1. **Higgs Physics and Physics of Boosted Object at Colliders:**

The main goal of this project would be to understand the boosted object kinematics and decay properties at hadron colliders. Few of the objects, on which we will focus on are SM and BSM Higgs, also heavy Neutrino. The production processes for Standard Model and different models will be explored in detail. The project involves a combination of analytic calculation, theoretical understanding of the different kinematic features, as well as numerical simulation.

At a later part of this project, application of Machine Learning techniques for Higgs phenomenology will be worked out.

Reading essentials: Collider Physics – Barger & Philips; Dynamics of the Standard Model by Barry R. Holstein, Donoghue John F, and Eugene Golowich; hep-ph/0508097; Higgs Hunter's Guide by Gunion and Haber, other reviews, https://arxiv.org/pdf/1012.5412.pdf etc. Also Massive Neutrinos in Physics and Astrophysics- by Pal, Mohapatra

Prerequisite: Quantum Field Theory, basic knowledge of group theory and particle physics, relativistic kinematics

2. **Neutrino and Dark Matter Searches:**

The project will focus on dark matter searches and the constraints that appear from neutrino experiments. One of the major puzzle of the universe is the dark matter abundance. Few of the models that explain light neutrino masses, can also satisfy the relic density of the universe. A major part of this project will be to understand models behind neutrino mass generation and if these models can be tested at dark matter experiments, in particular through light neutrino measurements. The project involves a combination of analytical calculation, as well as numerical simulation.

Reading essentials: The Early Universe by Kolb and Turner; also Massive Neutrinos in Physics and Astrophysics- by Pal, Mohapatra; Dynamics of the Standard Model by Barry R. Holstein, Donoghue John F, and Eugene Golowich, hep-ph/0606054, and other reviews.

Prerequisite: Quantum Field Theory, basic knowledge of group theory and particle physics