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THE CLASSIFICATION OF NONLINEAR SIMILARITIES OVER \mathbf{Z}_r

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The real representations ρ_1 and ρ_2 of a finite group G are *topologically similar* (written $\rho_1 \sim_t \rho_2$) if there is a homeomorphism $h : V(\rho_1) \rightarrow V(\rho_2)$, where $V(\rho_i)$ denotes the vector space of the representation ρ_i , such that $h(\rho_1(g) \cdot v) = \rho_2(g) \cdot h(v)$ for $v \in V(\rho_1)$ and $g \in G$ (i.e. the representation spaces are equivariantly homeomorphic).

De Rham [dR] conjectured that topological similarity implies the linear equivalence of the two representations, and proved some results in this direction. De Rham's Conjecture has been shown to be true in numerous special cases, e.g. G of exponent 2 or 4 (easy), of exponent p^r or $2p^r$ with p an odd prime [Sch], or more generally if the exponent of G is odd or two times an odd number [HP or MR]. (A complete determination of those groups for which de Rham's Conjecture is always true is given in [CS₄].)

The first counterexamples to de Rham's Conjecture were given by the first two authors, for $G = \mathbf{Z}_{4q}$ for any $q > 1$, between representations of dimension ≥ 9 . The first three authors, together with the last, then give counterexamples over \mathbf{Z}_{4q} in all dimensions ≥ 6 for all $q > 2$ [CSSW]. (We show here that $q > 2$ is necessary for counterexamples in dimension < 9 .) Thus, by [CS₂],

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