Mixing times and coagulation-fragmentation

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I will first describe a result on the uniqueness of invariant distributions for a certain process of coagulation and fragmentation. This result was first proved by Diaconis, Mayer-Wolf, Zeitouni and Zerner (2004) using representation theory, but subsequently Oded Schramm (2005) found a completely different and probabilistic proof. I will then explain how ideas from this approach can be used to give a new and probabilistic proof of the famous Diaconis-Shahshahani (1981) result about mixing times of random transpositions. In fact, this readily extends to much more general random walks on the permutation group (for which the increment is at each step uniformly selected from a given conjugacy class). This proves a conjecture of Roichman (1996). Joint work with Oded Schramm and Ofer Zeitouni.