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The weight part of Serre's conjecture for $U(3)$

Let F be a CM field in which p is unramified. For Galois representation $\bar{\rho} : G_F \rightarrow \mathrm{GL}_3(\overline{\mathbb{F}}_p)$ arising from the cohomology of a $U(3)$ arithmetic manifold which is tamely ramified and sufficiently generic at p , we describe the weights of $U(3)$ algebraic modular forms which give rise to $\bar{\rho}$ in terms of the restriction of $\bar{\rho}$ to the inertia groups at p . This confirms the $U(3)$ analogues of conjectures of Herzig and Emerton-Gee-Herzig-Savitt, which generalize Serre's conjectures in the case of classical modular forms. We prove this by proving the first automorphy lifting results in semisimple rank greater than one outside the Fontaine-Laffaille range. This is joint work with Bao Viet Le Hung, Brandon Levin, and Stefano Morra.