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$B \to D^* \ell \nu$ at nonzero recoil from lattice QCD

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A very rich place to look for phenomena to challenge our current understanding of physics is the flavor sector of the Standard Model (SM). In particular, the V_{cb} matrix element of the CKM matrix is the subject of a long standing tension, depending on whether it is determined using inclusive or exclusive methods. On top of that, the current average of $R(D^*)$ shows a 3σ tension between experiment and the SM calculations. Theoretical support is urgently needed, and in this work I present the first lattice QCD calculation of the form factors for the decay $B \to D^* \ell \nu$ at non-zero recoil. This analysis includes 15 MILC asqtad ensembles with $N_f = 2 + 1$ flavors of asqtad sea quarks. The lattice spacing ranges from $a \approx 0.15$ fm down to 0.045 fm, whereas the ratio between the light and the strange quark mass ranges from 0.05 to 0.4. The valence b and c quarks are treated using the Wilson-Clover action with the Fermilab interpretation, whereas the light sector employs asqtad staggered fermions. After the form factors are extrapolated to the physical point and the continuum limit in the small recoil range, these are extended to the whole kinematic range by using a model-independent parametrization. Comparison with current experimental results coming from Belle and BaBar follows, as well as a joint fit to extract the matrix element $|V_{cb}|$. The lattice prediction for the differential decay rate can be integrated to determine $R(D^*)$ using only lattice data.

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