US-Korea Workshop: International Cooperation on Particle, Nuclear and Astrophysics Research

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April 24, 2012 KAIST Institute Building (E-4) Fusion Hall, 1F

8:30 – 9:00 Registration

Welcome

- 9:05 – 9:10 Soonkeon Nam (Kyung Hee U)
- 9:10 – 9:15 Eun-Suk Seo (President, AKPA)

Nuclear Physics Session 1 (Chair : B.S. Hong, Korea U)

- 9:15 – 9:45 Robert Tribble (Texas A&M)
  Low-Energy Nuclear Physics Facilities in the U.S. and Opportunities for Collaboration
- 9:45 – 10:10 Sun Kee Kim (Director of RISP, IBS)
  Rare Isotope Science Project
- 10:15 – 10:45 Chueng-Ryong Ji (N.C.S.U)
  Road Map of Nuclear Theories for the Physics with Rare Isotope Accelerators

10:45 – 11:00 Coffee Break

Nuclear Physics Session 2 (Chair : Y.S. Oh, Kyungpook Nat. U)

- 11:00 – 11:30 William Lynch (Michigan State U)
  Probing the equation of state of asymmetric matter
- 11:30 – 12:00 Jin Hee Yoon (Inha University)
  Ridge Behavior in Heavy Ion Collision
- 12:00 – 12:30 Haiyan Gao (Duke University)
  Probing the Three-Dimensional Structure of the Nucleon at 12-GeV Jefferson Lab and Beyond

12:30 – 2:00 Lunch

Particle Physics Session (Chair : S. Nam, Kyung Hee U)

- 2:00 – 2:30 Jaehoon Yu (U. of Texas, Arlington)
  Searches for the Higgs Particle and the Future
- 2:30 – 3:00 Sung-Won Lee (Texas Tech & CMS)
  Recent Results from the CMS Experiment at LHC
- 3:00 – 3:30 Soo-Bong Kim (Seoul Nat. U.)
  Observation of the last, weakest neutrino transformation at RENO

3:30 – 4:00 Coffee Break

Astrophysics Session (Chair : M.G. Park, Kyungpook Nat. U)

- 4:00 – 4:30 Vernon Jones (NASA)
  Overview of the NASA Astrophysics Program and its Suborbital Projects
- 4:30 – 5:00 Il Hung Park (Ewha Womans U)
  TBA
- 5:00 – 5:30 Eun-Suk Seo (Univ. of Maryland)
  High Energy Cosmic Ray Astrophysics
- 5:30 – 6:00 Hyung Mok Lee (Seoul Nat. U)
  Gravitational Wave Research in Korea

Move to Riviera Hotel

6:30 – 8:30 Banquet and Introduction to ISBB (Peony Hall, 14F)

- 6:30 – 6:35 Sung-Chul Shin (President, Korean Physical Society)
- 6:35 – 7:05 Sejeong Oh (President, ISBB)
  Introduction to ISSB
- 7:05 – 8:30 Banquet

April 25 (Wed) KAIST Institute Building (E-4) Fusion Hall, 1F

Current Issues in Theories (Chair : K. Choi, KAIST)

- 8:45 – 9:15 Michael Peskin (SLAC)
  New Elementary Particles at the TeV Energy Scale: Why? Who? Where?
- 9:15 – 9:45 Piljin Yi (KIAS)
  Topics in D4-D8 Holographic QCD

9:45 – 10:00 Coffee Break

Discussions and Future Directions (Chair : J. Yu)

- 10:00 – 10:30 Barry Barish (Caltech - GDE)
  TBA
- 10:30 – 11:00 Young-Kee Kim (U. of Chicago)
  TBA
- 11:00 – 11:30 Peter H.Yoon (U. of Maryland)
  Outstanding Problems in Space and Astrophysics

Closing 11:30 – 11:35 Soonkeon Nam (Kyung Hee U)

Sessions of KPS meetings starts at 1:00 pm

This conference is partially supported by National Science Foundation (USA), and by CQUeST(Sogang), KAIST, KISTI, LHC-Korea, RCMST(Ewha), SKKU, WCU-CCP(KNU).

Titles and Abstract

Robert Tribble (Texas A&M)

Low-Energy Nuclear Physics Facilities in the U.S. and Opportunities for Collaboration

In the U.S., accelerator facilities are operated by the Department of Energy and the National Science Foundation to carry out research in low-energy nuclear physics. The broad-based research program includes studies of nuclear structure, nuclear reactions, nuclear astrophysics, and fundamental symmetries. Among others, the Department of Energy supports the user facility ATLAS at Argonne National Laboratory and the Cyclotron Institute at Texas A&M University (TAMU). The National Science Foundation supports university facilities at Florida State University (FSU), Notre Dame University (ND), and the National Superconducting Cyclotron Laboratory user facility at Michigan State University. During my presentation I will provide a brief overview of these U.S. facilities, with a focus on facility upgrades and research programs at ATLAS, FSU, ND, and TAMU. These four facilities have very different research capabilities and each of them provides a unique opportunity for collaborative research with groups from the Republic of Korea.

Sun Kee Kim (Director of RISP, IBS)

Rare Isotope Science Project

Recently Rare Isotope Science Project was established in the Institute for Basic Science to lead the design and the construction of heavy ion accelerator complex for the researches in various fields with rare isotopes. The facility includes ISOL(Isotope Separation On-Line) system with a driver cyclotron and IF(In-Flight Fragmentation) system with a superconducting linear accelerator driver for the production of variety of rare isotopes. The design of the accelerators and experimental apparatus is in progress. The status and prospects of the project will be reported.

Chueng-Ryong Ji (N.C.S.U)

Road Map of Nuclear Theories for the Physics with Rare Isotope Accelerators

With the current worldwide development of rare isotope accelerators such as the Korea Rare Isoptope Accelerator (KoRIA) and the Facility for Rare Isotope Beams (FRIB), it is timely to review the forefront of the nuclear theories that can analyze the data from these accelerators and provide the deeper understanding on the physics of nuclei and the nuclear astrophysics. In this presentation, I will first summarize some of these theories of nuclei and nuclear astrophysics that will be carried out with the new generation of rare isotope beam facilities. I will then discuss a possible road map for the nuclear physics with rare isotope accelerators.

William Lynch (Michigan State U)

Probing the equation of state of asymmetric matter

The equation of state of asymmetric matter strongly influences the structure, stability and dynamics of nuclei, nuclear collisions, neutron stars and core-collapse supernovae. Some examples of these connections will be presented. Then the talk will focus on the constraints that have been obtained on the equation of state from laboratory experiments. The talk will conclude with a discussion of some prospective for future constraints on the equation of state using next generation rare isotope facilities.

Jin Hee Yoon (Inha University)

Ridge Behavior in Heavy Ion Collision

Haiyan Gao (Duke University)

Probing the Three-Dimensional Structure of the Nucleon at 12-GeV Jefferson Lab and Beyond

The exploration of the internal structure of the nucleon in terms of quarks and gluons, the fundamental degrees of freedom of Quantum Chromodynamics (QCD), has in recent years moved beyond the one-dimensional space (collinear picture) to three-dimensional spaces. I will present latest results, and insights from these new studies, and future plans to probe the three-dimensional structure of the nucleon with12 GeV at Jefferson Lab and the possibility of a future Electron-Ion Collider. This work is supported by the U. S. Department of Energy under Contract No. DE-FG02-03ER41231.

Jaehoon Yu (U. of Texas, Arlington)

Searches for the Higgs Particle and the Future

The Large Hadron Collider experiments at the European Center for Nuclear and Particle Physics laboratory, CERN, in Geneva, Switzerland, has been performing very well and has delivered five times the anticipated data statistics. The LHC has just resumed its operation at higher energy than 2011 and is gearing up fast to provide the full luminosity. This performance of the LHC experiments and the accelerator provides an excellent prospect for discovering the last undiscovered particle, the Higgs particle, which is thought to be the manifestation of the mechanism that gives mass to all particles in the universe. The discovery of this particle will trigger a whole new generation of accelerator based experiments for precision measurements to determine the precise nature of the discovered particle. In this talk, I will be describing the current status of the Higgs particle searches, precision electroweak measurements, and the prospects for the upcoming year and conclude with what is expected in the future.

Sung-Won Lee (Texas Tech & CMS)

Recent Results from the CMS Experiment at LHC

The Standard Model of particle physics is a remarkable picture of the most fundamental constituents of matter and their interactions, and describes our knowledge of the particles and forces that comprise the universe. The predictions of the Standard Model have been thoroughly tested experimentally, and have been successfully confirmed by precision measurements for the past few decades. The model is not complete, however, in the sense that there still remain numerous outstanding and fundamental questions. In late 2009, the new particle accelerator, the Large Hadron Collider (LHC) at CERN, located in Geneva, Switzerland, and the two large general-purpose detectors, ATLAS and CMS, started operating at the world highest particle energy, 7 TeV, allowing the study of quantum universe in the Tera-scale. It will contribute to answering many of the current questions in particle physics, extending our kinematic reach to a new level. In this talk, I will discuss a recent results from proton-proton collisions at LHC. I will also discuss the performance of the CMS experiment, comparison of the recent LHC data with expectations from production of the known Standard Model particles and searches for new particles.

Soo-Bong Kim (Seoul Nat. U.)

Observation of the last, weakest neutrino transformation at RENO

The RENO experiment has observed the disappearance of reactor electron antineutrinos, consistent with neutrino oscillations, with a significance of 4.9 standard deviations. Antineutrinos from six reactors at Yonggwang Nuclear Power Plant in Korea, are detected by two identical detectors located at 294 m and 1383 m, respectively, from the reactor array center. In the 229 day data-taking period of 11 August 2011 to 26 March 2012, the far (near) detector observed 17102 (154088) electron antineutrino candidate events with a background fraction of 5.5% (2.7%). A ratio of observed to expected number of antineutrinos in the far detector is 0.920+-0.009(stat.)+-0.014(syst.). From the deficit, we find sin^2(2theta_13)=0.113+-0.013(stat.)+-0.019(syst,) based on a rate-only analysis. In this talk, we will describe experimental setup, data taking, data analysis, and results for the measurement of theta_13.

Vernon Jones (NASA)

Overview of the NASA Astrophysics Program and its Suborbital Projects

The U.S. goals for astronomy and astrophysics are driven by a series of decadal surveys conducted with oversight by the National Academy of Science. The recommended activities from the most recent study, Astro2010, were presented in the categories of small, medium and large-scale space and ground activities. Perhaps the most relevant priority for this workshop is the recommended augmentations to the Suborbital Program for balloon and sounding rocket science that is broad, but including especially cosmic microwave background and particle astrophysics. Also recommended is an augmentation to the Explorer Program for rapid response to science opportunities by increasing the current mission plan over the decade by two mid-class and two small-class Explorer Missions, as well as four Missions of Opportunity. NASA implements the recommended activities in cooperation with other federal agencies and international partners. A formal process is used for soliciting and selecting investigations and investigators for both space missions and basic research. The key to successful cooperation in this

competitive process is a close tie with U.S. investigators having similar interests. Examples exist for US-Korea cooperation in Explorer, sounding rocket, and balloon missions. Some of these will be reviewed to demonstrate possible approaches for successful future cooperation.

Il Hung Park (Ewha Womans U)

TBA

Eun-Suk Seo (Univ. of Maryland)

High Energy Cosmic Ray Astrophysics

Cosmic ray research focuses on highly relativistic particles produced in the most extreme non-equilibrium environments in nature, e.g., supernova explosions. Their interactions with galactic matter and fields are the source of much of the diffuse gamma ray, x-ray, and radio emissions. Direct measurements of cosmic rays with satellite or balloon-borne detectors are used for understanding cosmic ray origin, acceleration and propagation, exploring the supernova acceleration limit, and searching for exotic sources such as dark matter. A challenge of direct measurements is that the detectors must be large enough to collect adequate statistics, yet stay within the weight limit for available space flight. Innovative approaches are achieving high quality measurements over an energy range that was not previously possible. Recent measurement results and their implications will be reviewed. The outlook for existing and future experiments will also be discussed, along with opportunities for US-Korea cooperation.

Hyung Mok Lee (Seoul Nat. U)

Gravitational Wave Research in Korea

Korean Gravitational Wave Group (KGWG) is a member of LIGO Scientific Collaboration (LSC) which operates Laser Interferometer Gravitational-wave Observatory(LIGO) pursuing the direct detection of gravitational waves. KGWG is primarily working with the Compact Binary Coalescence (CBC) Working group within LSC. The current research activities include detector characterization, parameter estimation,data analysis associated with gamma-ray burst, and reduction of electromagnetic wave followup observation data. KGWG recently expanded its scope to instrumentation and software development by collaborating with the Japanese 'KAGRA' project, which is the next generation gravitational wave detector that is currently under construction. KGWG further attempts to carry out the study of the next generation detector technologies, and astrophysical research related to gravitational waves. The first detection of gravitational wave is expected to be made within a decade. KGWG plays an active role to initiate and to participate in the interdisciplinary collaboration between Korean scientific community and international gravitational wave groups.

Michael Peskin (SLAC)

New Elementary Particles at the TeV Energy Scale: Why? Who? Where?

In this lecture, I will review the problem of the origin of symmetry breaking in the weak interactions. I will review some possible origins of this phenomenon. I will discuss the status of searches at the CERN Large Hadron Collider for the particles that might be responsible.

Piljin Yi (KIAS)

Topics in D4-D8 Holographic QCD

Barry Barish (Caltech - GDE)

TBA

Young-Kee Kim (U. of Chicago)

TBA

Peter H.Yoon (U. of Maryland)

Outstanding Problems in Space and Astrophysics

The purpose of this talk is to overview some of the "unsolved" or "outstanding" problems in space and astrophysics. Although it may not be the most authoritative source, the online open encyclopedia called Wikipedia lists the following problems among the so-called "unsolved" problems in astronomy and astrophysics (http://en.wikipedia.org/wiki/List_of_unsolved_problems_in_physics): These are, [1] Accretion disc jets, [2] Coronal heating problem, [3] Diffuse interstellar bands, [4] Gamma ray bursts, [5] Supermassive black holes, [6] Observational anomalies, [7] Supernovae, [8] Ultra-high-energy cosmic ray, [9] Rotation rate of Saturn, and [10] Origin of magnetar magnetic field. Of these, the physics of ionized gas, or plasma physics plays a central role in problem [2], i.e., the coronal heating and solar wind acceleration. The plasma physics also plays roles in problems [1], [4], and possibly [8] or [10]. Being a space and plasma physicist, I will necessarily pay attention to those problems that are closest to my field of research such as the coronal heating problem. However, the joint KPS-AKPA symposium provides an excellent opportunity to discuss some outstanding scientific issues with a broad, but necessarily superficial, perspective in an age where scientific endeavor is increasingly becoming narrow and deep in each area of specialty