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Form factors for $B_c^+ \rightarrow D^0 \ell^+ \nu_\ell$ and rare $B_c^+ \rightarrow D_s^+ \ell^+ \ell^-$ with HISQ

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We present HPQCD's results of the first lattice QCD calculation of the weak matrix elements for $B_c^+ \rightarrow D^0 \ell^+ \nu_\ell$ facilitated by a $b \rightarrow u$ transition. Together with observation of this process from LHCb, our form factors will lead to a new determination of V_{ub} . In tandem, we also calculate the form factors for rare $B_c^+ \rightarrow D_s^+ \ell^+ \ell^-$. Results are derived from correlation functions computed on MILC Collaboration gauge configurations with three different lattice spacings including 2+1+1 flavours of dynamical sea quarks in the Highly Improved Staggered Quark (HISQ) formalism. HISQ is also used for all of the valence quarks. We cover the full range of q^2 . The uncertainty on the branching fractions $\mathcal{B}(B_c^+ \rightarrow D^0 \ell^+ \nu_\ell)$ from the error on our form factors is roughly twice as large as the contribution from the uncertainty on the present PDG value for V_{ub} . Prospects for reducing errors on our form factors are discussed which will guide future calculations, setting out the path towards highly precise determinations of the form factors.

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