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Xiaorui Sun and **John Wilmes*** (wilmesj@math.uchicago.edu). *Structure and automorphisms of primitive coherent configurations.*

Coherent configurations (CCs) are highly regular vertex- and edge-colorings of the complete digraph. CCs generalize association schemes; their history goes back to Schur in the 1930s. A CC is primitive (PCC) if the digraph in each edge-color is connected.

We address the problem of classifying PCCs with large automorphism groups. This project was started in Babai's 1981 paper in which he showed that only the trivial PCC admits more than $\exp(\tilde{O}(n^{1/2}))$ automorphisms. (Here, n is the number of vertices and the \tilde{O} hides polylogarithmic factors.)

We classify all PCCs with more than $\exp(\tilde{O}(n^{1/3}))$ automorphisms, making the first progress on Babai's conjectured classification of all PCCs with more than $\exp(n^\epsilon)$ automorphisms.

A corollary to Babai's 1981 result solved a then 100-year-old problem on uniprimitive permutation groups, giving an $\exp(\tilde{O}(n^{1/2}))$ bound on their order. Similarly, our result implies an $\exp(\tilde{O}(n^{1/3}))$ upper bound on the order of such groups, with known exceptions. This improvement of Babai's result was previously known only through the Classification of Finite Simple Groups (Cameron, 1981), while our proof, like Babai's, is elementary and almost purely combinatorial. (Received September 10, 2015)