**Doctoral Dissertation Defense**

**Hui Wang**

**Thursday, November 21, 2019
 at 2:00pm in SES 2214**

**Committee Chair: Richard Cavanaugh**

**Committee Members: David Hofman, Nikos Varelas, Ho-Ung Yee, Kenichi Hatakeyama (Baylor University)**

**Search for natural Supersymmetry with the run 2 data collected by the CMS detector at the LHC**

The Standard Model (SM) is the most successful, experimentally verified theory which describes ordinary matter and the laws of their interactions. However, it also has several weaknesses such as the so-called hierarchy problem and it does not include any candidates for the known existence of dark matter. Supersymmetry is a beautiful framework which provides solutions to these weaknesses by introducing a super-partner to each SM particle. Two searches of Supersymmetry are presented in this dissertation, based on data from proton-proton collisions at a center-of-mass energy of 13 TeV, collected by the CMS detector at the LHC. Both searches target supersymmetric partners to the top quark, called top squarks, in the final states of multiple jets, large transverse momentum imbalance, and no leptons. The first search, which is based on the data collected in 2016, corresponds to an integrated luminosity of 36 fb−1 and has been published with no statistically significant excess observed between data and predictions of the SM background. Consequently, exclusion limits at 95% confidence level are set on various top-squark production processes, also known as “simplified models.” For simplified models involving the direct production of top squarks, top-squark masses of up to 1020 GeV and neutralino masses of up to 430 GeV have been excluded. While for models involving gluino mediated production of top squarks, gluino masses of up to 2040 GeV and neutralino masses of up to 1150 GeV have been excluded. The second search, which is based on the full Run 2 dataset (2016, 2017 and 2018) corresponding to an integrated luminosity of 137 fb−1, is prospective and not yet final. Simulation-based results show that the full Run 2 dataset has improved sensitivity and is expected to be able to exclude top-squark masses up to around 1300 GeV and neutralino mass up to around 650 GeV for simplified models involving direct top-squark production. In the case of simplified models for gluino mediated top-squark production, gluino masses up to about 2200 GeV and neutralino masses up to about 1300 GeV can be excluded. Various models with small mass differences between the top squark and the neutralino have also been studied and top squark masses of up to 650 GeV can be excluded if the mass difference is smaller than 80 GeV.