Algonquin Radio Observatory

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Abstract

This report gives an overview of the activities at the Algonquin Radio Observatory. It also summarizes the technical parameters and upgrades done to improve the antenna performance. Finally, the Algonquin VLBI team is introduced.

Figure 1. Algonquin Radio Observatory 46m Antenna

1. Overview

The Algonquin Radio Observatory (ARO) is situated in Algonquin provincial park, about 250 km north of Ottawa. The 46-m telescope was built and operated by the National Research Council (NRC) of Canada and began operations in May, 1966. At the current time the ARO is operated by the Geodetic Survey Division of Natural Resources Canada in partnership with the Space Geodynamics Laboratory, CRESTech.

The ARO was used in the first successful VLBI experiment in 1967 and was involved as early as 1968 in geodesy, when the baseline length between the ARO and a telescope in Prince Albert,

Saskatchewan was measured to be 2143 km (sigma=20 m). The antenna participated in the NASA CDP and DOSE programs beginning in 1984. A long term loan of a Mark III terminal from NASA in 1989 makes it possible to participate regularly in VLBI observations in support of the maintenance of the celestial and terrrestrial reference frames in the CORE and NEOS series. The GSD also maintains a permanent GPS monitoring station at Algonquin which is used by all IGS Analysis Centers as a fiducial reference. Satellite laser ranging and absolute gravity observations are also available for the site which is located on the stable pre-cambrian Canadian Shield. Local site stability has been monitored regularly using a high-precision network.

The Algonquin Radio Observatory Act protects the site from radio interference. This protection extends to a few hundred kilometers, making Algonquin a very quiet site.

2. General Specifications

- Latitude : N 45 57 19.812
- Longitude : E 281 55 37.055
- Elevation : 260.42 m
- Reflector : 46 m diameter with first 36.6 m made of 0.634 cm steel plates surrounded by 4.6 m of steel mesh.
- Foci : S and X band at prime focus. Gregorian capability with 3 m elliptical subreflector.
- Focal length : 18.3 m (prime focus)
- Focal ratio : f/D = 0.4 for full surface and 0.5 for solid surface.
- Surface accuracy : 0.32 cm for solid portion and 0.64 for mesh.
- Beamwidth : 3.0 arcmin at 3 cm wavelength (10 Ghz)
- Azimuth speed : 24 degrees per minutes.
- Elevation speed : 10 degrees per minutes.
- Receiver : S and X cryogenic receiver.
- VLBI equipment : Mark III with thick tape drive. : S2 data acquisition and recording terminal.
- PCFS version : 9.3.7
- Time standard : NR Maser
- GPS receiver : Rogue

3. Antenna Improvements

In order to improve the operational performance of Algonquin, GSD undertook a major upgrade of the antenna control system which was completed in 1997. For high precision tracking of radio sources the original control system used a Master Equatorial (ME) system to control the 46-m antenna. In recent years this system became unreliable and had to be replaced. In the new system

the azimuth and elevation drives are directly controlled by computer. This greatly simplifies the control system and has produced a major improvement in the reliability of the Algonquin antenna.

This antenna control system still uses the original azimuth and elevation encoders to determine antenna position. In the next year, we are planning to upgrade them in a way that should not affect scheduled operations.

4. Antenna Survey

The antenna is surrounded by a high stability network made of 13 concrete piers. This network has been precisely measured four times to obtain the geodetic tie between the VLBI, the GPS and the SLR reference points with a precision of few mm. The VLBI antenna itself requires a special indirect survey since the reference point cannot be accessed directly.

Figure 2. Algonquin Antenna with co-located GPS Antenna

This year we are planning to re-measure the network. In addition to tying GPS and SLR to VLBI, we will be doing a special survey to determine the antenna deformation as a function of elevation angle.

5. Algonquin VLBI team

The Algonquin VLBI team has a very diversified background with many years of experience in VLBI. The team is based in Ottawa, 250 km from the Algonquin antenna. Using satellite communication, the team can monitor the Algonquin site from its office in Ottawa. For a VLBI experiment, three members of the team drive to the site a day in advance to check the antenna and the VLBI equipment. At the same time they perform general maintenance of the site. All members are experienced VLBI operators.

- Mario Bérubé : (50%) station programming, geodetic data analysis
- Sylvain Brazeau : (90%) electronics, cryogenic, RF, VLBI equipment
- Mike Daniels : (75%) data quality, masers, VLBI equipment, gravity
- Stephen Farley : (90%) VLBI logistics, site operations, Linux
- Calvin Klatt : (10%) VLBI data analysis, scheduling
- Jacques Lafrance : (50%) high precision survey, transportable antenna

Contractor

- Normand Servant : Site maintenance and VLBI operations

Consultants

- Doug Sparkes : Electronics engineer for antenna control system
- Don Buchan : Mechanical engineer for antenna

6. Operations 1998-1999

Algonquin Radio Observatory is involved in several international VLBI networks. We summarize below the activities in the past year.

- CORE-A 26
- NEOS 15
- CORE-B 6
- MARS 5
- CGLBI 5
- NAPS 2