

Institut de Physique Théorique

# Cours de Physique Théorique

## Exploring High-Energy Physics with Jets

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On Fridays 10, 17, 24, 31 January 2020 and 7 February 2020, from 10:00 to 12:15.

Modern collider physics probes the structure of fundamental interactions at high energy. "Jets" are a ubiquitous tool in this quest. This set of lectures will give a taste of the wide range of phenomenological applications of jet physics.

Collider physics seeks to learn about fundamental interactions by colliding particles at high energy and studying the products of the collisions. In this sense, talking about jets is essentially talking about the highly-energetic quarks and gluons produced in these collisions and their dynamics governed by the strong interaction. Jets are therefore a cornerstone of colliders phenomenology, present (to varying degrees) at almost all levels.

This set of lectures is mostly two-folded: on one side it will try to give a taste of the broad range of aspects and applications of jet physics, on the other side it will show how it is rooted in (perturbative) Quantum Chromodynamics (QCD).

The (tentative) program of the lectures will include:

1. The concept of jets: from elementary QCD aspects to key properties of the final state of  $e^+e^-$  collisions (e.g. LEP) and  $pp$  collisions (e.g. LHC).
2. All-order calculations in QCD: the jet mass as a case study.
3. Jet substructure: concepts and (many) applications.
4. Jet substructure: what QCD tells us for several applications (quark/gluon separation, heavy boson tagging and more...)

Most of material can be found in the Springer Lecture Notes "Looking Inside Jets" (arXiv:arXiv:1901.10342) as well as in the earlier review "Towards Jetography" (arXiv:arXiv:0906.1833) and standard QCD textbooks (e.g. "QCD and collider physics" by K.Ellis, J.Stirling and B.Webber).



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