



**CALIFORNIA STATE SCIENCE FAIR  
2012 PROJECT SUMMARY**

<b>Name(s)</b> <b>Abrar Choudhury</b>	<b>Project Number</b> <b>S1804</b>
<b>Project Title</b> <b>Developing a Novel Method to Decontaminate dSph Data for M31 Mass Estimation</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> Many galaxies have smaller satellite galaxies orbiting around them, known as dwarf spheroidal galaxies (dSphs). The goal of the research was to use fifteen dSphs of the Andromeda galaxy (M31) to calculate the mass of Andromeda. More accurately calculating Andromeda's mass is necessary to better model and understand our Universe. I hypothesized that this would be possible since the gravitational force of Andromeda on these dSphs corresponds with Andromeda's mass.</p> <p><b>Methods/Materials</b> To use the dSphs to find the properties of Andromeda, the dSph data sets first needed to be decontaminated by eliminating foreground and background stars that were not part of each dSph. I developed a novel decontamination method using the stars' velocities, metallicities, and distances from each dSph. After determining which stars were members of the dSphs, I calculated the dSphs' velocity properties. By setting the centripetal acceleration of the dSphs equal to Andromeda's gravitational force, I was able to use the velocity properties to calculate Andromeda's mass.</p> <p><b>Results</b> I calculated Andromeda's mass to be <math>6.78 \times 10^{11}</math> solar masses. I also used stars from Andromeda's halo as gravitational tracers to calculate Andromeda's mass. The mass calculated with the latter technique was <math>7.61 \times 10^{11}</math> solar masses.</p> <p><b>Conclusions/Discussion</b> The data decontamination method I developed successfully removed a vast majority of the contaminants in the dSph data sets. The velocity properties calculated using the method correspond well with older results for the six previously studied dSphs. Also, the successful mass calculation conclusively proves that my hypothesis was supported. Because no other comprehensive method exists for decontaminating dSph data sets, my method has already been used by fellow researchers, and will be critical for all future studies of dSphs. The mass I calculated is corroborated by the mass determined from the halo stars, which was calculated for the first time in this research. Furthermore, my mass estimate is a factor of two smaller than the previous mass estimate. However, my data sets are newer, more comprehensive, and come from more optimally located dwarf galaxies. Future steps may include calculating the dark matter content of the dSphs or analyzing their chemical properties.</p>	
<b>Summary Statement</b> I calculated a more accurate estimate for the Andromeda galaxy's mass with Andromeda's satellite galaxies by using a novel decontamination method that I developed.	
<b>Help Received</b> Dr. Guhathakurta mentored me, provided me with the data, and vetted my scientific procedures.	