The topology and geometry of automorphism groups of free groups

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In the 1970's Stallings showed that one could learn a great deal about free groups and their automorphisms by viewing the free groups as fundamental groups of graphs and modeling their automorphisms as homotopy equivalences of graphs. Further impetus for using graphs to study automorphism groups of free groups came from the introduction of a space of graphs, now known as Outer space, on which the group $Out(F_n)$ acts nicely. The study of Outer space and its $Out(F_n)$ action continues to give new information about the structure of $Out(F_n)$, but has also found surprising connections to many other groups, spaces and seemingly unrelated topics, from phylogenetic trees to cyclic operads and modular forms. In this talk I will highlight various ways these ideas are currently evolving.