Measuring Branching Fractions of $J/\Psi$ and $\Psi' \rightarrow \omega\eta, \omega\eta', \phi\eta$ and $\phi\eta'$

The Standard Model is a robust physical theory that describes the interactions of the smallest forms of matter. One type of interaction included in the Standard Model is the strong force, which is the interaction between quarks. Quarks are indivisible forms of matter that form particles called hadrons. Calculating observable quantities resulting from the strong force is extremely difficult to do, so approximations must be made, which can be compared to experimental results. One such observable is a particle decay rate, or branching fraction. This defense will discuss measurements of branching fractions in order to compare them to strong force predictions. This analysis was largely motivated by the $\rho\pi$ puzzle, which is a significant discrepancy between theoretical predictions and experimental measurements. This discrepancy is especially confusing because similar theoretical predictions of branching fractions agree well with experiment, while other predictions starkly disagree. The resulting branching fraction measurements performed in this analysis add new information to the puzzle. This defense will discuss measurements of branching fractions of decays very similar to those in the $\rho\pi$ puzzle using data collected at the Beijing Electron Spectrometer (BESIII) experiment in Beijing, China. A description of the BESIII detector, data collection, and software is included, as is a detailed discussion of the method used to extract branching fraction measurements from the data. The measured branch-
ing fractions are more precise than the world average, and in a few of the channels, the measurements are the first significant measurements made. These results will be compared to the branching fraction of $\rho\pi$ in the context of the puzzle, and will hopefully contribute to its solution.