

Proposal for an internship of the Master 2 Physique Fondamentale et Application Univers-Particules

“measuring the CP violation phase γ in open charm B decays at LHCb”

General layout and importance of the CKM angle γ

The precise measurement of the angle γ of the Cabibbo-Kobayashi-Maskawa (CKM) Unitarity Triangle is a central topic in flavour physics experiments. Its determination at the sub-degree level in tree-level open-charm b-hadron decays is theoretically clean and provides a standard candle for measurements sensitive to new physics effects as accessible through global coherence tests of the KM mechanism, with respect to the Standard Model expectations. In addition to the results from the B factories (i.e. BaBar and Belle), various recent measurements from the LHCb experiment at CERN allow the angle γ to be determined with an uncertainty of around 5° . However, no single measurement dominates the world average, as the most accurate measurements have an accuracy of about 10° to 20° .

Alternative methods are therefore important to improve the precision. Among them, an analysis of the decay B_s^0 to $\bar{D}^{0(*)}\phi$ has the potential to make a significant impact.

Internship description and management team

The data taking of LHC Run2 has just finished and represent a factor 5 gain in statistics with respect to that of LHC Run1 for which the decays B_s^0 to $\bar{D}^{0(*)}\phi$ have been observed and published recently in Phys. Rev. D 98, 071103(R) (2018) [arXiv:1807.01892] together with the modes B_s^0 to $\bar{D}^0 KK$ (Phys. Rev. D 98, 072006 (2018) [arXiv:1807.01891]). I am one the main authors of the 2 former papers and I collaborate with LHCb Beijing UCAS and Tsinghua universities and LAPP Ancey colleagues, within the France China Particle Physics Laboratory (FCPPL) CNRS Laboratoire International Associé (LIA) on the follow-up of those measurements towards a measurement of the CKM angle γ . In a first time we concentrate our efforts on the B_s^0 to $\bar{D}^{0(*)}\phi$ modes, where many sub-decay modes of the D meson have to be measured (see Phys. Lett. B253 (1991) 48 and LHCb-PUB-2010-005).

During the internship, the internship student will participate to the phenomenological and statistical study of the sensitivity to the angle γ , with the CKMfitter group tools, and will focus on the observation the sub-decay D^0 to $K\pi^+\pi^0$. We propose to analyze all data 2011 and 2012 (i.e. LHC

Run1) and 2015, 2016, 2017, and 2018 (i.e. LHC Run2) which have been filtered beforehand, for a "end of chain" analysis, where modern statistical multivariate discriminators and likelihood projection technique (*sPlot*) will be employed. The experimental difficulty is related to the detection of the neutral π^0 , for which the members of the LPC LHCb group are the experts for the LHCb collaboration. After a familiarization with the physics of LHCb and the statistical tools of analysis the candidate will carry out the study of this mode in collaboration with the working team described above and will participate in the working meetings of the Working Group LHCb at CERN, to which this analysis depends on: study of the decays of B in Open charm ("B2OC" LHCb Analysis Working Group).

This internship will eventually be pursued with a PhD thesis on the subject within the LPC LHCb group, where possible contributions to the installation and commissioning of the new SciFi sub-detector during the LHC Long Shutdown 2 (LS2), that will occur in 2019 and 2020, for a restarting of LHC data taking in 2021 are also foreseen.

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Contact

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