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Connacht Schools Planetary Radio Telescope Network

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Abstract

This project will fund the installation of eight dual dipole antenna radio telescopes on the grounds and playing fields of several rural secondary schools in Ireland. Each will be used by the teachers and students at these schools to observe the aurora of the planet Jupiter, and in so doing contribute to the larger network of NASA's Radio Jove dipole based facilities used to monitor the giant planet's active magnetosphere. Conducting decameter observations is ideally suited to the 'temperate' Irish climate with the low population density around the western city of Galway limiting radio frequency interference. Each observatory will feed observations in real time to a server operating at the National University of Ireland that will provide both a central repository of this data but also a means to publicise the schools activities to the wider public in this part of the island.

1. Motivation

Finding innovative ways for teachers and students to explore STEM subjects beyond the set national education curriculum forms the motivation for this project. Practical activities in astronomy have great potential in this regard however these are limited due to the need for specialised equipment and facilities, to work at unsocial hours and, of course, clear skies, certainly for optical astronomy. Radio astronomy offers a very cost effective means alternative for teachers and students to participate in actual observations of radio-bright objects such as the Sun and the planet Jupiter, particularly at decameter wavelengths. A simple dipole antenna (Figure 1) with a lengthscale of 7m placed in a low radio frequency interference environment can easily observe at 20 MHz Jovian auroral activity at night and solar flare bursts by day, when both objects transit the local meridian. The acquisition and subsequent analysis of such observational data involves the use of a range of STEM subjects encompassing physics, electronics, computing, applied mathematics and statistics - not to mention astronomy. The automated nature of its operation means observations can be conducted 'after hours' or remotely, regardless of typical Irish weather conditions.

Figure 1: An operating dual dipole antenna [2]

2. NASA's Radio Jove Project

In its second decade of operation, NASA's Radio Jove project [1] is a non-profit organisation that ships radiotelescope kits for assembly and use primarily by secondary schools throughout the US and beyond. Instructions are provided to build the dipole antennae from parts easily obtained at local hardware stores, whilst Radio Jove provide the receiver electronics (pre-assembled or in kit form) and software to visualize the signals detected, with the total cost being $\sim$ \$500 per 'kit'. Once assembled, and connected to a

PC, well detailed lesson plans provided by Radio Jove can be used to fully explore the capabilities of each schools' new radiotelescope, and each group is welcome to participate in the wider Radio Jove community, which counts up to 1100 teams of students and citizen scientists in its community to date.

3. Astronomy with Radio Jove

Using software provided as part of the kit, or alternatively open-source alternatives, observations of the three brightest radio sources in the sky are possible, namely the Sun, the planet Jupiter, and the diffuse radio emission from the Milky Way. Of particular interest are observations of Jupiter, where these telescopes can be used as part of a wider network (Figure 2) in support of studying the interactions between the planet's magnetosphere and its innermost moon, Io. This is currently the case for the Juno mission where the underlying auroral physics are being probed by combining the "near field" measurements of both particles and waves from Juno with the 'far field' wave data generated by ground-based observers. Outside of the annual Jovian apparition, long term monitoring of the solar corona is possible throughout the school year.

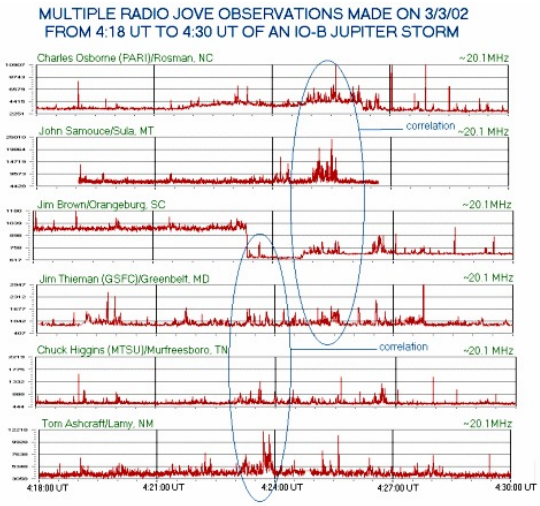

Figure 2: Multiple observations of Jovian Aurora [1]

4. The Schools

With the help of the Irish Science Teachers Association [3], several highly motivated teachers from eight schools in counties Galway, Mayo and Roscommon (Figure 3) will participate in this project. Once installed and operational, the network of radiotelescopes have the potential to be used by over 3500 secondary level students each year as part of their STEM activities, and the low cost and maintenance of each guarantees a long term educational return on a very small initial investment.

5. Project Implementation

Radio Jove 'kits', supplies and instructions for antenna assembly and a dedicated PC form the basis for each 'flatpack' will be delivered to each school and support provided for local assembly and commissioning. A dedicated web/data server at NUI Galway will coordinate operations among the schools and an annual workshop hosted on campus for the teachers/schoolchildren each year to present the results of their work. Having the network operational for the next apparation of Jupiter between April and August 2019 is the project's principal deadline.

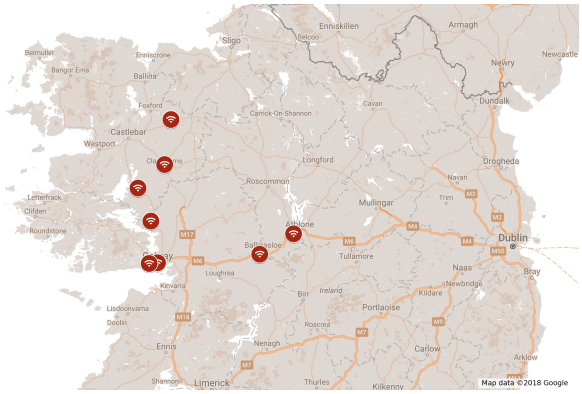

Figure 3: Participating school locations

Acknowledgements

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References

[1] https://radiojove.gsfc.nasa.gov/

[2] https://starlightcascade.ca/radiojove/

[3] http://www.ista.ie/