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Brauer characters for representations of bismash products

For a finite group G, Brauer characters give a way of studying irreducible representations in characteristic $p > 0$, by "lifting" information to characteristic 0. In joint work with A. Jedwab, we extend the notion of Brauer characters and its properties to the case of a bismash product Hopf algebra $H_k = k^G \# kF$ of groups F, G over a field k; such an algebra is constructed from a factorizable group $L = FG$, where F, G are subgroups of L and $F \cap G = 1$. Since the representations of H come from representations of certain stabilizer subgroups F_x of F, our method is to lift the classical Brauer characters from these F_x to a character of H. We define a Cartan matrix analogously as for groups and show its determinant is a power of p. We prove the analog of a theorem of Thompson (1986) on Frobenius-Schur indicators:

THEOREM: Let k be an algebraically closed field of odd characteristic and let C be the complex numbers. Then if H_C is "totally orthogonal" (that is every irreducible representation has a symmetric, non-degenerate H_C-invariant bilinear form), the same is true for H_k.

We apply the theorem and our previous work with Jedwab over C to show that if k is as in the theorem and $H_k = k^{C_n} \# kS_{n-1}$ is the bismash product constructed from the standard factorization of the symmetric group $S_n = S_{n-1}C_n$, then H_k is totally orthogonal.