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Duality and hidden symmetries in transport models

The transformation to dual processes is a technique developed in the probabilistic literature (Liggett) that allows one to obtain elegant and general solutions of some interacting particle systems. One transforms the evaluation of a correlation function in the original process to a simpler quantity in the dual one. Some years ago, Sandow and Schutz recognized that non-abelian symmetries in the evolution operator naturally yield dual models. They exemplified this with the simple symmetric exclusion process whose $SU(2)$ symmetry they made explicit by writing the evolution operator in quantum spin notation. We will consider duality for transport models that

(i) have in the bulk a symmetry associated with a conserved quantity (the one that is transported);
(ii) are coupled to reservoirs at their boundaries.

For the transport of mass we consider the $SU(2)$ symmetry for generalized exclusion processes that allow up to $2J$ particles per site. This generalizes previous results and helps to understand the role of boundaries for the dual process in the easy context of finite state space. Then we consider Markov processes with a continuous state space. For models of energy transport we uncover a hidden $SU(1,1)$ symmetry. We discuss general strategies to find out whether a model admits a dual.