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*Integral Formulas for the Asymmetric Simple Exclusion Process.*

We give general integral formulas for probabilities in the asymmetric simple exclusion process (ASEP) on the integer lattice  $\mathbb{Z}$  with nearest neighbor hopping rates  $p$  to the right and  $q = 1 - p$  to the left. For the most part we consider an  $N$ -particle system but for certain of these formulas we can let  $N \rightarrow \infty$ . First we obtain, for the  $N$ -particle system, a formula for the probability of a configuration at time  $t$ , given the initial configuration. For this we use Bethe Ansatz ideas to solve the master equation, extending a result of Schütz for the case  $N = 2$ . The main results of the paper, derived from this, are integral formulas for the probability, for given initial configuration, that the  $m$ th left-most particle is at  $x$  at time  $t$ . In one of these formulas we can take the  $N \rightarrow \infty$  limit and it gives the probability for an infinite system where the initial configuration is bounded on one side. For the special case of the totally asymmetric simple exclusion process (TASEP) our formulas reduce to the known ones. We conclude with a discussion of some unsolved asymptotic problems. (Received July 26, 2007)