IFJ PAN Particle Physics Summer Student Programme '18
Seminars

1 Monday, July 9^{th}, 11:00 – 12:00, main lecture hall (aula)

Introduction to QCD Physics

dr Rafał Staszewski

Quantum Chromodynamics (QCD) is the theory describing the strong interaction. During the seminar, I will discuss the most important topics related to the strong interaction in the world of elementary particles. I will start with the experimental evidence behind the existence of quarks, gluons and three different color charges. I will present the properties of strong interactions and how they manifest themselves in particle interactions at high energies. I will also discuss the proton structure.

2 Tuesday, July 10^{th}, 11:00 – 12:00, main lecture hall (aula)

Virtual LHC colliders = Monte Carlo Event Generators.
How we play a roulette to understand the basic laws of the nature.

dr Andrzej Siódmok

There is a huge gap between a one-line formula of a fundamental theory, like the Lagrangian of the Standard Model, and the experimental reality that it implies. General Purpose Monte Carlo (GPMC) event generators are designed to bridge that gap. One can think of a GPMC as a "Virtual Collider" that produces simulated collisions similar to those that are produced in the actual LHC experiments, and therefore its results can be directly compared against the experimental data. GPMC are employed to relate experimentally measured variables to the parameters of the underlying theory that we wish to probe. They are also widely used by theorists and experimenters to simulate the physics of future experiments and help to define their operational requirements.

This is the reason why the GPMC event generators are central to high energy physics (HEP) and are an indispensable part of HEP experiments. In fact almost all measurements and discoveries in the modern era have relied on GPMC generators, most notably the discovery of the Higgs boson. It is therefore very impotent to understand how they work and how to use them. During my lecture I will briefly describe the basic building blocks of the Monte Carlo Event Generators and show some comparisons with the recent experimental data.

3 Wednesday, July 11^{th}, 11:00 – 12:00, main lecture hall (aula)

How you CAN have your cake and eat it?
Detection of diffractive events.

dr Maciej Trzebiński

I will discuss how one can learn about a peculiar event production – so-called diffractive physics. In such eventsm particles (like a Higgs boson) can be produced, but the interacting protons remain intact. It is like eating the cake and still having it! Such protons are produced when a colourless object - photon (electromagnetic) or Pomeron (strong interaction) - is exchanged. Thus, they may be a signature of so-called diffractive and 'beyond Standard Model' physics. I will discuss detection and reconstruction techniques used at the LHC to measure such events.

4 Thursday, July 12^{th}, 11:00 – 12:00, main lecture hall (aula)

Machine Learning for HEP

dr hab. Marcin Wolter

Nowadays nearly every analysis in physics is based on many variables and their optimal use is a key to get a final result. Each new generation of particle physics experiments is more demanding and finding the signals of new physics become a veritable case of 'finding needles in a hay-stack'. What helps us in this task are Machine Learning algorithms that give computers the ability to learn without being explicitly programmed.

Last years a great progress was done with the invention of Deep Learning algorithms, being now the core of artificial intelligence programs. They become to be used in HEP as well showing a great potential.

5 Friday, July 13^{th}, 11:00 – 12:00, main lecture hall (aula)

The search of the new phenomena on the B-factories

dr hab. Andrzej Bożek

I will present the case why e^+e^- colliders are the good option to search physics beyond Standard Model. The constraints on the detectors and physics analysis will be overview. While we don't yet have any definitive proof of the new phenomena but we have several hints leading to possible to challenges in our understanding of electroweak sector of Standard Model. The current physics results and the perspectives for next few years will be outlined.