

Physics Department Summer Lectures 2019

Report of Contributions

Contribution ID: 1

Type: **not specified**

Visible and Invisible Clues for New Physics

Friday, 7 June 2019 12:30 (1h 15m)

In this presentation, we will briefly describe the main elements of the Standard Model of particle physics. This theory, together with General Relativity, provides a precise description of a vast array of experimental and observational data, from microscopic to astronomical scales. However, solid empirical evidence and conceptual clues lead us to expect that this “standard” picture is incomplete. We will discuss some of the key reasons for this expectation.

Presenter: DAVOUDIASL, Hooman (Brookhaven National Laboratory)

Contribution ID: 2

Type: **not specified**

The Anomalous Magnetic Moment of the Muon and the Standard Model of Particle Physics

Tuesday, 11 June 2019 12:30 (1h 15m)

At the end of this lecture, you will know:

What is anomalous about the magnetic moment of the muon?

What is the magnetic moment of the muon ?

What is the muon ?

Why Bohr said “Anyone who thinks they understand Quantum Mechanics, and is not deeply disturbed by it, doesn’t understand Quantum Mechanics.”

What the Standard Model Theorists have to fear from the anomalous magnetic moment of the muon.

Presenter: MORSE, Bill (BNL)

Contribution ID: 3

Type: **not specified**

The Little Neutral One

Friday, 14 June 2019 00:30 (1h 15m)

In the past 50 years, the study of neutrinos, the lightest, yet most abundant of the known elementary particles has revealed cracks in the Standard Model of Particle Physics. Could neutrinos explain the matter anti-matter asymmetry in our Universe? To answer these questions we need to better understand the properties of these elusive polymorphs. I will present a brief history of the neutrino, what we have learnt so far about it, and what we hope to learn in the next couple of decades from some of the most ambitious experiments in particle physics.

Presenter: BISHAI, Mary (Brookhaven National Laboratory)

Contribution ID: 4

Type: **not specified**

Search for a new particle in the decay of the Higgs boson

Friday, 21 June 2019 12:30 (1h 15m)

In this talk, I will discuss the search strategies that led to the discovery of the Higgs boson. Then, I will focus on the usage of the Higgs boson as a portal to “new physics”. I will conclude with dark sector states as a possibility for physics beyond the Standard Model of particle physics.

Presenter: ASSAMAGAN, Ketevi Adikle (BNL)

Contribution ID: 5

Type: **not specified**

The Really Big Picture: Cosmology in the 21st Century

Tuesday, 25 June 2019 12:30 (1h 15m)

Starting from a very basic level we review how to describe the standard Big Bang model of an expanding universe. We discuss the connection between expansion dynamics and different types of matter and energy densities, and focus on the evidence for the accelerated expansion of our Universe driven by dark energy. Different schools of observation and measurement will be mentioned and we conclude with possible projections for our (very) long-term future.

Presenter: STANKUS, Paul (Brookhaven National Lab)

Contribution ID: 6

Type: **not specified**

Using Gravitational Lensing to measure Dark Matter and Dark Energy in the Universe

Friday, 28 June 2019 12:30 (1h 15m)

Gravitational lensing is the bending of the path of light near massive bodies. Mass produces a curvature of space time, and light follows a curved path that is calculable using the General Theory of Relativity. I will discuss how the lensing effect is used to measure the amount of Dark Matter in galaxies and in the universe as a whole. I will also discuss how we use lensing to measure the properties of the mysterious Dark Energy that is driving the accelerated expansion of our universe.

Presenter: SHELDON, Erin (Brookhaven National Laboratory)

Contribution ID: 7

Type: **not specified**

Astronomical CCDs and light-sensitive sensors for fast imaging

Tuesday, 2 July 2019 12:30 (1h 15m)

I will review how the state-of-the-art sensors developed for astronomical applications can precisely measure the positions and shapes of billions of galaxies. The talk will focus on the camera and sensors for the Large Synoptic Survey Telescope (LSST) and will discuss limitations on the achievable precision coming from the instrumentation. I will also discuss light sensitive sensors which can be used for fast imaging of single photons in QIS and other applications.

Presenter: NOMEROTSKI, Andrei (BNL)

Contribution ID: 8

Type: **not specified**

Silicon Detectors for Particle and Nuclear Physics

Tuesday, 9 July 2019 12:30 (1h 15m)

Silicon technology is approximately 70 years old but thousands of years by the multitude of researchers that have been dedicated to RD; the well-established microelectronic industry is based on it. Being that the silicon is sensitive to photons (from infrared to X-rays, passing through visible light and ultraviolet) and to charged particles, we can leverage the microelectronic technology to make sensors out of silicon. Silicon sensors are used in a variety of applications including scientific experiments (High Energy Physics, Astrophysics, Photon Science, etc) as well as industrial and commercial use (cameras, etc). The basic structure is the p-n junction across which a voltage is applied. When an ionizing event occurs (a photon or a charged-particle interacting with silicon), a short current pulse (~ few ns) is generated and detected by the read-out electronics. There are many kinds of silicon sensors and each one must be tailored according to the specific application. We'll give an overview of the state of the silicon technology and its different applications.

Presenter: GIACOMINI, Gabriele (BNL)

Contribution ID: 9

Type: **not specified**

Quantum Chromodynamics (QCD) as a many-body theory: An existential tale in four acts.

Tuesday, 16 July 2019 12:30 (1h 15m)

QCD, our nearly perfect theory of the strong interaction, is also deeply profound because all phenomena are emergent features of the many-body dynamics of the quark and gluon fields and the vacuum of the theory. This talk on many-body QCD is organized as a play in four acts:

- i) Origins, mysteries, symmetries
- ii) The power and the glory of QCD
- iii) Surprises from boiling the QCD vacuum in heavy-ion collisions:
 - a) why the world's hottest fluid, albeit also being its most viscous, flows with almost no resistance
 - b) a possible unexpected universality between the hottest and coldest fluids on earth
 - c) What magnetar strength magnetic fields created in heavy-ion collisions may reveal about the topology of the QCD vacuum
- iv) Looking ahead to the Electron-Ion Collider: what the ultimate IMAX experience may reveal of QCD's mysteries

Presenter: VENUGOPALAN, Raju (BNL)

Contribution ID: **10**

Type: **not specified**

Basics of Neutrino Interactions in Matter

Tuesday, 18 June 2019 00:30 (1h 15m)

I will review the basics of neutrino interactions in matter with emphasis on calculations of cross sections and rates. The lecture will provide introduction to the physics of weak interactions.

Presenter: DIWAN, Milind (BNL)

Contribution ID: 11

Type: **not specified**

A golden age in physics, an overview of what the... is going on in the RHIC tunnel

Friday, 12 July 2019 12:30 (1h 15m)

I will give a general introduction to the modern theory of “strong” interactions, which involve quarks and gluons. At about a trillion degrees, these form a Quark-Gluon Plasma, which we believe is created in the collisions of heavy ions at very high energies, such as at the Relativistic Heavy Ion Collider here at Brookhaven. I also make extensive comments about the sociology of the field, especially the phenomenon of “As everyone who is anyone knows...”

Presenter: PISARSKI, rob (bnl)

Contribution ID: 12

Type: **not specified**

Introduction to Statistics in High-Energy Physics

Friday, 19 July 2019 12:30 (1h 15m)

In this lecture, I will introduce some basic statistical concepts commonly used in the data analysis of high-energy physics experiments. I will review the basic procedure in setting confidence intervals. Some advanced topics in data unfolding, selection of test statistics, and usage of linear algebra in reducing computation will be touched upon.

Presenter: QIAN, Xin (BNL)

Contribution ID: 13

Type: **not specified**

Searching for and understanding the quark-gluon plasma in heavy-ion collisions

Tuesday, 23 July 2019 12:30 (1h 15m)

Lattice-QCD predicts the occurrence of a phase transition above a critical temperature from ordinary nuclear matter to a new state of matter, usually referred to as the quark-gluon plasma (QGP), in which partons are relevant degrees of freedom. One primary goal of the heavy-ion physics is to create and study the properties of the QGP created in these collisions. The last couple of decades have seen tremendous progresses in understanding the QGP, thanks to the successful operation of dedicated experiments at the RHIC and the LHC. In this lecture, I will discuss the detectors designed for heavy-ion physics, and how an experimentalist turns electronic signal into physics results. Future direction of heavy-ion experiments will also be discussed.

Presenter: MA, Rongrong (Brookhaven National Laboratory)

Contribution ID: 14

Type: **not specified**

From Raw Data to Physics Results

Friday, 26 July 2019 12:30 (1h 15m)

Modern nuclear and particle physics experiments generate huge amounts of data that need to be calibrated, processed and analysed so that we can extract and publish physics results. In this talk I will describe the journey of data, from the bits that leave the detectors through its transformation into well-understood physics objects that are analysed by physicists all over the world. We will look in particular at how this exabyte scale problem requires computing and software solutions that operate on a global scale, and take a look at the challenges that still lie ahead of us.

Presenter: LAYCOCK, Paul (Brookhaven National Laboratory)

Contribution ID: 15

Type: **not specified**

Celebration

Tuesday, 30 July 2019 11:30 (1h 30m)

A catered luncheon for lecturers and participants including deserts and soft drinks.