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Section:

13. Combinatorics

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On transitive permutation groups without semi-regular subgroups

The following question is, to our knowledge, still open: find an example of a finite graph Γ with the vertex set V such that the automorphism group $\mathrm{Aut}(\Gamma)$ acts transitively on V and does not have a semi-regular subgroup. In our attempts to construct such an example we started from a few series of transitive permutation groups (H, V) about which it was known (W. M. Kantor) that they do not contain a semi-regular subgroup. We found 2-orbits of (H, V) and computed the 2-closure $(H^{(2)}, V)$ (in the sense of Wielandt, see also reference). It turns out that the 2-closure does not have the desired property.
This is joint work with G. Jones (Southampton).
Reference: M. Ch. Klin, R. Pöschel, K. Rosenbaum, Angewandte Algebra. Einführung in gruppenteoretisch-kombinatorische Methoden. *Vieweg, Braunschweig,* 1988.