Second High Energy Physics Graduate Workshop

University of Mohamed Boudiaf - M'sila

1. Introudction:

M’sila university currently is preparing to play a strong role in the national particle physics scene mainly after the PhD openings. However, many steps are needed to move forward with a solid student’s formation in the foreseen assigned research topics.
The actual graduate workshop present unique and well timed opportunity to drive the new generation of particle physicists and add to the growing physics community who will ultimately be part of building and enhance the various research fields in Algeria.

The group courses will follow the structure of formal lectures in the morning, on topics such as phenomenology and experimental physics, followed by a hands on session where the students will be introduced to the most common High Energy Physics (HEP) Tools that are available in the market.

2. Proposal Overview

The Standard Model (SM) of the electroweak and strong interactions is extremely successful in explaining most of the measurements in particle physics at high energies accessible today. However, there are several questions which remain un-answered. Among these un-explained mysteries: the neutrino masses and mixing, the nature of the Dark Matter (DM, as one of the most striking and hot research topics nowadays), and the origin of the Baryon Asymmetry of the Universe. Nonetheless there appears to be a need for physics beyond the SM at about the weak scale, with additional features that could explain the presence of dark matter in the universe and provide a mechanism to naturally stabilize the Higgs boson mass at its observed value of 125 GeV.

Along this line, the main research directions of the High Energy Physics graduate workshop will focus on exploring all phenomena related to the mentioned research topics above. The expected research works will be split into twofolds: High Energy Physics: Phenomenology (as a leading part) and Experimental parts.

Keywodrs: Beyond the Standard Model, Higgs Physics, Neutrino physics, Higgs Physics, Dark Matter, Top quark physics, Collider Physics, Data Analysis.

3. Anticipated total duration

Three days: March 20-22, 2021

4. Anticipated participants

The total number of participating students (internal and external) that are expected to take part are from Master and PhD levels. However, the latter one would be convenient to follow-up.

5. Aim of the conferences

Within the expected HEP projects we want to address two of the most known problems in particle physics and cosmology communities which are getting more interests.
These outstanding open problems are namely:

i) **The nature of Dark Matter (DM):**

Astronomical data and recent observations in cosmology show that 95% of the universe's energy density is in a dark sector including Dark Matter (DM), a form of unidentified material, and dark energy whose origin is unknown. These two forms of energy have strong cosmological consequences but are difficult to detect directly.
Moreover, Dark Matter composes a large part of the mass-energy of the universe, yet its exact nature remains unknown. Discovery of DM particles and understanding their interactions with SM particles is one of the greatest quests in particle physics and cosmology today.

ii) **The mechanism for the smallness of Neutrino masses:**

The neutrinos are considered to be massless in the SM which is in contradiction with the evidence from neutrino oscillation experiments.
Finding a mechanism or paradigm understanding
the smallness of its mass is a major current focus of particle theory research.

6. Research Objectives (Phenomenology and Experimental):

Therefore, along this direction, we want initially (as the first research group task) to tackle the previous open questions and probe their (Heavy Neutrinos) possible signatures at the CERN-Large Hadron Collider (LHC) in Geneva, Lepton-Lepton Colliders (ILC) in Japan, the Future Circular Collider (FCC: hadron-hadron, electron-hadron, electron-electron) at CERN, as well as the Circular Electron Positron Collider (CePC) in China.

Conference Outline:
The Conference outline will tackle the following topics.

1. Introduction
2. Where we are in High Energy Physics ? Theory and Experimental Parts
3. BSM Searches
4. Collider Physics
5. Dark Matter Searches
6. Machine learning and Artificial intelligence in HEP.
7. HEP Hands-on: LHC and future colliders.
8. What's next and how to proceed to tackle the BSM searches ?

The corresponding program page will be hosted at the CERN indico server.
The prelimanty program will be provided by next week.

Project Members:
Lecturers:

- Marjorie Shapiro (University of California Berkeley USA)
- Salah Nasser (Al Ain University UAE, ICTP)
- Rachik Soualah (Sharjah Univeristy UAE, ICTP)
- Amine Ahriche (Sharjah University UAE, ICTP).
- Adil Jueid (Konkuk University South Korea)
- Cherifa Sabrina Amrouche (University of Geneva).
- Dalila Salamani (University of Geneva).

Organizing committee:

- Dr. Essma Redouane-Salah (Chair)
- Prof. Ettayib Bensaci
- Prof.Boussahel Mounir
- Dr. Soheyb Medjedel

Logistics and supplies

Within the framework of M'sila Physics doctoral school (CFD), High Energy Physics graduate Workshop is a three-days-activity taking place at Physics Department. designated to post graduate students.

The overall agenda for M'sila graduate workshop is the following: In the morning, students are introduced to research topics in High energy physics, BSM, experiments and detectors within two lectures.
In the afternoon session students are introduced to hands on session and tutorials with the help of lecturers. Before students leave, we will hand out certificates of participation.

The whole activity will be held online, all we need is a Zoom platform Access.