

Radio Telescope for CAN-ARX Project



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Summary

A radio telescope developed for the CAN-ARX project as part of a university team (McMaster Advanced Space Systems).

[Hobby & Makers](#) > [Other Ideas](#)

Tags: [experiment](#) [amateurradio](#) [radioamateur](#) [amateurradioantenna](#) [livinglabcharlevoix](#) [charlevoix](#) [canarx](#) [radiotelescope](#) [radioastronomy](#) [livinglab](#)

A radio telescope that was developed for the CAN-ARX project as part of a university team (McMaster Advanced Space Systems). The Canadian Analog Research Expedition (CAN-ARX) involves proposing an experiment to be done with the aid of Living Lab Charlevoix and Students for the Exploration and Development of Space (SEDS-Canada) that would then be performed in a Canadian region analogous to extraterrestrial conditions. A link for more information on the project is below.

CAN-ARX: <https://seds.ca/can-arx/>

The experiment that was brought forth by our team was to construct a portable and modular radio telescope in order to identify how conditions on other planets would affect operations and observations. The telescope is meant as a proof of concept for future telescopes that could be

deployed in extraterrestrial environments. The telescope is currently tuned to study the 21 cm H1 line.

The telescope was designed to be nearly entirely 3D printable via FDM processes in PLA to quickly prototype and manufacture the final design as well as facilitate its portability and modularity. The mechanical design consists of 16 segments of the dish that are each covered in foil tape and then connected to each other via dovetails and to a backplate via M8 screws and nuts. Any gaps between segments are sealed with foil tape on-site. The dish is mounted to the backplate with a 3D printed spacer between that follows the contour of the dish. The backplate was machined on a CNC waterjet cutter out of 1/8" 6061 aluminum sheet and is fixed to a dovetail bar that was machined from some 6061 aluminum stock through another 3D printed spacer with M4 screws and corresponding tapped threads to enable the dish to be mounted to an Explore Scientific iEXOS 100-2 PMC-8 telescope mount. This stand was chosen since it was motorized and had GOTO capability and supported the weight of the dish (around 4.5 kg with all segments). A 3D printed arm was also made in segments that makes use of M4 screws and nuts to hold the antenna and low noise amplifier at the focal point of the dish. A waveguide was also 3D printed and coated in foil tape to go around the antenna, with the other end of the arm going to a 3D printed C-clamp placed on the edge of one of the dish segments. The ring clamps at the ends of this arm also have a small piece of craft foam added to more securely hold onto the LNA and C-clamp respectively. The design makes the telescope easy to be manufactured and deployed quickly while also being quite lightweight for the size.

The onboard electrical system consists of a 5.25 cm long 6-gauge copper wire antenna, a Nooelec SAWbird+ H1 low noise amplifier (LNA), a Nooelec NESDR Mini USB RTL-SDR, and a few coaxial adapters and a coaxial cable to connect everything. The SDR is connected to a laptop running GNU Radio on Windows Subsystem for Linux (WSL) to obtain frequency spectrum data that can be manipulated and studied.

Being a mechanical lead on the team, my focus was mainly regarding the design and testing of the mechanical aspects of the telescope, working on the CAD and the 3D printing as well as aiding others in such work.

For more information on the team, links are provided below.

Instagram: https://www.instagram.com/mac_spacesystems/

LinkedIn: <https://www.linkedin.com/company/mcmaster-advanced-space-systems-mass/>

For more information on the project, links are provided below.

Le Charlevoisien: <https://www.lecharlevoisien.com/2024/04/08/une-mission-spatiale-dans-charlevoix/>

Royal Astronomical Society of Canada (RASC): <https://www.hamiltonrasc.ca/mcmaster-students-to-build-a-radio-telescope/>





The entire assembly and all parts were made in Autodesk Inventor for easy collaboration between members of the team.

The clamp used in this project is a remix I made of an clamp made by Studio Space Dust on Printables. Both the original and remix are linked below as the 3D models are not directly included here as a result of using different licenses.

Original Clamp: <https://www.printables.com/model/730655-c-clamp-with-swappable-clamp-ends>

Remixed Clamp: <https://www.printables.com/model/965402-c-clamp-with-jaws-for-parabolic-curved-surfaces>

Model files

<< STL Files		9 files
	dovetail.stl	
	dovetail_spacer.stl	
	backplate.stl	
	dishspacer.stl	



dish1.stl



dish2.stl



arm1.stl



arm2.stl



waveguide.stl



Step Files

9 files

dovetail.stp

dovetail_spacer.stp

backplate.stp

dishspacer.stp

dish1.stp

dish2.stp

arm1.stp

arm2.stp

waveguide.stp



Machining Drawings

3 files

dovetail.dwg

backplate.dwg

backplate.dxf

Other files



Inventor Assembly

1 file

radio_telescope.zip



Engineering Drawings

2 files

dovetail.pdf

backplate.pdf

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