ICGAC-XIII & IK15

PROGRAM BOOKLET

for the Joint Meeting of

XIIIth International Conference on Gravitation, Astrophysics & Cosmology
and
15th Italian-Korean Symposium on Relativistic Astrophysics

July 3 - 7, 2017

Ewha Womans University, Seoul in Korea

https://www.apctp.org/plan.php/ICGAC-IK
(e-mail: ICGAC13IK15@gmail.com)

<u>Preface</u>

Dear Colleagues

I would like to invite you on behalf of the International Organization Committee.

I am pleased to invite you to the conference in Seoul, Korea, based on the accomplishments of the ICGAC community in the Asia-Pacific region over the past 26 years and the academic friendship that has been achieved through relativistic astrophysics between Italy and Korea for 30 years.

The evidence of the gravitational wave released in February of last year, have made the belief to Einstein's relativity theory even stronger, and have contributed greatly to the creation of a new observation field of gravitational wave physics, so called "New Window to our Universe". In addition, many forms of observation and discovery of our universe have played a role in astrophysics and cosmology to expand the horizon. In the coming decade, these new compasses will direct the direction of our knowledge advancement and will do important work in human history. As a result, our understanding of the universe will be expanded and applied to the world, and a new era of physics will emerge.

The 13th International Conference on Gravitation, Astrophysics, and Cosmology (ICGAC-XIII) and the 15th Italian-Korean Joint Symposium on Relativistic Astrophysics (IK15) are combined at the prestigious Ewha Womans University with a history of more than 130 years and an integrated conference will be held. I hope that you will have valuable time to make good conclusions by learning, discussing and sharing recent issues during the conference. I also hope that many young scholars attending this conference learn and acquire a lot of skills and design to carry on future astrophysics.

I hope you will take time to enjoy the values of Ewha Womans University as well as to have a meaningful time to explore Seoul, Korea.

Thank you to all IAC, IOC, LOC committee members and organizations that helped make this conference happen. I am deeply grateful to all of you, especially the Korean Physics Society Astrophysics Division, International Center for Relativistic Astrophysics Network (ICRANet), Asia-Pacific Center for Theoretical Physics (APCTP), Division of Astrophysics, Cosmology and Gravitation (DACG) of Asia Pacific Physics Society (AAPPS), National Research Foundation of Korea, Consiglio Nazionale delle Ricerche (CNR, Italy), Institute for Basic Science (IBS), Ewha Womans University, Konkuk University, Kunsan National University, Physics Department and Professor Leung Memorial Fund at University of Massachusetts Dartmouth, and Springer Verlag.

Without their supports, this conference will not be held here, at this time.

Welcome to ICGAC-XIII & IK15 !

Sung-Won Kim
Chair of IOC, ICGAC-XIII & IK15

International Organizing Committee

Sung-Won Kim (EWU, Chair)**, Remo Ruffini** (ICRANet, Co-Chair)**, Sang-Pyo Kim** (Kunsan Nat'l U., Co-Chair)**, Gungwon Kang** (KISTI, Co-Chair)**, Jonghyuk Yoon** (Konkuk U., Co-Chair)**, Warrick Couch** (AAO)**, Bruce Dawson** (U. Adelaide)**, Yungui Gong** (HUST)**, Zhong-Hong Zhu** (BNU)**, Yipeng Jing** (SJTU)**, Pascal Chardonnet** (CNRS)**, Jutta Kunz** (U. Oldenburg)**, Claus Lammerzhahl** (U. Bremen)**, She-Sheng Xue** (ICRANet)**, Gregory Vereshchagin** (ICRANet)**, Takahiro Tanaka** (Kyoto U.)**, Jun'ichi Yokoyama** (U. Tokyo)**, Jiro Soda** (Kobe U.)**, Kiwoon Choi** (KAIST)**, Hyung Won Lee** (Inje U.)**, M.H.P.M. van Putten** (Sejong U.)**, V.N. Melnikov** (MSU)**, A.A. Starobinsky** (ITP Russia)**, Pisin Chen** (NTU)**, Hoi-Lai Yu** (Sinica)

International Advisory Committee

David Blair (UWA)**, John Webb** (UNSW)**, Valeri Frolov** (U. Alberta)**, Don Page** (U. Alberta)**, Rong-Gen Cai** (ITP, CAS)**, Jun Luo** (HUST)**, Jean-Michel Alimi** (LUTH)**, Thibault Damour** (IHES)**, Roland Triay** (CNRS)**, Varun Sahni** (IUCAA)**, Vladimir Belinski** (ICRANet)**, Salvatore Capozziello** (U. Naples)**, Alexander Dolgov** (U. Ferrara)**, Remo Ruffini** (ICRANet)**, Kei-ichi Maeda** (Waseda U.)**, Masakatsu Kenmoku** (NWU)**, Misao Sasaki** (Kyoto U.)**, Medeu Abishev** (KNU)**, Ratbay Myrzakulov** (ENU)**, Yongmin Cho** (Konkuk U.)**, Chul Hoon Lee** (Hanyang U.)**, Hyun Kyu Lee** (Hanyang U.)**, Hyung Mok Lee** (SNU)**, Il Hung Park** (SKKU)**, A. Garcia** (Cinvestav)**, Hernando Quevedo** (UNAM)**, J. Buchbinder** (TSPU)**, D. Gal'tsov** (MSU)**, S.V. Chervon** (UlSPU)**, D.S. Gorbunov** (INR)**, Chiang-Mei Chen** (NCU)**, James M. Nester** (NCU)**, W.-T. Ni** (NCU)**, Yu. Shtanov** (BITP)**, A. Zhuk** (ONU)**, Dieter Brill** (UMD)**, Jong-Ping Hsu** (UMass)**, Ho Jung Paik** (UMD)**, Bobomurat Ahmedov** (INP)**, Nguyen Suan Han** (VNU)**, Pierre Darriulat** (VATLY)

Local Organizing Committee

Hyeong-Chan Kim (KNUT, Chair), **Inyong Cho** (SNUT), **Bogeun Gwak** (Sejong U.), **YuRi Kang** (EWU), **Chanju Kim** (EWU), **Hee Il Kim** (SNU & ZettaHPC), **Kyoung Yee Kim** (Inje U.), **Seoktae Koh** (Jeju Nat'l U.), **Chang-Hwan Lee** (Pusan Nat'l U.), **Hyunjoo Lee** (Incheon Nat'l U.), **Jae-Weon Lee** (Jungwon U.), **Seokcheon Lee** (KIAS), **Wonwoo Lee** (Sogang U.), **John J. Oh** (NIMS), **Sang Hoon Oh** (NIMS), **Mu-In Park** (Sogang U.), **Edwin J. Son** (NIMS)

Host Organization

- Research Institute of Curriculum Instruction, Ewha Womans University

Managing Organizations

- Astrophysics Division of Korea Physical Society
- International Center for Relativistic Astrophysics Network (ICRANet)

Supporting Organizations

- Asia Pacific Center for Theoretical Physics
- Division of Astrophysics, Cosmology and Gravitation in the Association of Asia Pacific Physics Society (DACG-AAPPS)
- National Research Foundation of Korea
- Consiglio Nazionale delle Ricerche (CNR, Italy)
- Konkuk University
- Kunsan National University
- Physics Department and Professor Leung Memorial Fund at University of Massachusetts Dartmouth
- Springer Verlag

Contents

Opening Ceremony

Opening Address

Sung-Won Kim (Ewha Womans University, Chair)

Welcoming Address

Heisook Kim (Ewha Womans University, President)

Yongmin Cho (Konkuk University)

Remo Ruffini (ICRANet)

Congratulatory Address

Marco della Seta (Ambassador of Italy in Korea)

Program Timetable

Place: Lee Sam Bong Hall (B4F, Main Rm), B147, and B149 in ECC, Ewha Womans University

Time (Mon.)	3 Mon.		4 Tue.			5 Wed.	6 Thu.		7 Fri.		Time (T/W/T/F)
08:00–09:00	Registration										08:50–09:00
09:00–09:45	**V. Frolov** (Main Rm)		**Yungui Gong** (Main Rm)			**Bum-Hoon Lee** (Main Rm)	**Y. Neiman** (Main Rm)		**Jong-Ping Hsu** (Main Rm)		09:00–09:35
09:45–10:30	**R. Ruffini**		**Hyung Mok Lee**			**J. Yokoyama**	**Rong-Gen Cai**		**D. Brill**		09:35–10:15
10:30–10:50	*Coffee Break*		*Coffee Break*			*Coffee Break*	*Coffee Break*		*Coffee Break*		10:15–10:45
10:50–11:10	**Opening Ceremony**		**S. Miyoki**			**Il Hung Park**	**D. Grumiller**		**Yong-Seon Song**		10:45–11:20
11:10–11:55	**M. Sasaki**		**Wei-Tou Ni**			**K. Maeda**	**Jeong-Hyuck Park**		**Eunil Won**		11:20–11:55
11:55–12:40	**Yongmin Cho**		**Ho Jung Paik**			**J. A. Rueda**	**Chiang-Mei Chen**		**M. Muccino**		11:55–12:30
			Photo Session								
12:40–14:00	*Lunch*		*Lunch*			*Lunch*	*Lunch*				12:30–14:00
14:00–15:30	**P1-1** Classical Gravity (Main Rm)	**P2-1** Quantum Gravity (B147)	**P3-1** Astro physics (Main Rm)	**P4-1** Gravitational Waves (B147)	**P5-1** Inflation and Dark Matter (B149)	Free Time for Excursions, Discussions, Informal Meetings, etc.	**P3-3** Astrophysics (Main Rm)	**P6-1** Gravity in String Theory (B147)	**P7-1** Cosmology (Main Rm)	**P8-1** Black Holes (B147)	14:00–15:30
15:30–16:00	*Coffee Break*						*Coffee Break*				15:30–16:00
16:00–18:00	**P1-2** Classical Gravity (Main Rm)	**P2-2** Quantum Gravity (B147)	**P3-2** Astro physics (Main Rm)	**P4-2** Gravitational Waves (B147)	**P5-2** Inflation and Dark Matter (B149)		**P3-4** Astrophysics (Main Rm)	**P6-2** Gravity in String Theory (B147)	**P7-2** Cosmology (Main Rm)	**P8-2** Black Holes (B147)	16:00–18:00
									Closing Remark		
			Banquet								

<u>Notice</u>

<u>Proceedings</u>

All presentations are eligible for publication in the proceedings through EPJ (European Physical Journal) Web of Conferences after proper reviewing process in accordance with the journals' Policy on Publishing Integrity.

<u>Awards for best presentations</u>

Certificate and 100,000KRWs Award will be given for five best student presentations selected by a committee.

Plenary Sessions

※ **Place: Lee Sam Bong Hall (B4F, Main Rm)**

3 July, Monday

Chair: Sang-Pyo Kim (Kunsan Nat'l U.)
08:00 - 09:00 Registration
09:00 - 09:45 Valeri P. Frolov (U. Alberta) Remarks on non-singular black holes
09:45 - 10:30 Remo Ruffini (ICRANet) From Supernovae, to Hypernovae to Binary Driven Hypernovae

10:30 - 10:50 *Coffee Break*

10:50 - 11:10 Opening Ceremony

Chair: Gungwon Kang (KISTI)
11:10 - 11:55 Misao Sasaki (Kyoto U.) Inflationary massive gravity
11:55 - 12:40 Yongmin Cho (Konkuk U.) Cosmic Production of the Electroweak Monopole

12:40 - 14:00 *Lunch*

4 July, Tuesday

Chair: Misao Sasaki (Kyoto U.)
09:00 - 09:35 Yungui Gong (Huazhong U. Sci. Tech.) On the polarization of gravitational waves in scalar-tensor theories of gravity
09:35 - 10:15 Hyung Mok Lee (Seoul Nat'l U.) What have we learned from the detection of gravitational waves?

10:15 - 10:45 *Coffee Break*

Chair: Medeu Abishev (Al Farabi Kazakh Nat'l U.)
10:45 - 11:20 Shinji Miyoki (ICRR) Current Status of KAGRA Gravitational Wave Telescope
11:20 - 11:55 Wei-Tou Ni (Nat'l Tsing Hua U.) Gravitational Wave Classification and the Space GW Detection Sensitivities
11:55 - 12:30 Ho Jung Paik (U. Maryland) Superconducting Tensor Gravitational-Wave Detector and Mitigation of Newtonian Noise
12:30 - 12:40 *Photo Session*

12:40 - 14:00 *Lunch*

18:30-20:30 *Banquet* **(B403 ECC Theater)**

5 July, Wednesday

Chair: Yongmin Cho (Konkuk U.)
09:00 - 09:35 Bum-Hoon Lee (Sogang U.) Higher Curvature Gravity
09:35 - 10:15 Jun'ichi Yokoyama (U. Tokyo) Creation of the inflationary universe from a black hole?

10:15 - 10:45 *Coffee Break*

Chair: Jun'ichi Yokoyama (U. Tokyo)
10:45 - 11:20 Il Hung Park (Sungkyunkwan U.) Status and Perspectives in GRB observations
11:20 - 11:55 Kei-ichi Maeda (Waseda U.) Inflation and Disformal Transformation
11:55 - 12:30 Jorge Armando Rueda (ICRANet) On the rate and on the gravitational wave emission of short and long GRBs

6 July, Thursday

Chair: Dieter Rudolf Brill (U. Maryland)
09:00 - 09:35 Yaakov (Yasha) Neiman (Perimeter Institute) Towards a working model of causal-patch physics in dS/CFT
09:35 - 10:15 Rong-Gen Cai (Chinese Academy of Science) Standard sirens and dark sector with Gaussian process

10:15 - 10:45 *Coffee Break*

Chair: Valeri P. Frolov (U. Alberta)
10:45 - 11:20 Daniel Grumiller (Vienna U. of Technology) Soft Heisenberg Hair
11:20 - 11:55 Jeong-Hyuck Park (Sogang U.) Stringy Gravity & solution to dark matter problem
11:55 - 12:30 Chiang-Mei Chen (Nat'l Central U.) Pair Production of Scalar Dyons in Kerr-Newman Black Holes

12:30 - 14:00 *Lunch*

7 July, Friday

Chair: Wei-Tou Ni (Nat'l Tsing Hua U.)
09:00 - 09:35 Jong-Ping Hsu (U. of Massachusetts Dartmouth) Experiments on the CMB Spectrum and Their Implications for the Missing Half of the Universe
09:35 - 10:15 Dieter Rudolf Brill (U. Maryland) The revival of General Relativity at Princeton.

10:15 - 10:45 *Coffee Break*

Chair: Rong-Gen Cai (Chinese Academy of Science)
10:45 - 11:20 Yong-Seon Song (KASI) Cosmological Implications of RSD
11:20 - 11:55 Eunil Won (Korea U.) Status of the GroundBIRD experiment
11:55 - 12:30 Marco Muccino (ICRANet) What can we learn from gamma-ray bursts?

12:30 - 14:00 *Lunch*

17:50 - 18:00 *Closing Remark*

Parallel Sessions

※ **All talks are for 20 minutes unless being marked with (15 mins)**

3 July, Monday- Parallel Sessions 1, 2

P1. **(Main Rm)** *Classical Gravity – Classical gravity, Modified gravity, etc.*

P1-1. **14:00-15:30 (10 minutes for overall discussions)**
Chair: Jong-Ping Hsu (U. of Massachusetts Dartmouth)
Jong Hyuk Yoon (Konkuk U.) Hamiltonian reduction of Einstein\'s gravity without isometries
Seung Hun Oh (Konkuk U.) Solution-generating methods of Einstein's equations by (2+2) Hamiltonian reduction
Chulmoon Yoo (Nagoya U.) Gravitational collapse of massless fields in an expanding universe
Hyeong-Chan Kim (Korea Nat'l U. Transportation) Matter Equation of State in General Relativity

15:30-16:00 *Coffee Break*

P1-2. **16:00-18:15**
Chair: Seung Hun Oh (Konkuk U.)
Jia-Rui Sun (Sun Yat-Sen U.) Analogue gravity in BEC and its gravity dual
Alexey Toporensky (Sternberg Astron. Inst.) A viable compactification scenario in Gauss-Bonnet gravity
Jong-Ping Hsu (U. of Massachusetts Dartmouth) Experiments on the Frequency Dependence of the Deflection of Light in Yang-Mills Gravity
Inyong Cho (Seoul Nat'l U. of Science & Technology) Black Holes in S3 and H3
(15 mins) Laura Marcela Becerra Bayona (Sapienza University of Rome and IcraNet) SPH simulations of the Induced Gravitational Collapse
Atsushi Naruko (Tohoku U.) Extended vector-tensor theories
J. Rodriguez (ICRANet) Strong-field gravitational-wave emission in Schwarzschild and Kerr geometries: some general considerations

P2. **(B147)** *Quantum Gravity – Quantum gravity, Black hole thermodynamics, Black hole entropy, etc.*

P2-1. **14:00-15: 35**
Chair: Chiang-Mei Chen (Nat'l Central U.)
Sang Pyo Kim (Kunsan Nat'l U.) Quantum Gravity Effects in Cosmology
Ehsan Bavarsad (U. Kashan) Effect of a magnetic field on Schwinger mechanism in de Sitter spacetime

Eoin O Colgain (APCTP) Calibrated Entanglement Entropy
Wonwoo Lee (CQUeST) Tunneling decay of false vortices with gravitation
(15 mins) Taishi Ikeda (Nagoya U.) Oscillon in Einstein-scalar system with double well potential and its properties

15: 35-16:00 *Coffee Break*

P2-2. **16:00-18:00**
Chair: Hyung Won Lee (Inje U.)
Hyun Seok Yang (CQUeST) Dark Matter and Dark Energy from Emergent Spacetime Picture
Alex Giacomini (U. Austral de Chile) On the compatibility of thermodynamic equilibrium conditions with lattice propagators
Muhammad Sharif (U. Punjab) Study of Generalized Second Law of Thermodynamics in Curvature-Matter Coupling Gravity
Yoonbai Kim (Sungkyunkwan U.) Entropy in Spacetime with Topological Hair
Hideki Maeda (Hokkai-Gakuen U.) Throat quantization of the Schwarzschild-Tangherlini(-AdS) Black Hole
Wontae Kim (Sogang U.) Origin of Hawking radiation

4 July, Tuesday- Parallel Sessions 3, 4, 5

P3. **(Main Rm)** *Astrophysics - Relativistic astrophysics, Observation, Cosmic rays, GRB, etc.*

P3-1. **14:00-15:35**
Chair: Myeong-Gu Park (Kyungpook Nat'l U.)
Medeu Abishev (Al Farabi Kazakh Nat'l U.) The orbital stability of a test particle motion in the field of two massive rotating bodies
Giovanni Battista Pisani (Sapienza University of Rome and ICRANet) The 1st ICRANet Catalog of Binary-driven HyperNovae
Gregory Vereshchagin (ICRANet) Cosmic horizon for GeV sources and photon-photon scattering
Naser Ahmadiniaz (Institute for Basic Science) Master formulas for the dressed scalar propagator in a constant field
(15 mins) Mehbub Khan (UMass) Baryonic Force for Accelerated Cosmic Expansion and Generalized Yang-Mills Symmetry

15:35-16:00 *Coffee Break*

P3-2. **16:00-18:00**
Chair: Gregory Vereshchagin (ICRANet)
Myeong-Gu Park (Kyungpook Nat'l U.) Accretion onto Black Holes with Outflow
Sehrish Iftikhar (Lahore College for Women U.) Particle Dynamics Around a Charged Black Hole
Mohammad Wali Hossain (APCTP) Quintessential inflation: A unified scenario of inflation and dark energy

(15 mins) Daria Primorac (ICRANet & Sapienza U. Roma) Analysis of the GRB110731A within the fireshell model

(15 mins) Yongsoo Jho (Yonsei U.) Search for Sphaleron from the Ultra-High-Energy cosmic rays and neutrinos

(15 mins) Rahim Moradi (Sapienza U. of Rome and ICRANet) Charged Cosmological Black holes

(15 mins) Julio David Melon Fuksman (Sapienza U. Rome & ICRANet) Simulation of an electron-positron plasma in the context of the IGC paradigm

18:30-20:30 *Banquet* **(B403 ECC Theater)**

P4. **(B147)** *Gravitational Waves – Gravitational wave astronomy/astrophysics, Numerical relativity, etc.*

P4-1. **14:00-15:30**
Chair: Muhammad Sharif (U. Punjab)
Dong-Hoon Kim (Seoul Nat'l U.) Gravitational waves with effects of radiation reaction,
Toshinori Matsui (KIAS) Gravitational waves from the first order electroweak phase transition in the Z_3 symmetric singlet scalar model
Hyung Won Lee (Inje University) TaylorF2 CBC waveform with eccentricity corrected phase
(15 mins) Luis Gabriel Gómez (Sapienza U. Rome & ICRANet) Gravitational wave emission versus dark matter dynamical friction in the evolution of compact star binaries
(15 mins) Gihyuk Cho (Seoul Nat'l U.) Theory of Gravitational Radiation

15:30-16:00 *Coffee Break*

P4-2. **16:00-18:00 (10 minutes for overall discussions)**
Chair: Hyung Mok Lee (Seoul Nat'l U.)
Jinn-ouk Gong (APCTP) Induced gravitational waves
Hisaaki Shinkai (*Invited,* Osaka Inst. Tech.) Gravitational waves from merging intermediate-mass black holes
Sunghoon Jung (*Invited,* Seoul Nat'l U.) Angular Resolutions of Mid-Frequency Gravitational Wave Detectors
Gungwon Kang (KISTI) Structural analysis of the SOGRO platform
(15 mins) Dawoo Park (Seoul Nat'l U.) Black Hole Binaries Dynamically Formed in Globular Clusters
(15 mins) HanGil Choi (Seoul Nat'l U.) Finding Quasi-Spherical Orbit Initial Condition of Black Hole Binary using Effective-One-Body Model

18:30-20:30 *Banquet* **(B403 ECC Theater)**

P5. **(B149)** *Inflation and Dark Matter*

P5-1. **14:00-15:40**
Chair: Jae-Weon Lee (Jungwon U.)

Hyun Min Lee (Chung-Ang U) Flattening the inflaton potential beyond the minimal gravity
Aditya Aravind (APCTP) Higgs Portal Inflation with Fermionic Dark Matter
(15 mins) Echal Chang (Chungnam Nat'l U.) Toward a more realistic Randall-Sundrum Brane World
(15 mins) Zhu Yi (Huazhong U. Sci. Tech.) Nonminimal coupling and inflationary attractors
(15 mins) Yongwan Gim (Sogang U.) On the thermodynamic origin of the initial radiation energy density in warm inflation
(15 mins) Dong Woo Kang (Yonsei U.) Electroweak Kaluza-Klein Dark Matter

15:40-16:00 *Coffee Break*

P5-2. **16:00-18:00 (10 minutes for overall discussions)**
Chair: Yungui Gong (Huazhong U. Sci. Tech.)
Jae-Weon Lee (Jungwon U.) Brief History of Ultra-light Scalar Dark Matter Models
Sichun Sun (National Taiwan U.) New views on dark matter from modified gravity
Yasuhiro Yamamoto (Yonsei U.) Protophobic Light Vector Boson as a Mediator to the Dark Sector
Seodong Shin (Yonsei U.) Non-minimal dark matter search in dark matter colliders
(15 mins) Soo Min Choi (Chung-Ang U) SIMP dark matter and its cosmic abundances
(15 mins) Yoo-Jin Kang (Chung-Ang U) Forbidden Channels and SIMP Dark Matter

18:30-20:30 *Banquet* **(B403 ECC Theater)**

6 July, Thursday- Parallel Sessions 3, 6

P3. **(Main Rm)** *Astrophysics - Relativistic astrophysics, Observation, Cosmic rays, GRB, etc.*

P3-3. **14:00-15:30 (10 minutes for overall discussions)**
Chair: Hyun Kyu Lee (Hanyang U.)
Anna Pollmann (*Invited,* U. Wuppertal) Searches for magnetic monopoles with IceCube
Insik Hahn (Ewha Womans U.) Nuclear astrophysics experiments related to the rp-process using rare isotope beams
Myung-Ki Cheoun (*Invited,* Soongsil U.) Modified Gravity in Nuclear Astrophysics and Big Bang Nucleosynthesis
Chang-Hwan Lee (Pusan Nat'l U.) Strangeness in Neutron Star Cooling

15:30-16:00 *Coffee Break*

P3-4. **16:00-18:00 (5 minutes for overall discussions)**
Chair: Jorge Armando Rueda (ICRANet)
Hyun Kyu Lee (Hanyang U.) Hadronic matter with emergent symmetries at high density
Hongjun An (*Invited,* Chungbuk Nat'l U.) Studying intrabinary shock emission in pulsar binaries
Dong-Hoon Kim (Seoul Nat'l U.) Pulsar radiation with general relativistic effects

Alexander Yushchenko (Sejong University) Velocity distribution in the clusters of galaxies
Hisaaki Shinkai (Osaka Inst. Tech.) Nonlinear dynamics in Gauss-Bonnet gravity
(15 mins) Andreas Krut (ICRANet) Dark matter and galactic structures

P6. **(B147)** *Gravity in String Theory*

P6-1. **14:00-15:30 (10 minutes for overall discussions)**
Chair: Chanju Kim (Ewha Womans U.)
Jae-Hyuk Oh (Hanyang U.) Phase transition in anisotropic holographic superfluids with arbitrary z and α
Run-Qiu Yang (KIAS) Strong energy condition and complexity growth bound in holography
Yun-Long Zhang (APCTP) Bell inequality from holographic gravity
Sunyoung Shin (CQUeST) Walls of massive Kähler sigma models on SO(2N)/U(N) in three dimensions

15:30-16:00 *Coffee Break*

P6-2. **16:00-18:00**
Chair: Keun-Young Kim (GIST)
Chanju Kim (Ewha Womans U.) Holographic micro state deformations of BTZ black holes
O-Kab Kwon (Sungkyunkwan U.) Exact holography of massive M2-brane theories and entanglement entropy
Kyung Kiu Kim (Sejong U.) Thermodynamic volume in AdS/CFT
Taejin Lee (Kangwon Nat'l U.) Gravitational Scattering Amplitudes and Closed String Field Theory in the Proper-Time Gauge
Hongsu Kim (KASI) 3rd Quantization of Taub Universe
Hongsu Kim (KASI) Callan-Rubakov Effect could answer the baryon asymmetry puzzle

7 July, Friday–Parallel Sessions 7, 8

P7. **(Main Rm)** *Cosmology – Cosmology, CMB, Perturbations, Structure formation, Quantum effect, etc.*

P7-1. **14:00-15:30 (10 minutes for overall discussions)**
Chair: Wonwoo Lee (CQUeST)
Seokcheon Lee (Gyeongsang Nat'l U.) Conformal equality
Dong-han Yeom (Nat'l Taiwan U.) Hartle-Hawking wave function and large-scale power suppression of CMB
Mu-In Park (Sogang U.) On Gauge Invariant Cosmological Perturbations in UV-modified Horava Gravity
Tae Hoon Lee (*Invited,* Soongsil U.) Quintessence in low-energy effective theory

15:30-16:00 *Coffee Break*

P7-2. **16:00-17:50 (10 minutes for overall discussions)**
Chair: Seokcheon Lee (Gyeongsang Nat'l U.)
Ki-Young Choi (Chonnam Nat'l U.) Lower-Bound on the reheating temperature with dark matter
Kyungjin Ahn (Chosun U.) Small-scale structure formation under the large-scale density and CDM-baryon drift velocity environment
Sungwook E Hong (KASI) Small-scale Features of Thermal Inflation: CMB Distortion and Substructure Abundance
Maurice H van Putten (*Invited*, Sejong U.) Fast evolution of the deceleration parameter in surveys of H(z)
Muhammad Sharif (U. Punjab) Stability Analysis of Bulk Viscous Cosmology

17:50-18:00 *Closing Remark*

P8. **(B147)** *Black Holes – Black holes, Wormholes, etc*

P8-1. **14:00-15:40**
Chair: Jong Hyuk Yoon (Konkuk U.)
Masakatsu Kenmoku (Nara Sci. Academy) Superradiant Phenomena for Spinor Fields in Rotating Black Hole Geometry
Khalid Saifullah (Quaid-i-Azam U.) Thermodynamics of rotating non-Kerr black holes
Bogeun Gwak (*Invited*, Sejong U.) Upper Limit of Radiation from Coalescence of Rotating Hayward Black Holes
Sung-Won Kim (Ewha Womans U.) Wormhole cosmological model
Jin Young Kim (Kunsan Nat'l U.) Wormholes in Einstein-Born-Infeld Gravity

15:40-16:00 *Coffee Break*

P8-2. **16:00-17:50 (10 minutes for overall discussions)**
Chair: Bogeun Gwak (Sejong U.)
Kimitake Hayasaki (*Invited*, Chungbuk Nat'l U.) Detection of gravitational wave emission by supermassive black hole binaries through tidal disruption flare
Medeu Abishev (Al Farabi Kazakh Nat'l U.) Dilatonic dyon black hole solutions in the model with two Abelian gauge fields
Seung Hun Oh (Konkuk U.) Poisson algebra of gauge-invariant quasilocal angular momentum and its asymptotic limit
Deniz Olgu Devecioglu(Sogang U.) Lifshitz black holes in Einstein-Yang-Mills theory
Lunchakorn Tannukij (Hanyang U.) Black holes in dRGT Massive Gravity

17:50-18:00 *Closing Remark*

Abstracts

3 July, Monday

Plenary Presentations

Valeri P. Frolov (U. Alberta): "Remarks on non-singular black holes"

We discuss spherically symmetric metrics which represent non-singular black holes in four- and higher-dimensional spacetimes. We first consider static metrics, which obey the following conditions: (i) Regularity at the center and (ii) Validity of the limiting curvature condition. We describe the Hayward model and its generalizations, which obey these properties. After this we discuss quantum radiation of a massless scalar field from an evaporating spherically symmetric non-singular black hole with finite lifetime. We demonstrate that in a general case there exists a huge outburst of the quantum radiation, emitted from the black hole interior from the domains close to the inner horizon. We discuss a relation of this phenomenon with the mass inflation effect. Finally, we shall make remarks on attempts to solve this problem and to provide self-consistency of the non-singular model in the quantum domain.

Remo Ruffini (ICRANet): "From Supernovae, to Hypernovae to Binary Driven Hypernovae"

Our concept of Induced Gravitational Collapse (IGC paradigm) from an incipient Supernova into a companion Neutron Star, has unlocked the understanding of seven different families of GRBs, indicating the path for the formation of Black Holes in the Universe. An authentic laboratory of relativistic astrophysics has been unveiled in which new paradigms have been introduced in order to advance in the knowledge of the most energetic, distant and complex systems of our Universe. A novel paradigm of the Cosmic Matrix has been introduced which parallel, in a relativistic cosmic level, the concepts of an S Matrix introduced by Feynmann, Wheeler and Heisenberg in the quantum world of microphysics. Here the "in" states are represented by a Neutron Star and a Supernova, the "out" states, generated, in less then a second, by a new Neutron Star and a Black Hole. This novel field of research needs very powerful technological observations in all wavelength ranging from Radio, to Optical, to X and Gamma radiation all the way to ultra-high-energy cosmic rays.

Misao Sasaki (Kyoto U.): "Inflationary massive gravity"

Inflation is a natural platform for modified gravity. Here we present a new massive gravity theory in which the gravitational wave (GW) modes become massive during inflation. Then we discuss its observational signatures, which are particularly intriguing in this coming era of GW physics/astronomy.

Yongmin Cho (Konkuk U.): "Cosmic Production of the Electroweak Monopole"

We discuss the cosmological production and the successive evolution of the electroweak monopole in the standard model, and estimate the remnant monopole density at present universe. We confirm that, although the electroweak phase transition is of the first order, it is very mildly first order. So, the monopole production arises from the thermal fluctuations of the Higgs field after the phase transition, not the vacuum bubble collisions during the phase transition. Moreover, while the monopoles are produced copiously around the Ginzburg temperature $T_G \simeq 59.6~{\rm TeV}$, most of them are annihilated as soon as created. This annihilation process continues very long, untill the temperature cools down to about 29.5 MeV. As the result the remnant monopole density in the present universe becomes very small, of 10^{-11} of the critical density, too small to affect the standard cosmology and too small comprise a major component of dark matter. We discuss the physical implications of our results on the ongoing monopole detection experiments, in particular on MoEDAL, IceCube, ANTARES, and Auger.

P1. Classical Gravity – Classical gravity, Modified gravity, etc.

Jong Hyuk Yoon (Konkuk U.): "Hamiltonian reduction of Einstein's gravity without isometries"

I apply the Hamiltonian reduction procedure to general spacetimes of 4 dimensions in the (2+2) formalism and find privileged spacetime coordinates in which the physical Hamiltonian is expressed in terms of the conformal two metric and its conjugate momentum. Physical time is the area element of the spatial cross-section of null hypersurfaces, and the physical radial coordinate is defined by equipotential surfaces on a given spacelike hypersurface of constant physical time. The physical Hamiltonian is local and positive in the privileged coordinates. I present the complete set of Hamilton's equations and find that they coincide with the Einstein's equations written in the privileged coordinates. This shows that the Hamiltonian reduction is self-consistent and respects general covariance.

Seung Hun Oh (Konkuk U.): "Solution-generating methods of Einstein's equations by (2+2) Hamiltonian reduction"

The purpose of this talk is to demonstrate a new method of generating exact solutions to the Einstein's equations obtained by the Hamiltonian reduction. The key element to the successful Hamiltonian reduction is finding the privileged spacetime coordinates in which physical degrees of freedom manifestly reside in the conformal two-metric, and all the other metric components are determined by the conformal two-metric. In the privileged coordinates the Einstein's constraint equations become trivial; the Hamiltonian and momentum constraints are simply the defining equations of a non-vanishing gravitational Hamiltonian and momentum densities in terms of conformal two-metric and its conjugate momentum, respectively. Thus, given any conformal two-metric, which is a constraint-free data, one can construct the whole 4-dimensional spacetime by integrating the first-order superpotential equations. As the first examples of using Hamiltonian reduction in solving the Einstein's equations, we found two exact solutions to the Einstein's equations in the privileged coordinates. Suitable coordinate transformations from the privileged to the standard coordinates show that they are just the Einstein-Rosen wave and the Schwarzschild solution.

The local gravitational Hamiltonian and momentum densities of these spacetimes are also presented in the privileged coordinates.

Chulmoon Yoo (Nagoya U.): "Gravitational collapse of massless fields in an expanding universe"

Gravitational collapse of nonlinear massless fields(scalar fields, gravitational waves) with a periodic boundary condition in a box is considered. We show the existence of the threshold value of the initial amplitude of the local inhomogeneity for black hole formation. The late time expansion law of the universe is also discussed.

Hyeong-Chan Kim (Korea Nat'l U. Transportation): "Matter Equation of State in General Relativity"

We study how a strong gravity affects the equation of state of matters. For this purpose, we employ a canonical ensemble of classical monoatomic ideal gas inside a box in a Rindler spacetime. The total energy decreases monotonically with the increase of the external gravity representing its attractiveness. It is however bounded below, which is different from that of the Newtonian gravity case. As for the entropy, it decreases with the external gravity in the Newtonian regime. However, in the presence of strong gravity or ultra-relativistic high temperature, the entropy increases with the gravity. This result can be a resolution of the negative entropy problem of the ideal gas in the Newtonian gravity. In the presence of strong gravity, the bottom of the box is very close to the event horizon of the Rindler spacetime mimicking a blackhole and the gas behaves as if it is on an effective two dimensional surface located at the bottom of the box. Investigating the equation of state in the strong gravity regime, the temperature of the system is found to be not a free parameter but to approach a fixed value proportional to the external gravity, which is reminiscent of the Unruh temperature.

Jia-Rui Sun (Sun Yat-Sen U.): "Analogue gravity in BEC and its gravity dual"

Analogue gravity appeared in non-gravitational systems show many features resemble to real gravitational systems such as the appearance of curved geometry and horizon. However, deep dynamical connections between the analogy gravity and the real gravity are still lacking. In this paper, we will show that the analogy gravity formed from the Bose-Einstein condensation (BEC) can be dynamically connected with a real gravitational system by using the approach of the gauge/gravity duality. In this sense, the analogy gravity in BEC is no longer just an analogy.

Alexey Toporensky (Sternberg Astron. Inst.): "A viable compactification scenario in Gauss-Bonnet gravity"

We propose a scenario in which a multidimensional anisotropic Universe starting with some non-zero measure set of initial conditions tends to a situation with three big almost isotropic

dimensions and inner dimensions with constant radius. The stabilization of compact dimensions occures due to negative spatial curvature. In contrast to earlier work on this type of compactification the present scenario does not require exact isotropy of big and inner dimensions.

Jong-Ping Hsu (UMass): "Experiments on the Frequency Dependence of the Deflection of Light in Yang-Mills Gravity"

Yang-Mills gravity is based on 4-dimensional translational gauge symmetry in flat space-time, can be quantized and is consistent with all known experiments. The eikonal equation for a light ray is derived from a version of Maxwells wave equations modified by gravity in the limit of geometric-optics. One obtains a Hamilton-Jacobi equation for the light ray, $G\mu\nu\partial\mu\psi\partial\nu\psi = 0$. Thus, in Yang-Mills gravity, light rays move as if L they were in a curved space-time with the effective metric tensor $G\mu\nu$. The deflection L angle of a light ray by the sun is about 1.53″ for optical frequencies $\approx$ 1014Hz. It is roughly 12% smaller than the usual value 1.75″. However, the experimental data for the bending of light by the sun in optical frequencies have uncertainties of 10-20% due to large systematic errors. If one does not take the geometric-optics limit, the eikonal equation is $G\mu\nu$ [$\partial\mu\psi\partial\nu$ ψ + ($\partial\mu\partial\nu$ ψ)tanψ] = 0. This eikonal equation implies L that the angle of light deflection by the sun should be frequency dependent. All recent accurate measurements of the light deflection angle by the sun have been performed in radio frequencies near 109 Hz, which is too far away from optical frequencies to see this effect. Yang-Mills gravity could be tested by detecting the frequency-dependence of the deflection angle by the sun. We propose carrying out a new experiment using frequencies 1012 Hz which would have an uncertainty of 0.1%, which is technically possible. This experiment could test new implications of Yang-Mills gravity.

Inyong Cho (SeoulTech): "Black Holes in S3 and H3"

The black-hole solutions in closed (S3) and open (H3) spaces are introduced. These black holes are formed in the presence of static perfect fluid. The charged case is also discussed. The spacetime structure, the geodesics, and the stability of the black holes will be discussed.

Laura Marcela Becerra Bayona (Sapienza University of Rome and IcraNet): "SPH simulations of the Induced Gravitational Collapse"

The induced gravitational collapse (IGC) paradigm will be presented. This has been applied to explain the long gamma ray burst (GRB) associated with type Ic supernova, and recently the X-ray flashes (XRFs). The progenitor is a carbon-oxygen core (CO) and a neutron star (NS) tight binary system. The CO core collapses and undergoes a supernova explosion (SN) which triggers the hypercritical accretion onto the NS companion (up to $10^{-2}\,M_\odot s^{-1}$). For the binary driven hypernova (BdHNe), the binary system is enough bound, the NS reach its critical mass, and collapse to a black hole (BH) with a GRB emission characterized by an isotropic energy $E_{iso}>10^{52}$ erg . Otherwise, for binary systems with larger binary separations, the hypercritical accretion onto the NS is not sufficient to induced its gravitational collapse, a X-ray flash (XRF) is produced with Eiso <~

1052 erg. With the SPH code, we're going to simulate the   SN ejecta motion under the gravitational atrattion of the NS in order to identify the binary parameters that limits the BdHNe systems with the XRFs systems.

Atsushi Naruko (Tohoku U.): "Extended vector-tensor theories"

Recently, several extensions of massive vector theory in curved space-time have been proposed in many literatures. In this talk, we consider the most general vector-tensor theories that contain up to two derivatives with respect to metric and vector field. By imposing a degeneracy condition of the Lagrangian in the context of ADM decomposition of space-time to eliminate an unwanted mode, we construct a new class of massive vector theories where five degrees of freedom can propagate, corresponding to three for massive vector modes and two for massless tensor modes. We find that the generalized Proca and the beyond generalized Proca theories up to the quartic Lagrangian, which should be included in this formulation, are degenerate theories even in curved space-time. Finally, introducing new metric and vector field transformations, we investigate the properties of thus obtained theories under such transformations.

J. Rodriguez (ICRANet): "Strong-field gravitational-wave emission in Schwarzschild and Kerr geometries: some general considerations"

We show how the concurrent implementation of the exact solutions of the Einstein equations, of the equations of motion of the test particles, and of the relativistic estimate of the emission of gravitational waves from test particles, can establish a priori constraints on the possible phenomena occurring in Nature. Two examples of test particles starting at infinite distance or from finite distance in a circular orbit around a Kerr black hole are considered: the first leads to a well defined gravitational wave burst the second to a smooth merging into the black hole. We notice a difference between our treatment and the one by Ori and Thorne (2000) which will affect the gravitational wave signal. This analysis is necessary for the study of the waveforms in merging binary systems.

P2: Quantum Gravity – Quantum gravity, Black hole thermodynamics, Black hole entropy, etc.

Sang Pyo Kim (Kunsan Nat'l U.): "Quantum Gravity Effects in Cosmology"

Within the geometrodynamic approach to quantum cosmology, we studied the quantum gravity effects in cosmology. The Gibbons-Hawking temperature is corrected by quantum gravity due to spacetime fluctuations and the power spectrum also gets a quantum gravity effect.

Ehsan Bavarsad (U. Kashan): "Effect of a magnetic field on Schwinger mechanism in de Sitter spacetime"

We investigate the effect of magnetic field background on the scalar QED pair production in de Sitter spacetime (dS). We obtained the pair production rate, which agrees with the known Schwinger result in Minkowski spacetime and with the Hawking radiation in the limit of zero electric field in dS. It implies how the cosmic magnetic field affects on the pair production rate. In addition, using the zeta function regularization scheme we calculate the induced current and examine the effect of magnetic field on the vacuum expectation value of the current operator. We find that in the strong electric E or magnetic B field the current responds as E.B, instead in the infrared regime, it responds as B/E, which leads to a phenomenon of infrared hyperconductivity. Those results of the induced current would be important for discussing the cosmic magnetic field evolution.

Eoin O Colgain (APCTP): "Calibrated Entanglement Entropy"

Entanglement entropy can be determined holographically through the identification of minimal surfaces in Anti-de Sitter (AdS) spacetimes. We report on the application of calibrated cycles for identifying minimal surfaces in both unwarped and warped AdS geometries.

Wonwoo Lee (CQUeST): "Tunneling decay of false vortices with gravitation"

We investigate the tunneling decay of vortices initially trapped in the false vacuum of scalar electromagnetic theory with gravitation in three spacetime dimensions. This paper is the extension of our previous paper, tunneling decay of false vortices, with gravitation. In this study, the false vacuum contains metastable vortex solutions instead of the homogeneous configuration at the initial moment. The vortex solution can have inside true vacuum state and the magnetic flux with the thin-wall in the present of gravitation. We present the numerical solutions for the gauge, scalar field, and metric functions.In the limit of vanishing gravitational coupling we smoothly retrieve our previously found results for the decay of the false vortex.

Taishi Ikeda (Nagoya U.): "Oscillon in Einstein-scalar system with double well potential and its properties"

We focus on the Einstein-scalar system with double well potential. In case of a scalar field with double well potential in Minkowsiki background, it is known that there is a longevity localized solution. This solution is called oscillon. Therefore, when we consider the gravitational collapse of the bubble in the Einstein-scalar system with double well potential, it is possible that oscillon appears as an intermediate state.   In many previous researches, the oscillon in a scalar field with double well potential in Minkowski background has been examined. In this study, we examined the fundamental properties of the oscillon in the Einstein-scalar system with double well potential, and found the several interesting properties.

Hyun Seok Yang (CQUeST): "Dark Matter and Dark Energy from Emergent Spacetime

Picture"

We emphasize that noncommutative (NC) spacetime necessarily implies emergent spacetime if spacetime at microscopic scales should be viewed as NC. The emergent gravity from NC U(1) gauge theory is the large N duality and the emergent spacetime picture admits a background-independent formulation of quantum gravity. We show that dark matter and dark energy arise as a holographic (UV-IR) manifestation of the coherent vacuum of Planck energy condensate. It turns out that emergent gravity distinguishes dark matter and dark energy according to the causal structure of emergent spacetime.

Alex Giacomini (U. Austral de Chile): "On the compatibility of thermodynamic equilibrium conditions with lattice propagators"

In this paper the compatibility is analyzed of the non-perturbative equations of state of quarks and gluons arising from the lattice with some natural requirements for self-gravitating objects at equilibrium: the existence of an equation of state (namely, the possibility to define the pressure as a function of the energy density), the absence of superluminal propagation and Le Chatelier's principle. It is discussed under which conditions it is possible to extract an equation of state (in the above sense) from the non-perturbative propagators arising from the fits of the latest lattice data. In the quark case, there is a small but non-vanishing range of temperatures in which it is not possible to define a single-valued functional relation between density and pressure. Interestingly enough, a small change of the parameters appearing in the fit of the lattice quark propagator (of around 10~\%) could guarantee the fulfillment of all the three conditions (keeping alive, at the same time, the violation of positivity of the spectral representation, which is the expected signal of confinement). As far as gluons are concerned, the analysis shows very similar results. Whether or not the non-perturbative quark and gluon propagators satisfy these conditions can have a strong impact on the estimate of the maximal mass of quark stars.

Muhammad Sharif (U. Punjab): "Study of Generalized Second Law of Thermodynamics in Curvature-Matter Coupling Gravity"

This paper explores the non-equilibrium behavior of thermodynamics at the apparent horizon of isotropic and homogeneous universe model in $f(G,T)$ gravity (G and T represent the Gauss-Bonnet invariant and trace of the energy-momentum tensor, respectively). We construct the corresponding field equations and analyze the first as well as generalized second law of thermodynamics in this scenario. It is found that an auxiliary term corresponding to entropy production appears due to the non-equilibrium picture of thermodynamics in first law. The universal condition for the validity of generalized second law of thermodynamics is also obtained. Finally, we check the validity of generalized second law of thermodynamics for the reconstructed $f(G,T)$ models (de Sitter and power-law solutions). We conclude that this law holds for suitable choices of free parameters.

Yoonbai Kim (Sungkyunkwan U.): "Entropy in Spacetime with Topological Hair"

Global topological solitons of the hedgehog ansatz are added to Schwarzschild black hole or de Sitter spacetime in arbitrary dimensions larger than three, and thermodynamic law is checked at the horizon without additional horizons. All geometric and thermodynamic quantities are varied in the presence of this interacting matter distribution including pressure, however the area law is satisfied in exact form.

Hideki Maeda (Hokkai-Gakuen U.): "Throat quantization of the Schwarzschild-Tangherlini(-AdS) Black Hole"

Adopting the throat quantization pioneered by Louko and Makela, we derive the mass and area spectra for the Schwarzschild-Tangherlini black hole and its anti-de Sitter (AdS) generalization in arbitrary dimensions. We obtain exact spectra in three special cases: the three-dimensional BTZ black hole, toroidal black holes in any dimension, and five-dimensional Schwarzshild-Tangherlini(-AdS) black holes. For the remaining cases the spectra are obtained for large mass using the WKB approximation. For asymptotically flat black holes, the area/entropy has an equally spaced spectrum, as expected from previous work. In the asymptotically AdS case on the other hand, it is the mass spectrum that is equally spaced.

Wontae Kim (Sogang U.): "Origin of Hawking radiation"

The origin of Hawking radiation will be discussed in connection with the firewall issue in the Unruh vacuum.

4 July, Tuesday

Plenary Presentations

Yungui Gong (Huazhong U. Sci. Tech.): "On the polarization of gravitational waves in scalar-tensor theories of gravity"

According to the Newman-Penrose formalism, in general there are six polarizations for general theories of gravity. In particular, the presence of the longitudinal mode means that the theory has all six polarizations. For massive scalar-tensor theory of gravity or f(R) theory, the longitudinal mode presents, but the theory has only three dynamical degress of freedom, it seems that there is inconsistency somewhere. We point out that the Newman-Penrose formalism is not directly applicable to massive mode, the polarization of the massive scalar field is a mix of breathing and longitudinal mode and the longitudinal mode is proportional to the mass, when the mass becomes zero, the mix mode becomes the pure breathing mode which is consistent with the Newman-Penrose formalism. Since the longitudinal mode is proportional to the mass, so it can be detected only in very low frequency band, like the PTA band.

Hyung Mok Lee (Seoul Nat'l U.): "What have we learned from the detection of

gravitational waves?"

The advanced LIGO detected three black hole binary mergers and one candidate during two observing runs. We are still in very early stage of gravitational wave astronomy, but we already learned many new things in astrophysics. The existence of the binary black hole was never established observationally until the LIGO made detections of binary black hole mergers. The binary neutron star merger have been considered to be the most robust source of gravitational waves for LIGO type detectors but such an event has not been detected yet. The masses of the black holes in the binaries before the merger appear to be systematically larger than the typical masses of the black hole candidates in X-ray binaries in the Galaxy. The black hole binary merger detected most recently appear to have spins that are not aligned to the orbital angular momentum. These results pause many fundamental questions regarding the evolution of massive stars, the epoch of formation of the black holes and origin of the compact black hole binaries. We need many more detections with high signal to noise retios in order to answer these questions. In this talk, I will focus on the astrophysical significances of the detected gravitational waves so far and discuss future prospects of gravitational astrophysics with current and future generation of gravitational wave detectors.

Shinji Miyoki (ICRR): "Current Status of KAGRA Gravitational Wave Telescope"

I will talk about the present status and future commissioning plan of KAGRA gravitational wave telescope in Japan.

Wei-Tou Ni (Nat'l Tsing Hua U.): "Gravitational Wave Classification and the Space GW Detection Sensitivities"

After reviewing the gravitational wave (GW) spectral classification. we discuss the sensitivities of GW detection in space aimed at low frequency band (100nHz–100mHz) and middle frequency band (100mHz–10Hz) with the science goals of detecting GWs from (i) Supermassive Black Holes; (ii) Extreme-Mass-Ratio Black Hole Inspirals; (iii) Intermediate-Mass Black Holes; (iv) Galactic Compact Binaries and (v) Relic GW Background. We present an overview on the sensitivity, orbit design, basic orbit configuration, angular resolution, orbit optimization, deployment, time-delay interferometry (TDI) and payload concept of the current proposed GW detectors in space under study. The detector proposals under study have arm length ranging from 1000 km to 1.3×10^9 km (8.6AU) including (a) Solar orbiting detectors
and (b) Earth orbiting detectors.

Ho Jung Paik (U. Maryland): "Superconducting Tensor Gravitational-Wave Detector and Mitigation of Newtonian Noise"

Detection of gravitational waves (GWs) from binary black holes (BHs) by Advanced LIGO has opened a new window of astronomical observation.   Many conceivable sources such as intermediate-mass BH binaries and white dwarf binaries, as well as stellar-mass BH inspiral,

would emit GWs below 10 Hz. It is highly desirable to open a new window for GW astronomy in the infrasound frequency band. A low-frequency tensor detector could be constructed by combining six magnetically levitated superconducting test masses. Such a detector would be equally sensitive to GWs coming from anywhere in the sky, and would be capable of resolving the source direction and wave polarization. I will present a design concept of a new terrestrial GW detector, named SOGRO, which could reach a strain sensitivity of 10^{-19}-10^{-21} Hz$^{-1/2}$ at 0.1-10 Hz. Seismic and Newtonian gravity noises are serious obstacles in constructing terrestrial GW detectors at frequencies below 10 Hz. I will explain how these noises are rejected in SOGRO. I will also discuss the possibility of mitigating the Newtonian noise for advanced laser interferometers by directly detecting and removing it with mini-SOGROs collocated with the interferometer test masses.

P3: Astrophysics - Relativistic astrophysics, Observation, Cosmic rays, GRB, etc.

Medeu Abishev (Al Farabi Kazakh Nat'l U.): "The orbital stability of a test particle motion in the field of two massive rotating bodies"

We investigate a motion of the test body in the restricted three body problem, where two massive bodies have their own rotation. We consider the problem of orbital stability of circular motion of a test body, where disturbances to motion of the test body (in the plane of motion of the second body) from the circular orbital motion of the second body in the field of central body are in order of relativistic corrections to the motion of a test body from the central body.
In the work [1], the orbital stability of the motion of a test body in the restricted three body problem in mechanics of general relativity (GR) is investigated (all bodies have no proper rotation). As a result[1], it is shown that the motion of the test body in the plane of the orbit of the two body is stable when orbit of the test body is circular. In this work, we consider the case when massive bodies have their own rotation. We found the evolution equation of motion for the test (third) body, which describes the average change of its orbital momentum. To do that, we'll study the evolutionary equations of motion by the asymptotic adiabatic theory, through the process of averaging of the corresponding equations using the vector elements M (the orbital moment) and A (the Laplace vector).
References
[1] Abishev M.E., Toktarbay S., Zhami B.A. On the Stability of Circular Orbits of a Test Body in the Restricted Three-Body Problem in GR Mechanics. Gravitation and cosmology, 20. (2014)

Giovanni Battista Pisani (Sapienza University of Rome and ICRANet): "The 1st ICRANet Catalog of Binary-driven HyperNovae"

In a series of recent publications, scientists from ICRANet led by Remo Ruffini have reached a novel comprehensive picture of "gamma-ray bursts" (GRBs) thanks to their development of a series of new theoretical approaches. Among those, the "induced gravitational collapse" paradigm explains a class of energetic, long-duration GRBs associated with Ib/c supernovae, recently named "binary-driven hypernovae" (BdHNe). Thanks to this novel theoretical and observational understanding, it was possible for ICRANet scientists to build the 1st BdHNe

catalog, composed by the 344 BdHNe identified up to the end of 2016.

Gregory Vereshchagin (ICRANet): "Cosmic horizon for GeV sources and photon-photon scattering"

Propagation of ultra high energy particles in the Universe is reviewed. Particular emphasis is given to the photon-photon scattering process.

Naser Ahmadiniaz (Institute for Basic Science): "Master formulas for the dressed scalar propagator in a constant field"

The worldline formalism has previously been used for deriving compact master formulas for the one-loop N-photon amplitudes in both scalar and spinor QED, and in the vacuum as well as in a constant external field. For scalar QED, there is also an analogous master formula for the propagator dressed with N photons in the vacuum. Here, we extend this master formula to include a constant field. The two-photon case is worked out explicitly, yielding an integral representation for the Compton scattering cross section in the field suitable for numerical integration in the full range of electric and magnetic field strengths.

Mehbub Khan (UMass): "Baryonic Force for Accelerated Cosmic Expansion and Generalized Yang-Mills Symmetry"

Based on conserved baryon number (or charge) and the generalized Yang-Mills symmetry, we discuss a new baryonic gauge field and its linear potential for two point-like baryon charges. The force between two baryons is repulsive, extremely weak, but independent of distance. Only in the later stage of cosmic evolution, when two baryonic galaxies are separated by an extremely large distance, the baryonic force can overcome their gravitation attractive force. Thus, this provides a gauge-field-theoretic understanding of the late-time accelerated cosmic expansion. The general forces between two big objects with baryon charges are calculated. The trajectories of two baryonic objects are also numerically calculated and displayed.

Myeong-Gu Park (Kyungpook Nat'l U.): "Accretion onto Black Holes with Outflow"

Recent works on the accretion flow onto black holes show that the accretion rate of the flow can be significantly different from the Bondi mass accretion rate. In addition, hot accretion flows are expected to develop outflows. We discuss the implications of the outflow in terms of the accretion rate and energetics as well as black hole growth.

Sehrish Iftikhar (Lahore College for Women U.): "Particle Dynamics Around a Charged Black Hole"

Black holes are the most important predictions of general relativity, which are the end

product of gravitational collapse. The study of geodesics reveals geometrical properties of such a curved spacetime. A physical particle follows either null or timelike geodesics. We explore the particle motion near a charged black hole. In this context, we study the stability of orbits through effective potential and examine the effect of charge on the motion of particles.

Mohammad Wali Hossain (APCTP): "Quintessential inflation: A unified scenario of inflation and dark energy"

In quintessential inflation, inflation and late time acceleration are described by a single scalar field. Such a scenario will be discussed with canonical and noncanonical scalar fields. The scalar field behaves as a inflaton field during inflation and as a quintessence field during late time. Comparison with recent Planck data will also be done.

Daria Primorac (ICRANet & Sapienza U. Roma): "Analysis of the GRB110731A within the fireshell model"

Long gamma-ray burst GRB 110731A was bright enough to cause Autonomous Repoint Request when it triggered the GBM onboard Fermi spacecraft. Swift Burst Alert Telescope was also triggered and immediately slew into the position. Many more observatories responded with prompt follow-up observation. As a result, provided data ranges from optical to gamma rays, covering few hundred seconds. This gives an unique opportunity to study the burst and identify its properties within the IGC paradigm, using the fireshell model. In the fireshell model, description of the GRB acceleration process invokes the dynamics of an optically-thick $e^{+}e^{-}$ plasma, which gradual annihilation causes its expansion and self acceleration. The dynamics of the fireshell up to the transparency point is fully described by the total energy of the plasma E and the barion load B. We determine these quantities by performing the time-resolved spectral analysis of the GRB 110731A light curve. We proceed with the light curve simulation from which we deduce the CBM density values and it's inhomogeneities. Finally, time-integrated spectra of the simulated light curve was compared with the spectra observed by NaI and BGO detectors onboard Fermi spacecraft.

Yongsoo Jho (Yonsei U.): "Search for Sphaleron from the Ultra-High-Energy cosmic rays and neutrinos"

We study the Ultra High Energy Cosmic Rays (UHECR) as a probe of the sphaleron processes. Our focuses are on the high energy proton-proton and neutrino-nucleon collisions for the cosmic ray observatories such as TA and Pierre Auger. With the attenuation and regeneration effects due to generic high-multiplicity processes such as the electroweak sphaleron and the microscopic Black hole, constraints from the neutrino telescopes, IceCube and Super-Kamiokande, are also discussed.

Rahim Moradi (Sapienza U. of Rome and ICRANet): "Charged Cosmological Black holes"

The cosmological black holes are black holes living not in an asymptotically flat universe but

in an expanding spacetime. They have a rich dynamics in particular for their mass and horizon. In this article we perform a natural step in investigating this new type of black hole: we consider the possibility of a charged cosmological black hole. We derive the general equations of motion governing its dynamics and report a new analytic solution for the special case of the charged Lemaitre-Tolman- Bondi equations of motion that describe a charged cosmological black hole. We then study various relevant quantities for the characterization of the black hole such as the C-function, the effect of the charge on the black hole flux and the nature of the singularity. We also perform numerical investigations to strengthen our results.

Julio David Melon Fuksman (Sapienza U. Rome & ICRANet): "Simulation of an electron-positron plasma in the context of the IGC paradigm"

The BdHN model has been introduced in the last years, to explain a subfamily of gamma-ray bursts (GRBs) with energies Eiso>= 10^{52} erg associated with type Ic supernovae. Such BdHNe have as progenitor a tight binary system composed of a carbon-oxigen core (COcore) and a neutron star (NS) undergoing an induced gravitational collapse (IGC) to a black hole (BH), triggered by the COcore explosion as a supernova (SN). This collapse produces an optically-thick e^+e^- plasma, part of which expands acceleratedly and impacts the SN ejecta at r~10^{10}cm. This process is here considered as a candidate for the production of X-ray flares, which are frequently observed following the prompt emission of GRBs. In this preliminary work we simulate the evolution of the e^+e^- plasma as it interacts with the SN ejecta, and estimate the subsequent photon emission.

P4: Gravitational Waves – Gravitational wave astronomy/astrophysics, Numerical relativity, etc.

Dong-Hoon Kim (Seoul Nat'l U.): "Gravitational waves with effects of radiation reaction"

In General Relativity, it is known that a particle moving in curved spacetime undergoes a force which results from the interaction of the particle with its own field; namely, a self-force or radiation reaction force. In this talk, I discuss the effects of the self-force on the orbital motion of a small object about a black hole: e.g. a test particle orbiting a small black hole (of about a solar mass), a small black hole (of about a solar mass) orbiting a supermassive black hole (of about a million solar masses), etc.. This study can be applied to design accurately the theoretical gravitational waveforms from binary systems consisting of a small black hole and a supermassive black hole (so called extreme-mass-ratio binaries), which are possible target sources of gravitational waves for eLISA detection.

Toshinori Matsui (KIAS): "Gravitational waves from the first order electroweak phase transition in the Z_3 symmetric singlet scalar model"

Among various scenarios of baryon asymmetry of the Universe, electroweak baryogenesis is directly connected with physics of the Higgs sector. We discuss spectra of gravitational

waves which are originated by the strongly first order phase transition at the electroweak symmetry breaking, which is required for a successful scenario of electroweak baryogenesis. In the Z_3 symmetric singlet scalar model in which the dark matter candidate is included, the significant gravitational waves are caused by the multi-step phase transition. We show that the model can be tested at future gravitational wave interferometers such as eLISA and DECIGO. This talk is based on a project collaborated with Zhaofeng Kang and Pyungwon Ko.

Hyung Won Lee (Inje University): "TaylorF2 CBC waveform with eccentricity corrected phase"

We developed eccentric corrected TaylorF2 waveform and performed to check determinability for eccentricity usign this waveform.

Luis Gabriel Gómez (Sapienza U. Rome & ICRANet): "Gravitational wave emission versus dark matter dynamical friction in the evolution of compact star binaries"

The measured orbital period decay of relativistic compact star binaries, with characteristic orbital periods ~ 0.1~days, is explained with very high precision by the gravitational wave (GW) emission of an inspiraling binary in vacuum predicted by general relativity. However, the binary gravitational binding energy is also affected by an usually neglected phenomenon, namely the dark matter dynamical friction (DMDF) produced by the interaction of the binary components with their respective DM gravitational wakes. Therefore, the inclusion of the DMDF might lead to a binary evolution which is different from a purely GW-driven one. The entity of this effect depends on the orbital period and on the local value of the DM density, hence on the position of the binary in the Galaxy. We evaluate the DMDF produced by three different DM profiles: the Navarro-Frenk-White (NFW) profile, the non-singular-isothermal-sphere (NSIS) and the fermionic Ruffini-Arg\"uelles-Rueda (RAR) model. We first show that indeed, due to their Galactic position, the GW emission dominates over the DMDF in the NS-NS, NS-WD and WD-WD binaries for which measurements of the orbital decay exist. Then, we evaluate the conditions (i.e. orbital period and Galactic location) under which the effect of DMDF on the binary evolution becomes comparable to, or overcomes, the one of the GW emission. In the case of NFW profile, we find that this occurs for orbital periods longer that 18~days for 1.3--0.2 $M_\odot$ NS-WD binaries and around 30~days for both 1.3--1.3~$M_\odot$ NS-NS binaries and 0.25--0.50~$M_\odot$ WD-WD binaries, located at distances 0.1--1.5~kpc from the Galactic center. For closer distances to the Galactic center, the DMDF effect increases and the above critical orbital periods become interestingly shorter.

Gihyuk Cho (Seoul Nat'l U.) Theory of Gravitational radiation

To detect GW in high precision we need to have highly accurate waveform of GWs. I pay attention to this problem in analytic method, specially using post-Newtonian theory. I will show some results and ongoing projects.

Jinn-ouk Gong (APCTP): **"Induced gravitational waves"**

We present the induced gravitational waves during matter dominated epoch sourced by not only the quadratic combinations of the linear scalar-scalar perturbations, but also tensor-tensor and scalar-tensor perturbations that were not known before. These contributions can be significant in certain frequency windows.

Hisaaki Shinkai (Osaka Inst. Tech.): **"Gravitational waves from merging intermediate-mass black holes"**

Based on a dynamical formation model of a supermassive black hole (SMBH), we estimate the expected observational profile of gravitational waves at ground-based detectors, such as KAGRA or advanced LIGO/ VIRGO.   We estimate the number density of galaxies from the halo formation model and estimate the number of BH mergers from the giant molecular cloud model assuming hierarchical growth of merged cores. At the designed KAGRA (and/or advanced LIGO/VIRGO), we find that the BH merger of its total mass $M \sim 60$ Msun is at the peak of the expected mass distribution. With its signal-to-noise ratio $r = 10$ (30), we estimate the event rate $R \sim 200$ (20) per year in the most optimistic case, and we also find that BH mergers in the range $M < 150$ Msun are $R > 1$ per year for $r = 10$. Thus, if we observe a BH with more than 100 Msun in future gravitational-wave observations, our model naturally explains its source. [ApJ 835 (2017)276]

Sunghoon Jung (*Invited,* Seoul Nat'l U.): **"Angular Resolutions of Mid-Frequency Gravitational Wave Detectors"**

Opening up the mid-frequency band of $f=0.1$-10 Hz is a next important goal of gravitational-wave physics. In particular, this band has an ideal balance between gravitational-wave lifetime and frequency for sub-degree angular resolution. We demonstrate how well a mid-frequency detector can localize compact binary mergers and discuss this ideal balance. Although we use an atom interferometer as an example detector in this band, any space detectors can generally achieve similar performance. But terrestrial detectors in this band would be swamped by gravity gradient noise.

Gungwon Kang (KISTI): "Structural analysis of the SOGRO platform"

SOGRO is a conceptual design for a superconducting low-frequency gravitational wave telescope. Its platform has three arms whose ends support six superconducting test masses. Among many required properties for the platform to work well as a main part of the detector, vibrational noises should be outside of the frequency bandwidth in interest (e.g., 0.1~10Hz). We report preliminary results of structural analyses in finite element method for several platform configurations including 30m and 50 m arm lengths.

Dawoo Park (Seoul Nat'l U.): **"Black Hole Binaries Dynamically Formed in Globular**

Clusters"

Globular clusters (GCs) are an ideal environment to form black hole (BH) binaries. BHs in GC quickly segregate into central region through dynamical friction, then BH-BH binaries can form under high densiy environment. Subsequent interactions of the binaries with other stars or BHs make the binaries tighter. The tightening of binaries means the release of binding energy in the form of kinetic energies of binaries and intereacting stars. Eventually binaries can be ejected from the GC. We investigate properties of BH binaries using direct N-body simulations. We considered the GC with various BH mass population, and studied properties of binaries that are ejected from the clusters. Our results show higher mass BHs are more likely to form BH binaries. The mass ratios of dynamically formed binaries are found to be close to one. The rate of BH binary merger rate density is estimated to be about 10 per year per cubic Gpc, which is consistent with the current estimation based on the detected events by LIGO so far. We further note that the progenitor of the latest BH merger event GW170104 may have been a dynamically formed binary system because the at least the spin axis of one BHs appeared to be non-aligned with the angular momemtum axis.

HanGil Choi (Seoul Nat'l U.): "Finding Quasi-Spherical Orbit Initial condition of Black Hole Binary using Effective-One-body model"

We are developing a iterative method for eccentricity reduction of compact binary inspiral based on the Effective-One-Body model[M. Pürrer et al. Phys. Rev. D. 85, 124051(2012)]. We improve the original method in using more state-of-the-art version of the EOB model, SEOBNRv4[A. Bohé et al. Phys. Rev. D. 95, 044028(2017)]. To cover spinning, precessing binary black hole configurations by SEOBNRv4, we adopt precessing orthonormal frame when integrating equation of motion of EOB instead of cartesian frame.

P5: Inflation and Dark Matter

Hyun Min Lee (Chung-Ang U): "Flattening the inflaton potential beyond the minimal gravity"

We consider inflation models at large field values, motivated by low energy physics to describe the Higgs phenomena such as the SM Higgs mechanism or the B-L symmetry for generating neutrino masses. We show that non-minimal coupling to gravity and/or modified gravity for large inflaton energy density play a crucial role in flattening the inflaton potential at large field values, being consistent with observed CMB data.

Aditya Aravind (APCTP): "Higgs Portal Inflation with Fermionic Dark Matter"

We discuss an inflationary model involving a gauge singlet scalar field and fermionic dark matter added to the standard model. Either the Higgs boson or the singlet scalar could play the role of the inflaton, and slow roll is realized through its non-minimal coupling to gravity. The effective scalar potential is stabilized by the mixing between the scalars as well as the coupling with the fermionic field. Mixing of the two scalars also provides a portal to dark

matter. Constraints on the model come from collider searches, dark matter relic density and direct detection and impose a constraining relationship on the masses of dark matter and scalar fields. Inflationary predictions are generically consistent with current Planck data.

Echal Chang (Chungnam Nat'l U.): "Toward a more realistic Randall-Sundrum Brane World"

In the original version of Randall-Sundrum Brane World scenario, they demonstrated the gravity localization/graviton trappon a "Poincare-invariant" 4-dim. Brane world. This is, however, a too much simplification as the "Poincare-invariant" 4-dim. Brane world can only be a cold, empty universe which obviously lacks its realistic, practical nature. We[Hongsu Kim; KASI], therefore, relax this original set-up to a more realistic/practical set-up Where the graviton still gets trapped on a "Ricci-flat" 4-dim. Brane world that, now, may allow for realistic structures like black holes or homogeneous, anisotropic cosmology [i.e., expanding universe] which are, particularly, solutions to the vacuum Einstein equation.

Zhu Yi (Huazhong U. Sci. Tech.): "Nonminimal coupling and inflationary attractors

We show explicitly how the T model, E model, and Hilltop inflations are obtained from the general scalar-tensor theory of gravity with arbitrary conformal factors in the strong coupling limit. We argue that ξ attractors can give any observables ns and r by this method. The existence of attractors imposes a challenge to distinguish different models.

Yongwan Gim (Sogang U.): "On the thermodynamic origin of the initial radiation energy density in warm inflation"

In warm inflation scenarios, radiation always exists, so that the radiation energy density is also assumed to be finite when inflation starts. To find out the origin of the non-vanishing initial radiation energy density, we revisit thermodynamic analysis for a warm inflation model and then derive an effective Stefan-Boltzmann law which is commensurate with the temperature-dependent effective potential by taking into account the non-vanishing trace of the total energy-momentum tensors. The effective Stefan-Boltzmann law shows that the zero energy density for radiation at the Grand Unification epoch increases until the inflation starts and it becomes eventually finite at the initial stage of warm inflation. By using the above effective Stefan-Boltzmann law, we also study the cosmological scalar perturbation, and obtain the sufficient radiation energy density in order for GUT baryogenesis at the end of inflation.

Dong Woo Kang (Yonsei U.): "Electroweak Kaluza-Klein Dark Matter"

In models with universal extra dimensions (UED), the lightest Kaluza-Klein excitation of neutral electroweak gauge bosons is a stable, weakly interacting massive particle and thus is a candidate for dark matter thanks to Kaluza-Klein parity. We examine concrete model realizations of such dark matter in the context of non-minimal UED extensions. The

boundary localized kinetic terms for the electroweak gauge bosons lead to a non-trivial mixing among the first Kaluza-Klein excitations of the $SU(2)_W$ and $U(1)_Y$ gauge bosons and the resultant low energy phenomenology is rich. We investigate implications of various experiments including low energy electroweak precision measurements, direct and indirect detection of dark matter particles and direct collider searches at the LHC. Notably, we show that the electroweak Kaluza-Klein dark matter can be as heavy as 2.4 TeV, which is significantly higher than 1.3 TeV as is indicated as an upper bound in the minimal UED model.

Jae-Weon Lee (Jungwon U.): "Brief History of Ultra-light Scalar Dark Matter Models"

I review the brief history of the scalar field dark matter model also known as fuzzy dark matter, BEC dark matter, wave dark matter, or ultra-light axion. In this model ultra-light scalar dark matter particles with mass $m = O(10^{-22})eV$ condense in a single Bose-Einstein condensate state and behave collectively like a classical wave. Galactic dark matter halos can be described as a self-gravitating coherent scalar field configuration called boson stars. At the scale larger than galaxies the dark matter acts like cold dark matter, while below the scale quantum pressure from the uncertainty suppresses the smaller structure formation so that it can resolve the problems of the conventional cold dark matter model.

Sichun Sun (National Taiwan U.): "New views on dark matter from modified gravity"

We discussed a scenario that the dark matter emerge from higher dimensional embedding of the 4-dimensional spacetime, such that the dark matter density can be determined by the Hubble constant, local gravity and the visible matter content. Our approach may give a new viewpoint for Verlinde's emergent gravity from higher dimensions. We also comment on the some phenomenological implications of this type of models, including gravitational wave solutions and MOND limit.

Yasuhiro Yamamoto (Yonsei U.): "Protophobic Light Vector Boson as a Mediator to the Dark Sector"

The observation of a protophobic 16.7 MeV vector boson has been reported by a ^{8}Be nuclear transition experiment. Such a new particle could mediate between the Standard Model and a dark sector, which includes the dark matter. In this paper, we show some simple models of the dark matter which satisfy the thermal relic abundance under the current experimental bounds from the direct and the indirect detections. In a model, it is found that an appropriate self-scattering cross section to solve the small scale structure puzzles can be achieved.

Seodong Shin (Yonsei U.): "Non-minimal dark matter search in dark matter colliders"

I will discuss the relativistic collisions of dark matter in non-minimal dark sector with the targets in current and future neutrino detectors such as Super/Hyper Kamiokande and DUNE,

which induces cascade signals in a scenario like inelastic boosted dark matter.

Soo Min Choi (Chung-Ang U): "SIMP dark matter and its cosmic abundances"

Thermal production of light dark matter with sub-GeV scale mass can be attributed to 3→2 self-annihilation processes. We consider the thermal average for annihilation cross sections of dark matter at 3→2 and general higher-order interactions. A correct thermal average for initial dark matter particles is important, in particular, for annihilation cross sections with overall velocity dependence and/or resonance poles. We apply our general results to benchmark models for SIMP dark matter and discuss the effects of the resonance pole in determining the relic density.

Yoo-Jin Kang (Chung-Amg U): "Forbidden Channels and SIMP Dark Matter"

We consider a thermal production of self-interacting dark matter in models with gauged Z3 symmetry. In particular, the 2-to-2 forbidden channels in the dark sector assist producing a SIMP dark matter from thermal freeze-out and extend the parameter space for a correct relic density. We show that dark photon and/or dark Higgs should be relatively light for unitarity and for forbidden channels to work. We identify the constraints on the parameter space of dark matter self-interaction and mass in the case that forbidden channels are important in determining the relic density.

5 July, Wednesday

Plenary Presentations

Bum-Hoon Lee (Sogang U.): "Higher Curvature Gravity"

We consider the properties of the gravity theories with higher curvature term, especially the Gauss-Bonnet term. The black holes carry the scalar charge, which is determined by the mass. There also exists the minimum mass for the existance of the black hole. We also study the cosmological implication by studying the role of the Gauss-Bonnet term during the inflation.

Jun'ichi Yokoyama (U. Tokyo): "Creation of the inflationary universe from a black hole?"

First I revisit the derivation of the Hawking-Moss transition rate between two de Sitter spacetimes. Using the static coordinates I show that the Euclidean action is entirely determined by the contribution of de Sitter entropy. I then discuss creation of a new inflationary universe from an evaporating black hole which produces high energy radiation around it due to the Hawking radiation. A thin wall bubble created around a black hole may tunnel to produce another universe.

Il Hung Park (Sungkyunkwan U.): "Status and Perspectives in GRB observations"

We present the status of and a few selected topics of GRB observations in space and ground are presented. The important issues for future observations will be discussed as well.

Kei-ichi Maeda (Waseda U.): "Inflation and Disformal Transformation"

The accelerating expansion of the Universe is a big mystery in modern cosmology. To solve it, modified gravity theories have been proposed. In this talk, we show that a disformal transformation is useful to analyze such complicated models, especially a slow-roll inflationary scenario. We present some examples, i.e., three Higgs inflationary models (the original Higgs inflation, the new Higgs inflation and the hybrid Higgs inflation).

Jorge Armando Rueda (ICRANet): "On the rate and on the gravitational wave emission of short and long GRBs"

GRBs, traditionally classified as "long" and "short", have been often assumed, till recently, to originate from a single black hole (BH) with an ultrarelativistic jetted emission. There is evidence that both long and short bursts have as progenitors merging and/or accreting binaries, each composed by a different combination of carbon-oxygen cores (CO core), neutron stars (NSs), BHs and white dwarfs (WDs). Consequently, the traditional long bursts have been sub-classified as (I) X-ray flashes (XRFs), (II) binary-driven hypernovae (BdHNe), and (III) BH-supernovae (BH-SNe). They are framed within the induced gravitational collapse (IGC) paradigm which envisages as progenitor a tight binary composed of a CO core and a NS or BH companion. The SN explosion of the CO core, originating a new NS (ν NS), triggers a hypercritical accretion process onto the companion NS or BH. If the accretion is not sufficient for the NS to reach its critical mass, an XRF occurs, leading to a ν NS-NS system. Instead, when the BH is already present or formed by the hypercritical accretion, a BdHN occurs, leading to a ν NS-BH system. Similarly, the traditional short bursts, originating in NS-NS mergers, are sub-classified as (IV) short gamma-ray flashes (S-GRFs) and (V) short GRBs (S-GRBs), respectively when the merging process does not lead or leads to BH formation. Two additional families are (VI) ultra-short GRBs (U-GRBs) and (VII) gamma-ray flashes (GRFs), respectively formed in ν NS-BH and NS-WD mergers. We use the estimated occurrence rate of the above sub-classes to assess the gravitational wave emission in the merging process and its detectability by Advanced LIGO, Advanced Virgo, eLISA, and resonant bars.

6 July, Thursday

Plenary Presentations

Yaakov (Yasha) Neiman (Perimeter Institute): "Towards a working model of causal-patch physics in dS/CFT"

Quantum gravity with de Sitter (dS) asymptotics is a major open question, both conceptually and technically. One possible avenue is to adapt the holographic framework of AdS/CFT to

the de Sitter setup. Working models of dS/CFT are hard to come by, but one such model has been found in 4 dimensions - a duality between higher-spin gravity in the bulk and a free vector model on the boundary. I will describe my attempts, within this model, to bridge the gap between the CFT at future de Sitter infinity and physics in the causal patch of a bulk observer. In the process, I will present some new results on the relationship between holography and twistor theory.

Rong-Gen Cai (Chinese Academy of Science): "Standard sirens and dark sector with Gaussian process"

Gravitational wave from a binary system is a standard siren to probe cosmological evolution history. In this talk, I will first show how to the reconstruction of dark matter and dark energy by using the SINa union 2.1 data, as an application of the Gaussian process. Then I will apply the method to reconstruct the interaction between dark matter and dark energy from mock data from Lisa and to show the constraint ability on the cosmological parameters with the mock data from Einstein Telescope.

Daniel Grumiller (Vienna U. of Technology): "Soft Heisenberg Hair"

Soft hair"" refers to zero energy excitations in the near horizon region of black holes or cosmologies, advocated by Hawking, Perry and Strominger. I review recent results on soft hair in 3 spacetime dimensions. The near horizon symmetry algebra is surprisingly simple, namely infinite copies of the Heisenberg algebra. The results are fairly universal and allow a semi-classical construction of microstates for BTZ black holes, whose degeneracy correctly accounts for their Bekenstein-Hawking entropy.

Jeong-Hyuck Park (Sogang U.): "Stringy Gravity & solution to dark matter problem"

Recent development in string theory has led to the extension of General Relativity, i.e. Stringy Gravity. It postulates the entire closed string massless sector to be geometric and thus gravitational. I will first introduce the mathematical foundation and then discuss a solution to dark matter/energy problems. In terms of R/(MG), i.e. the dimensionless radial variable normalized by mass, Stringy Gravity agrees with General Relativity near infinity, but modifies it at short distance. At far short distance, gravitational force can be even repulsive. These may solve the dark matter and energy problems, as they essentially arise from small R/(MG) observations: far distance divided by much heavier mass.

Chiang-Mei Chen (Nat'l Central U.): "Pair Production of Scalar Dyons in Kerr-Newman Black Holes"

We study the spontaneous pair production of scalar dyons in the near extremal dyonic Kerr-Newman (KN) black hole, which contains a warped AdS_3 structure in the near horizon region. The leading term contribution of the pair production rate and the absorption cross section ratio are also calculated using the Hamilton-Jacobi approach and the thermal

interpretation is given. In addition, the holographic dual conformal field theories (CFTs) descriptions of the pair production rate and absorption cross section ratios are analyzed both in the J-, Q- and P-pictures respectively based on the threefold dyonic KN/CFTs dualities.

P3: Astrophysics - Relativistic astrophysics, Observation, Cosmic rays, GRB, etc.

Anna Pollmann (*Invited*, U. Wuppertal): "Searches for magnetic monopoles with IceCube"

Particles that carry a single magnetic charge are proposed by various theories which go beyond the Standard Model of particle physics. The expected mass of the magnetic monopoles varies depending on the theory describing its origin, but generally the monopole mass exceeds those possible by direct creation in accelerators by far. In large scale magnetic fields, magnetic monopoles can gain kinetic energy up to relativistic velocities. IceCube is a high energy neutrino detector using the clear ice close to the South Pole as the detection medium. Relativistic magnetic monopoles induce Cherenkov or luminescence light production while passing through the ice. Depending on the monopole kinetic energy, light can also be induced by secondary particles which result from ionization or the proposed catalysis of nucleon decay by magnetic monopoles. A review of possible detection methods and the limits for the monopole flux over a broad parameter range are described for the IceCube Neutrino Observatory, the most sensitive detector available for magnetic monopole searches.

Insik Hahn (Ewha Womans U.): "Nuclear astrophysics experiments related to the rp-process using rare isotope beams"

Nuclear astrophysics experiments using radio isotope beams have been very successful to understand some of the important reactions related to explosive hydrogen burning process. Some reactions such as $^{14}O(a,p)^{17}F$, $^{15}O(a,g)^{19}Ne$, $^{18}F(p,a)^{15}O$ are important for studying the breakout mechanism from the HCNO cycle to the rp process. The above reactions were investigated using radioactive ion beams at the Center for Nuclear Study in RIKEN. We plan to study the structures of neutron-deficient ^{66}Se and ^{56}Zn relevant to the rp-process at RIKEN. Korea will build the radioactive ion beam accelerator facility called RAON. This new facility is expected to carry out nuclear astrophysics experiments for understanding explosive nuclear synthesis in stellar sites such as X-ray bursts and novae as well as the origin of proton-rich elements in the rp-process. Current activities and prospects of nuclear astrophysics in Korea will be discussed.

Myung-Ki Cheoun (*Invited*, Soongsil U.): "Modified Gravity in Nuclear Astrophysics and Big Bang Nucleosynthesis"

We discuss roles of gravitation in the compact cosmological objects like neutron star because equations of state turn out to be so sensitive on the gravity and the modified gravity. In this

talk, we also make a brief summary about the equations of state which is now widely and intensively discussed in the nuclear astrophysics. Finally, the Big-Bang nucleosynthesis will be shown to be a useful test of the gravitation as well as the new physics beyond the standard model.

Chang-Hwan Lee (Pusan Nat'l U.): "Strangeness in Neutron Star Cooling"

I this talk, I will review our recent work on the thermal evolution of neutron stars in the resence of hyperons or kaons in the core. Our results indicate that the nucleon and hyperon direct Urca processes play crucial roles for macroscopic cooling behavior of neutron stars. There are possibilities that the neutron star equation of states with hyperons and kaons are consistent with both mass and temperature observations. However, requirement of the fine-tuning of the parameters to explain the observations is still an open problem.

Hyun Kyu Lee (Hanyang U.): "Hadronic matter with emergent symmetries at high density"

The neutron stars with high core density have been considered among the most relevant objects for the formaton of GRB centers and gravitational radiations. It is expected that the detection of GRBs and gravitational radiations provide us the opportunity of constraing the EoS of extreme high dense hadronic matter at the core of neutron stars. The possibilty of emergent scale symmetry along with local flavor symmetry will be discussed in relation to EoS with   GRB and gravitational wave detections.

Hongjun An (*Invited,* Chungbuk Nat'l U.): "Studying intrabinary shock emission in pulsar binaries"

We present our studies of intrabinary emission of the gamma-ray binary 1FGL J1018.6-5856. We measure the light curve and phase-resolved spectra, and model them using an intrabinary shock emission model. The model assumes a slow and a fast population of particles accelerated in the shock, and computes the high-energy emission spectra produced by synchrotron and self-Compton processes of the high-energy particles in the shock. Fitting the data with the model allows us to constrain the binary geometry, most importantly the inclination angle. This model can be used for other pulsar binaries and help to determine the inclination angle of the binary hence the mass of the neutron star.

Dong-Hoon Kim (Seoul Nat'l U.): "Pulsar radiation with general relativistic effects"

We consider a magnetic dipole model of a pulsar and investigate general relativistic effects on electromagnetic radiation from the pulsar. The general relativistic modifications should be found applicable to many well-known issues in pulsar astronomy. Among other things, the modifications of Goldreich-Julian model and subpulse drift would be challenging issues of significant interest. The electromagnetic fields in the pulsar magnetosphere are computed by solving Maxwell's equations defined in the strongly curved spacetime around the pulsar, hence containing the properties of the strong gravitational effect. In combination with this

effect, the effects from rotation and obliqueness of the pulsar are investigated so that we work out general-relativistic extensions of Goldreich-Julian model and subpulse drift.

Alexander Yushchenko (Sejong University): "Velocity distribution in the clusters of galaxies"

Using SLOAN survey we analyzed the distribution of galaxy redshift in five hundred clusters of galaxies. The mean profiles were constructed for different redshift intervals. It was found that rich clusters have members with discordant redshifts.The   possible interpretations are discussed.

Hisaaki Shinkai (Osaka Inst. Tech.): "Nonlinear dynamics in Gauss-Bonnet gravity"

We numerically investigated how the dynamics depends on the dimensionality and how the higher-order curvature terms affect to singularity formation in two models: (i) perturbed wormhole in spherically symmetric space-time, and (ii) colliding scalar pulses in planar space-time. Our numerical code uses dual-null formulation, and we compare the dynamics in 5, 6 and 7-dimensional General Relativity and Gauss-Bonnet (GB) gravity. Both results suggest that GB correction works for avoiding singularity formation in their dynamics. We also found that the existence of the trapped surface in GB gravity does not directly indicates formation of a black hole.

Andreas Krut (ICRANet): "Dark matter and galactic structures"

A self-gravitating system composed of massive fermions in spherical symmetry is considered. We solve the Einstein equation for a thermal and semi-degenerate fermionic gas considered as a perfect fluid in hydrostatic equilibrium. No additional interaction is assumed for the fermions besides their fulfilling of quantum statistics and the relativistic gravitational equation. Within this more general approach a new family of density profiles arises which explains DM halo constraints of the Galaxy and provides at the same time an alternative to the central black hole scenario. Further, we show predictions of that model for galactic structures from dwarf spheroidals to big ellipticals in agreement with observations.

P6: Gravity in String Theory

Jae-Hyuk Oh (Hanyang U.): "Phase transition in anisotropic holographic superfluids with arbitrary z and α"

Einstein-dilaton-U(2) gauge field theory is considered in a spacetime characterised by α and z, which are the hyperscaling violation factor and the dynamical critical exponent respectively. We obtain the critical values of chemical potential μ_c that is defined on its boundary dual fluid and derives phase transition from spatially isotropic to anisotropic phase for the various values of the α and z. To do so, we first apply Sturm-Liouville theory and estimate the upper

bounds of the critical values of the chemical potential. We also employ a numerical method in the ranges of $1 \leq z \leq 4$ and $0 \leq \alpha \leq 4$ to check if the Sturm-Liouville method correctly estimates the critical values of the chemical potential. It turns out that the two methods are agreed within 10 percent error ranges. Finally, we compute free energy density of the dual fluid by using its gravity dual and check if the system shows phase transition at the critical values of the chemical potential µc for the given parameter region of α and z. Interestingly, it is observed that the anisotropic phase is more favoured than the isotropic phase for small values of z and α. However, for large values of z and α, the anisotropic phase is not favoured.

Run-Qiu Yang (KIAS): "Strong energy condition and complexity growth bound in holography"

In this talk, I will discuss a result about strong energy condition and action growth bound in holographic complexity. I will prove that if eternal neutral black holes satisfy some general conditions and matter fields only appear in the outside of the Killing horizon, the strong energy condition is a sufficient condition to insure that the vacuum Schwarzschild black hole has the fastest action growth of the same total energy. This result is consistent with the bound of computational complexity growth rate and gives a strong evidence for the holographic complexity-action conjecture.

Yun-Long Zhang (APCTP): "Bell inequality from holographic gravity"

We show that the manifestation of quantum entanglement in Bell inequality can be reproduced from the gravitational theory in the bulk, and the CHSH formula of Bell inequality can be related with the holographic Schwinger-Keldysh correlator from AdS gravity.

Sunyoung Shin (CQUeST): "Walls of massive Kähler sigma models on SO(2N)/U(N) in three dimensions"

We construct walls of massive Kähler sigma models on SO(2N)/U(N) in three dimensions by using moduli matrices. We discuss the operators generating walls and the root vectors.

Chanju Kim (Ewha Womans U.): "Holographic micro state deformations of BTZ black holes"

We find general deformations of BTZ spacetime and identify the corresponding thermofield initial states of the dual CFT. We deform the geometry by introducing bulk fields dual to primary operators and find the back-reacted gravity solutions to the quadratic order of the deformation parameter.

O-Kab Kwon (Sungkyunkwan U.): "Exact holography of massive M2-brane theories and entanglement entropy"

We obtain an exact holographic relation for the vacuum expectation values of the chiral primary operator with conformal dimension 1 in the large N limit in mass-deformed ABJM theory. Our results involve infinite number of exact dual relations for all possible supersymmetric Higgs vacua and so provide a nontrivial test of gauge/gravity duality away from the conformal fixed point in the large N limit. Using the Ryu-Takayanagi conjecture to obtain the entanglement entropy in gravity side, we calculate the holographic entanglement entropy (HEE) in the reduced 4-dimensional gravity theory. We also obtain constraints for the HEE, which is the counterpart of the perturbed Einstein equations.

Kyung Kiu Kim (Sejong U.): "Thermodynamic volume in AdS/CFT"

The cosmological constant in AdS space can be interpreted as a pressure of the bulk. If the variation of the cosmological constant is allowed, the pressure has a dual thermodynamic volume. We study on the physical meaning of the variation and related quantities through the standard AdS/CFT dictionary.

Taejin Lee (Kangwon Nat'l U.): "Gravitational Scattering Amplitudes and Closed String Field Theory in the Proper-Time Gauge"

We construct a closed string field theory in the proper-time gauge which is the closed analog of the deformed cubic open string field theory and define the general closed string scattering amplitudes. Taking the zero-slope limit, we explicitly evaluate the three-graviton scattering amplitudes and the four-graviton scattering amplitudes. We discuss in the framework of the closed string field theory, the Kawai-Lewellen-Tye (KLT) relations, which relate the tree level closed string scattering amplitudes to those of open string.

Hongsu Kim (KASI): "3rd Quantization of Taub Universe"

In the present work, we address the issue of Quantum Field Theory of Taub Cosmology. To be more concrete, we describe this issue in more detail one at a time: "Taub Cosmology model [A.H. Taub, Am. Math. 53,472 (1951)] can be thought of as a special limit of the Bianchi-type IX (Mixmaster) cosmology. Namely, it is a homogeneous but anisotropic cosmology model. Next, in a physical system consisting of matter and gravity(spacetime), we 1st[quantum mechanics] and 2nd[quantum field theory] quantize the matter fields to begin with. Then we turn to gravity and 1st[universe wave function as a solution to the Wheeler-DeWitt eq.] and 2nd[promote the universe wave function to a field operator a. la. Hosoya-Morikawa] quantize the spacetime. Now the name, "3rd quantization" manifests itself as the gravity is 2nd quantized only after the matter in it gets 2nd quantized beforehand!, Lastly, in order to work it out, the Bogoliubov transformation comes into play...
That is, the choice of mode functions to span the universe field operator is NOT unique as each set of mode functions is separately complete, orthonormal (in the Hilbert space). This is because the physical state of the system (subject to the mode expansions) keeps changing during its (time) evolution. As a result, the Bogoliubov transformations come into play and

result in non-trivial Mode (or, frequency) mixing that, in turn, leads to the notion of vacuum and creation, annihilation of universe(quanta) in its Hilbert space…

To summarize, even the universe itself can be treated as quanta that undergo "birth and destroy".

Hongsu Kim (KASI): "Callan-Rubakov Effect could answer the baryon asymmetry puzzle"

Back in 1982,Callan and Rubakov, independently, pointed out that the "t'Hooft-Polyakov magnetic monopole", a topological soliton solution in Yang-Mills-Higgs theory with SSB in WGS standard model for the electroweak interaction could "catalyze" the proton decay. This is obviously an academic speculation which has NOT been motivated by any precision observational evidence at the time as the proton is known to be definitely stable &secure with its lifetime being as long as the age of the universe itself! As such, we find, after 30 years, that this effect is not just a purely academic speculation, but also a severely wrong-motivated set-up, as now we know the matter-antimatter(or baryon) asymmetry in our present universe… That is, in the present universe, we have severe matter-antimatter(or baryon) asymmetry in which, the number of proton is overwhelmingly greater than that of antiproton… This reality teaches us the lesson that after all, it is "anti proton" rather than proton that should(spontaneously) decay and disappear! To summarize, the age-old Callan-Rubakov Effect has to be modified to its opposite objective; "monopole-catalyzed antiproton decay"!

In the present work, therefore, we briefly revisit and review the original version of the Callan-Rubakov effect and discuss how it should be modified and reorganized for our new perspective and new objective: "monopole-catalyzed antiproton decay"

7 July, Friday

Plenary Presentations

Jong-Ping Hsu (UMass): "Experiments on the CMB Spectrum and Their Implications for the Missing Half of the Universe"

Based on the concept of Lorentz-Poincar\'e invariance and its limiting continuation, we propose an alternative formulation of the generalized Planck distribution that leads to a new physical interpretation of the observed anisotropy of the Cosmic Microwave Background (CMB). We also discuss how data from satellite experiments might be used to search and discover the missing half of the universe, i.e., an extremely distant `antimatter-blackbody,' through accurate measurements of the CMB spectra towards and away from the constellation Leo.

Dieter Rudolf Brill (U. Maryland): "The revival of General Relativity at Princeton."

After General Relativity was established in essentially its present form in 1915 it was celebrated as a great success of mathematical physics. But the initial hopes for this theory as a basis for all of physics began to fade in the next several decades, as General Relativity was relegated to the margins of theoretical physics. Its fate began to rise in the 1950's in a revival of interest and research that over time made gravitational physics one of the hottest research

topics it is today. One center of this renaissance was Princeton, where two relative newcomers explored new and different approaches to gravitational physics. Robert Dicke showed that gravity is not as inaccessible to experiment as was thought, and John Wheeler propelled it into the mainstream by proposing highly original and imaginative consequences of Einstein's theory. We will concentrate on these ideas that, in his characteristically intriguing style, Wheeler called ""Daring Conservatism"" -- a term well known to his associates, but one he never menstioned in print. With the aid of unpublished manuscripts and notes we will explore Daring Conservatism's origin and motivation, its successes and failures, and the legacy it left behind. In passing we will encounter a small footnote to the geon problem.

Yong-Seon Song (KASI): "Cosmological Implications of RSD"

The mapping of dark matter clustering from real space to redshift space introduces the anisotropic property to the measured density power spectrum in redshift space, known as the redshift space distortion effect. The mapping formula is intrinsically non-linear, which is complicated by the higher order polynomials due to indefinite cross correlations between the density and velocity fields, and the Finger--of--God effect due to the randomness of the peculiar velocity field. Whilst the full higher order polynomials remain unknown, the other systematics can be controlled consistently within the same order truncation in the expansion of the mapping formula, as shown in this paper. The systematic due to the unknown non--linear density and velocity fields is removed by separately measuring all terms in the expansion directly using simulations. The uncertainty caused by the velocity randomness is controlled by splitting the FoG term into two pieces, 1) the ``one--point" FoG term being independent of the separation vector between two different points, and 2) the ``correlated" FoG term appearing as an indefinite polynomials which is expanded in the same order as all other perturbative polynomials. Using 100 realizations of simulations, we find that the Gaussian FoG function with only one scale--independent free parameter works quite well, and that our new mapping formulation accurately reproduces the observed 2--dimensional density power spectrum in redshift space at the smallest scales by far, up to $k\sim 0.2\hompc$, considering the resolution of future experiments.

Eunil Won (Korea U.): "Status of the GroundBIRD experiment"

The GroundBIRD experiment, a ground-based telescope for the detection of the B-mode of the CMB polarization down to the tensor to scalar ratio of 0.01 is under construction at KEK in Japan. The observation site is Tenerife Island in Spain and the telescope is planned to be moved to the site in early 2018. We discuss present construction details and prospects for the future observation.

Marco Muccino (ICRANet) "What can we learn from gamma-ray bursts?"

Gamma-ray busts (GRBs) are powerful transient sources spanning a wide range in their energy release, duration and redshift distributions. These properties makes GRBs perfect candidates for studying their rates and the possible progenitor systems.

On behalf of a large collaboration, I review the major results obtained in the past two years: 1) the classification of GRBs into seven different sub-classes, each one characterized by distinct set of observational features, different astrophysical systems as progenitors and occurrence rates; 2) the assessment of the gravitational wave emission for some of the above sub-classes and its detectability by Advanced LIGO, Advanced Virgo, eLISA, and resonant bars.

P7: Cosmology – Cosmology, CMB, Perturbations, Structure formation, Quantum effect, etc.

Seokcheon Lee (Gyeongsang Nat'l U.): "Conformal equality"

It is well known that cosmological observables (like Primordial curvature perturbation and Hubble parameters) are frame independent (under conformal transformation) at early Universe. However, late time cosmological observables are frame dependent and issues for physical frame are open. We discuss these issues both in classical level and in quantum one.

Dong-han Yeom (Nat'l Taiwan U.): "artle-Hawking wave function and large-scale power suppression of CMB"

In this talk, I will first describe the Hartle-Hawking wave function in the Euclidean path integral approach. After we introduce perturbations to the background instanton solution, following the formalism developed by Halliwell-Hawking and Laflamme, one can obtain the scale-invariant power spectrum for small-scales. We further emphasize that the Hartle-Hawking wave function can explain the large-scale power suppression by choosing suitable potential parameters, where this will be a possible window to confirm or falsify models of quantum cosmology. Finally, we further comment on possible variations of background solutions, e.g., Euclidean wormholes, which can result in distinct signatures to the power spectrum.

Mu-In Park (Sogang U.): "On Gauge Invariant Cosmological Perturbations in UV-modified Horava Gravity"

We revisit gauge invariant cosmological perturbations in UV-modified, $z = 3$ Horava gravity with one scalar matter field, which has been proposed as a renormalizable gravity theory without the ghost problem in four dimensions.

Tae Hoon Lee (*Invited,* Soongsil U.): "Quintessence in low-energy effective theory"

Considering a theory of scalar-tensor gravity with non-renormalizable couplings of heavy fields, we derive the low-energy effective theory action in the universe of temperature much lower than the heavy field mass. An effective potential of the scalar field is induced through the heavy field interactions in the late-time universe and we find a de Sitter cosmological solution with the potential of the scalar field. We also investigate stability properties of the solution.

Ki-Young Choi (Chonnam Nat'l U.): "Lower-Bound on the reheating temperature with dark matter"

We suggest new lower-bound on the reheating temperature from the cosmological evolution of the dark matter.

Kyungjin Ahn (Chosun U.): "Small-scale structure formation under the large-scale density and CDM-baryon drift velocity environment

The cosmological structure formation, if in the mildly nonlinear regime, cannot be well estimated by the linear approximation. Even in the regime that used to be believed to be linear, Tseliakhovich and Hirata have shown that small-scale structure formation can be affected by the large-scale, CDM-baryon drift velocity environment and thus the linear approximation is invalid. We show that an even stronger effect comes from the large-scale density environment (ApJ 830:68). Therefore, how small-scale structure evolves is determined by the competition between the density environment and the CDM-baryon drift-velocity environment. In terms of the nonlinear objects, minihalos whose mass is about 10^8 solar mass or below, are the ones that are strongly affected. This may also affect the formation of more massive halos that are usually used for galaxy surveys through suppressed merger, so cosmology from galaxy surveys may have to be examined more carefully. We also present BCCOMICS, a cosmological initial condition generator for numerical simulations, which includes this effect and thus surpasses the accuracy of the linear Boltzmann solver such as CAMB.

Sungwook E Hong (KASI): "Small-scale Features of Thermal Inflation: CMB Distortion and Substructure Abundance"

Thermal inflation is an additional inflationary mechanism before the big bang nucleosynthesis, which solves the moduli problem and naturally provides a plausible dark matter candidate. Thermal inflation leaves a slight enhancement followed by huge suppression of a factor of ~50 in the curvature and matter power spectrum, which can be expressed in terms of a single characteristic scale $k_{\rm b}$. Here we describe the observability of the small-scale features of thermal inflation from various observations, such as CMB distortion, satellite galaxy abundance in the Milky-Way-sized galaxies, and 21-cm power spectrum before the epoch of reionization.

Maurice H van Putten (*Invited*, Sejong U.): "Fast evolution of the deceleration parameter in surveys of H(z)"

Redshift evolution Q(z)=dq/dz of the deceleration parameter q(z) is shown to satisfy Q0\simeq 2.8 in recent heterogeneous data on H(z) over 0 < z < 2. This observation rules out Q0\lesssim1 in LambdaCDM at a level of confidence of 4.36\sigma.

Muhammad Sharif (U. Punjab): "Stability Analysis of Bulk Viscous Cosmology"

This paper explores the non-equilibrium behavior of thermodynamics at the apparent horizon of isotropic and homogeneous universe model in f(G,T) gravity (G and T represent the Gauss-Bonnet invariant and trace of the energy-momentum tensor, respectively). We construct the corresponding field equations and analyze the first as well as generalized second law of thermodynamics in this scenario. It is found that an auxiliary term corresponding to entropy production appears due to the non-equilibrium picture of thermodynamics in first law. The universal condition for the validity of generalized second law of thermodynamics is also obtained. Finally, we check the validity of generalized second law of thermodynamics for the reconstructed f(G,T) models (de Sitter and power-law solutions). We conclude that this law holds for suitable choices of free parameters.

P8: Black Holes – Black holes, Wormholes, etc

Masakatsu Kenmoku (Nara Sci. Academy): "Superradiant Phenomena for Spinor Fields in Rotating Black Hole Geometry"

We derive the results (i) non-existence of zero modes and (ii) the completeness relation for spinor fields in rotating black hole geometry. From these results, we show the superradiant phenomena for spinor fields should be type 2: positive momentum on the horizon ($p\_H>0$) and negative frequency at infinity ($\omega<0$).

Khalid Saifullah (Quaid-i-Azam U.): "Thermodynamics of rotating non-Kerr black holes"

Some rotating black holes, other than the famous Kerr solution, have attracted a lot of attention in the literature. In this talk the thermodynamical properties of some of these non-Kerr black holes are discussed. First slow rotation and then full rotation has been studied. The relationship between the Hawking temperature and the radius of the black holes is investigated and their physical interpretations discussed. This analysis gives rise to some interesting features of these objects.

Bogeun Gwak (*Invited*, Sejong U.): "Upper Limit of Radiation from Coalescence of Rotating Hayward Black Holes"

We have studied the spin interaction and the gravitational radiation thermally allowed in a head-on collision of two rotating Hayward black holes. The Hayward black hole is a regular black hole in the modified Einstein equation. The potential of the spin interaction can be analytically obtained. For the collision of massive black holes, the gravitational radiation is numerically obtained as the upper bound using the laws of thermodynamics. The effect of the Hayward black hole tends to increase the radiation energy, but we can limit the effect by comparing it with the gravitational waves.

Sung-Won Kim (Ewha Womans U.): "Wormhole cosmological model"

As the McVittie derived the black hole solution in a cosmological model, we derive the

cosmological model with a wormhole at the origin of the "cosmical" coordinate system by solving the Einstein's equation with proper matter distribution. We also find the apparent cosmological horizon from the redefined metric and derive the Hawking temperature by using the conventional methods.

Jin Young Kim (Kunsan Nat'l U.): "Wormholes in Einstein-Born-Infeld Gravity"

We study a new approach for the wormhole construction in Einstein-Born-Infeld theory with a cosmological constant, which does not require exotic matters in the Einstein equation. We study the relation of the newly introduced conditions with the usual continuity for the energy-momentum tensor and the gravitational Bianchi identity. We find that there is no violation of energy conditions for the Born-Infeld fields contrary to the usual approaches. The exoticity of energy-momentum tensor is not essential for sustaining the wormholes.

Kimitake Hayasaki (*Invited*, Chungbuk Nat'l U.): "Detection of gravitational wave emission by supermassive black hole binaries through tidal disruption flare"

Galaxy mergers produce binaries of supermassive black holes, which emit gravitational waves prior to their coalescence. We perform the hydrodynamic simulations to study the tidal disruption of stars by such a binary in the final centuries of its life. We find that the gas stream of the stellar debris moves chaotically in the binary potential and forms accretion disks around both black holes. The accretion light curve is modulated over the binary orbital period owing to relativistic beaming. This periodic signal allows to detect the decay of the binary orbit due to gravitational wave emission by observing two tidal disruption events that are separated by more than a decade.

Medeu Abishev (Al Farabi Kazakh Nat'l U.): "Dilatonic dyon black hole solutions in the model with two Abelian gauge fields"

Dilatonic black hole dyon solutions in the gravitational 4d model with a scalar field, two 2-forms, two dilatonic coupling constants $\lambda_i \neq 0$, $i = 1, 2$, obeying $\lambda_1 \neq -\lambda_2$ and sign parameter $\varepsilon = \pm 1$ for scalar field kinetic term are considered. Here $\varepsilon = -1$ corresponds to ghost scalar field. These solutions are defined up to solutions of two master equations for two moduli functions, when $\lambda_{2i} \neq 1/2$ for $\varepsilon = -1$. Some physical parameters of the solutions: gravitational mass, scalar charge, Hawking temperature, black hole area entropy and parametrized post-Newtonian (PPN) parameters β and γ are obtained. PPN parameters do not depend on couplings λ_i and ε. A set of bounds on gravitational mass and scalar charge are found by using a certain conjecture on parameters of solutions, when $1 + 2\lambda_{2i}\varepsilon > 0$, $i = 1, 2$. The composite dyon solution with $\lambda_1 = \lambda_2$ was considered in ref. [1]. References [1] M.E. Abishev, K.A. Boshkayev, V.D. Dzhunushaliev and V.D. Ivashchuk, Dilatonic dyon black hole solutions, Class. Quantum Grav. 32, No. 16, 165010 (2015).

Seung Hun Oh (Konkuk U.) "Poisson algebra of gauge-invariant quasilocal angular momentum and its asymptotic limit"

In this talk, we will discuss the previously proposed quasilocal angular momentum of gravitational field in the absence of isometries in detail, and find the condition in which it is gauge-invariant. The gauge-invariant angular momentum has the following attractive properties; (i) it follows from one of the Einstein's constraint equations, (ii) it satisfies the Poisson algebra $\{L(\xi), L(\eta) \}_{\rm P.B.} = L([\xi, \eta]_{\rm L})$, up to a constant normalizing factor, (iii) its Poisson algebra reduces to the standard $SO(3)$ algebra of angular momentum at null infinity, and (iv) it reproduces the standard value for Kerr spacetime at null infinity. It will be argued that our angular momentum is a quasilocal and canonical generalization of A. Rizzi's geometric definition.

Deniz Olgu Devecioglu (Sogang U.): "Lifshitz black holes in Einstein-Yang-Mills theory"

We find that the four-dimensional cosmological Einstein-Yang-Mills theory with SU(2) gauge group admits Lifshitz spacetime as a base solution for the dynamical exponent z>1. Motivated by this, we next demonstrate numerically that the field equations admit black hole solutions which behave regularly on the horizon and at spatial infinity for different horizon topologies. The solutions depend on one parameter, the strength of the gauge field at the horizon, which is fine-tuned to capture the Lifshitz asymptotics at infinity. We also discuss the behavior of solutions and the change in Hawking temperature for black holes that are large or small with respect to the length scale L, which is itself fixed by the value of the cosmological constant.

Lunchakorn Tannukij (Hanyang U.): "Black holes in dRGT Massive Gravity"
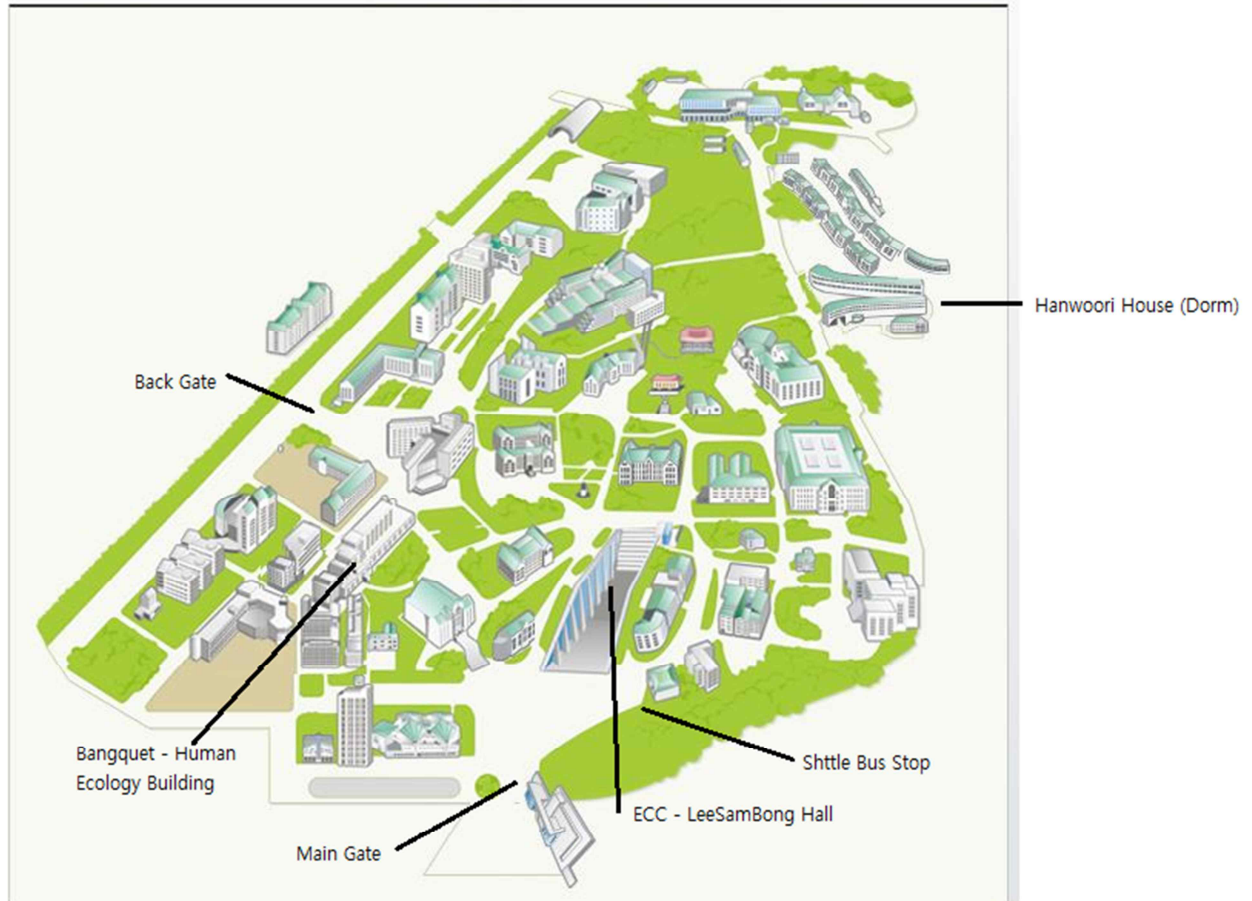
Massive gravity is a gravity theory in which the gravitational force is described through a concept of having massive graviton as a force carrier. One of the successful massive gravity theory is known as the dRGT massive gravity in which mass is given to the graviton in a special way so that there is no theoretical pathologies in the theory. By computing its solution, we can obviously see differences between massive gravity and general relativity in an astronomical aspect. In this talk, we present both a sperically symmetric solution and a cylindrically symmetric solution to the dRGT theory. Metric functions of those solutions appear to incorporate a characteristic which can be interpreted as an effective cosmological constant while they also contain a linear term which cannot be obtained from the general relativity. Moreover, some thermodynamical properties like temperatures and heat capacities of those solutions will be mentioned.
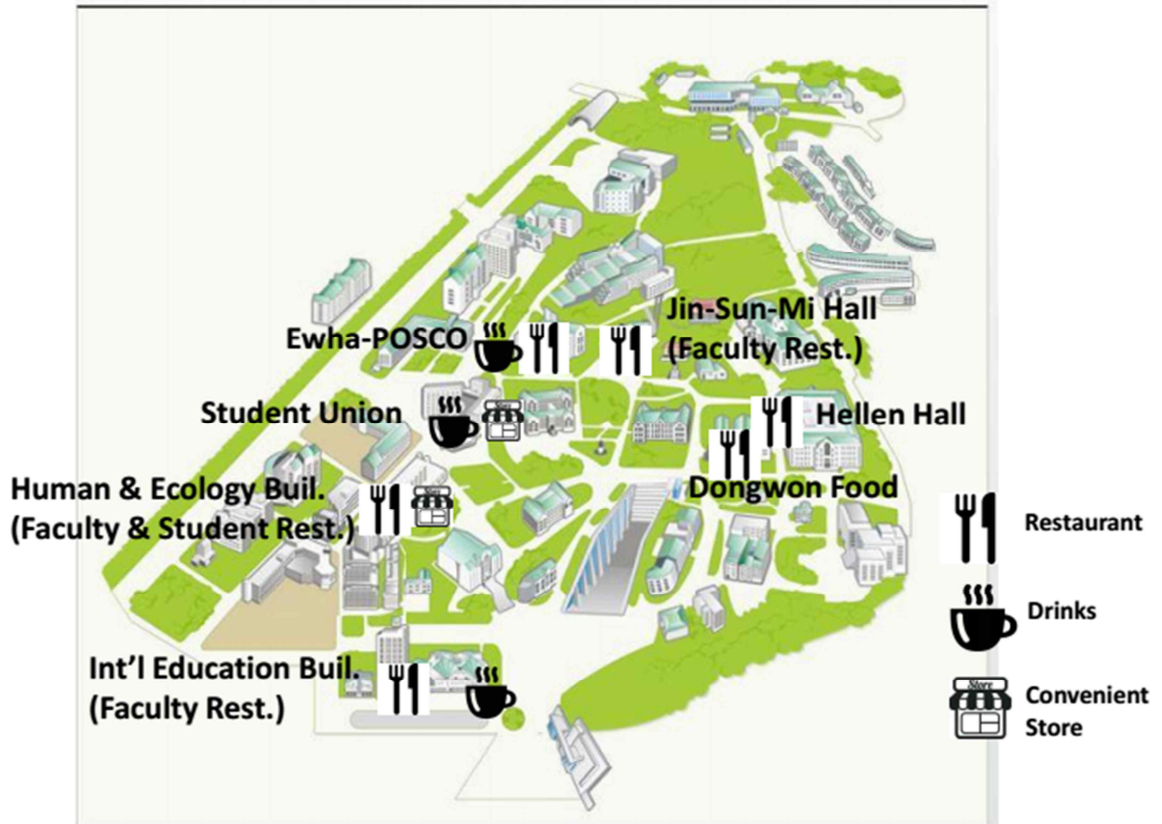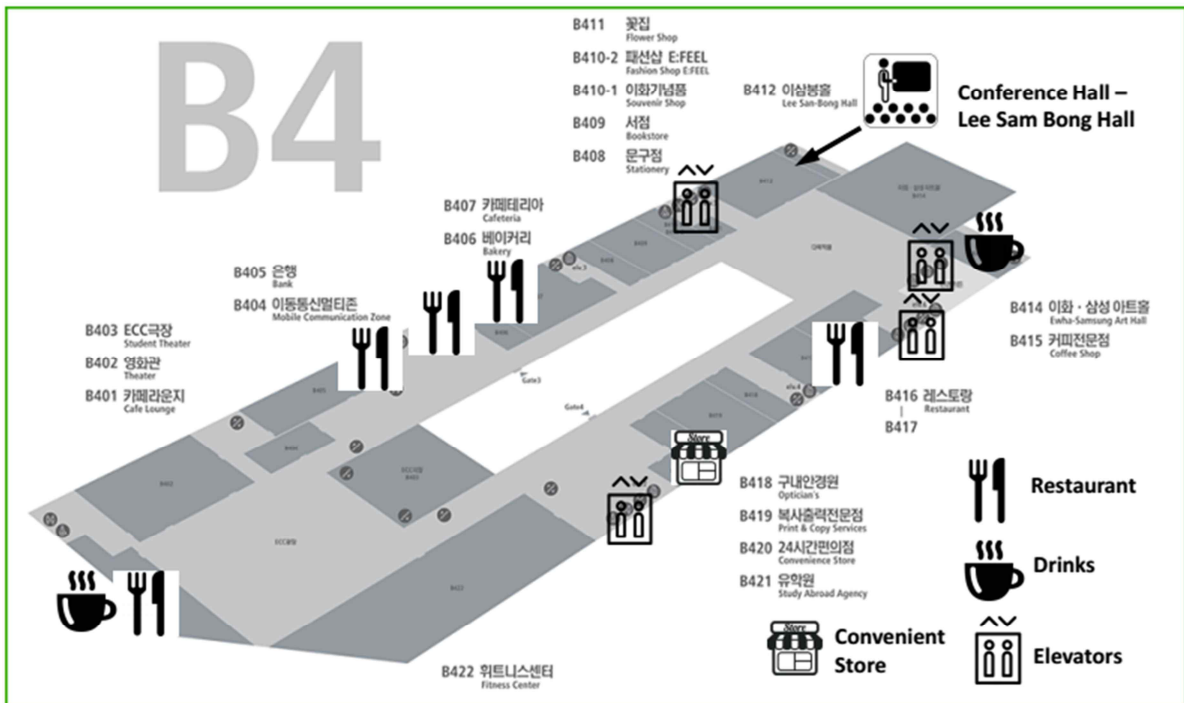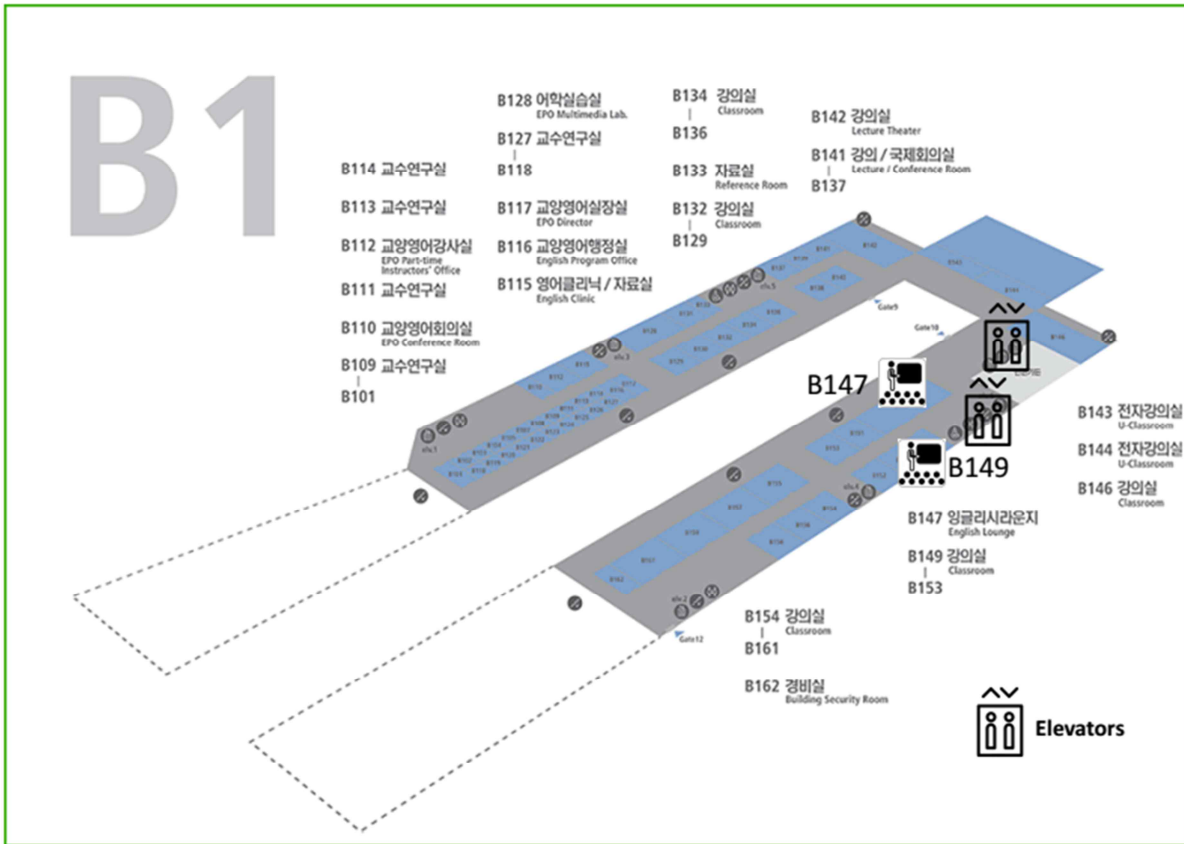
Guides

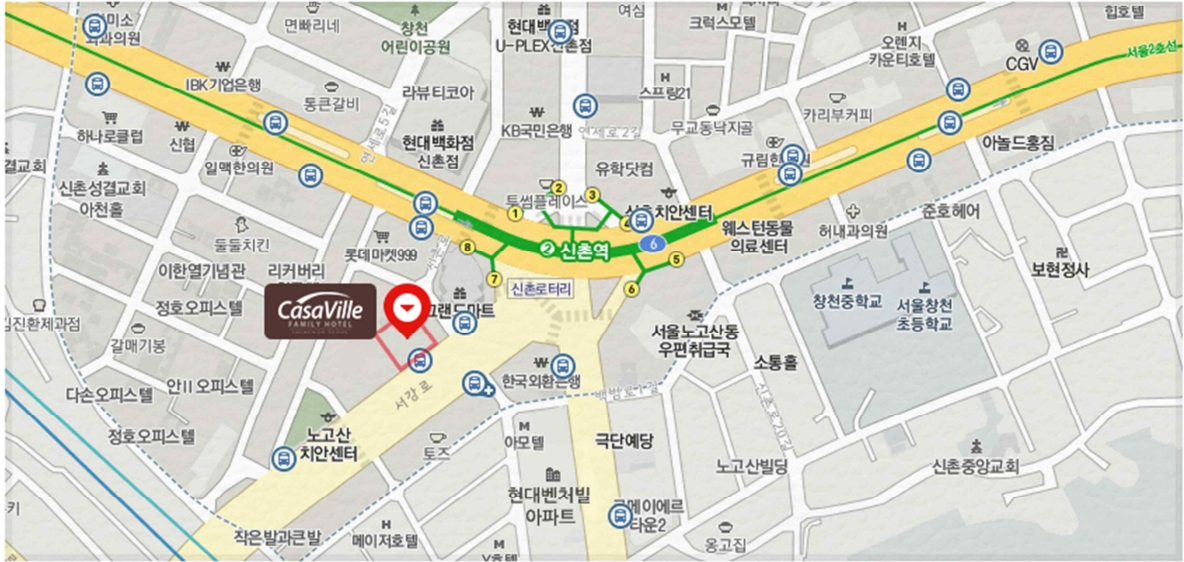Venue: Lee Sam Bong Hall (B4F), ECC.

Ewha Womans University Campus Map

Ewha Womans University Campus Map - Food & Drinks in Campus

Facilities in ECC

B1

B128 어학실습실
EPO Multimedia Lab.
B127 교수연구실
B118

B114 교수연구실
B113 교수연구실
B112 교양영어강사실
EPO Part-time
Instructors' Office
B111 교수연구실
B110 교양영어회의실
EPO Conference Room
B109 교수연구실
|
B101

B117 교양영어실장실
EPO Director
B116 교양영어행정실
English Program Office
B115 영어클리닉 / 자료실
English Clinic

B134 강의실
Classroom
B136

B133 자료실
Reference Room
B132 강의실
Classroom
B129

B142 강의실
Lecture Theater
B141 강의 / 국제회의실
Lecture / Conference Room
B137

B147
B149

B143 전자강의실
U-Classroom
B144 전자강의실
U-Classroom
B146 강의실
Classroom

B147 잉글리시라운지
English Lounge
B149 강의실
|
B153

B154 강의실
|
B161

B162 경비실
Building Security Room

Elevators

B4

B411 꽃집
Flower Shop
B410-2 패션샵 E:FEEL
Fashion Shop E:FEEL
B410-1 이화기념품
Souvenir Shop
B409 서점
Bookstore
B408 문구점
Stationery

B412 이삼봉홀
Lee San-Bong Hall

Conference Hall –
Lee Sam Bong Hall

B407 카페테리아
Cafeteria
B406 베이커리
Bakery
B405 은행
Bank
B404 이동통신멀티존
Mobile Communication Zone
B403 ECC극장
Student Theater
B402 영화관
Theater
B401 카페라운지
Cafe Lounge

B414 이화·삼성 아트홀
Ewha-Samsung Art Hall
B415 커피전문점
Coffee Shop

B416 레스토랑
|
B417

B418 구내안경원
Optician's
B419 복사출력전문점
Print & Copy Services
B420 24시간편의점
Convenience Store
B421 유학원
Study Abroad Agency

B422 위트니스센터
Fitness Center

Restaurant

Drinks

Convenient
Store

Elevators

TAXI CARD (Show this card to taxi driver)

주소: 서울시 마포구 노고산동 57-26 까사빌신촌호텔

전화: 02-6220-4000

신촌 로터리 그랜드마트 뒤쪽 건물이며 1 층에 롯데리아, 강화약국 건물입니다

CasaVille Family Hotel Shinchon Seoul 57-26, Nogosan-dong, Mapo-gu, Seoul, Korea, Tel: 02-6220-4000

저희 고객님을 CasaVille Shinchon 까지 안전하게 모셔다 주세요. 기사님 감사합니다.

Shuttle bus time table (Casa Ville <-> EWU)

Morning (Casa Ville -> EWU)
8:00. 8:30, 9:00

Afternoon (EWU -> Casa Ville)
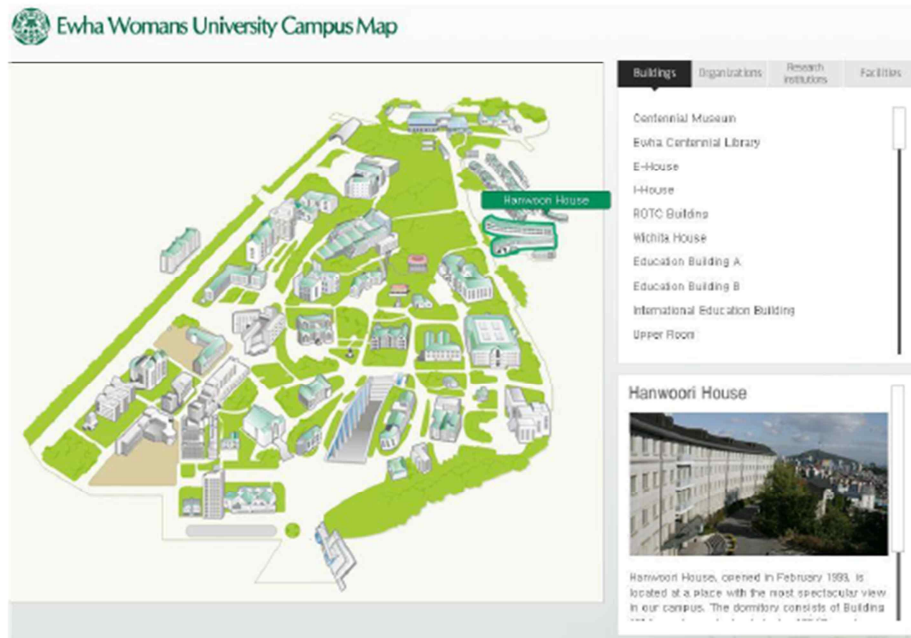18:30, 19:00, 19:30 (Mon, Thu. Fri.)
20:30, 21:00, 21:30 (Tue.)
13:00, 13:30, 14:00 (Wed.)

The new time table will be announced at the bulletin boards in CasaVill and Conference Main Hall in case of time change.

http://www.ewha.ac.kr/mbs/ewhakr/jsp/campusmap_eng.jsp

Shuttle bus time table (Main gate – Hanwoori (E/V Tower))

Shuttle Time Table

(Mon.~Fri.)	AM 7:50 ~ PM 9:00 (Interval : 10 min.) Main Gate → POSCO Bldg. → E/V Tower → Industry CLB Foundation → E/V Tower → POSCO Bldg. → Main Gate
(Mon.~Fri.) (Sat.)	PM 9:10 ~ PM 11:40 (Interval : 10 min.) PM 6:00 ~ PM 9:00 (Interval : 10 min.) Admission Hall → POSCO Bldg. → Hanwoori → E-House 202 → Hanwoori → POSCO Bldg. → Admission Hall
(Sun.)	No Service

In an emergent case in Korea, you may call the following numbers;

Prof. Sung-Won Kim (Chair of IOC): +82-(0)10-8902-2698
Prof. Hyeong-Chan Kim (Chair of LOC): +82-(0)10-8969-1536

Ewha Womans University,
global leader in the history of
women's education,
is now ready to open a new chapter
on innovation and challenge
to be witnessed by the world.

EWHA INNOVATION

Supported by