IPMU International Conference

dark energy: lighting up the darkness!

program

(final version)

June 22	
16:00-19:00	reception: cafeteria “Plaza Ikoi” in Kashiwa campus
June 23	
09:30-09:40	welcome (H. Murayama)
09:40-10:20	opening review (M. Turner)
cosmic microwave background	
10:20-11:00	D. Spergel: What have we learned from the microwave background?
11:00-11:30	break
11:30-12:00	S. Ho: What can you do with CMB as a backlight?
12:00-12:30	J. Dunkley: Cosmology from the polarized CMB
12:30-14:10	lunch
theory, part I	
14:10-14:50	L. Amendola: New observables for dark energy
14:50-15:20	M. Sami: Dark Energy: What could it be?
15:20-15:40	T. Chiba: The Equation of State of Slowly-Rolling Quintessence
15:40-16:10	break
16:10-16:30	K. Bamba: Phantom crossing in F(R) gravity
16:30-16:50	Y. Fujii: How successful can the scalar-tensor theory be in understanding the accelerating universe?
16:50-17:10	M. Kasai: Out of darkness, towards inhomogeneity
June 24	
large scale structure	
09:30-10:10	D. Eisenstein: Baryon Acoustic Oscillations: A Robust and Precise Route to the Cosmological Distance Scale
10:10-10:40	U. Seljak: Dark energy from galaxy clustering: beyond BAO
10:40-11:10	break
11:10-11:40	O. Lahav: Cosmology from Photometric Redshift Surveys

11:40-12:00	A. Taruya: Non-linear evolution of matter power spectrum in modified theory of gravity
12:00-12:20	T. Nishimichi: Accurate Modeling of Nonlinear Effects on Baryon Acoustic Oscillations
12:20-14:00	lunch
14:00-14:20	S. Saito: How can we precisely determine both neutrino masses and dark energy parameter through nonlinear galaxy power spectrum?
theory, part II	
14:20-14:50	S. Mukohyama: Higgs phase of gravity and ghost condensation
14:50-15:10	S. Tsujikawa: Matter density perturbations in modified gravity models of dark energy
15:10-15:30	L. Hui: Order Unity Equivalence Principle Violations in Modified Gravity
15:30-16:00	break
16:00-16:20	T. Kobayashi: Can higher curvature corrections cure the singularity problem in f(R) gravity?
16:20-16:40	J.-A. Gu: An Approach to Testing Dark Energy Models by Observations
16:40-18:00	poster session
18:00-	public lecture: the Dark Side of the Universe (M. Turner)
June 25	
clusters	
09:30-10:10	J. Mohr: Cluster Cosmology: Status and Prospects for the Coming Decade
10:10-10:40	A. Vikhlinin: Constraining Dark Energy with observations of structure growth using X-ray galaxy cluster data
10:40-11:10	break
11:10-11:50	J. Carlstrom: Update on the South Pole Telescope SZ cluster survey
11:50-12:20	S. Staggs: Cosmology from the Atacama Cosmology Telescope
12:20-14:00	lunch
14:00-14:20	S. Majumdar: Self and External Mass Calibration in Cluster Studies of Dark Energy
lensing, part I	
14:20-15:00	G. Bernstein: The power of cosmic shear + galaxy redshift surveys
15:00-15:20	U. Seljak: Weak lensing and cluster abundance results from SDSS
15:20-15:50	break
15:50-16:20	M. Oguri: Cosmology with Strong Lensing: Current Status and Future Directions
16:20-16:40	J. Jee: HST Weak-Lensing Study of >20 Galaxy Clusters Beyond Redshift One

special talk on results from Fermi	
16:40-17:10	T. Kamae: Fermi-LAT constraints on the dark-matter
18:30-	banquet: Crest Hotel
June 26	
supernovae	
09:30-10:10	G. Aldering: Advances in Cosmology with Type Ia Supernovae
10:10-10:40	N. Yasuda: Subaru contribution on supernova cosmology
10:40-11:10	break
11:10-11:40	D. Kasen: Physics of Type Ia Supernovae as Standardized Candles
11:40-12:00	K. Nomoto: Progenitors of Type Ia Supernovae
12:00-12:20	T. Moriya: Peculiar Type Ia Supernovae - Is It Really Type Ia?
12:20-14:00	lunch
lensing, part II	
14:00-14:30	H. Aihara: Subaru Dark Energy Survey - Hyper Suprime-Cam Project
14:30-14:50	D. Clowe: Weak Lensing Tomography with Clusters of Galaxies
14:50-15:10	M. Takada: LoCuSS: Subaru Weak Lens Study of 30 Galaxy Clusters
15:10-15:30	break
15:30-15:50	S. Jouvel: Optimising cosmological Weak Lensing survey for future Dark Energy space mission
15:50-16:10	A. Amara: Weak Lensing From Space: Prospects and Challenges for Euclid
16:10-16:30	conference summary (N. Sugiyama)

If you spot any error please contact the LOC (darkenergy09@ipmu.jp) for corrections. Thank you!

list of posters

(final version)

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1	Leopoldo Infante	The ISW@VST survey
2	Masatoshi Shoji	Third-order Perturbation Theory with Non-linear Pressure
3	Atsushi Nishizawa	Impact of photometric redsfhit error on the dark energy measurement
4	Keiichi Maeda	Asymmetry in Supernovae Explosions
5	Issha Kayo	A model independent method to measure pairwise velocity dispersion of galaxies
6	Donghui Jeong	Effect of non-linearities and non-Gaussianities on measuring cosmological distances
7	M. Nakashima	New Constraint on the varying fine structure constant
8	Yasuomi Kamiya	Intrinsic Color Dispersion of Type Ia Supernovae
9	Masanori Sato	Simulations of Wide-Field Weak Lensing Surveys: Basic Statistics and Non-Gaussian Effects
10	Satej Khedekar	Constraining cosmology using clusters as an ensemble of cosmic rulers
11	Dai G. Yamazaki	Dark energy, Finite-mass Neutrino, and Primordial Magnetic Field
12	Tomonori Furukawa	Ghost condensation in cosmology
13	Kiyotomo Ichiki	Constraining the nature of dark energy from recent observations and its relation to inflation parameters
14	Maresuke Shiraishi	Constraints on the cosmological constant from WMAP5 and BBN if neutrinos have finite masses and chemical potentials
15	Ilya Gurwich	Natural Neutrino Dark Energy
16	Kensuke Homma	Probing light scalar/pseudoscalar fields by extremely strong laser-laser diffraction
17	Shoichi Ichinose	Renormalization Flow of Cosmological Constant
18	Hyeong-Chan Kim	Dark energy from Cosmic Hawking radiation
19	H. Motohashi	Evolution of density fluctuation in f(R) gravity
20	Fuminobu Takahashi	Strong CP problem and cosmological constant
21	Tomo Takahashi	Testing dark energy models: possible complications and some issues of dark energy perturbations
22	Yuko Urakawa	Can we rule out unified dark matter models?
23	M. Sohaib Alam	Signatures in the CMB of Pre-Inflation Anisotropy
24	Grant Mathews	Constraints on Some Alternative Unifying Views of Dark Energy and Dark Matter

Logistics

Opening reception

Opening reception will be held during 16:00 - 19:00 on June 22 (Mon) at the university cafeteria "Plaza Ikoi" in the Kashiwa Campus. Some drink and light food will be provided. The campus map is available at
http://www.u-tokyo.ac.jp/campusmap/cam03_04_11_e.html.
The red-color building in the map above is the cafeteria; the left-lower, gray-color building is the conference venue, Kashiwa Library Media Hall.

No shuttle bus will be provided between hotels in Kashiwa and the campus for the reception. Please come to the cafeteria by yourself. You can find the ways to get to the campus from http://www.ipmu.jp/visitors/access-ipmu.

Shuttle bus

During June 23 - 26, *two* shuttle buses will be provided every morning and every evening. The schedule is the following:

morning:
~8:15am (Mitsui Garden Hotel) - 8:30am (Crest Hotel) - 9:00 (campus)

evening:
Tue: 17:30 (campus) - 18:00 (Crest Hotel) - 18:15 (Mitsui Garden Hotel)
Wed: 17:30 (campus) - 18:00 (Crest Hotel) - 18:15 (Mitsui Garden Hotel)
Thu: 17:45 (campus) - 18:15 (Crest Hotel) - 18:30 (Mitsui Garden Hotel)
Fri: 16:45 (campus) - 17:15 (Crest Hotel) - 17:30 (Mitsui Garden Hotel)

Every bus will stop at the Mitsui Garden Hotel and the Crest Hotel, both of which are close to the Japan Rail (JR) Kashiwa station.

After the public lecture on Wednesday, additional buses will leave from the campus at 20:00, and go to Kashiwa-no-ha Campus Station and JR Kashiwa station.

Food

Light breakfast (bread, coffee, and tea) will be provided before the morning session. No lunch will be provided, but we will have lunch at the university cafeteria, the same place as the opening reception.

Public lecture

Prof. Michael Turner kindly agreed to give a public lecture “The dark side of the Universe” to the general public at the Kashiwa Library Media Hall, from 18:00 to 19:30 on June 24. The talk is in English, but the presentation will be translated into Japanese. You are very welcome to join the public lecture. The shuttle bus after the public lecture will be provided as mentioned above.

Conference banquet

The banquet will be held at the Crest Hotel from 18:30 on June 25. An on-site registration for banquet is still available, so just stop by the registration desk if you want to join.

Poster presentation

The poster presentation will be held at the Kashiwa Library Media Hall. The size of poster panel is width x height = 90 x 210 cm, such that an A0-sized poster is well fitted. Each poster is assigned an ID number as indicated in the poster list. Please put your poster onto the panel with the same ID number.

Contributed Talks: abstract

Weak Lensing From Space: Prospects and Challenges for Euclid

Adam Amara
ETH Zurich

Gravitational lensing allows us to measure dark matter in the low redshift Universe. From this we can construct a history of how structures have grown and how the Universe has evolved. Given the great promise of this technique, considerable resources are being channelled into developing surveys to measure lensing over the whole sky. I will give an update on the potential that missions such as Euclid (which is part of the ESA Cosmic Vision Program) have for measuring dark matter, dark energy and initial conditions in the Universe. Euclid will also provide a strong test of Einstein gravity. I will briefly discuss the strength and possible pitfalls of a weak lensing approach. The success of lensing surveys over the coming decade will depend on our ability to control systematics, as well maintaining a sensible cost cap on missions. Euclid's strategy for achieving these goals is to take full advantage of a ground-space synergy, in which we us ground-base data where possible and do in space only what could only be done in space, namely high resolution imaging and deep Near-IR photometry and spectroscopy.

Phantom crossing in F(R) gravity

Kazuharu Bamba
National Tsing Hua University

A scenario to explain the current accelerated expansion of the universe is to study a modified gravitational theory, such as F(R) gravity, in which the action is described by an arbitrary function F(R) of the scalar curvature R. On the other hand, various observational data imply that the ratio of the effective pressure to the effective energy density of the universe, i.e., the effective equation of state (EoS), may evolve from larger than -1 (non-phantom phase) to less than -1 (phantom phase). Namely, it crosses (or crossed) -1 (the phantom divide) at the present time (or in near past). In this presentation, we reconstruct an explicit model of F(R) gravity with realizing a crossing of the phantom divide. Reference: Phys. Rev. D 79, 083014 (2009) [arXiv:0810.4296 [hep-th]]

The Equation of State of Slowly-Rolling Quintessence

Takeshi Chiba
Nihon University

I derive slow-roll conditions for quintessence. I solve the equation of motion in the limit where the equation of state w is close to -1 to derive the equation of state as a function of the scale factor. I find that the equation of state involves only two parameters and its evolution is not fit by a linear function of the scale factor.

Weak Lensing Tomography with Clusters of Galaxies

Douglas Clowe
Ohio University

I will discuss uses of weak lensing caused by massive clusters of galaxies in constraining dark energy, and how, in particular, one may use this technique to measure the effects of dark energy from geometry along (no dependence on the rate of structure growth). I will discuss an initial attempt to do this with existing HST images of galaxy clusters, and how such studies can be performed as supplemental measurements of dark energy from large area imaging surveys.

How successful can the scalar-tensor theory be in understanding the accelerating universe?

Yasunori Fujii
Waseda University

The accelerating universe is best described in terms of a small cosmological constant, which, through today's version of the cosmological constant, or the twin questions; fine-tuning and coincidence problems, likely requires the presence of a scalar field. The scalar-tensor theory invented by P. Jordan in 1955, can be developed successfully beyond expectation. Through a better understanding of conformal transformations and frames from a physical point of view we reach a consistent way to interpret the Jordan and Einstein frames for the theoretical and physical frames, respectively. In particular, we implement the scenario of a decaying cosmological constant; $ Lambda_{\\rm eff}\\sim t^{-2}$, numerically realized by $10^{-120}\\sim (10^{60})^{-2}$ with the present age of the universe $1.37 \\times 10^{10}{\\rm y}\\approx 10^{60}$ in units of the Planck time, showing that today's $\\Lambda$ is extremely small not because of fine-tuning parameters but only because we are old. This success is regarded as one of the most remarkable achievements of the scalar-tensor theory, though we must go through rather complicated modifications beyond the simplest version, including the technical details from the scaling to tracking behaviors, to arrive at realistic fits to the observed acceleration.

An Approach to Testing Dark Energy Models by Observations

Je-An Gu
National Taiwan University

An approach to the consistency test of dark energy models with observations will be presented. To test a dark energy model, we suggest introducing a characteristic Q(z) that in general varies with the redshift z but in that model plays the role of a constant distinct parameter. Then, by reconstructing dQ(z)/dz from observational data and comparing it with zero we can assess the consistency between data and the model under consideration. For a model that passes the test, we can further constrain the distinct parameter of that model by reconstructing Q(z) from data. For reconstructing Q(z) and dQ(z)/dz from data, a parametrization of the relevant physical quantity is required. For demonstration, we invoke a widely used parametrization of the dark energy equation of state, w(z) = w_0 + w_a (1-a), for data analysis. This method of the consistency test is efficient because for all models we invoke the constraint of only a single parameter space that by choice can be easily accessed. The general principle of our approach is not limited to dark energy. It may also be applied to the testing of various cosmological models and even the models in other fields beyond the scope of cosmology.

Order Unity Equivalence Principle Violations in Modified Gravity

Lam Hui
Columbia University

Theories that modify general relativity in an attempt to explain cosmic acceleration inevitably introduce extra degrees of freedom, notably a scalar. This encompasses all known theories, including f(R), DGP, degravitating models and generalizations thereof. Such a scalar must be screened on small scales to be consistent with solar system and terrestrial experiments. In this talk, I will show that depending on the screening mechanism, there can be order one violations of the equivalence principle i.e. different objects will fall at different rates. Small galaxies in cosmic voids provide the most promising places to look for such effects.

HST Weak-Lensing Study of >20 Galaxy Clusters Beyond Redshift One

James Jee
University of California, Davis

We study more than 20 galaxy clusters at z>1 through HST weak gravitational lensing. Despite the challenges set by the substantially reduced number density of background galaxies and the intrinsically low masses of these high-z clusters, we are able to measure a significant (>10 sigma) lensing signal from most of these high-redshift clusters. Together with the two-dimensional mass maps, we present our preliminary mass-temperature relation at z>1, and discuss the mass function and its cosmological implications.

Optimising cosmological Weak Lensing survey for future Dark Energy space mission

Stephanie Jouvel
Laboratoire d'Astrophysique de Marseille

Cosmological weak lensing has emerged as one of the most effective dark energy probe (Dark Energy Task Force report) as it is both sensitive to the Universe geometry and to the growth of structures. In order to construct the most efficient cosmological weak lensing survey, one first needs to have a good understanding of galaxy properties (redshift, luminosity, spectro-photometry, size, morphology and types), as they are the tracers used to measure the weak lensing signal. Extrapolating from current observations of the deep Universe, I have explored different ways to produce representative mock catalog of the galaxy distribution as they will be observed by future space-based mission. This work was more specifically conducted in the context of the SNAP/JDEM mission. These realistic mock catalogs are unique tools to explore the impact of the surveys parameters (mirrors transmission, number of filters, and filter shapes, detectors efficiency, pixel size, survey strategy). Using those catalogs, I have revisited the photometric parameters of the survey in order to improve the redshift bias, redshift dispersion and minimize the number of catastrophic redshift. In this presentation, I will talk about these mock catalogs and survey designs of future dark energy mission derived from the photometric redshift accuracy for weak-lensing measurements.

Out of darkness, towards inhomogeneity

Masumi Kasai
Hirosaki University

I briefly review the backreaction of nonlinear inhomogeneities to the cosmic expansion, with some historical remarks. Then I propose an inhomogeneous viewpoint that the apparent acceleration of the cosmic expansion is a consequence of large-scale inhomogeneities in the universe.

Can higher curvature corrections cure the singularity problem in f(R) gravity?

Tsutomu Kobayashi
Waseda University

Although $f(R)$ modified gravity models can be made to satisfy solar system and cosmological constraints, it has been shown that they have the serious drawback of the nonexistence of stars with strong gravitational fields. In this paper, we discuss whether or not higher curvature corrections can remedy the nonexistence consistently. The following problems are shown to arise as the costs one must pay for the $f(R)$ models that allow for neutrons stars: (i) the leading correction must be fine-tuned to have the typical energy scale $\mu \lesssim 10^{-19}$ GeV, which essentially comes from the free fall time of a relativistic star; (ii) the leading correction must be further fine-tuned so that it is not given by the quadratic curvature term. The second problem is caused because there appears an intermediate curvature scale and laboratory experiments of gravity will be under the influence of higher curvature corrections. Our analysis thus implies that it is a challenge to construct viable $f(R)$ models without very careful and unnatural fine-tuning.

Self and External Mass Calibration in Cluster Studies of Dark Energy

Subha Majumdar
Tata Institute of Fundamental Research

Upcoming surveys of clusters of galaxies, with large yields, have the potential to probe cosmological parameters (like properties of Dark Energy) with precision. The major systematic in such efforts is our incomplete understanding of the connection between the observables and the underlying cluster mass which is the one parameter link to numerical simulations. One needs do follow-up mass measurements to high redshifts to understand and quantify such a connection. On the other hand, it has been shown that the data is rich enough to do cosmology and self-calibrate this connection at the same time. In this brief talk, I discuss some issues related to the two approaches.

Peculiar Type Ia Supernovae - Is It Really Type Ia?

Takashi Moriya
The University of Tokyo

On November 7, 2008, supernova (SN) 2008ha was first detected in an irregular galaxy UGC 12682 and found to be one of the faintest supernovae ever discovered. Since its spectra are similar to those of a peculiar Type Ia SN 2002cx, SN 2008ha was first classified as a member of the peculiar subclass of SNe Ia. However, because of the low-velocity spectra and rapid evolution of the light curve, some studies suggest that SN 2008ha is originated from a core collapse explosion, not a thermonuclear explosion. We perform hydrodynamical simulations of core-collapse SN explosions with low explosion energies and show that a very faint supernova can be led from a core collapse explosion. In such weak explosions, the most part of the stellar envelope falls back to the central remnant and only the outer most layers are ejected. We compare the observations of SN 2008ha with our results and see whether it is possible to reproduce its light curve and spectra. Furthermore, we present characteristics of the extremely faint class of core-collapse SNe.

Accurate Modeling of Nonlinear Effects on Baryon Acoustic Oscillations

Takahiro Nishimichi
The University of Tokyo

The baryon acoustic oscillations (hereafter BAOs) are important tools to access to the nature of dark energy. On-going and up-coming wide and deep galaxy redshift surveys are supposed to measure the characteristic scale of BAOs very accurately, and we need to construct an accurate theoretical template to confront with the observations. We will report the current status of our theoretical template for the galaxy power spectrum (or the two-point correlation function) constructed by theoretical models and N-body simulations. We model the nonlinear growth of matter clustering with 1% accuracy at the scale of BAOs in k-space. We also investigate the accuracy of matter clustering in redshift space, and found that the achieved accuracy is well within the statistical error expected from the WFMOS survey. We will also address the current investigation on the halo clustering in our N-body simulations.

Progenitors of Type Ia Supernovae

Ken Nomoto
IPMU

We present quantitative binary evolution models for both single degenerate and double degenerate cases. By clarifying the possible range of binary parameters to realize Type Ia Supernovae (SNe Ia), we discuss why the single degenerate model for SNe Ia is more plausible. We then present a theoretical delay time distribution of SNe Ia to compare with observations.

How can we precisely determine both neutrino masses and dark energy parameter through nonlinear galaxy power spectrum?

Shun Saito
The University of Tokyo

Baryon Acoustic Oscillations (BAOs) imprinted in galaxy power spectrum is powerful tool to determine the distance scale of the universe and therefore the equation of state of dark energy. The key issues to achieve the high accuracy are nonlinearities such as gravitational evolution, galaxy biasing, and redshift distortions in galaxy distribution. Moreover, in recent studies on these issues, the effect of massive neutrinos are basically neglected just for simplicity. However considering the percent level measurement of power spectrum, the effect of massive neutrinos cannot be neglected. This is because, at smaller scale than neutrino free-streaming where nonlinearity is important, neutrinos suppress the amplitude of power spectrum at more than one percent level. In this work, we show the impact of massive neutrinos on determination of dark energy parameter including nonlinear effects on galaxy power spectrum.

LoCuSS: Subaru Weak Lens Study of 30 Galaxy Clusters

Masahiro Takada
IPMU

We use Subaru data to conduct a detailed weak-lensing study of the dark matter distribution in a sample of 30 X-ray luminous galaxy clusters at $0.15<z<0.3$. We in detail explore the best-available accuracy of estimating cluster masses from weak lensing information, for each cluster basis and for stacked cluster signals and using several methods (the model profile fitting and the model-independent aperture mass estimate). Some highlights of our findings are (1) cluster mass enclosed by the spherical over-density

500 can be constrained at 10-20% accuracy for individual clusters and (2) the mass-halo concentration scaling relation is found at a 2-sigma level.

Non-linear evolution of matter power spectrum in modified theory of gravity

Atsushi Taruya
The University of Tokyo

We present a formalism to calculate the non-linear matter power spectrum in modified gravity models that explain the late-time acceleration of the Universe without dark energy. Any successful modified gravity models should contain a mechanism to recover General Relativity (GR) on small scales in order to avoid the stringent constrains on deviations from GR at solar system scales. Based on our formalism, the quasi non-linear power spectrum in the Dvali-Gabadadze-Porratti (DGP) braneworld models and $f(R)$ gravity models are derived by taking into account the mechanism to recover GR properly. We also extrapolate our predictions to fully non-linear scales using the Parametrized Post Friedmann (PPF) framework.We find that the mechanism to recover GR suppresses the difference between the modified gravity models and dark energy models with the same expansion history, but the difference remains large at weakly non-linear regime in these models.

Matter density perturbations in modified gravity models of dark energy

Shinji Tsujikawa
Tokyo University of Science

We derive the equation of matter density perturbations on sub-horizon scales for a general Lagrangian density f(R, phi, X) that is a function of a Ricci scalar R, a scalar field phi and a kinetic term X. This is useful to constrain modified gravity dark energy models from observations of large-scale structure and weak lensing. We obtain the solutions for the matter perturbation as well as the gravitational potential for some analytically solvable models. We also estimate the growth factor of matter perturbations in f(R) gravity and scalar-tensor models, which shows notable differences from the LCDM model.

Poster Presentations: abstract

Signatures in the CMB of Pre-Inflation Anisotropy
M. Sohaib Alam
The University of Texas, Austin

We explore the statistics of the two-point correlation functions, assuming a background that at the beginning of inflation was anisotropic but homogeneous and described by a Bianchi type I metric. It has been known for a while that the inflaton field dynamically drives this background to a regular FRW metric. Under the assumption that the number of e-foldings is sufficiently small so that not all of the primordial anisotropy is wiped out, we explore the statistics of the two-point correlation function assuming Gaussianity. The results are then to be compared against CMB data to yield constraints on the extent of anisotropy that could have existed before inflation.

Ghost condensation in cosmology
Tomonori Furukawa
Nagoya University

As a model of explaining an accelerating universe today, the ghost condensate is considered. This is the fluid and modification of gravity. However, it is little known how the fluid evolve as universe expands. So we calculate the evolution of the simplest of ghost condensation model in FRW background and constrain parameter.

Natural Neutrino Dark Energy
Ilya Gurwich
Ben-Gurion University

The observed value of the cosmological constant seems to be in disagreement with the natural scale of gravity and most of the emerging scales in QFT. We are therefore urged to seek a different source for dark energy with a natural scale similar to that of the cosmological constant. The fact that the neutrino mass seems fit the scale of the vacuum energy (\Lambda/G), seems to offer an intriguing window of opportunity. I will review the approaches to neutrino dark energy and present a new one that requires no additional physics. Vacuum-matter interaction leads to a "Casimir-like" effect, that generates a constant energy density proportional to the mass^4 of the field. This energy becomes exponentially suppressed when the effective temperature drops below the mass of the field. This will result in an effective phase transition and serves as an explanation as to why we do not observe the contribution of the more massive fields. This model suggests

that the value of the cosmological constant was higher in the early universe and will be lower in the future, thus also resolving the cosmic coincidence puzzle. I will also discuss the quantum ambiguity of this model. Finally, I will present the possible future observational verifications of this model, including the predicted DE equation of state, larger cosmological constant in the past and traces of the phase transitions.

Probing light scalar/pseudoscalar fields by extremely strong laser-laser diffraction

Kensuke Homma
Hiroshima University

If the dark energy is attributed to the quantum nature of the vacuum, it must be probed even at laboratory experiments. A possibility to explain the observed energy density of (2.39meV)^4 is the assuption of omnipresent light stable fileds with the mass of ~1meV and the small coupling to matters beyond the age of the present universe. By aiming at the world's first observation of real photon-photon interactions in QED in the lower frequency range, we can generally measure the macroscopic birefringence of the vacuum under extremely strong laser fileds. If the birefringence significantly deviates from what is expected in QED, it can be an indication of the coupling of the light fields to two photons (an effect of finite long range force). We would like to present a concrete experimental setup to search for the effect of such light fileds.

Constraining the nature of dark energy from recent observations and its relation to inflation parameters

Kiyotomo Ichiki
Nagoya University

We investigate how the nature of dark energy affects a test of inflation. For this purpose, the constraints on the primordial fluctuation, in particular the scalar spectral index, its running and the amplitude of tensor mode are studied in models with a generalized dark energy. Usually a cosmological constant is assumed when one investigates observational constraints on such quantities. However, we do not know the nature of dark energy yet, it may be premature to assume a cosmological constant as dark energy. In this poster, we assume a generalized dark energy to obtain the constraints on the primordial fluctuation and then discuss the implications on the early universe. By using the current cosmological data from cosmic microwave background, large scale structure and so on, we show how the allowed region can be changed depending on what type of dark energy is assumed. The limits on the parameters of generalized dark energy from recent and near future observations are also presented.

Renormalization Flow of Cosmological Constant

Shoichi Ichinose
University of Shizuoka

We approach the problem of the dark energy and the cosmological constant from the extra dimension model. We introduce a new type regularization, called "sphere lattice regularization" in order to control the UV-divergences. Using the 5D Electromagnetism on the AdS5 background curved space, we succeed in obtaining the finite Casimir energy and its renormalization property. The smallness of the cosmological constant is naturally understood as the flow. Related references: ArXiv: 0903.4971, 0812.1263

The ISW@VST survey

Leopoldo Infante
Ponfiticia Universidad Catolica de Chile

We plan to carry out a southern 5000 deg^2 deep survey of galaxies in the r band to detect the Integrated Sachs-Wolfe Effect with a signal to noise ratio 40\% higher than any other survey so far (e.g. SDSS DR4) . The aim is to determine the equation of state of the universe by cross-correlating this galaxy map with high resolution CMB anisotropy maps from existing WMAP and future Planck observations. In this contribution we show that we can reach a near-maximum S/N value of the ISW effect using a single broad-band (r-band) spatially-contiguous galaxy catalog with a mean redshift = 1.2 at a particular scale of the sky (0.5 deg^2). Furthermore, galaxy binning it is not required and therefore redshift information is not needed for all galaxies to compute the ISW effect. To cover the desired field, 64 nights in 4 years (r_AB<~23.8, 16 dark-grey 1.0 arcsec seeing nights per year) would be required with a survey telescope like ESO-VST. The ISW results from this survey will surpass the results from SDSS, because of its depth, and be comparable to the results of the Dark Energy Survey, but 3 years earlier.

Effect of non-linearities and non-Gaussianities on measuring cosmological distances

Donghui Jeong
The University of Texas, Austin

We analyze the effect of non-linearities and primordial non-Gaussianities on measuring the angular diameter distance and Hubble expansion rate at high redshift from the galaxy power spectrum.

Intrinsic Color Dispersion of Type Ia Supernovae

Yasuomi Kamiya
The University of Tokyo

A Type Ia Supernova is thought to explode when a mass of a carbon-oxygen white dwarf in a close binary system becomes very close to a Chandrasekhar mass. Thus, Type Ia Supernovae are expected to have homogeneous properties and used as (correctable) standard candles in cosmology. However, recent studies show that Type Ia Supernovae do have intrinsic dispersion. For instance, there is dispersion in (U-B)--(B-V) diagram, where the data are used at the time of the maximum magnitude in the B band. This observed dispersion is not explainable by the extinction in the Milky Way and in the host galaxies of

Type Ia Supernovae. In order to study this intrinsic dispersion of Type Ia Supernovae, we performed multi-frequency time-dependent radiation transfer simulations. We show that the dispersion can originate from varieties of the 56Ni mass and of the mixing degree in the ejecta. The less synthesized 56Ni is, and the more extensive mixing is, the redder U-B and B-V become. This can explain the dispersion in the color-color diagram.

A Model independent method to measure pairwise velocity dispersion of galaxies

Issha Kayo
IPMU

We have developed a method to measure large-scale velocity dispersion of galaxies. This method is based on Peebles(1980) and improved so as to handle the feature of the two-point correlation function at large scale more properly. It does not require strong assumptions on the shape of the probability distribution function of the pairwise velocity contrary to ordinary methods where Gaussian or exponetial forms are often adopted. We checked and tuned the method using N-body simulations and applied it to the SDSS galaxy data. Using the method, we evaluated the luminosity dependence of the velocity dispersion of the SDSS galaxies and confirmed the non-monotonic feature found by Jing & Boerner (2004).

Constraining cosmology using clusters as an ensemble of cosmic rulers

Satej Khedekar
Tata Institute of Fundamental Research

Abundance and distribution of clusters of galaxies depend on the expansion history of the Universe as well as the growth of cosmic structures. On the other hand, a measurement of the angular diameter distance as a function of redshift depends on the expansion history. These can be used as complimentary probes of cosmology. These distances may be estimated in two ways- 1) By joint measurement of clusters in both XRays and SZ from surveys with overlapping sky coverage, and; 2) By measuring the isophotal size of clusters in a survey. We probe the above mentioned complementarity using clusters and show that by combining cluster number count observations with distance measurements, one can break the cosmological parameter degeneracies. Especially, there is significant improvement on dark energy constraints. Our estimates promises another promising application of upcoming cluster data.

Dark energy from Cosmic Hawking radiation

Hyeong-Chan Kim
Chungju National University

We suggest that dark energy is the energy of Hawking radiation from a cosmic horizon due to quantum vacuum fluctuations. (JCAP0708:005,arXiv:0803.1987). It is well known that for the De Sitter universe the Hawking radiation has the equation of state -1 but O(H^4) energy density after renormalization, where H is the Hubble parameter. However, using the

quantum field theory on curved space-time we show that if there is a Planck scale UV-cutoff this energy density is O(H^2 M_P^2) which is comparable to the observed dark energy density. The Hawking radiation also has an appropriate equation of state consistent with the observed value.

Asymmetry in Supernovae Explosions

Keiichi Maeda
IPMU

We present observational support and test for the explosion asymmetry in supernova (SN) explosions, both for core-collapse SNe from massive stars and Type Ia SNe used as standard distance indicators. Identifying the SN explosion asymmetry is a key to understand still-unresolved explosion mechanisms. This may also be important to develop better luminosity indicators for SNe Ia than currently used. We have been proposing to use late-time spectra in optical and NIR, taken about an year after the explosion, in order to tackle this issue. Theoretical expectations based on our numerical investigations of the explosive nucleosynthesis and radiation transfer are compared with the observational data, partly obtained by ourselves with the Subaru Telescope.

Constraints on Some Alternative Unifying Views of Dark Energy and Dark Matter

Grant Mathews
University of Notre Dame

The simple fact that the present closure contributions from dark matter and dark energy are nearly equal begs the question as to whether they could be different aspects of the same physical phenomenon. Here, we review constraints several postulates as to how this coincidence might have been achieved. AMong the topics we have analyzed are:1) The possibility that the dark matter decays producing a bulk viscosity in the cosmic fluid; 2) the cosmic acceleration is produced by the inflow of dark matter from a bulk dimension in brane-world cosmology; and 3) The possibility that relativistic corrections to the Friedmann equation from the presence of local inhomogeneities produce acceleration terms. Constraints and observational tests of each of these cosmologies are proposed. We find that all of these paradigms can either be ruled out or require such fine tuning that they are unlikely as a source for dark energy. Nevertheless, future observations may find some of the unique signatures which we identify for such alternative unified models.

Evolution of density fluctuation in f(R) gravity

Hayato Motohashi
The University of Tokyo

There are many models to explain cosmic acceleration or dark energy. Though LCDM model is a simplest solution, the model has some difficulties. One of the alternative approaches is f(R) gravity. We consider the evolution of density perturbation in f(R) model and compare it with observation.

New Constraint on the varying fine structure constant

Masahiro Nakashima
The University of Tokyo

We present new constraints on the time variation of the fine structure constant at recombination epoch relative to its present value taking into account simultaneous variation of other physical constants, the electron mass and the proton mass. Under some unification theory motivated relations between the variation of these constants, we obtain tighter constraints than those in the previous work in which the variation of the proton mass was not included. Furthermore, we investigate the degeneracy of other parameters with varying constants, in particular, the degeneracy between the fine structure constant and the dark energy equation of state.

Impact of photometric redsfhit error on the dark energy measurement

Atsushi Nishizawa
The University of Tokyo

The weak lensing is expected to be a powerful tool for constraining dark energy parameters. However it includes many systematic uncertainties. One of the most important systematic error is caused by photometric redshift of background galaxies, i.e. lensed galaxies. We develop a new method to improve the photometric redshift uncertainty by discarding so called outliers, whose photometric redshifts are catastrophically misestimated. Generally speaking, they have a broad, sometimes bimodal distribution in thier chi square distribution. We quantify the broadness of distribution function, and success to identify the outliers. Assuming a upcoming weak lensing survey, for example, Hyper Suprime-Cam on Subaru, at most 70% galaxies should be discarded in order to achieve the systematic error on equation of state to be comparable with statistical one.

Simulations of Wide-Field Weak Lensing Surveys: Basic Statistics and Non-Gaussian Effects

Masanori Sato
Nagoya University

We run 400 cosmological N-body simulations to study the lensing convergence power spectrum and its covariance for a standard CDM cosmology. We use the outputs to perform a total of 1000 independent ray-tracing simulations. We compare the simulation results with analytic model predictions. The semi-analytic model based on Smith et al. (2003) fitting formula underestimates the convergence power by ~30% at arc-minute angular scales. For the convergence power spectrum covariance, the so-called halo model reproduces the simulation results remarkably well over a wide range of angular scales and source redshifts. The signal-to-noise ratio for the convergence power spectrum is degraded by the non-Gaussian covariances by up to a factor 5 for a weak lensing survey to z~1. The probability distribution of the convergence power spectrum estimators, among the realizations, is well approximated by a ^2-distribution with broadened variance given by the non-Gaussian covariance, but has a larger positive tail. The skewness and kurtosis have non-negligible values especially for a shallow survey. We argue that a prior knowledge on the full distribution may be needed to obtain an unbiased estimate on the ensemble averaged band power at each angular scale from a finite volume survey.

Constraints on the cosmological constant from WMAP5 and BBN if neutrinos have finite masses and chemical potentials

Maresuke Shiraishi
Nagoya University

In this conference, I present constraints on the cosmological constant and neutrino properties from WMAP5 data and light element abundances by using a Markov chain Monte Carlo (MCMC) approach. In order to take consistently into account the effects of neutrino chemical potentials, I ran the Big Bang Nucleosynthesis code for each value of neutrino chemical potentials and the other cosmological parameters to estimate the Helium abundance, which is then used to calculate CMB anisotropy spectra instead of treating it as a free parameter. I found that the constraint on the cosmological constant slightly changes if the lepton asymmetry is allowed.

Third-order Perturbation Theory with Non-linear Pressure

Masatoshi Shoji
The University of Texas, Austin

We calculate the non-linear matter power spectrum using the 3rd-order perturbation theory without ignoring the pressure gradient term. We consider a semi-realistic system consisting of two matter components with and without pressure, and both are expanded into the 3rd order in perturbations in a self-consistent manner, for the first time. While the pressured component may be identified with baryons or neutrinos, in this paper we mainly explore the physics of the non-linear pressure effect using a toy model in which the Jeans length does not depend on time, i.e., the sound speed decreases as a-1/2, where a is the scale factor. The linear analysis shows that the power spectrum below the so-called filtering scale is suppressed relative to the power spectrum of the cold dark matter. Our non-linear calculation shows that the actual filtering scale for a given sound speed is smaller than the linear filtering scale by a factor depending on the redshift and the Jeans length. A ~40% change is common, and our results suggest that, when applied to baryons, the temperature of the Inter-galactic Medium inferred from the filtering scale observed in the flux power spectrum of Lyman-alpha forests would be underestimated by a factor of two, if one used the linear filtering scale to interpret the data. The filtering mass, which is proportional to the filtering scale cubed, can also be significantly smaller than the linear theory prediction especially at low redshift, where the actual filtering mass can be smaller than the linear prediction by a factor of three. Finally, when applied to neutrinos, we find that neutrino perturbations deviate significantly from linear perturbations even below the free-streaming scales, and thus neutrinos cannot be treated as linear perturbations

Strong CP problem and cosmological constant

Fuminobu Takahashi
IPMU

We point out that the long-standing strong CP problem may be resolved by an anthropic argument. The key ideas are: (i) to allow explicit breaking(s) of the Peccei-Quinn symmetry which reduces the strong CP problem to the cosmological constant problem, and (ii) to conjecture that the probability distribution of the vacuum energy has a mild pressure towards higher values. The cosmological problems of the (s)axion with a large Peccei-Quinn scale are absent in our mechanism, since the axion acquires a large mass from the explicit breaking.

Testing dark energy models: possible complications and some issues of dark energy perturbations

Tomo Takahashi
Saga University

We discuss the issue of testing dark energy models, paying particular attention to some possible complications when one takes into account an uncertainty in other cosmological aspects. After discussing theoretical aspects of some dark energy models, we investigate the possibilities of testing some models, in particular, the cosmological constant, with future cosmological observations such as CMB, SNeIa and so on. In addition, we investigate the issue of dark energy perturbations. Since it is possible that some different models of dark energy can give an almost identical cosmological background evolution, the study of dark energy perturbations would be interesting. We study possible signatures of dark energy perturbations and discuss its implications for tests of dark energy models.

Can we rule out unified dark matter models?

Yuko Urakawa
Waseda University

We investigate the observational signatures of Unified Dark Matter (UDM) models, in which a scalar field behaves both as dark matter and as dark energy. It is known that in most of UDM models, the Jeans instability disappears after the transition to the present acceleration era and therefore the power spectrum of the Large Scale Structure shows a problematic behavior. Recently, however, several UDM models described by a scalar field with a non-canonical kinetic term are shown to predict the power spectrum which is in good agreement with SDSS data. Computing weak lensing spectra and the Integrated Sachs-Wolfe effect, we study in more detail the observational signitures of these models and discuss whether such UDM models are viable or not.

Dark energy, Finite-mass Neutrino, and Primordial Magnetic Field

Dai G. Yamazaki
Institute of Astronomy and Astrophysics, Academia Sinica

Placing constraints on the neutrino mass is an important goal in modern physics. Recently an upper limit of neutrino mass is constrained less than 1 eV order by kinematical research as tritium beta decay experiments and cosmological observations. On the other hand, Magnetic fields have been observed in clusters of galaxies with strength of 0.1-1.0 ~ \\mu G. One possible explanation for such magnetic fields in galactic clusters is the existence of a primordial magnetic field (PMF) of order 1 nG whose field lines collapse as structure forms. In this presentation, we show effects of the PMF on the cosmic microwave

background and the matter power spectrum with finite-neutrinos, and discuss influences of the PMF and finite-neutrinos in the constraint on the dark energy from cosmological observations.