

# Measurement of $B^0 \rightarrow D^- \pi^+ \pi^0$ at the Belle Experiment

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Hadronic B decays involving  $b \rightarrow c$  quark transitions (known as charm decays) are orders of magnitude more common than those which don't, and provide many opportunities for physics analyses. These can be used in the extraction of CP violating parameters, but also allows for the determination of Cabibbo–Kobayashi–Maskawa (CKM) matrix parameters and other searches for physics beyond the standard model. Many charm B decays act as backgrounds for rarer B physics analyses and should therefore be studied to reduce their systematic uncertainties.

Despite the presence of the common  $b \rightarrow c$  transition the decay  $B^0 \rightarrow D^- \pi^+ \pi^0$  has had no previously published branching fraction. The most recent related measurement was done by CLEO in 1994 on a sample of 79 events and found a branching fraction for  $B^0 \rightarrow D^- \rho^+$  which the PDG reports as  $(7.6 \pm 1.2) \times 10^{-3}$  [1, 2]. It has theoretical interest for reasons beyond its unobserved status including its relevance as a control mode in rare to charmless hadronic decays.

A study performed by T. Huber et. al [3] explored the applicability of the QCDF/SCET factorisation method to heavy-to-heavy, three-body, non-leptonic B decays and presented a derivation of their decay amplitude factorisations up to next-to-next-to-leading order. Additionally, they provide a discussion of asymmetries in the helicity angle distributions which are dependent on perturbative higher order corrections, experimental observation of which can be a probe for potential sources of isospin violating corrections.

This analysis uses the Belle experiment dataset consisting of  $620 \times 10^6$  B meson pairs and includes a first measurement of the branching fraction and helicity angle asymmetry of  $B^0 \rightarrow D^- \pi^+ \pi^0$  as well as an update to the branching fraction of  $B^0 \rightarrow D^- \rho^+$ .

- [1] R.L. Workman et al. (Particle Data Group), to be published in Prog. Theor. Exp. Phys. 2022, 083C01 (2022).
- [2] M. S. Alam et al., *Exclusive hadronic b decays to charm and charmonium final states* (Physical Review D, 1994) vol 50.
- [3] T. Huber, J. Virto and K. Keri Vos, *Three-Body Non-Leptonic Heavy-to-heavy B Decays at NNLO in QCD* (JHEP, 2020) vol 11.