

Proposition de sujet de stage M2 / M2-Internship Proposal

2023-2024

Novel Strategies for Light New Particle Searches at Colliders

Description :

Light new particles are ubiquitous in models beyond the Standard Model, and allow to elegantly address conceptual and phenomenological problems. The perhaps most famous example are axions, an excellent candidate to explain Dark Matter, and the most elegant solution to the observed absence of CP violation in the strong force.

Light new particles in the MeV-GeV mass range are under-tested, and high-intensity meson decays actually provide exquisite probes. The case of **rare decays** is especially under-explored, at both the theoretical and experimental levels. This M2-PhD proposal aims at a well-defined direction of investigation within this subject:

- Theoretically, one can construct an **effective theory** that includes the low-energy Standard Model plus the new light particle, and calculate a specific rare decay: a Kaon to two muons plus the new invisible particle.
- Experimentally, novel ideas exist on how to enhance such search at the LHCb detector within the Large Hadron Collider, e.g. by constructing new **signal/background separation** criteria based on machine-learning techniques.

The M2 internship aims at introducing the student to the mentioned effective theory (including a sample calculation) and to the experimental tools needed for the actual search. The internship aims at continuing as a PhD thesis, producing novel results on both the subjects itemized above. A co-tutelle with the University of Santiago (Spain) — where substantial expertise on the subject is located — is anticipated as a possibility. We are thus seeking an ambitious and talented candidate for a PhD subject concurrently theoretical and experimental, and leading to a double (French & Spanish) PhD degree.

Ouverture vers un sujet de thèse : OUI

Mots-clefs : effective theories beyond the Standard Model ; axion-like particles ; collider physics ; LHCb ; rare Kaon decays

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