Blocks of finite reductive groups and local-global conjectures in modular representation theory

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The representations of a finite group over a field of positive characteristic p are closely related on the one hand to its representations over the complex numbers (via p-modular reduction) and on the other hand to the embeddings of and relationships between the p-subgroups of the finite group (p-local structure). These relationships, first revealed in the work of Richard Brauer in the 1940s, form the bedrock of modular representation theory. There are many long-standing conjectures which make these relationships precise. The classification of finite simple groups and George Lusztig's work on the character theory of finite groups of Lie type provide us with powerful tools to tackle these problems. In my talk I will discuss recent progress on two of these problems: Brauer's height zero conjecture and the Donovan finiteness conjecture.