LABORATOIRE DE PHYSIQUE THEORIQUE ET HAUTES ENERGIES

Precision predictions for four-top production at the LHC

Advisors: Benjamin Fuks and Hua-Sheng Shao

The Standard Model of particle physics is an extremely successful theory whose predictions match data to an excellent extent. Despite this success, the current experimental status reveals several of its conceptual and practical limitations, like the absence of a candidate for dark matter, the hierarchy problem or the problematics of neutrino masses. The Standard Model is therefore acknowledged as an effective theory that should originate from a more fundamental one yet to be discovered, and new phenomena are expected at energies well below the Planck scale. One interesting avenue in the searches for new physics relies on probes involving the comparison of precision theoretical predictions to accurate experimental measurements.

By far and large, this currently means making use of matrix elements computed to (at least) the next-to-leading-order accuracy and possibly matched with the resummation of threshold logarithms. The latter consists of an attempt to quantify the effects of a well-defined set of corrections to all orders of perturbation theory, with the aim of reducing the theory error bars (so that meaningful comparisons with experimental data could be achieved). In recent years, we have developed a numerical program achieving resummed predictions for four-top production at hadron colliders. The choice to focus on such a process is driven by the fact that among all measurements to be made at the currently on-going LHC Run 3, those related to four-top production will be performed for the first time with enough precision for being compared with theoretical predictions. It is therefore critical to provide precise theoretical predictions. The proposed internship aims to make use of the program that has been developed at LPTHE, understand the underlying concepts (inherent to the theory of the strong interaction, *i.e.* QCD) and improve its efficiency so that it could be shared with the high-energy physics community as a whole.

After the M2 internship that is expected to last a few months in Spring 2024 and subject to mutual agreement, the candidate will then apply for a PhD fellowship (from EDPIF or other sources) to start in Fall 2024 and for a duration of three years.

Application procedure

Candidates familiar with computer programming languages like C/C++ are particularly encouraged to apply.

Candidates should send by email to fuks@lpthe.jussieu.fr and huasheng.shao@lpthe.jussieu.fr their CV, a transcript of their academic records (M1 + L3 + existing M2 results if any) and a short motivation letter (optional and no longer than one page). They should also arrange for one or two letters of recommendation to be sent to the same addresses, by scientists familiar with their studies and academic records.

Applications are preferred within 31st December 2023, but will be considered afterwards if the position is not filled. Short-listed candidates will be invited for a meeting, either in person or remotely.

Sorbonne Université - UMR 7589 du CNRS - Case Courrier 126 - Tour 13-14 - 4ème étage
4 Place Jussieu - 75252 Paris cedex 05