

Hunting new physics in semileptonic $b \rightarrow u$ transitions

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Properties and interactions of elementary particles are successfully described by the theory known as the Standard Model (SM). Despite the countless confirmations of the theory, it is generally believed that physics beyond the SM (BSM) should exist. In particular, the increase in the experimental precision has put more stringent constraints on the theory and a number of tensions between the SM predictions and the related experimental results have emerged. In the flavour sector such tensions are usually referred to as flavour anomalies.

A possible way to get insight into BSM physics is a bottom-up approach, mainly driven by experiment. It consists in considering the SM as an effective theory valid at the electroweak scale and investigate the features of the more general theory from which it descends, without any reference to a specific new physics model. This kind of approach is realized in the Standard Model Effective Field Theory (SMEFT). SMEFT assumes that NP exists at the electroweak scale, so that the SM is regarded as an effective theory at that scale.

Within this framework this thesis considers semileptonic decays induced by the underlying $b \rightarrow u$ quark level transition. In particular, exclusive $B \rightarrow \pi \ell \bar{\nu}_\ell$ and $B \rightarrow \rho \ell \bar{\nu}_\ell$ modes are studied. We extend the Standard Model effective Hamiltonian governing this modes with the inclusion of the full set of Lorentz invariant dimension 6 operators compatible with the gauge symmetry of the SM and weighted by new physics couplings. Exploiting recent data provided by the Belle Collaboration, the allowed parameter space of the such couplings introduced will be identified. It will be discussed whether the SM performs better or worse than the case in which new physics is present.

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