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 *$p$ -adic companion forms for Yoshida lifts*

Coleman defined a  $p$ -adic theta operator on overconvergent forms, mapping forms of slope 0 and weight  $2 - k$  to forms of slope  $k - 1$  and weight  $k$ . By explicitly computing the  $q$ -expansion, he proved that the critical  $p$ -stabilization of a  $p$ -ordinary CM form lies in the image of the theta operator. The parallel statement on the Galois side is that the Galois representation of a CM form splits locally at  $p$ . Coleman and Greenberg conjectured the respective converse, but both still remain open. In the  $\mathrm{GSp}_4$  setting, the Galois representation of a Yoshida lift splits locally into two 2-by-2 blocks at  $p$ . Our goal is to prove that the critical  $p$ -stabilization of a Yoshida lift lies in the image of a relevant theta operator. With Bharathwaj Palvannan, we figured out the effect of the relevant theta operator on the  $q$ -expansion as a first step toward the goal.