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B_c decays from highly improved staggered quarks and NRQCD

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We use both non-relativistic QCD (NRQCD) and fully relativistic formalisms to calculate semileptonic form factors for the decays $B_c \rightarrow \eta_c \ell \nu$ and $B_c \rightarrow J/\psi \ell \nu$ over the entire q^2 range. To achieve this we employ a highly improved lattice quark action at several lattice spacings down to $a=0.044$ fm, which allows a fully relativistic treatment of charm and simulation of the full q^2 range with controlled continuum extrapolation. We have two ways of treating the b quark: either with an $O(\alpha_s)$ improved NRQCD formalism or by extrapolating a heavy mass m_h to m_b in the relativistic formalism. Comparison of the two approaches provides an important cross-check of methodologies in lattice QCD. Nonperturbative renormalisation of the currents in the relativistic theory also allows us then to fix NRQCD-charm normalisation for b to c decays such as $B \rightarrow D$ and $B \rightarrow D^*$.

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