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Orthogonal Representations: From Groups to Hopf Algebras

In 1906, Frobenius and Schur proved the following basic theorem on the representation theory of finite groups: let V be an irreducible representation of the finite group G over the complex numbers $\mathbb{C}$. Then there are only three possibilities:

(1) V admits a symmetric non-degenerate G-invariant bilinear form;

(2) V admits a skew-symmetric non-degenerate G-invariant bilinear form;

(3) V does not admit any non-degenerate G-invariant bilinear form.

Moreover they give a simple formula involving the character χ of the representation which determines the type of V.

A group G is called *totally orthogonal* if all V are of type (1); equivalently, all representations of G are real. For example, it is known that any finite real reflection group is totally orthogonal.

In the last ten years Frobenius and Schur's result has been extended to finite dimensional Hopf algebras. In addition explicit results are known about the representations of certain Hopf algebras which may be constructed from finite groups, such as the Drinfel'd double $D(G)$.

In this talk we will survey this recent work.