

Title: Radio Jove Studies of Jupiter Radio Storms at MSUM

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I. Project Description

a) Statement:

Several years ago, Pam Jeppson built a Radio Jove receiver and antenna for the Physics Department. This “radio telescope” has the ability to pick up radio signals from both the Sun and Jupiter. Although both astronomical bodies are interesting, I will be working towards picking up radio signals from Jupiter.

Jupiter, due to its enormous magnetic field, produces decametric radio waves mostly from cyclotron emission¹. Charged particles become accelerated in the magnetic field, and release energy as they spiral along field lines. The interesting thing about the radiation, is that it comes in bursts, or storms. These radio storms appear to be related to the position of the satellite Io in its orbit around Jupiter. Io is the inner-most Galilean satellite, and emits plumes of material during volcanic activity. The material forms a torus around Jupiter, and it is believed that the material in the torus feeds these radio storms.

Predictions exist for when a radio storm will occur, based on the phase of Io (Io A, B, or C). A perusal of the timetables for storm predictions, shows that of the order of ten storms per month are predicted, with each storm lasting anywhere from 1 hour to 3 hours².

b) Plan:

I plan to verify that the Radio Jove system we have essentially works, by first obtaining a radio signal from the Sun (these signals occur every day, and can be picked up when the Sun is above a specified altitude). Then, I will set up the telescope when possible when a storm is predicted, and will collect radio data on these storms. With this data, I will be able to determine statistics on how often the predictions are valid. I will also be able to compare spectral content in the bursts that occur for the three different Io phases.

This project is valuable to the department, because we would like to have a radio telescope in operation at the Buffalo River Interpretive Center. We would like to have students in AST 102 (solar system astronomy) monitor radio signals in the solar system as a possible observing project. My experience with the telescope and the radio storms will help the department evaluate the use of the instrument by introductory astronomy students.

c) Timeline

Semesters remaining prior to graduation:

Rest of Spring 2009—4 hours every other week, to go out to the Center, set up the telescope, and wait for the Sun to go through the antenna lobes. I hope to acquire at least one, if not more, radio signals from the Sun and will present them in a progress report at the end of this semester

Fall 2009—4 hours every week, to go out to the Center, set up the telescope, and try to gather signals from Jupiter storms. I plan to go out for at least one of the predicted storms each week, and wait out the storm. I will report on the storms observed at the end of the semester.

Spring 2010—I plan to: analyze the storms for spectral content, as well as statistics on “success” rate.

II. Resources needed

I will need frequent access to the Buffalo River Interpretive Center, and the warm room for the Feder Observatory. The parts to the radio telescope as well as the data acquisition system to acquire radio signals, all are in the warm room. However, the telescope must be carried outside and set up in the ground between the center building and the observatory dome. The antenna consists of two dipole wires that must be mounted on 4 long poles. I also anticipate needing one other helper to help set-up the antenna. I have chosen Amanda Feldspar to help set-up the antenna and keep me company while I am at the Center. Amanda is a freshman physics major. She has agreed to help me, because she is interested in possibly an astronomy concentration.

III. Timeline (*For each semester between now and your graduation date, list: 1) how many hours per week will you devote to the project? 2) What milestones will occur in completing this project?*)

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III. Anticipated difficulties

Two problems come to mind: weather and equipment. It may be raining or snowing on dates of storm prediction, in which case I will not be able to set up the antenna. Also, the radio telescope has been verified that it can pick up signals, but it has not yet picked up signals from an astronomical body. If it is shown that the receiver is not working, precious time may be lost trying to debug and fix the electronics.

Fortunately, there is Radio Jove data available on line. Three colleges have set up continuous data streams for their Radio Jove instrument. These colleges also have data archives. Furthermore, there is a larger dataset of observations available from the Radio Jove project, for observers who are not connected permanently to the internet with streaming data.

IV. References (primary references marked with *)

1. L. N. Garcia, *The Jovian Decametric Radio Emission, Radio Jove science brief*, http://radiojove.gsfc.nasa.gov/library/sci_briefs/decametric.htm

2. Radio Jove: Jupiter radio storm predictions, <http://radiojove.gsfc.nasa.gov/observing/predictions.htm>

3. *Burke, B. F. and K. L. Franklin, Observations of a variable radio source associated with the planet Jupiter, *Journal of Geophysical Research*, vol. 60, pp 213-217, 1955.

4. *Franklin, K. L. An account of the discovery of Jupiter as a radio source. *Astronomical Journal*, vol. 64, pp. 37-39, 1959.

5. *Belcher, J.W., The Jupiter-Io Connection: An Alfvén Engine in Space, *Science*, vol. 238, pp 170-176, 1987.