CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

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Project Number
S0715

Project Title
Heating the Rings: The Thermodynamics of the Rings of Saturn

Abstract

Objectives/Goals
The intent of our project was to determine the sources of energy in Saturn#s rings by writing programs to compute and analyze their temperatures.

Methods/Materials
We wrote software in C# that analyzed the spectral data from the lit and unlit sides of the rings in order to determine temperature. This was done by fitting them to an ideal blackbody curve. We then plotted the ring temperatures as a function of radius to analyze general trends. We found optical depth data for the rings and plotted it with our temperature graphs. We then computed theoretical temperatures for the lit and unlit sides and compared them with the observed temperatures.

Results
With the Stefan-Boltzmann law, we calculated the energy that should be coming from Saturn and the Sun, and found that in the optically thick B and C rings those bodies did not explain all of the energy, leaving 7.2K in the B ring and 6.8K in the C ring. Graphing the difference between the actual lit temperature and the calculated temperatures as a function of optical depth showed a direct correlation. We then calculated theoretical temperatures for the unlit side using the optical depth and lit side temperatures to determine the amount of energy making it through the rings to the unlit side. Similarly to our lit side results, we found a direct correlation between the difference of the actual temperature and calculated temperature and optical depth.

Conclusions/Discussion
As the number of ring particles is directly correlated with optical depth, we concluded from these two correlations that the excess temperatures were caused by collisions amongst the ring particles.

Summary Statement
We investigated the sources of the energy in Saturn's rings and calculated rough ratios of each source.

Help Received
Ian Dobbs-Dixon of USCS mentored us and gave us the project idea