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Multiline queue crystals, FM projection, and RSK

Multiline queues were introduced by Ferrari and Martin to compute the stationary probabilities of the totally asymmetric simple exclusion process via fibers of the type map. Viewed as binary matrices, they carry two commuting crystal structures, with dual-RSK realized by the collapsing map. We characterize how the type changes under the crystal operators on the multiline queue crystal, allowing us to identify the type map on nonwrapping multiline queues with the right-key map under the natural crystal isomorphism with semistandard Young tableaux. We further show that the type of a multiline queue is determined by the type of its collapsed image together with a recording tableau. As applications, we prove Demazure-atom positivity at $t = 0$ for ASEP polynomials and permuted-basement Macdonald polynomials, as well as quasisymmetric-Schur positivity for quasisymmetric Macdonald polynomials.