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*Emerton-Gee stacks for  $\mathrm{GSp}_4$  and Serre weight conjectures*

In the Langlands program, we want to construct a certain correspondence between automorphic representations and Galois representations. The meaning of this correspondence can be explained in terms of the  $L$ -functions. However, one can also ask how the structure of one side is reflected on the other side. Serre weight conjectures explicitly explain that how (Serre) weights of the automorphic side and the ramification behavior on the Galois side are related. During the first half of my talk, I will discuss the Serre weight conjectures and their relation to local Galois representations. This will motivate us to understand certain Galois deformation rings. Then I will discuss Emerton-Gee stacks (which allows a more geometric approach to Galois representations) and local models of Le-Le Hung-Levin-Morra (which can describe parts of Emerton-Gee stacks explicitly), as well as their generalizations to the group  $\mathrm{GSp}_4$ .