Physics Department Summer Lectures 2020

Report of Contributions

Contribution ID: **1** Type: **not specified**

Standard Model: Necessary but not Sufficient (Block 1)

Tuesday, 23 June 2020 12:00 (1h 15m)

Abstract: Although the Standard Model of particle physics, in conjunction with General Relativity, explains a wide range of physical phenomena, there are good reasons to believe that it does not represent a complete description of Nature. In this lecture, we will introduce the Standard Model and discuss some of its empirical and conceptual shortcomings.
Some of the ideas that have been proposed to address these open questions will also be briefly discussed.

Recording is available at https://bluejeans.com/s/Wuqxc/

Presenter: DAVOUDIASL, Hooman (Brookhaven National Laboratory)

Contribution ID: **2** Type: **not specified**

The Anomalous Magnetic Moment of the Muon (Block 2)

Friday, 26 June 2020 12:00 (1h 15m)

What is a muon?
Who ordered that?
What is a magnetic moment?
What is anomalous about the magnetic moment of the muon?
Most of the time, a muon is simply a muon, but very briefly, some of the time, by Quantum Mechanics, the muon is a muon, plus an electron, plus an anti-electron, for example.
How can the vacuum know about all of the standard model, and all of the new physics beyond the standard model?
You will know the answer to all these interesting questions after just one hour!

Recording is available at https://bluejeans.com/s/1oAGB/

Presenter: MORSE, Bill (BNL)

Contribution ID: **3** Type: **not specified**

The Hunt for the Little Neutral One (Block 2)

Tuesday, 30 June 2020 12:00 (1h 15m)

The neutrino - the “Little Neutral One” in Italian - is the most abundant of the elementary particles of physics in our Universe, yet remains the most mysterious. Physicists have hunted for signals of this elusive particle in vast vats of water and cleaning fluids located in deep mines and under mountains, at powerful nuclear reactors and particle accelerators, and in the Antarctic ice. In this lecture we will examine the fascinating history of the neutrino and its strange properties that lead to 4 Nobel prizes and multi-billion dollar experiments.

Recording is available at https://bluejeans.com/s/Mfk9_/

Presenter: BISHAI, Mary (Brookhaven National Laboratory)

Contribution ID: **4** Type: **not specified**

A Golden Age in Physics (Block 3)

Wednesday, 1 July 2020 12:00 (1h 15m)

Abstract: I give a meandering and historical introduction to our understanding of the modern theory of strong interactions, Quantum ChromoDynamics (QCD), and how at high temperature it is formed in the collisions of heavy ions at ultrarelativistic energies, to form a Quark-Gluon Plasma (QGP).

Presenter: PISARSKI, Rob (Brookhaven National Laboratory)

Contribution ID: **5** Type: **not specified**

Introduction to high energy spin physics (Block 3)

Tuesday, 7 July 2020 12:00 (1h 15m)

Abstract:In the first part, I give an elementary introduction to hadron physics and QCD (Quantum Chromodynamics), and explain how scattering experiments allow us to probe the internal structure of the proton. In the second part, I focus on spin physics. I introduce the notion of spin in particle physics and then point out that understanding the spin of a composite particle (in particular the proton) is an fascinating subfield of QCD. I give an overview of the basic problems and the current experimental/theoretical status, as well as an outlook for the future.

Recording is available at https://bluejeans.com/s/pFDzV8sqCsS/

Presenter: HATTA, Yoshitaka (BNL)

Contribution ID: **6** Type: **not specified**

The Really Big Picture: Cosmology in the 21st Century (Block 4)

Friday, 10 July 2020 12:00 (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.

Recording available at https://bluejeans.com/s/ohla9n4@Kx7/

Presenter: STANKUS, Paul

Contribution ID: **7** Type: **not specified**

How to analyze charge spectra from photo-sensors (Block 5)

Tuesday, 14 July 2020 12:00 (1h 15m)

Abstract: In this lecture, we will take a detailed look at the functioning and analysis of a common detector used in particle and nuclear physics. We will go through a detailed calculation of what we expect from a sensitive photo-multiplier tube used to detect photons.
Through this calculation, you will learn the use of many tools that you already know from courses in calculus, probability and statistics, Fourier analysis, etc. In the end we will compare our results to actual measurements and discuss what we have learned and how to apply it in your laboratories.

Recording is available at https://bluejeans.com/s/_a5OcxoHEk8/

Presenter: DIWAN, Milind (BNL)

Contribution ID: **8** Type: **not specified**

Silicon Detectors (Block 5)

Friday, 17 July 2020 12:00 (1h 15m)

Abstract: Silicon technology is approximately 70 years old, but thousands of years have been dedicated to R&D by a multitude of researchers; 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.

Recording is available at https://bluejeans.com/s/RPyRp2WTXky/

Presenter: GIACOMINI, Gabriele (BNL)

Contribution ID: **9** Type: **not specified**

Astronomical CCDs (Block 5)

Tuesday, 21 July 2020 12:00 (1h 15m)

Abstract: 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 also provide more detail on the camera and sensors for the Vera Rubin's Observatory Legacy Survey of Space and Time (LSST) and will discuss limitations on the achievable precision coming from the instrumentation.

Recording is available at https://bluejeans.com/s/d0lLCT84aI3/

Presenter: NOMEROTSKI, Andrei (BNL)

Contribution ID: **10** Type: **not specified**

Using the Higgs boson to search for dark sector particles (Block 6)

Friday, 24 July 2020 12:00 (1h 15m)

The discovery of the Higgs boson opens a new and rich experimental program that includes using the Higgs the boson to search for new particles. In this talk, I will discuss searches for dark sector particles in the decays of the Higgs Boson.

Recording is available at https://bluejeans.com/s/klU_gKZkQhQ/

Presenter: Dr ASSAMAGAN, Kétévi Adiklè (BNL)

Contribution ID: **11** Type: **not specified**

Searching for and understanding the quark-gluon plasma in heavy-ion collisions (Block 6)

Tuesday, 28 July 2020 12:00 (1h 15m)

Abstract: 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), which is also believed to have existed momentarily after the Big Bang. One primary goal of the heavy-ion physics is to create and study the properties of the QGP. The last couple of decades have seen tremendous progresses in characterizing the QGP properties, 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.

Recording is available at https://bluejeans.com/s/xurfWGoB2a5/

Presenter: MA, Rongrong (Brookhaven National Laboratory)

Contribution ID: **12** Type: **not specified**

Review of Linear Algebra Applications in Some Recent Neutrino Experiments (Block 7)

Friday, 31 July 2020 12:00 (1h 15m)

Abstract: Linear algebra has been widely used in physics analysis of experiments. In this talk, I am going to review some of its recent usage in detector signal processing, noise filtering, event reconstruction, and data unfolding. In particular, its connections to various numerical and analytical techniques including the Fast Fourier Transformation, the Compressed Sensing, and the biconjugate gradients stabilized method, will be discussed. Through many real world applications, we show the power of linear algebra in high-energy experiments.

Recording is available at https://bluejeans.com/s/IEzP5b3BcNz/

Presenter: QIAN, Xin (BNL)

Contribution ID: **13** Type: **not specified**

From Raw Data to Physics Results (Block 7)

Friday, 7 August 2020 12:00 (1h 15m)

Abstract: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

Recording is available at https://bluejeans.com/s/HeqhxQl4RHF/

Presenter: LAYCOCK, Paul (Brookhaven National Laboratory)

Contribution ID: **14** Type: **not specified**

Quantum Computation for Nuclear Physics (Block 7)

Tuesday, 11 August 2020 12:00 (1h 15m)

Abstract: I will give an introduction into the exciting field of quantum computation and quantum simulation from the perspective of a nuclear theorists.
My goal is to convince you that this potentially is the very beginning of a new era, where theorists may be able to compute things that had been impossible before.
I will highlight the many connections between high energy and nuclear, condensed matter and atomic, molecular and optical physics that are inspired by advances
in controlling matter at the single quantum level. These connections force us to think about old (and new) problems in very different and exciting ways.

Recording is available at https://bluejeans.com/s/dVLP4UopXEg/

Presenter: MUELLER, Niklas (Brookhaven National Laboratory)

Contribution ID: **15** Type: **not specified**

The electron-ion collider: A collider to unravel the mysteries of visible matter. (Block 3)

Thursday, 9 July 2020 12:00 (1h 15m)

Abstract:Understanding the properties of nuclear matter and its emergence through the underlying partonic structure and dynamics of quarks and gluons requires a new experimental facility in hadronic physics known as the Electron-Ion Collider (EIC). The EIC will address some of the most profound questions concerning the emergence of nuclear properties by precisely imaging gluons and quarks inside protons and nuclei such as the distribution of gluons and quarks in space and momentum, their role in building the nucleon spin and the properties of gluons in nuclei at high energies. In January 2020 EIC received CD-0 and Brookhaven National Laboratory was chosen as site. This presentation will highlight the capabilities of an EIC and discuss its status, accelerator design and the concepts for the experimental equipment.

Recording is available at https://bluejeans.com/s/dRrqwj8D7P1/

Presenter: Dr ASCHENAUER, E. C. (BNL)

Contribution ID: **16** Type: **not specified**

Physics Department Summer Lectures 2020: Q&A with lecturers

Friday, 14 August 2020 12:00 (2 hours)

Final session of the Physics Department Summer Lecture Series. Participants are invited to participate in Q&A and informal discussions with lecturers.

12:00-12:30: Nuclear and Particle physics experiments and experimental measurements: Higgs, dark matter, neutrinos, quark-gluon plasma, EIC

12:30-:1:00pm: Enabling technologies: detector and accelerator technologies and designs

1:00-1:30 pm: Analysis and Computing: Mathetmatical and statistical techniques, computational challenges, deep learning and quantum computing

1:30-2:00pm: Nuclear and Particle Theory

Recording is available at https://bluejeans.com/s/v2yd8WiOBAg/

Presenter: BISHAI, Mary (Brookhaven National Laboratory)