MIPS 24 micron-selected galaxies over a wide range of luminosities as a function of look-back time. In this talk, I will analyse in detail the evolution of mid-IR galaxies and their environment through the study of their optical spectra, up to $z \sim 1.2$. I will also present our first results on the study of LIRGs and ULIRGs at $z \geq 1.5$. I will discuss the importance of the combination of IR data and optical spectra to understand how star-formation and AGN activities proceed through cosmic time.

25′
Session 2
4

Tracing distribution and evolution of metals in the intracluster medium

P. Tozzi, I. Balestra, S. Ettori, P. Rosati, S. Borgani, V. Mainieri, C. Norman

Using the Chandra and XMM archives, we measure the spatial distribution of Iron and other metals in the inner regions of a large number of clusters of galaxies in the redshift range $0.1-0.4$. We also measure the evolution of the Iron abundance in about 50 high-redshift clusters, up to $z \sim 1.3$. The comparison of data with models for the metal production in the cluster galaxies and their eventual release into the ICM, puts strong contraints on the chemical and thermodynamical history of the ICM in a time range of about 8 Gyr.

25′
Session 2
5

Cosmology from large-scale galaxy surveys

Matthew Colless

Large-scale galaxy redshift surveys have been one of the main observational pathways to cosmological understanding. In this talk I will review the evolution of this field over the past two decades, and consider its future prospects. The earliest surveys in the mid-1980's first revealed the complexity of large-scale structure. The 1990's saw a rapid increase in the number, size and depth of galaxy surveys, as structures were mapped over the whole sky and to high redshifts. The most recent generation of massive surveys cover huge volumes of the low-redshift universe and have unlocked the full richness of the cosmological information coded in the galaxy distribution. Current surveys now seek to measure the power spectrum on still-larger scales, map the peculiar velocity field, study the evolution of structure at high redshifts, and determine the dark energy equation of state. The future holds even more ambitious programs.

25′

Session 2

6

The Origin of Massive Galaxies

A. Fontana, A. Grazian, E. Giallongo, S. Cristiani

How and when did massive galaxies form? Does this process still challenges hierachical scenario of galaxy formation? I will discuss these issues by reviewing the results obtained with our GOODS-MUSIC survey, containing ~ 3000 K_s-selected galaxies with multi-wavelength coverage extending from the U to the Spitzer 8 micron band, with its recent extension to the 24 micron band and X ray ultradeep imaging. In particular, we take advantage of the multi-wavelength approach to isolate massive ($M > 10^{11} M_{\odot}$) and old (age$>$ 1 Gyr) galaxies at $z \sim 2-4$ from the bulk of objects with extremely red colors. We use this sample to investigate the mass assembly, clustering, star formation of massive red galaxies at $z > 2$ and the importance of AGN activity in the assembly of high-z galaxies. We finally compare these observed properties of massive red galaxies at high redshifts with up-to-date hierarchical merging models.

25′
Session 2
7

Probing the IGM and ISM at High z with Gamma-Ray Bursts

Jason X. Prochaska

40′
Session 2
8

I will review new results on the study of the interstellar and intergalactic medium of the high redshift universe as probed by spectroscopy of gamma-ray burst (GRB) afterglows. I will describe the observational experiment, the analysis techniques, and the basic measurements provided by the data. These data are used to constrain the HI column density, metallicity, dust content, H2 fraction, and chemical abudances of the ISM surrounding GRBs. The observations also reveal the kinematic characteristics and allow an estimate of the location of the gas along the sightline. I will discuss these results and their implications for GRB progenitors and galaxy formation in the young universe. Finally, the same data permits an investigation of the universe along the sightline; I will summarize results on this intergalactic medium.

The GRB Luminosity Function in the light of the Swift 2-year Data

Ruben Salvaterra

We compute the luminosity function and the formation rate of long gamma ray bursts by fitting the observed differential peak flux distribution obtained by the BATSE satellite in three different scenarios: i) GRBs follow the cosmic star formation and their LF is constant in time; ii) GRBs follow the cosmic star formation but the LF varies with redshift; iii) GRBs form preferentially in low-metallicity environments. We find that the differential peak flux number counts obtained by BATSE and by Swift can be reproduced using the same LF and GRB formation rate, indicating that the two satellites are observing the same GRB population. We then check the resulting redshift distributions in the light of Swift 2-year data, focusing in particular on the relatively large sample of GRBs detected at $z > 2.5$. We show that scenario i) is ruled out. Swift data can be explained by assuming that the LF varies with redshift and/or that GRB form out of low-metallicity environments.

25′
Session 2
9

ALFALFA: HI Cosmology in the Local Universe

Riccardo Giovanelli

For the last 25 years, the 21 cm line has been used to investigate the LSS of the Universe, its peculiar velocity field and the measurement of cosmic paramaters. In Feb. 2005 a blind HI survey of 7000 deg^2 of sky was started at Arecibo, using a feed array (ALFA). The Arecibo Legacy Fast ALFA (ALFALFA) Survey will produce a census of HI-bearing objects over a cosmologically significant volume of the local Universe. When completed, $> 20,000$ HI sources will be detected. ALFALFA is better than previous blind surveys by $\sim$ one order of magnitude in both sensitivity and areal resolution. As of mid 2007, $\sim 1/3$ of the survey observations and $> 10\%$ of the source extraction are completed. Given the poor statistics on low HI mass systems of previous surveys, estimates of the cosmic abundance of low mass, baryon rich halos are extremely uncertain: preliminary results of ALFALFA will be presented, with special emphasis on this aspect (see also paper by Haynes).

25′
Session 2
10

ALFALFA: The Search for (almost) Dark Galaxies and their Space Distribution

Martha P. Haynes

As of mid 2007, some 5000 HI sources will have been identified in the data sets of ALFALFA, the extragalactic legacy HI survey presently underway at the Arecibo Observatory. Over the next few years, ALFALFA aims to complete coverage of 7000 square degrees of sky to an rms sensitivity of 2 mJy with a velocity resolution of 10 km/s and to a radial velocity $cz \sim 18,000$ km/s. ALFALFA allows the detection of HI masses as low as 1 million solar masses with positional accuracy better than 0.5 arcmin. The large-scale properties of the extant ALFALFA catalog, which includes sources in the region of the Virgo cluster and its environs as well as in local voids, will be presented. This presentation will focus on the "void problem" (do low density regions provide more hospitable environments than high density ones to the survival of baryons in low mass systems?) and the possible existence of HI-rich, optically dark systems. (See also the presentation by Giovanelli.)

25′
Session 2
11

The new cosmology with ALMA

30′

Massimo Tarenghi

Session 2

12

August, 29th, 2007

Galaxy evolution from the VIMOS VLT Deep Survey

Olivier Le Fèvre, and the VVDS team

40′
Session 2
1

The VIMOS VLT Deep Survey has assembled more than 30000 spectroscopic redshifts of galaxies at depth up to $I_{\rm AB} = 24.75$, reaching redshifts up to $z = 5$. The simple selection function enables to build a comprehensive picture of galaxy evolution from one single sample. I will present the latest results on the clustering of galaxies, as well as on the evolution of the mass and star formation rate.

Assessing the predictive power of galaxy formation models: a comparison of predicted and observed rest-frame optical luminosity functions at $2 < z < 3.3$

Danilo Marchesini & Pieter van Dokkum

Recent galaxy formation models successfully reproduce the local luminosity function (LF) of galaxies. As these models are optimized to fit the LF at low redshift, a crucial question is how well they predict the LF at earlier times. We compare recently measured rest-frame V-band LFs of galaxies at $2 < z < 3.3$ to predictions of semi-analytic models by De Lucia & Blaizot (2007) and Bower et al. (2006) and cosmological hydrodynamic simulations by Dave' et al. (2006). The models succeed for some luminosity and redshift ranges, and fail for others. Splitting by rest-frame color, we find that the luminosity density of red galaxies increases sharply from $z = 3$ to $z = 2.2$, but that it is approximately constant in the observations. Conversely, in the models the luminosity density of blue galaxies is approximately constant whereas it decreases in the observations. These discrepancies suggest that current models do not yet provide a complete description of galaxy formation and evolution since $z \sim 3$.

$20'$
Session 2
2

Galaxy Buildup in the First 2 Gyr: Evolution of the UV LF from $z \sim 8$ to $z \sim 4$

Rychard Bouwens, Garth Illingworth

20′
Session 2
3

Large samples of galaxies have been assembled at $z \sim 4$, 5 and 6 from all the deep HST ACS imaging data ever taken (4671, 1416, and 627 sources, respectively). Following a rigorous procedure, robust LFs have been derived that reach $4-5$ mag fainter than L^*. A striking result is that the faint-end slope is constant and very steep (~ -1.75). Within the errors ϕ^* is roughly constant, but the characteristic luminosity M^* brightens significantly over this 0.7 Gyr period by 0.7 mag. The observed increase in M^* is almost identical to that expected in the halo mass function. At $z \sim 7-8$, we have also more than doubled our sample sizes, using all available deep HST data, and find that the evolution at the bright end of the LF continues from $z \sim 8$. Spitzer observations of galaxies at $z \sim 7-8$ have been used to estimate masses and ages, suggesting a significant level of star formation at $z \geq 9$. These results show that the hierarchical build-up seen at $z \sim 4-6$ is present in the reionization epoch.

First results from ALHAMBRA: A deep, wide-area photometric redshift survey

Alberto Fernandez-Soto

I will present the first results from the ALHAMBRA survey. ALHAMBRA will cover a relatively wide area (4 sq.deg. divided in seven independent areas in the sky) using a purposely-designed set of 20 medium-band filters, down to an homogeneous magnitude limit AB ~ 25 in most of them, adding also deep near-infrared imaging in *JHK*. To this aim we are using the Calar Alto 3.5m telescope.
A small area of the ALHAMBRA survey has already been observed through our complete filter set, and this allows for the first time to check all the steps of the survey, including the pipelines that have been designed for the project, the fulfilment of the data quality expectations, the calibration procedures, and the photometric redshift machinery for which ALHAMBRA has been optimised.
I will present the basic results regarding the properties of the galaxy sample selected in a 15×15 arcmin^2 area of the ALHAMBRA-8 field, which includes approximately 10000 galaxies with precise photometric redshift measurements. In a first estimate, approximately 500 of them must be galaxies with $z > 2$. I will particularly introduce some of the most interesting objects in terms of their extreme colours or luminosities, or emission-line properties, and the possibilities that the whole survey will offer to analyse their properties and evolution as an ensemble.

20′
Session 2
4

Clustering properties and masses of starforming galaxies at $z \sim 2$: the Spitzer view

M.Magliocchetti, L. Silva, A.Lapi, G. De Zotti, G.L. Granato, D. Fadda, L. Danese

A multiwavelength-analysis of the ~ 800 optically invisible ($R > 25.5$) sources observed at 24μm by the Spitzer First Look Survey (Fadda et al. 2006) reveals that they are ultraluminous far-IR galaxies located in the redshift range $z = [1.6 - 2.7]$. The properties of these objects (from number counts to redshift distribution) are fully consistent with those of proto-spheroidal galaxies in the process of forming their stars and growing their active nucleus. The dimension of the sample allows for the first time high precision estimates of the clustering properties of high-redshift dusty galaxies and determinations of their masses. We find that the amplitude of their spatial correlation function is very high: the associated comoving length is $r_0 \simeq 14$ Mpc (comoving), value which puts these objects amongst the most strongly clustered populations in our known universe. Matches with models furtherly show that these sources have to be hosted by dark matter haloes more massive than $\sim 10^{13.4} M_{\odot}$.

20′
Session 2
5

The FIR & Sub-mm View on Galaxies: from Spitzer & SCUBA to Herschel & SCUBA2

Mattia Vaccari, Alberto Franceschini, Giulia Rodighiero & Stefano Berta

We discuss the constraints set on galaxy formation and evolution by FIR & sub-mm observations by Spitzer & SCUBA and detail the implications for similar projects being planned with Herschel & SCUBA2. Results from Spitzer & SCUBA indicate extremely high rates of evolution for IR galaxies, exceeding those measured at other wavelengths. We introduce a phenomenological model of extragalactic populations, reproducing observed number counts, z-distributions, and L-functions. Adopting such a model we simulate sources to be detected by Herschel & SCUBA2. These new instruments operating at largely unexplored wavelengths will characterize the SED of a large number of ultra-luminous starburst galaxies with peak evolution between $z = 2$ and $z = 4$. We finally present a full set of predictions based on plans for extragalactic surveys, outlining the importance of this new vantage point on galaxies which we will be offered in the Herschel & SCUBA2 era.

20′
Session 2
6

The mass assembly histoty of massive galaxies

M. Cirasuolo, R.J. McLure, J.S. Dunlop

20′
Session 2
7

The potential of deep near-IR observations to measure the cosmological evolution of the stellar mass of galaxies has long been understood. I will present our latest results derived from the UKIDSS Ultra Deep Survey: at the moment the deepest *K*-band image over a contiguous area of ~ 0.7 square degrees.
I will focus on the evolution of the luminosity and mass function of *K*-band selected galaxies from the local Universe up to $z \sim 4$ and compare them with the predictions of recent theoretical models. Exploiting the large size of our sample ($\sim 100,000$ galaxies) I will explore the differing cosmological evolution of the red and blue galaxy populations and show how the strength of the colour bimodality as a function of redshift.

The assembly of stellar mass in galaxies during the last 10 Gyr: VVDS results

B. Garilli on behalf of the VVDS consortium

The VVDS Survey, with half a square degree of coverage, its high and unbiased spectrocopic depth, and its large multiwavlength coverage, is one of the best data set to follow the evolution of stellar mass assembly from $z \sim 2$ to present day. We will present the most recent and yet unpublished results obtained on Galaxy Stellar Mass Function evolution, the evolution of the mass-metallicity relation, and the dependance of star formation efficiency on mass. The global picture obtained is consistent with a scenario where the most massive objects appear to have formed their main stellar population more than 10 Gy ago, while in less massive objects star formation is still playing an important role.

$20'$
Session 2
8

Morphology of $z \sim 1$ galaxies form deep K-bando AO imaging in the COSMOS field

Huertas-Company, M., Rouan, D., Soucail, G., Le Fèvre, O., Tasca, L.

We present the results of an imaging programme of distant galaxies ($z \sim 0.8$) at high spatial resolution ($\sim 0.1''$) aiming at studying their morphological evolution. We observed a $(7')^2$ area with the NACO AO system in K_s band with $V \sim 14$ guide stars. Observed fields are selected within the COSMOS survey area. High angular resolution *K*-band data have the advantage to probe old stellar populations in the rest-frame, enabling to determine galaxy morphological types unaffected by recent star formation, better linked to the underlying mass than classical optical morphology studies (HST). AO on ground based telescopes is the only method today to obtain such high resolution in the *K*-band. The purpose of the talk is to show that reliable results can be obtained and establish a first basis for larger observing programmes by analizing the morphologies of 79 galaxies with magnitudes between $K_s = 17 - 23$ using B/D decompositions.

20′
Session 2
9

August, 30th, 2007

The Role of Simulations in Cosmology

Jeremiah P. Ostriker

40′
Session 2
1

The study of cosmology has been totally transformed in the last decade, and computers have played a major role in the change. New theories have arisen which make the subject, formerly almost a branch of philosophy, into a quantitative science. A standard, precisely specifiable model has emerged which has been labeled "Concordance Cosmology." It is based on a universe having roughly scale invariant Gaussian random perturbations imposed on a geometrically flat substrate of dark matter, dark energy, photons and baryons. Initial tests of this model, either using data on galaxy distributions in the local universe or the cosmic background radiation fluctuations, indicate rough agreement with the simplest predictions of the theory. Simplified numerical simulations based on gravity, dark matter and dark energy have, for some time, been able to give us pictures of large scale cosmic structure which are consistent with our knowledge of the distributions of mass, velocity and potential in the real world. But to model the observable world of stars, galaxies and hot gas, much more is needed. And now that fully three-dimensional, time dependent numerical simulations can be made on modern, parallel architecture computers, we can examine (using good physical modeling) the detailed quantitative predictions of the concordance model and its variants to see if we produce an output consistent with the real world being revealed to us by the latest ground- and space-based survey instruments.

Current simulations have matched in exquisite detail the observations of the Lyman-alpha clouds and do an excellent job of predicting/fitting the X-ray observations of hot gas in the great clusters of galaxies. The current challenge is to see if a sufficient dynamic range and complexity of physical input can be achieved with the next generation of computers to accurately model galaxy formation and structure.

Galaxy formation and evolution: the far-IR/sub-mm view

James S. Dunlop

I will review how recent sub-mm/mm surveys, coupled with multi-frequency follow-up observations, have informed our current view of galaxy formation and evolution. In particular I will present the latest results from the SHADES project, and the resulting implications for current models of galaxy formation. I will conclude with a discussion of the exciting prospects offered by the now imminent next generation of mm-far-IR facilities, such as Laboca, SCUBA2, Herschel and eSMA.

40′
Session 2
2

Galaxy formation, dark matter substructure, and reionization

Piero Madau

35′
Session 2
3

The development of primordial inhomogeneities into the non-linear regime and the formation of the first astrophysical objects within dark matter halos mark the transition from a simple, neutral, cooling universe – described by just a few parameters – to a messy ionized one – the realm of radiative, hydrodynamic, and star formation processes. It is an early generation of extremely metal-poor massive stars and/or seed accreting black holes in subgalactic halos that may have generated the ultraviolet radiation and mechanical energy that reheated and reionized most of the hydrogen in the cosmos. In this talk I will summarize studies of the dawn of galaxies and the lessons recently learned from large supercomputer simulations of galaxy halos.

Multi-wavelength observations of galaxies at $z \geq 2$

Mauro Giavalisco

$20'$

Session 2

4

Large Scale Structure in the First Billion Years

Laura Douglas

15′
Session 2
5

I will present results from a programme exploring the properties of a large sample of spectroscopically-confirmed galaxies at $z > 5$. Drawn from 14 widely separated fields, the sample consists of just under 100 galaxies at $z \sim 5$ and above, and is the largest sample of confirmed Lyman Break galaxies (LBGs) at these redshifts. The multiple fields used in this survey has allowed me to explore the effect of cosmic variance and large-scale structure only a billion years after the Big Bang.
I have found considerable field to field variation of the 3D number density of galaxies. Two of the richest fields show clear, highly significant spikes in their redshift distributions at $z = 5.15$ and $z = 4.95$, clear evidence of sheets or filaments of large scale structure at the highest redshifts. The galaxies in the spikes are typically very young starbursts (< 100 Myr), but have not had time to dynamically interact, indicating that they are the tip of an iceberg of darker (baryonic) matter.

The CODEX-ESPRESSO Experiment: Cosmic Dynamics, Fundamental Physics, Planets and much more...

Stefano Cristiani and the CODEX-ESPRESSO Team

CODEX, a high resolution, super-stable spectrograph to be fed with the E-ELT, the most powerful telescope ever conceived, will for the first time provide the possibility of directly measuring the change of the expansion rate of the Universe with time and much more, from the variability of fundamental constants to the search for other earths. A study for the implementation at the VLT of a precursor of CODEX, dubbed ESPRESSO, is presently carried out by a collaboration including ESO, IAC, INAF, IoA Cambridge and Observatoire de Geneve. In the present talk I will focus on the cosmological aspects of the experiment.

15′
Session 2
6

Growth and consequences of black holes beyond $z = 6$

40′
Session 2
7

Martin J. Rees

A Brief History of Cosmic Expansion and Acceleration

Adam G. Riess

The expansion rate and its evolution must be empirically determined for our Universe to reveal its composition, scale, age, and fate. In 1998, high-redshift SNe Ia provided the first and only direct evidence for an accelerating Universe and the existence of dark energy. To identify the nature of dark energy we seek to improve on past and present measurements of the recent history of cosmic expansion. Today's keystones of expansion are distant type Ia supernovae and Cepheid variables in their hosts. I will report on new calibrations of the Hubble diagram of SNe Ia with new SN Ia and Cepheid data and an extension of its reach to $z > 1$ when cosmic expansion was still decelerating. These measurements are providing new clues about the nature of the mysterious dark energy.

40′
Session 2
8

The Carnegie Supernova Project

Wendy Freedman

20′
Session 2
9

The Carnegie Supernova Project (CSP) is designed to provide independent constraints on the acceleration of the universe and the measure of dark energy. A primary goal of the CSP is to provide an i'-band restframe Hubble diagram for type Ia supernovae. Using three (1-meter, 2.5-meter and 6.5-meter) telescopes at the Las Campanas Observatory, the CSP is aimed at testing for and reducing systematic uncertainties, by obtaining a sample of multiwavelength observations over the redshift range $0 < z < 0.7$. I will describe the overall goals of this long-term program and present light curves and a preliminary i'-band Hubble diagram. These independent data, with improved reddening, corrections based on near-infrared photometry, confirm the basic conclusion that the universe is accelerating. I will also present a Fisher-matrix analysis, estimating the uncertainties in cosmological parameters upon the completion of the CSP.

Cosmological parameters from strong gravitational lensing and stellar dynamics in elliptical galaxies

Claudio Grillo

I will present a new observational technique able to investigate the geometry of the Universe, making use of strong gravitational lensing and stellar dynamics in ellipticals. Accurate measurements of the matter and dark energy density parameters can be produced by studying a statistically significant sample of lenses. A gravitational lensing estimate of the mass enclosed inside the Einstein ring is directly related to the geometry of the lensing configuration. A dynamical estimate of such mass can also be given by measuring the central stellar velocity dispersion. Identifying these mass estimates, the combination of a measurement of the Einstein angle and of the central stellar velocity dispersion can be related to a function of the redshifts of the lens and the source and of the matter and dark energy density parameters. I will show the results from the SLACS and LSD Surveys, and I will discuss the precision attainable applying this method to larger samples from forthcoming Surveys.

15′
Session 2
10

Using the DEEP2 Survey to Constrain Cosmological Parameters

Marc Davis

25′
Session 2
11

The volume density of weak groups of galaxies at $z \sim 1$, for which we have measured velocity dispersions, is computed with the DEEP2 redshift survey, which combines very high space density, accurate redshifts, and a large volume. This volume density, combined with local samples such as SDSS or 2dFGS, is a very strong test of σ_8, w, and Ω_m. It can be used to set a strong constraint on the deviations of the Universe from an λCDM model.

The red and blue Galaxy Luminosity Function in the GOODS field: evidence for an excess of red dwarfs

Salimbeni, S., Giallongo, E. et al.

We study the evolution of galaxy luminosity function up to $z = 3$. We obtained a rest-frame B complete sample of galaxies from the GOODS-MUSIC catalog. About 15% of the sample has spectroscopic z, and the remaining has well calibrated photometric z derived from the multi-wavelength coverage in 14 bands (from 0.3 to the 8μm). We studied the photometric properties of these galaxies and we confirm a bimodality in the $U-V$ color and SSFR distributions up to $z = 3$. According to these properties the sample has been divided in red/early-blue/late populations. The LFs of the blue/late and total samples are well represented by steep Schechter functions evolving in luminosity with increasing z. The LFs of the red/early populations decrease in volume density with increasing z. The shape of the red/early LFs shows an excess of faint red dwarfs respect to the extrapolation of a flat Schechter function. Hints on the nature of this objects are given on the basis of their mass and spatial distributions.

10′
Short Talks
12

The VIRMOS-VLT Deep Survey: 10 billion years of evolution of the large scale structure

A. Pollo, L. Guzzo, O. Le Fèvre, B. Meneux and the VVDS team

10′
Short Talks
13

We discuss the evolution of clustering of galaxies back to $z \sim 2$, using the VIMOS-VLT Deep Survey (VVDS) data. We analyze the evolution of the projected two-point correlation function for the global galaxy population and for particular galaxy classes, with different intrinsic luminosities, spectral types, colors and other properties. Particularly interesting is e.g. the difference between the clustering of the brightest galaxies (with $L > L^*$) now and in the past; the shape of their correlation function deviated from the power-law much more strongly at $z \sim 1$ than it is observed now. This finding, which can be interpreted e.g. in the framework of Halo Occupation Distribution models (HODs), results in a strong scale-dependence of the relative galaxy bias and implies a significant change in the way luminous galaxies traced dark-matter halos at $z \sim 1$ with respect to now. Our observations represent an important constraint for models trying to reproduce the evolution of galaxy clustering.

A solution of the cusp problem in relaxed halos

E.Mikheeva, A.Doroshkevich, V.Lukash

We consider the inner structure of virialised halos allowing for the random velocities of collapsed DM particles caused by the small scale initial perturbations. We combine the properties of initial perturbations at linear epoch with main characteristics of simulated relaxed halos. To do this we describe the linear and nonlinear periods of halo formation by the entropy of DM particles. The gasdynamic approach allows us to take into account joint action of small scale initial perturbations and the processes of nonlinear relaxation of compressed matter on the inner structure of virialised halos. We show that the random initial velocities suppress the formation of cusp–like halo profiles and favor the formation of core–like halos. Such approach allows us to explain the difference between the simulated and observed rotation curves and, so, provides quite well description of observed circular velocities.

10′
Short Talks
14

On the Lagrangian theory of cosmological density perturbations

Vladimir Strokov

10′
Short Talks
15

We show that hydrodynamical and field approaches in theory of cosmological scalar perturbations are equivalent for a single medium. The case of a few media (fields) is also considered.

Spectroscopy of galaxies at $z = 6$ and above: Cosmological implications

E. R. Stanway, M N Bremer, A. J. Bunker

The analysis of Lyman-break galaxies lying at $z > 5$ has greatly increased our understanding of star formation at this cosmologically-important epoch. However the vast majority of candidate galaxies at these redshifts either lack spectroscopic confirmation or were selected for their extreme youth and strong Lyman-alpha emission. Spectroscopy is essential both to constrain the redshifts and properties of the candidate galaxies, and to eliminate lower redshift interlopers. I will discuss results from our recent spectroscopy of high redshift, rest-UV selected sources using 8 and 10m telescopes and the contribution of such observations to our overall understanding of the cosmological evolution of the galaxy population.

$10'$
Short Talks
16

Studying Reionization with Ly alpha Emission

Matt McQuinn

10′
Short Talks
17

We use large-scale radiative transfer simulations to understand the effect of reionization on the statistics of Lyman-alpha emitting galaxies. Reionization changes the clustering properties of these emitters, creating large-scale correlations due to the HII bubbles modulating their observed distribution. We show that this effect is detectable with upcoming $z > 6$ emitter surveys.

1st ranked poster

5′

Short Talks

18

2nd ranked poster

5′

Short Talks

19

3rd ranked poster

5′

Short Talks

20

August, 31st, 2007

Prospects for Future Cosmology

John C. Mather

I will summarize the accomplishments of missions such as COBE, HST, and WMAP in establishing the precision cosmology of today, and describe the outlook for future missions such as the James Webb Space Telescope to extend the discoveries even farther. ESA is about to fly the Planck observatory to measure the CMBR fluctuations even better, and NASA is considering the Joint Dark Energy Mission and the Inflation Probe, observatories which could in principle produce additional Nobel Prize-winning discoveries. These three missions and others yet to come will make the next 50 years of astrophysics a period of extraordinary breakthroughs.

40′

Session 3

1

From Boomerang to B-Pol

40′

Paolo De Bernardis

Session 3

2

The Cosmic Microwave Background Radiation Anisotropies: Their Discovery and Utilization

George F. Smoot

25′
Session 3
3

Review of events leading to the discovery of CMB anisotropies and subsequent observations. How the CMB anisotropies are utilized and what they tell us about cosmology now and in the coming decade.

Chasing Lambda

Aleksandra Kurek, Marek Szydlowski

15′
Session 3
4

Recent astronomical obserwations of SNIA, CMB, as well as BAO in the Sloan Digital Sky Survey and large scale structure bounds suggest that current universe has entered a stage of an accelerated expansion with the redhift transition at $z = 0.5$. While the simplest candidates for explanation of this fact is cosmological constant/vacuum energy there exists a serious problem of coincidence. In the theoretical cosmology we can find many possible approaches alleviating this problem by applying new physics or other conception of dark energy. We consider state of art candidates for the description of accelerating universe in the framework of the Bayesian model selection. We point out advantages as well as troubles of this approach. We find that the combination of five databases gives a stringent posterior probability of the LCDM model greater than 98%. This fact is a quantitative exemplification of a turmoil in modern cosmology over the Lambda problem.

The Cosmic X-ray Background level at its emission peak

F. Frontera, M. Orlandini, R. Landi et al.

We report on a measurement of the Cosmic X-ray Background (CXB) in the energy band from 15 to 50 keV, obtained with the high energy instrument PDS aboard the BeppoSAX satellite. From this measurement we get an accurate normalization of CXB in the hard X-ray energy band. We describe the measurement and discuss its astrophysical implications, like the constraints on the population size of Compton thick AGNs and the diffuse WHIM.

15′
Session 3
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Measuring the Cosmic Microwave Background Radiation (CMBR) polarization with QUIET

Dorothea Samtleben on behalf of the QUIET collaboration

15′
Session 3
6

The CMBR is a rich source of cosmological information and allows access to the earliest times in the Universe. A major goal of upcoming experiments is to reveal the subtle signature of inflation in the polarization pattern which requires unprecedented sensitivity and control of systematics. Since the sensitivity of single receivers has reached fundamental limits future experiments will take advantage of large receiver arrays in order to significantly increase the sensitivity. The talk will introduce the status and goals of the Q/U Imaging ExperimenT (QUIET). It will use HEMT-based receivers in chip packages at 90(40) GHz in the Atacama Desert. Data taking is planned for the beginning of 2008 with prototype arrays of 91(19) receivers, an expansion to 1000 receivers is foreseen. With the 2 frequencies and a careful choice of scan regions there is the promise of effectively dealing with foregrounds and reaching a sensitivity approaching 0.01 for the tensor to scalar perturbations.

The Role of Dark Matter in the Cosmos

David Cline

We discuss the current concepts for dark matter and the current worldwide search. The discovery would have profound effects on our view of cosmology. For example, a WIMP or a sterile neutrino would have different origins.

15′
Session 3
7

Present and (near) future of CMB observations from space

Marco Bersanelli

The results from the WMAP satellite and from a number of sub-orbital CMB experiments have played a central role in recent breakthroughs of our understandig of cosmic dynamics and composition. These observations have greatly improved the reconstruction of the angular power spectrum of CMB temperature anisotropies and have provided evidence of E-mode polarisation signatures. The Planck satellite, to be launched in 2008, is designed to produce the next step forward with a set of 9 full-sky maps in the frequency range $30 - 850$ GHz with an unprecedented combination of sensitivity, angular resolution and monitoring of astrophysical foregrounds. All channels from 30 GHz to 350 GHz are polarisation sensitive. Control of potential systematic effects is a major driver of the instruments design and mission plan. Two complementary instruments cover the frequency spectrum, using coherent radiometers cryogenic HEMTs at low frequencies and 0.1 K spider-web bolometers at high frequencies. The two instruments have recently completed their on-ground cryogenic calibration campaign and are now integrated in the flight model Planck satellite. An overview of the Planck scientific objectives, instrument design, and calibration approach will be presented.

25′
Session 3
8

Dark Matter: at the brink of a discovery?

Bernard Sadoulet

I will review the status of searches for Dark Matter, in particular for Weakly Interactive Massive Particles: the explosion of the number of technologies proposed, the current upper limits, the prospects in the next few years and the complementarity with LHC and GLAST, which are simultaneously exploring similar parameter space.

30′
Session 3
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Massive neutrinos and 'inos' and the upper cut-off to the fractal structure of the Universe

M. Lattanzi, R. Ruffini, G.V. Vereshchagin

15′
Session 3
10

Recent observations by the Sloan Digital Sky Survey indicate that at $z \sim 0.3$, galaxies are homogeneously distributed at scales larger than $R \sim 70\,h^{-1}$ Mpc, while they follow a distribution with fractal dimension $D = 2$ up to scales $R \sim 20\,h^{-1}$ Mpc. We will discuss how the transition to homogeneity is related to the mass and properties of the dark matter particles, and in particular we will focus on the role of neutrinos and light fermions.

Cosmic shear results from the CFHT Legacy Survey

Henk Hoekstra

Weak lensing by large scale structure, aka cosmic shear, is a powerful tool for the study of the dark matter distribution in the universe. The current generation of surveys, of which the ongoing CFHT Legacy Survey is the largest, will also be able to measure the growth of structure, significantly improving the sensitivity to a range of cosmological parameters, most notably the equation of state of the dark energy. In this talk I will review the status of the CFHTLS and present some results of this ongoing project and provide an projection of what may be expected from future surveys.

15′
Session 3
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Measuring Dark Matter and Dark Energy from redshift-space distortions at $z = 1$: early results from the VVDS-Wide survey

Luigi Guzzo & VVDS Team

15′
Session 3
12

Using an early complete subs-set of the VVDS-Wide survey ($\sim 10,000$ redshifts to $I_{\rm AB} = 22.5$ over ~ 6 deg^2), we have detected for the first time the signature of linear redshift-space distortion due to the growth of density fluctuations at $z \sim 1$. Modelling $\xi(r_p, \pi)$, we measure the distortion parameter $\beta \sim \Omega_{\rm M}^{0.6}/b = 0.6 \pm 0.3$, a value well consistent with the concordance model at this z's. Extensive simulations performed on mock VVDS-Wide surveys built from the Millennium Simulation, indicate that with the final VVDS-Wide survey of 10 deg^2 and $75,000$ redshifts, we will reach an rms error of 11% on the value of β. This represents a direct probe of the cosmological model at $z \sim 1$, complementary to methods based on functions of $H(z)$ as BAO's or Sn-Ia, and able to discriminate among different DE models. No other redshift survey has currently the combination of area and depth of VVDS-Wide to produce such a measurement.

Observationalist Optimism for Progress on Dark Energy

Saul Perlmutter

40′

Session 3

13

Cosmological model from initial conditions to late Universe

Vladimir N. Lukash

30′

Session 3

14

The progress and problems of the cosmological model are reviewed: initial conditions and geometry of the Universe, structure formation and identification of dark matter, standard model and new physics.

Starting now what would I plan knowing where we are?

George P. Efstathiou

40′
Session 3
15

List of posters

HOD in the VVDS

Ummi Abbas, VVDS team

With the advent of larger and deeper redshift surveys it is becoming possible to obtain a better understanding of the evolution of structure. For one, the clustering of galaxies is seen to exhibit a break in the traditional power-law becoming more pronounced at higher redshifts. This effect can be quantified in terms of the halo model. With the help of the VVDS and its largest-to-date collection of spectroscopic galaxies at a depth $17.5 < I_{\rm AB} < 24$ extending to $z \sim 5$ we are able to study the evolution in the correlation function to unprecedented accuracy. Within the halo model framework we will show the change in the weighted average halo mass and corresponding occupation number through time.

Poster 1

Cosmology with Gamma-ray Bursts

L. Amati et al.

Poster 2

Gamma-Ray Bursts (GRB) are the most luminous cosmological transient events in the universe, with isotropic-equivalent radiated energies up to more than 10^{54} erg and redshifts up to at least 6.4 . Thus, in addition to their astrophysical interest, these sources potentially constitute a very useful tool for cosmology. Cosmology with GRB include: use as beacons to study the properties of the WHIM and the metallicity evolution in star forming regions and galaxies through X-ray absorption spectroscopy, study of the first generation (pop III) stars (by exploiting the GBR - SN connection and the high redshift of GRBs), possible future use of GRBs for the estimate of cosmological parameters by standardizing them through “spectral-energy” correlations. I review and briefly discuss these topics, which constitute an important part of the scientific case of the EDGE space mission proposed to ESA Cosmic Vision 2015-2025 programme.

Measuring Cosmic Expansion and Large Scale Structure with Destiny

Dominic J. Benford and Tod R. Lauer for the Destiny Team

Destiny is a simple, direct, low cost mission to determine the properties of dark energy by obtaining a cosmologically deep supernova (SN) type Ia Hubble diagram and by measuring the large-scale mass power spectrum over time. Its science instrument is a 1.65m space telescope, featuring a near-infrared survey camera/spectrometer with a large field of view. During its first two years, Destiny will detect, observe, and characterize $>$ 3000 SN Ia events over the redshift interval $0.4 < z < 1.7$, thereby constructing a high-precision Hubble diagram to constrain the dark energy equation of state. Destiny will be used in its third year as a high resolution, wide-field imager to conduct a weak lensing survey covering $>$ 1000 square degrees to measure the large-scale mass power spectrum. The combination of surveys is much more powerful than either technique on its own, and will have over an order of magnitude greater sensitivity than will be provided by ongoing ground-based projects.

Poster 3

Evolution of the luminosity functions in the red bands from a K-band selected sample in the VVDS

Micol Bolzonella & VVDS collaboration

Poster 4

The Vimos-VLT Deep Survey is one of the largest spectroscopic surveys conceived for cosmological studies. Taking advantage of its depth and its large baseline of photometric data we can infer clues on galaxy evolution. One of the most notable method to investigate the history of the assembly of galaxies relies on near-infrared selection. Deep K-band data, $K_{\rm AB} \leq 22.84$, presented in Iovino et al. (2005) have been complemented with a larger area limited to $K_{\rm AB} \leq 22.34$. The NIR sample, with ~ 10000 objects selected over an area of 623 arcmin^2, allows us to derive the evolution of the luminosity functions for a K-band selected sample up to $z \sim 2$, using spectroscopic redshifts and high quality photometric redshifts calibrated on the spectroscopic subsample. The comparison of LF evolution to theoretical models and the different evolution of luminosity functions for different photometric types of galaxies provide insights into the galaxy formation history.

Large Scale Structure at High Redshift in the GOODS Field

D. Trevese, M. Castellano, S. Salimbeni, A. Grazian, A. Fontana, E. Giallongo

A method to measure galaxy volume-density, based on photometric redshift, has been applied to the GOODS field to identify high redshift structures. Structures are found at redshifts 0.6, 0.7, 1.0 and 1.6. The efficiency of the method in detecting high redshift structures and the the dependence of galaxy population on local density are discussed.

Poster
5

High-z Quasars in the UKIDSS

Kuenley Chiu, Andrew Bunker, Karl Glazebrook, Linhua Jiang, Xiaohui Fan

Poster 6

Over the ~ 5 years of its full operations, the SDSS rapidly broke high-z quasar discovery barriers by exploiting the advantages of the near-infrared/optical z filter, combined with a high efficiency and large-area imaging array. During this time, dedicated searches by our group and collaborators revealed many new quasars at $z \sim 5-6$ using the i-dropout technique. These samples probed new parameter spaces and signficantly expanded our understanding of the properties and environments of such rare objects. The UKIRT Infrared Deep Sky Survey (UKIDSS) offers the possibility to continue such interesting discoveries to even higher redshifts. We review the attributes of the survey that makes such rare object discovery possible, the challenges and techniques required to identify such objects from the sea of candidates in such large datasets, and some preliminary results of an ongoing search.

2DPHOT - A Multi Purpose Environment for the Analysis of Wide-Field Images

de Carvalho, R.R., La Barbera, F., Soares-Santos, M., Kohl-Moreira, J.L., Gal, R.R., and Capaccioli, M.

We describe a general purpose analysis environment, 2DPHOT, that allows automated detection and analysis to be performed on wide-field deep images. 2DPHOT is an automatic tool to obtain both integrated and surface photometry of galaxies in a given image, performing reliable star-galaxy separation, with an accurate estimate of contamination at faint flux levels and completeness of the image catalogue. It does also detect clusters and groups of galaxies using the Voronoi Tesselation method. The new environment is thought as a dedicated tool to process a large amount of data coming from wide-field imaging surveys coming up in the following years. The package has been already applied to the Palomar Abell Cluster Survey and will be extensively applied to survey data, such as the VLT-Survey Telescope (VST) Surveys and Palomar Quest.

Poster 7

CMB Temperature Measurements by Sunyaev-Zel'dovich Effect spectra of clusters of galaxies

S. De Gregori, et al.

Poster 8

The standard scaling of the Cosmic Microwave Background temperature with redshift is under test by two independent observational approaches. Measurements of microwave transitions excited by CMB photons are reported up to large redshifts but with increasing systematic errors. SZE spectra of clusters of galaxies allow to infer the CMB temperature independently of the cluster redshift. The method is presented with the first data, the most recent observations and the future application.

The cosmological properties of the absorbed and unabsorbed population in the XMM-Newton Hard Bright Survey

Della Ceca R., Caccianiga A., Severgnini P., Maccacaro T., and Cocchia, F.

Hard ($E \sim 2-10$ keV) X-rays can directly probe AGN activity, are almost uncontaminated by star formation processes at the X-ray luminosities of interest ($L_X > 10^{42}$ cgs) and are sensitive to absorbed AGN up to $N_H \sim 10^{24}$ cm^{-2}, that is to say, they detect all but the Compton Thick sources. Using the AGN sample (62 objects in total) selected in the XMM-Newton Hard Bright Survey (XMM HBS; $E = 4.5-7.5$ keV band) we present here their physical and cosmological properties. Given the very high identification rate of the XMM HBS ($\sim 97\%$) we are now in the position to discuss a few hot topics (e.g. the relationship between optical and X-ray absorption, the intrinsic ratio of absorbed and unabsorbed AGN, the absorbing Nh distribution of the AGN population) on firm statistical bases.

Poster 9

Post-starburst galaxies and the galaxy color bimodality

Sven De Rijcke, Pieter Buyle, D. J. Pisano, Dolf Michielsen, Ken Freeman, Herwig Dejonghe

Poster 10

We present results from a multi-wavelength observing campaign of a sample of post-starburst galaxies (PSGs). The origin and redshift evolution of the bimodal galaxy color distribution is at the focus of current extragalactic and cosmological research. PSGs have just experienced a strong and abruptly truncated starburst, causing them to evolve across the color gap. This makes them prime targets for studying the physical processes that govern the galaxy color bimodality. Our deep 21 cm observations reveal significant amounts of atomic gas in 50% of them. This shows that starbursts not always stop because of the exhaustion of the available gas reservoir and leaves the possibility of future star formation. No CO or HCN emission was detected, suggesting that star formation stopped because the UV radiation of the starburst evaporated the molecular clouds. Using our VIMOS 3D spectra, we check whether PSGs can evolve into early-types and we constrain the mechanism that triggered the starburst.

Precision Measurements of the Ly-alpha Forest from High-Resolution Quasar Spectra

Claude-André Faucher-Giguère, Adam Lidz, Matias Zaldarriaga, Lars Hernquist

We will present precision measurements of the Ly-alpha flux decrement and flux power spectrum at redshifts $2 < z < 4.5$ from high-resolution quasar spectra obtained with the ESI and HIRES spectrographs on Keck, and with the MIKE spectrograph on Magellan. We will discuss the implications of these measurements.

Poster
11

Simbol-X: a new generation hard X-ray telescope

P. Ferrando, P. Giommi, F. Fiore, M. Arnaud, U. Briel, E. Cavazutti, R. Cledassou, J.L. Counil, A. Goldwurm, O. Lamarle, P. Laurent, F. Lebrun, G. Malaguti, S. Mereghetti, G. Micela, G. Pareschi et al.

Poster 12

Simbol-X is a new technology hard X-ray astronomy mission currently under Phase-A study, carried out jointly by France and Italy with participation of the MPE. Simbol-X is dedicated to hard X-ray imaging and spectroscopy in the $1-100$ keV X-ray band coupled for the first time to microCrab sensitivity. By pushing grazing incidence imaging to $\sim 80-100$ keV Simbol-X will provide an up to about three orders of magnitude improvement in sensitivity and angular resolution above 10 keV compared to all operating instruments. This technological breakthrough will open a new window in astrophysics and cosmology allowing detailed studies on a very wide range of sources. The discovery space that Simbol-X will uncover is particularly large for two crucial areas of : (1) Black hole physics and census, and (2) Particle acceleration mechanisms. We will describe the mission status and review the expected scientific breakthroughs with a particular emphasis on the topics related to cosmology.

Cosmological SZ surveys and cluster magnetic fields

J. Geisbuesch, P. Alexander, M. Krause and R. Bolton

We discuss how up-coming Sunyaev-Zel'dovich surveys can be used in various cosmological experiments. In particular we consider how they can be used to constrain cosmological parameters and how when combined with surveys of background polarized sources with instruments such as the SKA and SKA pathfinders the cosmological evolution of cluster magnetic fields can be determined. Our discussion includes aspects of cluster selection, sample contamination, rotation measure grids and system requirements to match these goals. Our contribution compares the performances of several instruments and detection algorithms and discusses future challenges.

Poster 13

The cosmological origin of the satellite distribution

M.A. Gómez-Flechoso, L. Benjouali, R. Domínguez-Tenreiro & H. Artal

Poster 14

The distribution of satellite galaxies relative to their host has been subject of debate among several authors. Some of them have found polar alignment in the satellite distribution in disk galaxies, while others have obtained a planar distribution (along the major axis of the disk seen in projection). We analyze the distribution of satellite galaxies in cosmological self-consistent hydrodynamical simulations. Our conclusions are that satellite galaxies present a planar distribution when seen in projection, in spite of having preferentially polar orbits. Another result from our simulations is that the orbits of the satellite galaxies are coplanar as a consequence of the satellite accretion along cosmological filaments.

The quasar clustering evolution from SDSS DR5

Ganna Ivashchenko

About 57800 photometrically classified quasars taken from the Fifth Data Release of the SDSS were used for studing the evolution of their clustering within the redshift range $0.1 - 2.2$. The measurements of the angular and projected correlation functions and their redshift and magnitude dependences were made with an application of a special random-samples construction technique. The results reveal some differences of the quasar clustering from the galaxies.

Poster 15

HI 21cm studies of damped Lyman alpha systems

Nissim Kanekar

Poster 16

I will describe HI 21-cm absorption studies of a large sample of damped Lyman-α systems (DLAs) at redshifts $0.09 < z < 3.5$. 21cm absorption was detected in 18 systems, with typical DLA spin temperatures (T_s) at all redshifts far higher (> 1000 K) than those in the Galaxy or nearby spirals (< 300 K). The only exceptions are a few low-z absorbers identified with spiral disks and a single new DLA at $z \sim 2.4$. I will present new evidence for an anti-correlation between temperature and metallicity, suggesting that metallicity is the primary factor in determining the temperature distribution in the ISM. The temperature and metallicity information will be used to probe the nature of DLAs. I will also describe new direct estimates of the physical size of DLAs through 21cm absorption studies against extended background sources and, finally, will discuss the potential for blind high redshift 21cm absorption surveys with telescopes such as the GBT and the SKA.

Five dimensional cosmological model with variable cosmological term Λ and a big bounce

Goverdhan S. Khadekar & Vaishali Kamdi

We assume the four dimensional induced matter of the 5D Ricci flat bouncing cosmological solution contains a perfect fluid. The big bounce singularity of simple 5D cosmological model is studied with the cosmological term $\Lambda = \alpha\rho$ and $\Lambda = \beta H^2$ where α and β are constants and ρ and H are respectively energy density and Hubble parameter. This big bounce singularity is found to be an event horizon at which the scale factor and mass density of the universe are finite, while the pressure is infinite.

Poster
17

Noncommutative multidimensional cosmology

Nima Khosravi

Poster 18

We present exact classical and quantum solutions for a noncommutative, multidimensional cosmological model and show that stabilization of extra dimensions sets in with the introduction of noncommutativity between the scale factors. An interpretation is offered to accommodate the notion of time, rendering comparison with the classical solutions possible.

Galaxy clusters at high redshift: laboratories for dark matter and dark energy

Lindsay King

The mass function of galaxy clusters is a sensitive test of the cosmological model. We discuss how gravitational lensing of galaxy populations and of the CMB can be used to estimate cluster masses, with future CMB polarisation experiments being ideal for clusters beyond $z \sim 1$. Recent observations have uncovered many more massive clusters at high redshift, compared with predictions where dark energy is the cosmological constant. We therefore consider structure formation in general quintessence models and identify classes of models which are consistent with observational data. In addition, we argue why this may explain the excess power seen on small angular scales of the CMB power spectrum, such as that detected by CBI.

Poster
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The zCOSMOS three-dimensional density field to $z \sim 1$

Katarina Kovač and zCOSMOS collaboration

Poster 20

zCOSMOS is a large redshift survey ($0.1 < z < 1.2$ and $1.4 < z < 3.0$) with one of the major goals to characterise the environments of galaxies ranging from the 100 kpc to the 100 Mpc scale. We will use the current ~ 10000 accurate zCOSMOS redshifts to define the 3-d density field in the COSMOS volume out to $z \sim 1$, with much greater resolution in the radial dimension than has been possible hitherto with either photo-z or weak lensing. We also apply new algorithms that we have developed (ZADE) to modify the individual z likelihood distributions of objects not yet observed spectroscopically and of fainter objects beyond our spectroscopic limit, so as to assign them to the structures defined by the spectroscopic redshifts. We will catalogue the locations of local peaks, voids and filamentary structures. The overall density distribution will be compared with previous structures defined by earlier COSMOS photo-z and weak-lensing analyses.

Cosmography with galaxy clusters - Shedding light on dark energy

F. La Barbera, R.R. de Carvalho, M. Soares, G. Busarello, M. Capaccioli, P. Merluzzi

The nature of dark energy, the fluid leading to the accelerated expansion observed in the Universe, is one of the main challenges of contemporary cosmology. A 'classical' cosmological test to constrain the nature of dark energy is that of measuring the abundance of clusters of galaxies as a function of redshift. I will discuss how this cluster abundance measurement can put strong constrains on the dark energy equation of state. Applying a new analysis environment (named 2DPHOT) to simulated images of galaxy clusters, we show that a moderately deep survey, such as the Kilo Degree Survey (KIDS) with the VLT Survey Telescope (VST), covering a sky area larger than 1000 square degrees, would allow one to measure galaxy clusters more massive than $10^{14.5}h^{-1}M_{\odot}$ up to $z \sim 1.5$, with a completeness of 100%. This would allow values of the equation of state parameter of dark energy (such as $w = -0.7$ and $w = -1.0$) to be distinguished at a high significance level.

Poster
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Testing different stellar mass estimator at $1 < z < 2$

Longhetti M., Saracco P., Mignano A.

Poster 22

Physical parameters of galaxies (as luminosity, stellar mass, age) are often derived by means of the model templates which best fit their photometric data. We have performed a quantitative test aimed at exploring the ability of this procedure in recovering the real physical parameters of early-type galaxies at $1 < z < 2$. A wide range of simulated SEDs are used to build photometric catalogs with wavelength coverage and photometric uncertainties similar to those of two topical surveys (i.e. VVDS and GOODS). Measures of the physical properties of the simulated galaxies are compared with the real known values. Results indicate that the stellar masses measured by means of optical bands are affected by larger uncertainties with respect to those obtained from near-IR bands, and they frequently underestimate the real values. The M/L ratio in the V band results strongly underestimated, even when derived from the recently proposed prescription based on restframe optical colours (e.g. $(B-V)$).

Probing dark matter in higher dimensional black holes

Archan S. Majumdar

We consider various black hole solutions inspired by higher dimensional string and braneworld models. For primordial black holes in the RS(II) braneworld it can be shown that accretion of radiation dominates in the early high energy era, favoring the survival of these black holes as a significant component of dark matter. A model for BH-BH binary formation is proposed, resulting in gravitational waves during coalescence with parameters in the range of sub-lunar compact objects. Other black hole geometries such as that of the string theoretic dilaton black hole, and the braneworld tidal charge black hole are investigated for their strong lensing properties, thus providing a tool for probe of dark matter in compact objects through observational lensing.

Poster 23

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[2] A. S. Majumdar, A. Mehta and J. M. Luck, Phys. Lett B 607, 219 (2005)
[3] A. S. Majumdar and N. Mukherjee, Int. J. Mod. Phys. D 14, 1095 (2005)
[4] A. S. Majumdar and N. Mukherjee, Gen. Rel. Grav. (2007)

Cosmological Constraints on Neutrino Mass

Alexandr Malinovsky

Poster 24

Cosmology at present provide one of strongest constraints on masses of standard neutrinos. By combining WMAP 3-years data with cluster mass function derived from a complete sample of low-redshift clusters, we obtain tight upper limits for the sum of neutrino masses.

Evolution of the partly-ionized-gas physical condition in AGNs

Y. Matsuoka, S. Oyabu, Y. Tsuzuki, and K. Kawara

The Fe II emission lines, one of the most prominent features in many AGN spectra, have long been hoped to provide significant information about some aspects of the AGNs and their host environments. Among them, the redshift evolution of the Fe abundance could work as the ”Cosmological Clock” which verifies some cosmological parameters. Thus many observations have been devoted to the Fe II flux measurement in high-redshift quasars over the last decade. Nonetheless, no significant trend in the Fe abundance evolution has been detected so far, which is presumably due to the diversity of the physical condition within the partly-ionized gas where the Fe II lines are formed, affecting the line emissivities. In response to this situation, we are carrying on a program to investigate the physical condition within the gas using the O I and Ca II emission lines as tracers. The observation results and their implications obtained to date are shown in the presentation.

Poster 25

Gravitational Lensing of the Pregalactic 21 cm Radiation

R. Benton Metcalf, Stefan Hilbert and S.D.M White

Poster 26

Low-frequency radio observations of neutral hydrogen during and before the epoch of cosmic reionisation will provide ~ 1000 quasi-independent source planes, each of precisely known redshift, if a resolution of ~ 1 arcminutes or better can be attained. These planes can be used to reconstruct the projected mass distribution of foreground material. We demonstrate that this structure can, in principle, be used to make mass images with a formal signal-to-noise per pixel exceeding 10, even for pixels as small as an arc-second. With an ideal telescope, both resolution and signal-to-noise can exceed those of even the most optimistic idealised mass maps from galaxy lensing by more than an order of magnitude. Even with a much less ambitious telescope, a wide-area survey of 21 cm lensing would provide very sensitive constraints on cosmological parameters, in particular on dark energy.

On the construction of the Hadamard sates in two dimensions

P. Moyassari

The two dimensional analog of the Hadamard state condition is used to specify the local Hadamard states associated with a linear quantum field coupled to a two dimensional gravitational background. To characterize a local Hadamard state corresponding to a physical vacuum state, we apply a superselection rule in which the state dependent part of the two-point function is determined in terms of a dynamical scalar field. It implies a basic connection between the vacuum state and a scalar field coupled to gravity. We study the characteristics of the Hadamard vacuum state through this superselection rule using two different background metrics, the two dimensional analog of the schwarzschild and FRW metric.

Poster
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Probing the nature of EROs through ASTRO-F/AKARI observations

A. Mignano, P. Saracco, M. Longhetti

Poster 28

We present a preliminary analysis of ASTRO-F/AKARI data of a complete sample of ~ 150 EROs ($R-K>5$) down to $K<19$ in the redshift range $0.8<z<2$, selected over two fields (S7 and S2) of MUNICS survey, covering an area of about 420 arcmin^2. We have imaged this area with AKARI teloscope in the N3 (3.4 μm), N60 (65 μm) and WL (140 μm) down to $\sim 5\mu$Jy in the N3 filter, in order to detect the rest frame H or K–band emission, thus providing an excellent sampling of the SED of our EROs. From the first analysis we have an identification rate of $\sim 60\%$ in the N3 filter. These data should allow us to distinguish starburst from passive early type phenomena, to meseaure the SFR of the starburst component and constrain the dust content of starburst EROs.

Coeval evolution of AGN and galaxies

L. Miller, A. Babic

AGN evolution and galaxy growth appear to be closely linked, with the cosmological evolution of AGN apparantly driven by the slowdown in growth of galaxies. The coeval growth picture accurately reproduces the observed bolometric luminosity density of AGN, the luminosity function and the X-ray background. It predicts that the average Eddington ratio of black holes in galaxies should be substantially higher at high redshift, with every galaxy hosting a low luminosity AGN. We also test the Eddington ratios of AGN in the Chandra deep fields and show that these too are consistent with coeval growth.

Poster 29

The Reionization and Galaxy Evolution probed by $z = 7$ Lyman Alpha Emitters

Kazuaki Ota

Poster 30

We made a narrowband NB973 (bandwidth of 200 A centered at 9755 A) imaging of the Subaru Deep Field (SDF) and found two $z = 7$ Lyman alpha emitter (LAE) candidates down to NB973= 24.9. By deep follow-up spectroscopy, we identified one of them as a $z = 6.96$ LAE. This shows galaxy formation was in progress just 750 Myr after the Big Bang. Meanwhile, the Lyman alpha line luminosity function of LAE declines as $(0.4-0.6)L^*$ from $z = 5.7$ to 6.6 in SDF. We also confirm that the number density of $z = 7$ LAE is only 17% of the density at $z = 6.6$. This decrease in density can be due to galaxy evolution at $z = 5.7-7$. However, using the UV continuum luminosity function of LAEs and Lyman break galaxies and a LAE evolution model based on the hierarchical clustering, we find that galaxy evolution alone cannot explain all the decrease in density. This extra density deficit might reflect the attenuation of the Lyman alpha photons from LAEs by the neutral IGM during the ongoing cosmic reionization at $z = 6.6-7$.

Physical properties of high redshift galaxies from the GOODS-MUSIC

L. Pentericci A. Grazian, A. Fontana, et al.

We have determined the ensamble properties of high z galaxies from the GOODS-MUSIC catalog using SEDs based on 14 bands from restframe UV to optical (IRAC). Relying on spectroscopic or accurate photometric redshift we selected galaxies from $z = 2.5$ to $z = 6.5$ and derived their physical properties, such as total mass, SFR,age and dust content. Galaxies at $z = 5-6$ are much younger and have lower masses than their $z = 3$ counterparts, although very massive galaxies are found up to the highest z.We then styudied the evolution of all properties and derived some basic trends. We explored the buildup of stellar mass and found that the specific star formation rate of massive objects declines beyond $z = 5$ while that of less massive ones increases up to the highest redshift probed. Finally in subset of $z = 3-4$ objects with available spectra we analysed the dependence of physical properties on the presence or absence of the Ly alpha emission, finding significant differences between the 2 populations.

Poster
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Simulated evolution of the DM LSS

M. Demianski, A. Doroshkevich, S. Gottlober, S. Pilipenko

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We analyze the evolution of basic properties of simulated large scale structure elements formed by dark matter (DM LSS). The samples of DM clusters are selected at seven redshifts from $z = 0$ to $z = 3$ in the high resolution simulation with the Minimal Spanning Tree technique. The main properties of selected clusters are analyzed in 3D space and with the core sampling approach what allows us to compare estimates of the DM LSS evolution obtained with two different techniques. In both cases we found that regular redshift variations of mean characteristics of th DM LSS are accompanied by negligible variations of their PDFs what indicates the self similar character of the DM LSS evolution. The high degree of relaxation of DM particles compressed within the LSS is found along the shortest principle axis of clusters. The simulated evolution of the DM LSS is compared with evolution of rich sample of Lyman-alpha adsorbers observed in high resolution spectra of 19 quasars.

Star formation in galaxies in different environments from the joint GALEX-CFHTLS data

Pollo, A., Arnouts, S., Heinis, S. Milliard, B.

We present an analysis of the dependence of the star formation history in the galaxies on the local galaxy density up to redshift ~ 1, based on the catalog made from the UV (GALEX) and CFHTLS (optical) data. We use UV colors as the galaxy star-formation history indicators and the distance to the 3-rd projected neighbor as an environment indicator. Our results suggest, among others, that at $z \sim 1$ the star formation was much stronger in the densest galaxy environment that it is observed now.

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Halo properties of isolated galaxies: mass growth from $z = 1$ to the present

Francisco Prada

Poster 34

I will discuss the progress we have made on the knowledge of the properties of dark matter halos of isolated galaxies. Using the SDSS, we probe the halo mass distribution at large radii, by studying the motions of satellites around isolated galaxies. We find direct observational evidence of the dark matter density decline in the peripheral parts of galaxies as predicted by the LCDM paradigm; we also note that this result contradicts alternative theories of gravity. We measure the virial mass-to-light and virial-to-stellar mass ratios of L^* galaxies and study the evolution in their dark matter halo and stellar masses between $z = 1$ and $z = 0$ by combining data from the DEEP2 galaxy redshift survey and the SDSS. Finally, I will comment on the study we are performing on the outer structure of galactic dark matter halos and the properties of their equilibrium regions as well as their mass growth in high-resolution cosmological simulations.

Gas in halos at high z

John Regan, Martin Haehnelt

We present results from high-resolution hydrodynamical simulations of the in-fall and subsequent cooling of gas inside the first massive halos to form at very high redshift. Implications for the formation of massive seed black holes are discussed.

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The clustering of merging star-forming haloes: dust emission as high frequency arcminute CMB foreground

Mattia Righi, Carlos Hernandez-Monteagudo & Rashid Sunyaev

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Future observations of CMB anisotropies will be able to probe high multipole regions of the angular power spectrum, corresponding to a resolution of a few arcminutes. Dust emission from merging haloes is one of the foregrounds that will affect such very small scales. We estimate the contribution to CMB angular fluctuations from objects which are bright in the sub-millimeter band due to intense star formation bursts following merging episodes. We base our approach on the Lacey-Cole merger model and on the Kennicutt relation which connects the star formation rate in galaxies with their infrared luminosity. We calibrate the free parameters with several observational tests and we show that the angular power spectrum arising from the distribution of such star-forming haloes will be one of the most significant foregrounds in the high frequency channels of future CMB experiments, such as PLANCK, ACT and SPT. The measurement of this signal will give important information about the galaxies in the early stage of their evolution.

SPACE: the SPectroscopic All-sky Cosmic Explorer

M. Robberto (STSci) & A. Cimatti (University of Bologna)

SPACE is a joint ESA-NASA class-M mission proposed within the ESA - Cosmic Vision 2015-2025 Plan. SPACE will produce the first all-sky spectroscopic survey of the Universe. Observing in slit mode at $R \simeq 400$ in the near-IR, SPACE will analyze 1 billion galaxies brighter than ~ 23 AB over a wide range of redshifts, determining their redshifts to an accuracy of $dz \simeq 0.001$ and deriving the most relevant physical and evolutionary properties. The main scientific goal of SPACE is to place the ultimate constraints on the Baryon Acoustic Oscillations and the nature of the Dark Energy. SPACE will obtain the first 3-D all-sky map of the Universe up to $z \simeq 2$, revealing the large scale structure of luminous baryons and its cosmic evolution. After a 2-year all-sky survey, SPACE will be offered to the community as an observatory for deeper, pointed observations. SPACE will have unique wide-field capabilities in the near-IR that ideally complement JWST, ALMA, and the future 25-50 m telescopes.

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Modelling the Galactic Magnetic Field using CMB data

B. Ruiz-Granados, J.A. Rubino-Martin and E. Battaner

Poster 38

We use the WMAP *K*-band (22GHz) polarization data to fit the three-dimensional large scale structure of the Galactic Magnetic Field. The polarization angle map at 22GHz has a complex structure, showing four antisymmetric lobes. These structures can not be reproduced by a simple magnetic field distribution. One of the models better fitting the WMAP data is a combination of a bisymmetric field and a distribution arising from an equilibrium of galactic and extragalactic fields produced by turbulent magnetic diffusion. Other possibilities will be discussed.

Resolving the Universe with Multifractals

Cristiano Sabiu, Luis Teodoro, Martin Hendry

We present a new method of quantifying structure in any discreet point set. The method is based on a multifractal approach and includes all relevant boundary and selection effects. The power of this technique lies in its connection to higher order moments, in that it not only probes clustering on different scales but also different densities. We then show how this can be applied to measurements of Baryon Acoustic Oscillations.

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Star formation and mass assembly in high redshift galaxies

Santini, P., Fontana, A., Grazian, A., Pentericci, L.,Salimbeni, S.

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The object of this study is to infer star formation properties and mass assembly process of high-z galaxies from their IR emission using MIPS 24μm images. We used the GOODS-MUSIC catalog, with multi-wavelength coverage from 0.3 to 8μm and spectroscopic or accurate photometric redshifts. Physical properties, such as total stellar masses, ages, dust obscuration, were determined through the comparison between the observed spectral energy distribution of each object and a set of synthetic templates. As for the SFR, we compared two different tracers: UV luminosity corrected for dust reddening and thermal IR emission by reprocessed UV photons. The conversion from observed 24μm to $8-1000\mu$m integrated luminosity has been done by fitting observed colors to a set of model template spectra. The relation between the specific SFR and the total stellar mass seems to support the theory of downsizing, as we find that the most massive galaxies have higher SF activity at higher z.

The evolution of the morphological scale of early-type galaxies since $z = 2$ from HST-NICMOS observations

P. Saracco, M. Longhetti, S. Andreon, A. Mignano

We present the morphological analysis based on HST-NICMOS observations in the F160W filter of a sample of ~ 25 early-type galaxies spectroscopically confirmed at $1.2 < z < 2$. We derive the effective radius R_e [kpc] and the mean surface brightness (SB) μ_e [mag/arcsec^2] in the rest-frame R-band. We find that the SB of these early-types should get fainter by ~ 2.5 mag from $z \sim 1.5$ to $z \sim 0$ to match the SB of the local early-types with comparable R_e. This evolution exceeds by a factor two the one expected for an early-type in this redshift range and more than a factor three the one derived from the observed luminosity function of galaxies. Thus, the luminosity evolution of galaxies is not able to account for the apparent higher compactness of early-types at $z \sim 1.5$. A possibility is to assume that galaxies evolve also in their morphological scale, i.e. that the effective radius R_e of a galaxy increases from the epoch of its formation towards $z = 0$.

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The Spitzer view of the X-ray obscured Universe

Paola Severgnini et al.

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The comprehension of the physical properties of obscured AGNs is one of the main goals of the high energy astronomy given their key role in tracing the accretion history of the Universe. Although X-ray and infrared data of AGN with a different level of absorption could provide a direct tool to test the predictions of the AGN models, only few sparse SED of obscured AGN are available so far. We present here the results obtained from Spitzer observations of a statistically complete sample of obscured AGN drawn from the XMM-Newton Hard Bright Sample. This is the largest hard X-ray sample with a complete spectroscopic identification. The Spitzer data, combined with good X-ray and optical spectroscopic data, has allowed us to define powerful diagnostic plots to select heavily obscured AGNs and to build up their spectral energy distributions.

Baryonic Content in the Warm-Hot IGM at Low Redshift

G. Sonneborn (NASA/GSFC), M. Shull and C. Danforth (U. Colorado), G. Sonneborn (NASA/GSFC), M. Shull and C. Danforth (U. Colorado), and W. Moos (JHU)

Baryons are 4.5% of the universe's mass/energy density; only 10% of these are in stars, galaxies, and clusters. At low-redshift 90% of baryons are in the IGM, 30% in Ly-α forest, but most are in hot gas (10^{5-7} K) produced by shocks during structure formation. O VI $1032-38$ A are the best tracers of this gas. The distribution of O VI absorbers observed by FUSE rises as $N^{-2\pm0.2}$, down to 10^{13} cm^{-2}. Integrated to $\log N = 13$, 7% of baryons reside in the O VI-bearing IGM at 10% solar metallicity, $T \sim 10^{5.5}$ K. At redshift $z < 0.1$ metals have been transported less than $800\,h^{-1}$ kpc from L^* galaxies and $200\,h^{-1}$ kpc from $0.1\,L^*$ galaxies. The steepness of dN/dz means that low-N absorbers contribute an equal mass of hot IGM as higher N gas. The total mass of O VI-bearing gas in the IGM depends on determining the turnover in dN/dz at low N(OVI). Future observations by FUSE are needed to reach lower N and to reduce the uncertainty in the dN/dz power law.

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Science Case for a 2 mm Bolometer Camera Optimized for Surveys of Dusty Galaxies in the High Redshift Universe

Johannes Staguhn, Christine Allen, Dominic Benford, Eli Dwek , S. Harvey Moseley, Elmer Sharp

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The 2 mm spectral range provides a unique window to observe the earliest active dusty galaxies in the universe and is well suited to better confine the star formation rate in these objects. We have built a bolometer camera (the Goddard-Iram Superconducting Millimeter Observer, GISMO) for operation in the 2 mm atmospheric window to be used at the IRAM 30 m telescope. The instrument uses a 16x8 planar array of multiplexed TES bolometers. The instrument will enable rapid observations of galactic and extragalactic dust emission, in particular from high-z ULIRGs and quasars. The instrument will fill in the SEDs of high redshift galaxies at the Rayleigh-Jeans part of the dust emission spectrum, even at the highest redshifts. Our source count models predict that GISMO will serendipitously detect one galaxy every four hours on the blank sky, and that one quarter of these galaxies will be at a redshift of $z > 6.5$.

Size evolution of most massive galaxies since $z \sim 2$: probing the monolithic scenario

Trujillo et al.

In the local Universe, galaxies with stellar masses greater than $10^{11} M_{\odot}$ are dominated by large elliptical galaxies with correspondingly large sizes. These nearby systems contain old and metal-rich stellar populations that formed quickly in the early universe. However, it has remained unknown whether the stars in these galaxies were all assembled in the same system, or formed in lower-mass galaxies that later merged. We will show, using the combined capabilities of the large near infrared Palomar/DEEP-2 survey, and the superb resolution of the ACS at the HST, that very massive galaxies, compared to their local massive counterparts, were a factor of four smaller, and 60 times denser, 9 Billion years ago. These small sized, high mass galaxies do not exist in the nearby Universe, suggesting that this new population merged with other galaxies over several billion years to form the largest galaxies we see today.

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SMBH Mass Function from velocity dispersion and luminosity

E. Tundo, M. Bernardi, R. K. Sheth, J. B. Hyde, A. Pizzella

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Black hole masses are tightly correlated with the stellar velocity dispersion of host galaxies, and slightly less-well correlated with the bulge luminosities. There is still debate on which of these predictors can better reproduce the local black hole mass function when coupled with an appropriate distribution function: the M_{bh}-σnrelation predicts fewer massive black holes than does the M_{bh}-L relation. This is because the L-σ in black hole samples currently available is inconsistent with that in the samples from which the distributions of L or σ are based. This suggests that current black hole samples are biased towards objects with abnormally large σ for their luminosities. Assuming that the bias is a selection rather than physical effect, then the M_{bh}-σ and M_{bh}-L relations currently in the literature are also biased from their intrinsic values. Our analysis suggests that the bias in the M_{bh}-σ relation is likely to be small, whereas the M_{bh}-L relation is biased towards predicting more massive black holes for a given luminosity. If this is the case, the velocity dispersion-based estimate of the intrinsic local supermassive black hole mass function is more reliable.

The brightest radio sources in the Subaru/XMM-Newton Deep Field (SXDF)

Eleni Vardoulaki, Steve Rawlings, Chris Simpson et al.

We study the 37 brightest radio sources in the Subaru/XMM-Newton Deep Field (SXDF). Using MIPS 24 micron data from Spitzer we expect to trace accretion activity, even if it is hidden at optical wavelengths, unless the obscuring column is extreme. Our results suggest that in the decade or so below the break in the radio luminosity function at least half, and potentially all, radio sources are associated with accreting quasar-like objects (Vardoulaki et al). This is not the true at lower radio luminosities where the quasar-like fraction approaches zero once compact sources are excluded. In total, radio sources in our sample seem to be fainter with increasing redshift in the K-band compared to the $K-z$ relation of Willott et al.

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Intense starbursts at $z \sim 5$: First significant stellar mass assembly in the progenitors of present-day spheroids

Aprajita Verma, Matthew Lehnert, Malcolm Bremer, Natascha Frster Schreiber, Laura Douglas

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I discuss the properties of Lyman Break galaxies (LBGs) at $z \sim 5$ selected from independent fields covering ~ 500 arcmin^2. While the broad characteristics of the LBG population has been discussed extensively in the literature, such as luminosity functions and clustering amplitude, I focus on the detailed physical properties of the sources in this large survey (~ 100 with spectroscopic redshifts) determined from multiwavelength data (rest-frame UV-to-visible). Specifically, I discuss ensemble mass estimates, stellar mass surface densities, core phase-space densities, star-formation intensities, characteristics of their stellar populations, and their contribution to the stellar mass and star formation rate density of the universe. The general picture that emerges is that these galaxies, observed about 1.2 Gyr after the Big Bang, have properties consistent with being the progenitors of the densest stellar systems in the local Universe – the centres of old bulges and early type galaxies.

Old Galaxies in a Young Universe

T. Wiklind, B. Mobasher, et al.

Combining observational data from optical to mid-infrared wavelengths, it has recently become possible to search for galaxies at look-back times of $12-13$ Gyrs. The expectation is to find small and actively star forming systems. While these type of galaxies are indeed seen, a different type of galaxies are also found. These are characterized by having a stellar population which is old, relative to the age of the universe at that epoch, formation redshifts are in the range $z = 9-15$, and to have a large stellar mass, in excess of $(5-10)\ 10^{10} M_{\odot}$. In addition, these stellar systems are extra-odinarily compact, with half-ligth radii of just a few kpc. No counterpart to these objects can be identified in the local universe. We have undertaken a study of these old and massive galaxies over the redshift range $z = 4-7$ and will present the results, discuss the potential biases in the analysis and discuss the role of these galaxies in the re-ionization process.

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"Stay the Course" Cosmology?

Donald Wilson

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A comparative analogy of the harmonious ΛCDM cosmology model with the Iraqi War situation dramatically reveals cosmology's present scientific stature. An example is the Dark Energy (DE) and Dark exotic Matter (DM) which can be equated to the Weapons on Mass Destruction (WMD), both being used to justify their respective scenarios while of questionable existence. The author (a professional expert investigator of scientific development for industry and active in cosmology data anaysis since 1970) backtracks through cosmology's past century of blunders, errors, ignored inputs, and motivated blips to reveal residual model development flaws. Today these persistent flaws interfer with model - observation compatability, necessitating a plethora of fudge factors. Removing the initial critical flaws (1917-1929) from the cosmology model's development produces a fudge-factor-free Contracting Steady State Universe with predictions for an electro-graviton (quantum) $= -1.63\,10^{-33}$ eV, et al.

Constraints on alternative theories of gravity and cosmology

A.F. Zakharov, A.A. Nucita, F. DePaolis, G. Ingrosso

In the last years generalizations of the classical Einstein-Hilbert Lagrangian were introduced to explain observational phenomena such as the accelerating Universe, large-scale structure, rotation curves etc. Usually, these approaches were successful like the standard general relativity (with dark matter and dark energy). Recently, gravitational microlensing has been investigated in the framework of the weak field limit of fourth order gravity theory. However, solar system data (i.e. planetary periods and light bending) can be used to put strong constraints on the parameters of this class of gravity theories. We find that these parameters must be very close to those corresponding to the Newtonian limit of the theory. We also discuss constraints on conformal cosmological models from from cosmological SNe Ia data.

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