Korea-Italy Bi-lateral Symposium

“Current developments in underground physics”

Date: Oct. 1st 2018 (9 AM – 5 PM)

Place: B-109 Institute for Basic Science (IBS), Daejeon 34126, Republic of Korea

Symposium Program

- 8:45 AM – 9:00 AM: Registration
- 9:00 AM – 9:10 AM: Opening speeches
- 9:10 AM – 9:45 AM: “Laboratori Nazionali del Gran Sasso (LNGS): an overview of facilities and activities”, Alba Formicola (LNGS, Italy)
- 9:45 AM – 10:30 AM: “Center for Underground Physics (CUP) introduction and AMoRE neutrinoless double beta decay experiment”, Yong-Hamb Kim (IBS CUP, Korea)
- 10:30 AM – 10:45 M: Coffee break
- 10:45 AM – 11:25 AM: “Searching for the neutrinoless double beta decay at LNGS”, Riccardo Brugnera (INFN Padova, Italy)
- 11:25 AM – 12:05 PM: “The XENON project @INFN-LNGS: new results from XENON1T and prospects with XENONnT”, Marco Selvi (INFN Bologna, Italy)
- 12:05 PM – 1:25 PM: Lunch (IBS cafeteria) and CUP lab tour
- 1:25 PM - 2:05 PM: “Darkside experiment”, Walter Bonivento (INFN Cagliari, Italy)
- 2:05 PM – 2:45 PM: “Status of COSINE-100 experiment”, Hyunsu Lee (IBS CUP, Korea)
- 2:45 PM – 3:25 PM: “Search for Axion and Axion-like particles in Italy”, Claudio Gatti (Laboratori Nazionali di Frascati, Italy)
- 3:25 PM – 3:40 PM: Coffee break
- 3:40 PM – 4:20 PM: “Collaboration opportunities between Korea and Italy at IBS/CAPP”, Yannis Semertzidis (IBS CAPP, Korea)
- 4:55 PM – 5:00 PM: Closing remark (Embassy of Italy in Korea)
- 5:00 PM – 7:00 PM: Dinner hosted by IBS (Place: Leekeowon 이계원 한정식)

- 7:00 PM – 11:00 PM: Deajeon → Yangyang Hotel, Gangwon province.

**Oct. 2nd. 2018**

**Underground lab and construction site visits**

- 8:30 AM – 9:00 AM: Hotel to Y2L

- 9 AM – 11 AM: Yangyang Underground Laboratory (Y2L) tour

- 11 AM – 00:30 PM: Lunch at Yangyang

- 00:30 PM – 2:30 PM: Bus to Handeok mine, Jeongseon, Gangwon province

- 2:30 PM – 4:30 PM: Handeok mine tour

- 4:30 PM – 6:00 PM: Bus to KTX station near Wonju (Manjong station)

- 6:18 PM – 7:27 PM: Manjong → Seoul station (KTX)
PERSONAL INFORMATION
Family, First Name: Formicola, Alba
Gender: Female
orcid.org/0000-0002-0152-5744
Date of birth: October 18, 1972
Nationality: Italian

Short Biography

I am a researcher in Experimental Nuclear Physics at Laboratori Nazionali del Gran Sasso (LNGS) from 2008. My activity is mainly in the field of the experimental Nuclear Astrophysics, I am member of the LUNA collaboration since 1998. I was the leading scientist, from the experimental design and setup, through to data analysis and interpretation of the results of extensive studies (2004-2011) of the $^{14}\text{N}(p,\gamma)^{15}\text{O}$ reaction (the bottleneck of the CNO cycle). The key astrophysical issues related to this process are the quantification of the solar neutrino flux due to the CNO cycle partially active in the sun and the age of Globular Clusters. The resulting reaction rate, after LUNA experiments, is lower than a factor 2 in comparison with the previous determination. I contributed significantly to all stages of these studies, starting from the installation and acceptance test of the LUNA 400 kV accelerator at LNGS. This $^{14}\text{N}(p,\gamma)^{15}\text{O}$ reaction became my flag in the Nuclear Astrophysics community and appointed me as an expert of Nuclear Astrophysics in Underground experiments. Since August 2014, I am the Local coordinator of LNGS for INFN National Nuclear Physic Scientific Committee. Since May 2015, I am the Head of Research Division of LNGS, I’m coordinating the management and the development of the various activities and
services of the entire Research Division, which involves about 45 people: researchers, engineers and technicians who work on the experiments. The Research Division disposes also Computing and Networking services, Electronic and Chemical workshops, Ultra Low Background Service, Vacuum and Cryogenic system Services. I was involved in a rich outreach program to disseminate underground science topics to schools, I was teaching in two edition of Princeton-South Dakota-Gran Sasso Summer School in Princeton University, to motivate young high school students to enter researcher careers to become key actors of the future. In the outreach and formation framework, I participate in several Open Day of LNGS to make our research accessible and comprehensible to everyone, from young students to adults. I am the Principal Investigator of a project, funded by MIUR, for the dissemination for scientific culture, we are realizing a videogame suited in LNGS underground lab., where the modern physics is presented in a ludic adventure to address the curiosity of the students’ and the interest of students’ high schools.

**SCIENTIFIC OUTPUT**

66 papers on international refereed journals and 1 review on Report on Progress in Physics
h-index: 27 (data from: Scopus)

**Selected publications**


**Review paper**

D. A. Scott, A. Caciolli A. Di Leva, **A. Formicola**, M. Aliotta, et al. “First direct measurement of $^{17}$O(p,g)$^{18}$F reaction cross-section at Gamow energies for classical Novae” - Phys. Rev. Lett. 109 (2012) 208001 Editors’ Suggestion


**Monograph:** Publishing Agreement with Springer (DocuSign Envelope ID: 426CDFBE-6F80-41DB-B46F-0FB622D77E0) for Graduate and advanced undergraduate textbook.


**Laboratori Nazionali del Gran Sasso**  
*an overview of facilities and activities*

**Alba Formicola**  
Laboratori Nazionali del Gran Sasso, INFN  
Via Acitelli 22, Assergi Aq  
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LNGS is a world class international facility for deep underground science, located at a depth of 1.4 km under the Gran Sasso Massif; it is within the two largest underground laboratory in the world characterized by an easy access through an highway tunnel. Shielding from cosmic rays provided by the rock coverage, low environmental radioactivity and additional shielding with ultrapure material provide ideal conditions for studying rare processes in particle physics, with a program primarily addressing Dark Matter searches Neutrino Physics and Nuclear Astrophysics. LNGS is operated as facilities hosting multiple experiments as biology in extreme environments and geophysics. An overview on the main features will be presented and a prospective for the future.
PERSONAL INFORMATION
Family, First Name:  Kim, Yong-Hamb
Gender: Male
orcid.org/0000-0002-8569-6400
Date of birth: Jan. 19, 1968
Nationality: Korean

SHORT BIOGRAPHY
2013 ~ Present: Group Leader
Institute of Basic Science, Center for Underground Physics

2011 ~ Present: Professor
Basic Science, University of Science & Technology
2005 ~ Present: Principal/Senior Research Scientist
Korea Research Institute of Standards and Science

2011 ~ 2012: Visiting Scientist
NASA Goddard Space Flight Center, Astrophysics division
2003 ~ 2005: Postdoctoral Research Associate, Brown University
2003: Ph.D. in Physics, Brown University, USA

SELECTED PUBLICATIONS
The Center for Underground Physics (CUP) was founded in 2013 as an IBS center with the vision to enhance our fundamental knowledge about the structure and the origin of the Universe. CUP has pursed numerous experimental searches for direct detection of dark matter and fundamental properties of neutrinos. In the presentation, CUP’s vision, organization and activities are introduced.

The AMoRE (Advanced Molybdenum based Rare process Experiment) is an international project to search for neutrinoless double beta decay of Mo-100. The project utilizes Mo-based scintillating crystals in phonon-scintillation detection with MMC (Metallic Magnetic Calorimeter) readout at 10-20 mK. A commissioning stage of the project, AMoRE-Pilot is running with six $^{40}\text{Ca}^{100}\text{MoO}_4$ crystals with a total mass of about 1.9 kg at Y2L (YangYang underground laboratory) South Korea. After the completion of the Pilot measurement, AMoRE-I is to be prepared with 18 crystals including several R&D crystals with a total mass about 6 kg in this year. The project also plans to build a next generation detector of AMoRE-II with 200 kg crystals improving effective Majorana mass sensitivity to 20-50 meV. AMoRE-II will be installed in a new 1,000 m deep underground laboratory (Yemi Lab) to be constructed by 2020. Recent results on the Pilot runs and plans on future upgrades will be presented.
Riccardo Brugnera

Biography

Riccardo Brugnera is associate professor at the Physics and Astronomy Department of the Padova University

Education:
1987: Degree in Physics at Padova University
1992: PhD in Physics
1991: Researcher at the Padova University
2006: Associate professor

Main scientific activities and responsibilities:
1986-1988: NN2 experiment at the I.L.L. laboratory in Grenoble. The experiment was dedicated to the study of the neutron-antineutron oscillations. He contributed to the tests, optimization and installation of the plastic scintillators used for trigger and time of flight.
1989-2007: ZEUS experiment at the HERA collider in Hamburg. The experiment was dedicated to the study of the electron-proton interaction at high energy. He worked on the tests of the limited streamer tubes for the barrel and rear muon detectors. He was technical coordinator of the muon detector starting from March 1999 up to 2007. He studied the elastic and inelastic photo and electro-production of J/ψ, ψ(2s), Y, the bottom photo-production and the di-muon production.
2000-2012: OPERA experiment at the National Laboratory of Gran Sasso (LNGS), dedicated to the study of the neutrino oscillations. His activity was concentrated in the production, test and installation of the RPC detectors. Run coordinator from 2008 to 2012.
2008-today: GERDA experiment at LNGS. The experiment is dedicated to the study of neutrinoless double beta decay of the 76Ge. Main activities: project manager of the DAQ and online software task group, national coordinator of the INFN groups starting from 2012, chair of the Collaboration Board from 2015 to 2017. He is now the spokesperson of GERDA from July 2017.
2014-today: JUNO experiment, placed in China. The experiment is dedicated to the study of the neutrino oscillations using antineutrinos coming from nuclear reactors. Main activities in such experiment: participation to the electronics development for the large PMTs.
2016-today: member of the LEGEND-200 experiment at LNGS. The experiment is dedicated to the study of neutrinoless double beta decay of the 76Ge. Main activities in such experiment: co-project manager of the DAQ & slow control task group.

He is co-author of more than 300 scientific publications on international scientific journals.
**Selected publications**

3. R. Acquafredda et al. (OPERA Collab.), *JINST* 4, P04018 (2009)

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**Searching for the neutrinoless double beta decay at LNGS**

**Riccardo Brugnera**
Padova University and INFN Padova
Via F. Marzolo 8, 35131 Padova (Italy)

*Brugnera@pd.infn.it*

Neutrinoless double beta decay is a lepton-number violating process which is predicted by many extensions of the Standard Model. It could be the key to understand the nature of the neutrino. If observed, it would prove its Majorana nature and the half-life of the decay would be a direct measure of the yet unknown absolute scale of the neutrino-mass, assuming the massive neutrino exchange as the dominant process.

At LNGS two leading experiments are searching for such rare decay: CUORE uses \(^{130}\)Te as active isotope, while GERDA uses \(^{76}\)Ge. In the talk the key features of both detectors will be described together with the more recent physics results. CUORE and GERDA at the end of their life will have explored the so called degenerate mass hierarchy region. The next step will be to extend the search to the inverted mass hierarchy. For such search detectors with larger mass and with lower background rate are necessary. The two aforementioned experiments have already set up a strategy to cope with these challenges. CUORE will evolve into CUPID and GERDA into LEGEND. In the talk their distinct characteristics will be delineated.
Marco SELVI

Biography

I was born in 1971 in Forlimpopoli – Italy. I’m married since 1998, with three children.

PhD in 2002 at University of Bologna on the Proposal of the MONOLITH experiment, to study oscillation of atmospheric neutrinos with a massive magnetized calorimeter.

Since 20 years I’m involved in Astroparticle physics @LNGS, mainly on SuperNova neutrinos (LVD experiment) and direct Dark Matter search with the XENON project. With the XENON1T detector, we obtained in May 2018 the world's best (most sensitive) results in Dark Matter search, and we are already planning the next upgraded detector, XENONnT, expected to start operations at the end of 2019. In XENON, I’m currently responsible of the Monte Carlo working group, for the simulation of the detector performances and the background prediction. I’m also the coordinator of the Neutron Veto working group, to optimize, design and build a neutron detector around the Xenon target, in order to reduce the neutron background (one of the most critical in the next phase of the experiment).

Since 2017 I’m the leader of the INFN groups in XENON.

Since 2015 I’m part of the INFN Astroparticle Committee, as coordinator of INFN–Bologna, and I act as referee for the DAMA and NEWS Dark Matter experiments, and the IXPE experiment dedicated to X-Ray Polarimetry in Space. I teach in several advanced courses (Master and PhD) at University of Bologna.

Selected publications

5. E. Aprile et al., “Physics reach of the XENON1T dark matter experiment”, JCAP 1604 (2016) no.04, 027
The XENON project @INFN-LNGS:
new results from XENON1T and prospects with XENONnT.

Marco SELVI
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The XENON project aims to discover dark matter in the form of Weakly Interacting Massive Particles, with double-phase xenon Time Projection Chambers, operated deep underground in the INFN Laboratori Nazionali del Gran Sasso.

We present the most recent results obtained with the current detector, XENON1T, with a fiducial mass of 1.3 t, a duration of 279 days, corresponding to a 1.0 t*yr exposure. The experiment obtained a record ultra-low background and set the strongest upper limit on the WIMP-nucleon cross section for WIMP mass larger than 6 GeV/c².

The next phase of the experiment is already in preparation for 2019, with an increase in target mass by a factor 3 and reduced background, to achieve an improvement in sensitivity by a factor 10 in 5 years and continuing leading the race to finally detect WIMPs.
Walter Marcello BONIVENTO

Biography
I am Senior Researcher at INFN Cagliari.
Currently I am Project Scientist of the DarkSide experiment and leader of the DarkSide Cagliari group.
I am also one of the proponents and leader of the Italian participation to the SHiP project at CERN, looking for new feebly interacting short-lived particles in a proton beam dump.
In the past I have been working at CERN in the LHCb experiment and I have been leader of the charm analysis working group. Before this I have been working in the DELPHI experiment.
I am currently member of the INFN Panel for Astro-Particle Physics.

Selected publications

1. LHCb Coll., Search for the rare decay $D^0 \rightarrow \mu^+\mu^-$ Phys. Lett. B 725, 15 (2013)
2. LHCb Coll., Observation of the rare $B^0 \rightarrow \mu^+\mu^-$ decay from the combined analysis of CMS and LHCb data, Nature 522 (2015) 68-72
3. W.Bonivento et al. Proposal to search for Heavy Neutral Leptons at the SPS CERN-SPSC-2013-024 SPSC-EOI-010
The DarkSide program

Walter Marcello BONIVENTO
INFN Cagliari, Italy
walter.bonivento@ca.infn.it

The DarkSide program aims at the direct detection of WIMP dark matter in liquid argon.
In 2018 the DarkSide-50 experiment at LNGS, Italy, produced two outstanding science results: the world best WIMP-nucleon spin-independent interaction cross section upper limit with WIMP masses in the range 1.8 to 6 GeV/c\(^2\) and the zero-background world best with argon WIMP-nucleon spin-independent interaction for masses above 30 GeV/c\(^2\).

Experimenters from four different argon dark matter searches have recently joined their forces in the "Global Argon Dark Matter Collaboration" to carry out a unified program for dark matter direct detection. The participants are researchers currently working on the ArDM experiment at LSC; on the DarkSide-50 experiment at LNGS; on the DEAP-3600 experiment at SNOLab; and on the MiniCLEAN experiment at SNOLab.

Researchers from the four experiments will jointly carry out as the single next step at the scale of a few tens of tonnes the DarkSide-20k experiment. DarkSide-20k was approved in 2017 by the Italian INFN, by the host laboratory LNGS, and by the US NSF. DarkSide-20k is also officially and jointly supported by the three underground laboratories LNGS, LSC, and SNOLab. DarkSide-20k is a 20-tonne fiducial volume dual-phase TPC to be operated at LNGS with a low-radioactivity underground argon fill, extracted by the Urania plant in Colorado, USA, and purified by the Aria plant in Sardinia, Italy. The experiment is designed to collect an exposure of 100 tonne \(\times\) years, completely free of neutron-induced nuclear recoil background and all electron recoil background. DarkSide-20k is set to start operating by 2021 and will have sensitivity to WIMP-nucleon spin-independent cross sections of \(1.2 \times 10^{-47}\) cm\(^2\) WIMPs of 1 TeV/c\(^2\) mass, to be achieved during a 5 year run, and will make use as photon detectors of more than 20 m\(^2\) of cryogenic SiPMs entirely developed, produced and assembled in Italy. An extended 10 year run could produce an exposure of 200 tonne \(\times\) years, with sensitivity for the cross-section of \(7.4 \times 10^{-48}\) cm\(^2\), for the same WIMP mass. DS-20k will explore the WIMP-nucleon cross-section down to the edge of the 'neutrino floor', where coherent neutrino-nucleus scattering from environmental neutrinos induce nuclear recoils in the detector.
Biography

I am associate director of Center for Underground Physics (CUP) at Institute for Basic Science (IBS) in Korea. I am in charge of dark matter search group in the center. Currently I am a co-spokesperson of COSINE dark matter search experiment. In the past, I have been working at Tevatron in the CDF experiment for precision measurement of top-quark mass.

Selected publications
5. H.S. Lee et al., "Pulse-shape discrimination between electron and nuclear recoils in a NaI(Tl) crystal", JHEP 08, 93 (2015).

Status of COSINE-100 experiment

Hyun Su Lee
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hyunsulee@ibs.re.kr

The COSINE-100 experiment searches for dark-matter interactions using an array of scintillating NaI(Tl) crystals that serve as a WIMP-interaction target in the low-background environment of the Yangyang underground laboratory. The main goal is to check the annual modulation signal observed by DAMA/LIBRA in the NaI(Tl) crystal array. The experiment has been running for more than 2 years stably. Several analyses in addition to the annual modulation are actively ongoing. Here, the performance of the detector, recent results, and future prospects will be presented.
Claudio GATTI

Biography
Claudio Gatti obtained his degree in Physics at Rome University “La Sapienza” and the Ph.D. in Physics at Pisa University in 2003. He is staff researcher at Laboratori Nazionali di Frascati (LNF) of INFN. His background is in experimental Particle Physics. He collaborated with the KLOE and ATLAS experiments. He is now Quax, an experiment searching for galactic axions through the electron coupling and coordinates the activity of the LNF group. Recently he proposed a new experiment, KLASH, a large haloscope for galactic-axion searches in the mass range 0.3-1 µeV.

Selected publications
7. F. Ambrosino et al., “|V(us)| and lepton universality from kaon decays with the KLOE detector,” JHEP 0804, 059 (2008).
Search for Axion and Axion-like particles in Italy

Claudio GATTI
Laboratori Nazionali di Frascati INFN
Via Enrico Fermi 40 00044 Frascati (Rome) Italy
Claudio.Gatti@lnf.infn.it

Well motivated extensions of the Standard Model of particle physics predict the existence of light particles such as axions or axion-like particles (ALPS). These particles may constitute the long sought dark matter, solve the strong-CP problem and explain astrophysical anomalies. The last decade witnessed an increasing interest in the search for these particles that involved also the research programs in Italy: The PVLAS experiment looked for the effect of nearly massless spin 0 particles in the polarization state of a laser propagating in a magnetic field; AXIOMA is searching for atomic transitions induced by galactic axions; QUAX aims at observing axion dark-matter through its coupling with electron spins in a magnetized sample; STAX proposes a light shining through the wall experiment with a microwave source; KLASH proposes to recycle a large solenoid-magnet from the KLOE experiment to build a large haloscope to search for axions in the mass range 0.3-1μeV. These projects stimulated an intense R&D activity in several fields such as magnetic materials, superconductive cavities, microwave-photon counters. The speaker will describe the Italian landscape of axion searches, discussing recent results and future developments.
Yannis K. Semertzidis

Center for Axion and Precision Physics Research
Institute for Basic Science, KAIST Campus
and
Department of Physics, KAIST
Daejeon 305-701, Republic of Korea

e-mail: yannis@kaist.ac.kr, Phone: +82-42-350-2522, FAX: +82-42-350-5537

Personal:

Place of birth: Katerini, Greece
Citizenship: USA.

Education:

1979-1984 BSc. in Physics, Aristotle University of Thessaloniki, Greece.
1985-1987 MSc. in Physics, University of Rochester, NY, USA.
1987-1989 PhD. In Physics, University of Rochester, NY, USA.

Important Milestones

1990-1992 Research Associate in Physics, University of Rochester.
1992-1995 Assistant Physicist, Department of Physics, Brookhaven National Laboratory (BNL), Upton, NY USA.
1993-1995 Fellow, PPE Division, CERN (European Organization for Nuclear Research, Switzerland).
1995-1997 Associate Physicist, Department of Physics, BNL.
1997 – Feb. 2000 Physicist, Department of Physics, BNL.
Mar. 2000 – Present  Tenured Physicist at BNL.

September 2012  Senior Scientist with Tenure, Department of Physics, BNL

January 2003  Recipient of the prestigious Brookhaven National Laboratory Science and Technology Award for contributions made to the muon g-2 experiment.

January 2005  Elected Fellow of the American Physical Society citing the work on the muon g-2 experiment.

The year’s theme was: “The Three Frontiers of Particle Physics”.

Oct. 2013 - Present  Director of Center for Axion and Precision Physics Research (CAPP), of IBS, at the KAIST Campus, Daejeon, Korea. For more information on current activities, see: https://capp.ibs.re.kr/html/capp_en/

Committee Memberships

2018 - Present  Member of the DESY Physics Research Committee.

2012 – 2018  Organized numerous workshops on Axions and Dipole Moments Physics

2012  Member of the Scientific Program Advisory Committee for the International Workshop on EDM Searches at Storage Rings, held at Trento, Italy, October 1-5, 2012.

2010 - Present  Member of the Scientific Program Advisory Committee for the International Symposium on Lepton Moments held in Cape Cod, Massachusetts, USA, July 18-22, 2010.

2005-2008  Co-convener for the WG on LFV and EDM plus g-2 of the “Flavour in the era of the LHC” series of workshops. We finished writing a report in three volumes including the physics reach of the flavor experiments.

2005-2008  I served as a member of the BNL RHIC/AGS Program Advisory Committee for a period of three years. This committee is charged with giving advice to the HENP Associate Lab Director on High Energy and Nuclear Physics proposals at BNL.

<table>
<thead>
<tr>
<th>Year</th>
<th>Activity</th>
</tr>
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<tbody>
<tr>
<td>2003</td>
<td>Member of the Scientific Program Advisory Committee for the International Symposium on Lepton Moments held in Cape Cod, Massachusetts, USA, June 9-12, 2003.</td>
</tr>
<tr>
<td>1999</td>
<td>Member of the Scientific Program Advisory Committee for the International Symposium on Lepton Moments held in Heidelberg, Germany, June 8-12, 1999.</td>
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**Research Activities**

<table>
<thead>
<tr>
<th>Year</th>
<th>Activity</th>
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<tbody>
<tr>
<td>2013-present</td>
<td>Director of the Center for Axion and Precision Physics Research with main goals to launch state of the art Axion Dark Matter Experiments in Korea, play a leading role in the proposed proton electric-dipole-moment (EDM) experiment and take a significant role in storage-ring precision physics involving EDM and muon g-2 experiments.</td>
</tr>
<tr>
<td>2009-present</td>
<td>Spokesman and initiator of a proposal for a sensitive proton electric dipole moment (EDM) in storage rings using high intensity polarized beams. This approach of using storage rings to study the EDM of charged particles promises to probe popular models of physics beyond the Standard Model, e.g. Supersymmetry (SUSY), with high sensitivity (&gt;300TeV) and may elucidate the Baryon-Antibaryon asymmetry in the Universe. This experiment, if successful at the level of $10^{-29}$ e×cm, will be the most sensitive experimental probe for CP-violation beyond the SM. We are preparing a proposal for a proton EDM experiment at Fermilab to be submitted by November 2014.</td>
</tr>
<tr>
<td>2003-2009</td>
<td>Spokesman and initiator of a proposal for a sensitive deuteron electric dipole moment (EDM) in storage rings using high intensity polarized beams at BNL. We submitted a deuteron EDM proposal to Brookhaven in the spring of 2008 for a sensitivity of $10^{-29}$ e×cm.</td>
</tr>
<tr>
<td>2008-present</td>
<td>Member of the new muon g-2 collaboration at FNAL. The experiment will be able to refute or confirm the current discrepancy between our experimental result and theory. If confirmed, it will be the best indication of Supersymmetry (SUSY) and will be able to place better constraints on certain SUSY parameters than the LHC. I am the electro-static quadrupole system team leader and in charge of its upgrade. I have developed a tracking simulation program, which is accurate to sub-parts per billion in the g-2 frequency. In addition, our group is studying beam and spin dynamics, and the muon losses systematic errors.</td>
</tr>
<tr>
<td>1992-2008</td>
<td>Member of the muon g-2 collaboration at BNL. This is a precision experiment sensitive to standard model and to speculative physics like Supersymmetry. I served as the team leader of the Electrostatic Focusing Quadrupoles. Our group designed successfully the electrostatic quadrupoles that minimize low</td>
</tr>
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energy electron trapping. Our design relaxed the vacuum pressure requirements considerably and improved the reliability of the quadrupole system making possible to run the experiment at higher than foreseen field focusing n-values. This point proved to be a crucial one in minimizing the systematic errors in $a_\mu$.

As a member of the fast-pulsed magnet system (a.k.a. kicker) team I have studied the kicker eddy currents. Our kicker plate design was aimed at minimizing the eddy currents during the muon precession measurement. I have also measured the induced magnetic fields using the Faraday effect and showed that they are in agreement with the predictions and at an acceptable level.

I served as the Offline Analysis Coordinator for the data taken in 1997 and 1998. We have developed a complete range of diagnostics tools to tell whether or not there is background in our data. Later as a member of the analysis team I worked on background subtraction and pattern recognition of physics and background effects in the data.

For my work on the muon $g$-2 experiment I received the BNL science and engineering award in 2003 and became a Fellow of the American Physical Society in 2005.

2004-2007 Initiated the re-analysis of the heavy ion data of RHIC in search of parity violating effects, after an agreement with the then BNL lab director. Our analysis revealed a parity violating effect in heavy ion collisions and we discovered why the previous analysis didn’t give consistent results. This effect is confirmed by further analysis, and it was the subject of a consequent physics run program. Today it is celebrated as one of the most important physics outcomes of RHIC.

2002-2005 Working on the muon to electron conversion experiment at BNL. There are two major contributions made: a) A geometrical approach of separating the muon and pion beam. The muon beam is diffused whereas the pion beam originated from a focused (proton) beam and therefore it could be brought to a tight focus. This quality allows for an efficient separation between the two species. b) Optimize the muon target geometry to increase production and allows for a crisper discrimination between the muon decay electrons and the muon to electron conversions. Both of those new ideas are currently being considered in the mu2e experiment at FNAL.

1996 Co-spokesperson and initiator of a letter of intent to J-PARC/Japan to improve the sensitivity of the electric dipole moment (EDM) of the muon by six orders of magnitude; a follow-up to the muon $g$-2 experiment at BNL. The experiment will be sensitive to popular models of physics beyond the Standard Model, e.g. Supersymmetry (SUSY).

July-October 2002 I worked on the Cern Axion Solar Telescope (CAST) experiment at CERN as visiting physicist with the Technical University of Darmstadt. I initiated two major ideas during my work there. The first one was to take into account the axion production probability as a function of the Sun radius for background
reduction purposes. The other one was to estimate the pressure uniformity requirement throughout the magnetic field volume for the stage two of the experiment when He-gas is to be used to enhance the axion/x-ray coherence length. I found the requirement to be strict and a special attention since then is paid to it to achieve it. I continued participation in the experiment and collaborating on axion physics up to the present.

1997-2002  Spokesperson and initiator of the experiment to detect charged beams with pico-second and eventually femto-second time resolution by optical techniques in the single shot mode. Our group made the first electro-optical observation of a charged particle beam in the world establishing the proof of principle. DOE has approved and funded our proposal in 2004 for FY2005 and FY2006. The experiment has been recently concluded after reaching its goals.

1993-1995  Member of the SMC collaboration at CERN; an experiment to study the Spin Structure Functions of the Proton and Neutron. As a member of the polarized target group of SMC I studied the proton non-linearity in the measurement of the NMR polarization and improved greatly the accuracy of the proton polarization estimation. I also initiated the search for a possible coherent background axion field (dark matter candidate) which resulted to a dedicated run looking for it with the best sensitivity for a terrestrial experiment at frequencies in the range 10-65 GHz.

1993-1995  I initiated and performed an experiment at BNL to put a limit on the optical photon charge of $10^{-17}$ electron charges.

1987-1992  Working at BNL on experiment 840, a coherent production of any light pseudoscalar (or scalar) that couples to two photons, and observation of the photon-photon scattering (Delbruck scattering). This was my thesis experiment, where we have constructed the best ellipsometer in the world. The limits on the production of light $m_a < 10^{-3}$ eV pseudoscalars (e.g. axions) are the best for any terrestrial experiment with a limit on the coupling constant $g_{\gamma a} < 3.6 \times 10^{-7}$ GeV$^{-1}$. The polarization rotation limit was $3.5 \times 10^{-10}$ rad for an optical path length of 2.2km in a 3.25T transverse magnetic field.

1986-1989  Working at BNL on experiment 805, the search for galactic axions; an experiment for axion search as dark matter candidates in the wide range of $4.5 - 16.3 \times 10^{-6}$ eV.

Summer, fall 1985  Working at FERMILAB on experiment 723; a search for anomalous forces at highly relativistic velocities.

1984-1985  Working at the University of Thessaloniki with ferroelectric materials for particle acceleration utilizing the strong electric fields present in them.

1983-1984  Working at LEAR/CERN on PS-182 (baryonium) and subsequently for the CP violation experiment. I wrote the first working Monte Carlo simulation, which was the basis of the CPLEAR proposal.
A number of selected publications as of 2012. For an updated list of publications please look at http://inspirehep.net/search?ln=en&p=find+a+semertzidis&of=hb&action_search=Search&sf=earliestdate&so=d


Collaboration opportunities between Korea and Italy at IBS/CAPP

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IBS/CAPP is establishing a number of breakthrough achievements that are placing us very competitively in the field of axion dark matter searches internationally. When we receive the state-of-the-art magnets: HTS (YBCO), 25T, 100mm bore diameter magnet from BNL and the LTS (Nb$_3$Sn), 12T 320mm from Oxford we will be able to probe axions competitively with a single cavity in the frequency range 0.7 – 10GHz and possibly up to 20GHz after that by applying our innovating techniques to achieve high effective volume for high frequency cavity resonators. Italy and Korea can collaborate together to strengthen each other in the development of high-quality cavity resonators, single photon detectors above 10GHz, high-volume for high-frequency resonators, etc.
Kangsoon Park

Biography
My position is principal engineer at the Center for Underground Physics (CUP), IBS with responsibilities of constructing a new underground laboratory and designing and producing detectors. I have a Ph.D. in elementary particle physics experiment with the Belle experiment at KEK, Japan. When the new underground laboratory construction is completed, I will work not only on the underground laboratory management but also on development of detectors.

Selected publications


6. H.O. Kim et al., (Belle), “Study of intermediate tow-body decays in bar(B^0) \to \Sigma_c(2455)^0 \bar{b} p \pi^+”, Phys. Lett. B 669 (2008) 287-293
7. K.S. Park et al., (Belle), “Study of the charmed baryonic decays $\bar{B}^0 \to \Sigma_{c}^{++} \bar{p} \pi^-$ and $\bar{B}^0 \to \Sigma_{c}^{0} \bar{p} (p) \pi^+$”, Phys. Rev. D 75 (2007) 011101(R)

The Construction of New Deep Underground Facility in Jeongseon Korea

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We are going to build a new deep underground facility called “Yemi-Lab” at Handeok iron mine in Jeongseon, Korea. It initially aims to carry out the the neutrinoless double beta decay search experiment (AMoRE) and the dark matter search experiment (COSINE). It will be a multi-purpose facility for various experiments that can be done only in deep underground. The construction project of the Yemi-Lab has started from late 2016 and is going to be completed by mid 2020. The lab is going to have 2,500 m$^2$ area and 25,258 m$^3$ volume with about 1,000 m overburden which can block the cosmic rays at a reduction rate of $10^{-6}$. 