Masters Thesis
Defense

Topics in Elliptic Curves: Images of Galois and Selmer groups

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Abstract: In this thesis, the author proves theorems on composite level images of Galois for elliptic
curves defined over Q. Building on recent work of Rouse, Zureick-Brown, and Zywina, the author
finds models for composite level modular curves whose rational points classify elliptic curves over
Q with simultaneously non-surjective, composite image of Galois. Also, the author classifies the
rational points for almost all of these curves except those of high genus using techniques such as
quotients, Chabauty-Coleman methods, etale descent, and associated Prym varieties. Furthermore,
the author gives an application of these results to the study of entanglement fields, which play a role
in the study of correction factors of various conjectural constants for elliptic curves. The author
also proves theorems on bounding the order of p-Selmer groups for twists of elliptic curves defined
over number fields. In 1988, Frey provided explicit examples of quadratic twist of elliptic curves
over Q with Q-rational points of odd, prime order p whose p-Selmer groups are non-trivial. The
author generalizes Frey’s result to elliptic curves defined over number fields of small degree using
class field theory and also provides explicit examples of elliptic curves over Q, which satisfy our
generalized Frey condition.

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