Radio-astronomy projects for university students

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Introduction

The recent availability of cheap Software Defined Radio (SDR) receivers makes possible the exploration of new aspects of radio-astronomy in a practical and inexpensive way. The SDR is one of the base technologies of upcoming data intensive radio-telescopes, like the Square Kilometre Array (SKA). We are currently building a radio station based on general use SDR receivers at the Royal Observatory of Edinburgh. Our main aim is to develop innovative projects for the training of students in the new radio data intensive techniques.

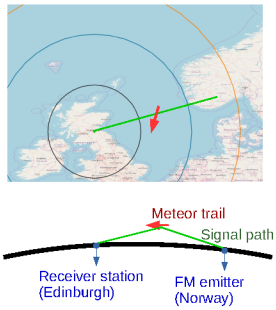
SDR receivers

RTL-SDR
Price: ~ $30
2 MHz bandwidth
30 MHz to 1.8 GHz

SDRPlay2
Price: ~ $230
10 MHz bandwidth
1 kHz to 2 GHz

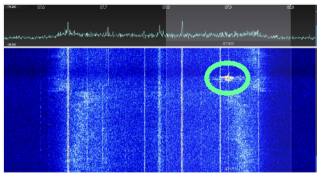
Meteor scatter

Meteors create an ionized trail that can reflect VHF radio signals. The scattered signal of far stations that could not be received otherwise can be detected if the location of the emitter, receiver, and meteor is appropriate.



Meteor scatter antenna at the Royal Observatory of Edinburgh

An FM directional Yagi antenna can be used to point in the direction of the far FM station. In our case the antenna points to Scandinavia and we were able to detect some meteor signals.

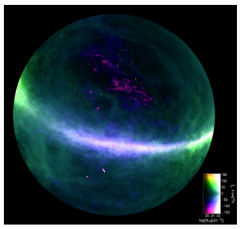


First detection of a meteor

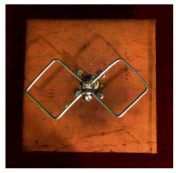
Milky Way atomic gas

The atomic gas of the Milky Way emits at a wavelength of 21 cm. A simple satellite dish and an antenna tuned to this frequency can be used to detect the transit of the Milky Way. We are still building the system which is composed of a 1.1 m dish, a biquad antenna feed and a couple of low noise amplifiers.

Offset dish antenna at the Royal Observatory of Edinburgh



The sky at 21 cm. The emission of the Milky Way dominates the view. Credit: © EBHIS Project: AIfA/Jürgen Kerp & MPIfR/Benjamin Winkel.



Biquad antenna feed that can be tuned to the 21 cm HI emission line. Credit: John Bradley - https://commons.wikimedia.org/wiki/File:BiQUad.jpg

Additional projects

There are some additional projects that can be explored like:

- Detection of Jupiter auroral activity in Short Wave
- Characterization of the solar activity at Very Low Frequencies
- Detection of pulsars
- Analysis of the ionospheric and auroral activity of the Earth
- Characterization of the equation of time using the solar transits

Most of these projects can be developed by university students with some help and some of them have potential to be used in divulgation of radio-astronomy.

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