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Companion forms in parallel weight one

A complication faced in the study of optimal weights in Serre's conjecture on the modularity of mod-p Galois representations is the existence of companion forms. Serre conjectured that a mod-p modular form has a companion form exactly when its Galois representation is tamely ramified at p. This was proved by Gross modulo some unchecked compatibilities, and later by Coleman-Voloch (almost) unconditionally.

This work has been generalized over totally real fields in many cases. In this talk, I will explain joint work with Toby Gee on the construction of companion Hilbert modular forms in parallel weight one. The proof entails a mix of modularity lifting results and geometry.