Laboratoire Leprince-Ringuet

ÉCOLE POLYTECHNIQUE

IP PARIS

Probing the Quark-Gluon Plasma with jets using the CMS experiment at the CERN-LHC

Scope:
M2 internship + PhD thesis for 2021

Context:
Collisions of heavy nuclei at the Large Hadron Collider are used to heat matter to extreme temperatures. In these conditions, a phase transition takes place, such that ordinary nuclear matter becomes a deconfined state of strong interacting particles known as the quark-gluon plasma. One of the best ways to study this novel state of matter, which permeated the early universe, is to look at the attenuation of energetic particles as they emerge from the quark-gluon plasma. This is achieved through via measurement of jets, clusters of hadrons from which the kinematics of hard-scattered quarks and gluons may be inferred.

Team:
The student will join the CMS heavy-ion group at LLR, consisting of 3 senior researchers, and a number of students and post-docs. The group is embedded in the larger CMS team, working on the Higgs physics, as well as the upgrade program for the High Luminosity era of the LHC.

Thesis Project:
The thesis will focus on one of number of proposed measurements of jet quenching in heavy-ion collisions using lead-lead collision data to be recorded in 2022. The exact measurement is to be elaborated in consultation with the student. The student is expected to participate in the data taking effort, spending some fraction of their time at CERN. Participation in the preparation of the High Granularity Calorimeter upgrade (HGCAL) is also possible.

Internship Project:
A number of topics are possible, including a feasibility study of a measurement of jets initiated by heavy quarks from the decay of a Z boson in heavy-ion collisions.

Financing:
The PhD thesis is financed by a grant from the European Research Council.

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Selected results from the group:

"Observation and studies of jet quenching in PbPb collisions", Phys.Rev.C84, 024906 (2011), arxiv:1102.1957

"Evidence of b-jet quenching in PbPb collisions", Phys. Rev. Lett. 113, 132301 (2014), arXiv:1312.4198

"Comparing transverse momentum balance of b jet pairs in pp and PbPb collisions", JHEP 03 (2018) 181, arxiv:1802.00707

"Fragmentation of jets containing a J/ψ meson in PbPb and pp collisions", CMS-PAS-HIN-19-007