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Universal deformation rings and group rings

Let k be a perfect field of positive characteristic p, and let G be a finite group. There are various classical results in the literature concerning lifts of finitely generated kG-modules to complete discrete valuation rings of characteristic 0, such as Green's liftability theorem. To understand and generalize these results, it is useful to reformulate them in terms of deformation rings. Deformation rings have become an important tool in the area of number theory, and in particular in the area of Galois representations and modular forms.

In this talk, I will introduce universal deformation rings and deformations of finitely generated kG-modules. This definition goes back to B. Mazur who used deformation rings to study lifts of Galois representations. I will show how the knowledge of the structure of the group ring of kG and its blocks together with the structure of the corresponding blocks in characteristic 0 can be used to determine the universal deformation rings of certain indecomposable kG-modules V. In particular, I will give examples when the universal deformation ring of V is directly related to the group ring of a defect group of the block to which V belongs.