STUDY GROUP ON THE WEIGHT PART OF SERRE'S CONJECTURE

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The goal of the study group is eventually to discuss some recent work of Diamond, Kassaei and Sasaki on a geometric version (including irregular weights) of the weight part of Serre's conjecture for Hilbert modular forms [DK16, DS17, DKS20].

Along the way, we will have some introductory talks on mod p modular forms (elliptic and Hilbert) and other aspects of Serre's conjectures on the modularity of mod p Galois representations.

Preliminary schedule:

April 22 Introduction (James Newton)

April 29 An overview of Serre's conjectures for modular forms, particularly the weight aspect. [Ser87] (Miriam Norris)

May 6 Preliminaries on modular curves and mod p modular forms. The Hasse invariant and theta operators.

May 13 The weight part of Serre's conjecture for modular forms: theta cycles, companion forms ([Edi92]). Interpretation in terms of crystalline lifts.

May 20 Hilbert modular forms and Hilbert modular varieties. Partial Hasse invariants, partial theta operators. [AG05]

May 27 Minimal weights [DK16]

June 3 Cohomological interlude: the BDJ conjectures [BDJ10] and more on crystalline lifts.

June 10 The Diamond–Sasaki conjectures on geometric weights [DS17] and the relationship to BDJ.

June 17 First talk on [DKS20]: geometric Jacquet–Langlands.

June 24 Second talk on [DKS20]: applications to mod p Hilbert modular forms.

REFERENCES

[AG05]   F. Andreatta and E. Z. Goren, *Hilbert modular forms: mod p and p-adic aspects*, Mem. Amer. Math. Soc. **173** (2005), no. 819, vi+100. MR 2110225

[BDJ10] Kevin Buzzard, Fred Diamond, and Frazer Jarvis, *On Serre's conjecture for mod l Galois representations over totally real fields*, Duke Math. J. **155** (2010), no. 1, 105–161. MR 2730374

[DK16]   Fred Diamond and Payman Kassaei, *Minimal weights of hilbert modular forms in characteristic p*, 2016, arXiv:1612.08725.

[DKS20] Fred Diamond, Payman Kassaei, and Shu Sasaki, *A mod p jacquet-langlands relation and serre filtration via the geometry of hilbert modular varieties: Splicing and dicing*, 2020, arXiv:2001.00530.

[DS17]   Fred Diamond and Shu Sasaki, *A serre weight conjecture for geometric hilbert modular forms in characteristic p*, 2017, arXiv:1712.03775.

[Edi92] Bas Edixhoven, *The weight in Serre's conjectures on modular forms*, Invent. Math. **109** (1992), no. 3, 563–594. MR 1176206

[Ser87] Jean-Pierre Serre, *Sur les représentations modulaires de degré 2 de* $\mathrm{Gal}(\overline{\mathbf{Q}}/\mathbf{Q})$, Duke Math. J. **54** (1987), no. 1, 179–230. MR 885783