

# The Department of Physics at Pusan National University

SUNGKYUN PARK  
DEPARTMENT OF PHYSICS, PUSAN NATIONAL UNIVERSITY



**Fig. 1:** The Jang-Jeon campus of Pusan National University.

## **PUSAN NATIONAL UNIVERSITY**

Founded in 1946, Pusan National University is the first national university of South Korea. Right after independence, with the help of a voluntary petition and fund raising by the citizens of Busan, which is the second largest city in the country, the first official law on the establishment of the university was legislated. Pusan National University pursues to educate world leading generations with emphasis on the values of truth, freedom and service. All those values are based on a humanitarian spirit. In its 70 years, Pusan National University has grown to establish four specialized campuses with 1,185 faculty members and 28,854 students (as of 2017). The university strives to become an academic hub for the region, opening a new corridor for research and education, starting from the northeastern end of the Eurasian continent, Busan.

## **DEPARTMENT OF PHYSICS**

The Department of Physics was launched in 1951 as the Department of Mathematics and Physics in the College of Liberal Arts. The department aims to educate students in fundamental science by providing opportunities to acquire a solid background in a wide range of physics, so that students can contribute to the development of both better national and regional communities by advancing science and technology.

The Department of Physics provides a variety of course work, including condensed matter physics, particle and nuclear physics, astrophysics, statistical physics, and non-linear/atom optics. These courses seek to whet our curiosity about the world and beyond by exposing students to essential questions on nature, ranging from the macroscopic world, the Universe, to the microscopic world

of elementary particles. Through internship programs, the department also encourages undergraduate students to participate in active fields of various research groups. Three different types of degree courses are offered, such as a BS degree course for undergraduate students, and MS, PhD, and MS/PhD combined courses for graduate students. In addition, MS/BS and MS/BS/PhD combined courses are also offered to promote consecutive studies in physics.

As of July 2018, there are currently 290 enrolled undergraduate students and 42 graduate students. One third of the undergraduate students is supported by various scholarship programs from the university and non-profit scholarship foundations. Graduate students are fully supported by Brain Korea 21 Plus (BK21+), TA (teaching assistant), and RA (research assistant) programs. There are 21 faculty members (including 2 non-tenure track faculty members), three research professors, and three research associates in the physics department, with annual research funds of 3 million USD yielding more than 150 publications per year, allowing our department to be ranked as one of the top ten physics departments in South Korea.

## RESEARCH AREAS

### Condensed Matter Physics

There are ten faculty members in the Condensed Matter Physics Group. The main research interests of the condensed matter physics group are the experimental realization and theoretical comprehension of multi-functional materials including multiferroic materials, magnets and superconductors with controlled dimensionality ranging from 3D bulk materials via 3D-2D interfaces to 2D crystals.

Young Cheol KIM explores fundamental electronic and magnetic properties of high-critical temperature superconductors.

Ho-Soon YANG investigates the characteristic physical phenomena that appear in nano-meter scale materials and are controlled via size and surface effects.

Bog Gi KIM studies not only fundamental science, but also industrial applications of transition-metal oxides and carbon nanotubes to organic light-emitting diodes and organic solar cells.



**Fig. 2:** The Department of Physics.

Yun Chul CHUNG uses semiconductor devices to understand the quantum mechanical properties of electrons.

Jai Seok AHN searches for interesting physical properties of multiferroic materials and strongly correlated electron systems using solid-state spectroscopic methods.

Sungkyun PARK studies low-dimensional systems such as the surface and interface of thin films to understand their magnetic, electronic, chemical, and structural properties.

Choongyu HWANG looks for strongly correlated electron phases in two-dimensional systems such as graphene, through a direct measure of their electron band structure using a photoemission technique.

Hyoungeen JEEN works on epitaxial synthesis of complex oxides and intermetallics and studies their physical and electrochemical properties in order to find new energy materials.

Jaekwang LEE investigates physical and electronic properties of materials by using first-principles density functional theory calculations.

Haeyong KANG studies low dimensional transport properties that appear in 2-dimensionanl condensed matter systems.

### Particle Physics, Nuclear Physics and Astrophysics

The Particle physics, Nuclear physics and Astrophysics Group deals with the most basic interactions of particles to explore matters ranging from the microscopic world,

such as elementary particles, to the macroscopic world, such as celestial bodies and the Universe. There are five professors in this group.

Deog Ki HONG studies theoretical particle physics. He has been working on particle phenomenology and also on the theoretical aspects of fundamental theories in order to understand the underlying principles of our universe.

Chang-Hwan LEE explores hadronic and astrophysical phenomena related to matters at extreme conditions such as high density and high temperature, including heavy ions, neutron stars and gravitational waves.

In-Kwon YOO is conducting an experimental study on new phases of a matter, such as quark-gluon-plasmas. His team is participating in an international project in collaboration with CERN in Switzerland, GSI in Germany, and Brookhaven National University (BNL) in the USA.

Bumseok KYAE is searching for a solution to solve the gauge hierarchy problem via the supersymmetric gauge theory and its extension, and to examine other alternatives.

Kwang Sik JEONG is searching for a fundamental theory in particle physics that solves problems in the standard model and investigates phenomenological and cosmological properties of the new theory.

#### **Statistical Physics**

Wonpyong GILL investigates not only a statistical model on the time evolution of genetic distribution, but also magnets and superconductors using the quantum Monte Carlo and diagonalization methods.

Ju Yeon YI is working to develop a theoretical basis in realizing a new type of transport mechanism, which would resemble that of the electronic transport observed in conventional semiconductors, but with minimal cost and effort in building up the devices.

#### **Nonlinear and Atom Optics**

Myoungsik CHA aims to understand the fundamental non-linear interaction of photons with a solid-state medium.

Han Seb MOON studies high-resolution laser spectroscopy, atomic coherence spectroscopy, atomic interferom-

eters, slow and fast photons, and photon storage using semiconductor lasers.

### **RESEARCH CENTERS**

#### **Research Center for Dielectric and Advanced Matter Physics (RCDAMP)**

In 1991, Research Center for Dielectric and Advanced Matter Physics (RCDAMP) was launched by Prof. Min-soo CHANG (emeritus professor of the Department of Physics) as part of the Science Research Center (SRC) Project supported by the National Research Foundation (NRF) of Korea with 22 professors from 13 universities and more than 100 graduate students. During the first phase of the program, the ultimate goal of the center has been to create novel phenomena and functionality of dielectric materials, and hence to educate world-leading scientists of the field. Currently, seven faculty members participate in the program with strong collaborations with international institutes such as UC Berkeley (USA), Lawrence Berkeley National Laboratory (USA), J-PARC (Japan), Osaka Univ. (Japan), RIKEN (Japan) and Hokkaido Univ. (Japan).

#### **Extreme Physics Research Center**

Established in 2012, 14 faculty members of the physics department participate in the program to understand extreme phenomena in particle physics, nuclear physics, astrophysics, advanced materials, and statistical physics. Currently, the research center is operating with an annual funding of ~2 million USD, funded by various organizations including the NRF, and focuses on the initiation of collaborative work with other academic and industrial institutions.

### **STUDENT ACTIVITIES**

Undergraduate students in the Department of Physics at Pusan National University have organized not only outreach programs, but also non-scientific activities that enrich their school lives.

#### **Open Lab**

Since 1997, undergraduate students have organized "Open Lab" as an outreach program for the public, primarily middle/high school students in Busan area. In May, undergraduate students design experimental setups, demonstrate physical phenomena, and encourage the public to participate in the actual demonstration. By doing so, they not only motivate themselves to pursue



**Fig. 3:** Open Lab in 2018.

fundamental physics, but also attract and promote public interest in physics. Every year, thousands of middle/high school students, teachers, and the public participate in and enjoy the Open Lab event.

### **PaC**

Stemming from an intra-department community, PaC has been organized by undergraduate students to study Physics using computers. PaC members also organize study-groups to help non-club members who want to learn computer software and hardware.

### **Haneul-Bae**

Haneul-Bae is a combined word of Haneul and Bae, which mean the sky and a ship, respectively, in Korean, and symbolizes a ship flying the sky. Established by undergraduate student union of the physics department in the late 80s, Haneul-Bae has achieved excellent results in the national rocket launching competition for the last few decades. Recently, they have also expanded their achievements in activities related to observation and comprehension of celestial bodies. In addition, club members also participate in Open Lab as a project team to provide basic astronomical information to the public.

### **Sports Activities**

Dunker and Big-Bang are basketball and soccer clubs, respectively, that have been organized by undergraduate students of physics department. Now they are expanding their members to include students from the College of Natural Sciences. They regularly participate in intramural competitions such as the Hyowon Cup.

Pusan National University and the Department of Physics is committed to excellence in science education and research for future leaders. For more information, please visit our website at: [phys.pusan.ac.kr](http://phys.pusan.ac.kr).



**Sungkyun Park** is a professor and since 2018, chair of the Physics Department at Pusan National University. He also served as an executive editor of *Current Applied Physics* (2015-2016) and as an associate editor of *New Physics: Sae Mulli* (2011-2012). After receiving his PhD from the University of Arizona, Tucson, AZ, USA (2001), he worked at Los Alamos National Laboratory (USA), Argonne National Laboratory (USA) and the Korea Basic Science Institute before joining Pusan National University in 2008. His research field is experimental condensed matter physics. Currently, he is also serving as a director in Core Research Facilities at Pusan National University and is one of the executive committee members of the Asia-Oceania Neutron Scattering Association.