

## The Dwingeloo 25 meter Radio Telescope PI9CAM



### *Abstract:*

*More than 30 volunteers are involved in a project at the Dwingeloo 25 meter Radio Telescope to bring this important historical dish in operation again. More than 400 people are supporting financially. Of course, EME will be one of the activities.*

*During World War II astronomers presumed that it might be possible to receive the 1420 MHz signal from neutral Hydrogen in the universe. After the war, the world famous Dutch astronomer professor Oort worked hard to realize an instrument that could receive the Hydrogen line. In 1956 his dream came true: the Dwingeloo 25 meter Radio Telescope was build. At that time it was the first radio astronomy instrument of this size in the world.*

*The radio telescope was a huge success, but the radio astronomers wanted more...*

*In 1970 the Westerbork Array was completed. It consists of 14 telescopes, each 25 m in diameter on a baseline of 2.8 kilometers. 14 telescopes see much more than one telescope, so the Dwingeloo dish became more and more obsolete.*

*In 1997 the Dwingeloo dish did its last observations...*

*No maintenance was done since than and people started to worry what would happen with the historic dish. There even have been thoughts about scrapping the telescope...*

*Fortunately the right people met each other at the right moment and during 2005 a foundation was formed to save the dish.*

*Professor Oort realized his dream in 1956, 52 years later we realize our dream!*

*This paper will discuss the restoration of the Dwingeloo dish and the EME results so far.*

## History

After the discovery of the background radiation from the universe by Jansky around 1930 and the explorations of Grote Reber with his home-made dish, it finally became obvious that there was something to be “seen” from the universe on radio wavelengths.

In 1944 the Dutch astronomers Oort and Van de Hulst worked out a theory about the 21 cm radio emission of neutral Hydrogen.

First explorations were done after the war with old German radar antennas (7,5 meter)

The 21 cm radiation was found, but Oort realized he needed a much bigger antenna to do precise observations. His calculations led to the idea that a 25 meter dish was needed.

It was a huge and costly project, but in 1956 the Dwingeloo dish was ready to start observing the skies.

This moment also marks the beginning of ASTRON, the organisation which owns the Dwingeloo dish as well as the Westerbork array.

## Results

Professor Hugo van Woerden (a former student of Oort) was one of the first observers at the Dwingeloo dish. Hugo is 81 years old now and he can tell fascinating stories about those first months. Imagine the thrill they experienced while mapping the sky, knowing that this was the first radiotelescope of this size in the whole world!

A hydrogen map of the sky was made and the spiral structure of our galaxy was discovered .

In the center of our galaxy hydrogen clouds were found which showed strange unexpected movements. Hugo sounds like a young man when he is telling about this.

When radio techniques improved, the results of the Dwingeloo dish improved too.

The antenna at the focus of the dish was first supported by 1 rod. When antennas became bigger they went to 3 rods. When cryogenic techniques were invented they had to use 4 rods and a lot of extra counterweight. Fortunately the dish was designed with a very big safety margin, so all this extra weight was not a problem.

One of the most memorable events was the discovery of two nearby galaxies which can only be observed by radio because they are “behind” our own galaxy. Those galaxies are now named Dwingeloo 1 and Dwingeloo 2.

At the end of the professional life of the dish a very detailed survey of hydrogen was made which resulted in an excellent hydrogen sky map.

## Getting old...

The Dwingeloo dish was the beginning of professional radio-astronomy. A lot of new important things were discovered and of course a lot of new questions arose.

To answer these new questions a bigger antenna was needed.

This resulted in the construction of the Westerbork Synthesise Radio Telescope (WSRT) in 1970. This array consists of 14 dishes of 25 meter, which works as one system with a diameter of 2,5 kilometer.

The Dwingeloo dish was getting old and maintenance became expensive.

This finally led to the decision to stop observing with ‘Dwingeloo’ in 1997.

Around 2003, ASTRON was getting concerned about what might happen with this historic instrument. Corrosion did its job and doing nothing would eventually lead to the loss of the dish...

This concern was made public in newspapers and this led to the foundation of CAMRAS in 2005. CAMRAS stands for C.A.Muller Radio Astronomy Station, in honour of C.A.Muller. He was an observer at Dwingeloo for a very long time, as well as a radio amateur (PA0CAM)



The goal of CAMRAS is to restore the telescope and make it available to organisations and groups of individuals who want to make use of it. In October 2007 the Dwingeloo dish became an official Dutch monument. So its future is secured now!

### Restoration

Before we started, the telescope was inspected by professionals to see whether it was safe or not. The conclusion was that there was a lot of

restoration work to be done, but there was no safety risk.

To restore the telescope we have defined 3 steps.

Step 1: Restoration of movement and radio.

Step 2: Emergency maintenance of the steel construction.

Step 3: Complete restoration and coating of the steel construction.

Step 1 included installation of new motors for azimuth and elevation, installation of new electrical cables and coax, the construction of antennas for 70 cm and 23 cm and a complete change of all grease and oil in all systems.

Fortunately there was a small but very motivated crew of about five people who nearly worked day and night for a few months to get this all done...

During the process we started to believe it was possible to be QRV for the very first time during the DUBUS 23 cm EME contest on May 10 and 11 2008.

This goal worked very motivating and we worked very hard to meet this deadline.

### First results

What else did we need? A callsign of course and because CAMRAS is a foundation, we received a PI9 prefix. As suffix we chose CAM to honour C.A.Muller.

The antennas were installed on May 9. The clock was ticking...

There was not much time to test the antennas as the EME contest was to start at May 10 at 00:00 UTC. Computer tracking was not ready yet so only manual movement was possible.

On 23 cm the gain of the antenna should be approximately 47 dB and this means a beamwidth of only 0.5 degrees. So it is not easy to control this old lady manually...

Nevertheless we managed to put the dish in a position and let the moon pass through its beam. ON7UN was asked to send test signals.

Great was our enthusiasm when we heard good signals from Eddy!



We tested our own echo's and eventually made a quick QSO before the moon was out of our beam. That was a great beginning! Temperature was rising!  
On Saturday May 10 we had a lot of work to do to get elevation tracking on line. At the end of the afternoon computer tracking was OK and now we were ready for EME!

It was absolutely fantastic to see the "old lady" move again. The three brandnew PC controlled servomotors did a great job.



We phoned Jan PA0SSB who had asked for a QSO.

Jan had not been active for two years so he too had some work to do to be QRV again.

We had our QSO. Echo's from Jan were strong, but our signals were not as strong as we expected.

After this we did a test with G4CCH and SM5LE. We heard both, but could only make a QSO with Howard G4CCH. Sven SM5LE obviously did not hear us...

We went on and made 22 QSO's on 23 cm during the weekend.

During the weekend there were a lot of radio-amateurs visiting us and they were all amazed by the echo's from the moon.

The Dwingeloo dish is located in a beautiful landscape, where lot of cycling tourists pass by.

Many of them stopped to see the dish move again and we had quite a few questions to answer.

We had a great weekend, although we know the signals should have been much stronger.

So we are going to investigate all parts of the system, and we hope to have a stronger signal in future.

### **EME Plans**

We hope to be active in future during major EME events from 144 MHz to 10 GHz, maybe even 24 GHz...

Our dream is to make more people enthusiastic for EME by providing an opportunity for every radio amateur with a small antenna to work us on one of the bands.

### **Other Plans**

EME will only be a small part of the second life of the Dwingeloo dish.

The main thing will be radio astronomy again.

In CAMRAS there is a number of enthusiastic amateur astronomers who even have plans for controlling the dish via internet and make the data available via the internet too.



We hope to be able to do the emergency maintenance of the steel construction in 2008.



The complete restoration will cost several hundredthousands euro's.  
There is a small possibility to win one milion euro's in a Dutch TV show called "the restoration".  
16 objects start in round one, only 8 will go through to round two and compete...  
Public will decide by televoting.  
If we win, our worries are over, otherwise we will have a lot of good publicity.

During the conference presentation you will hear the latest news from PI9CAM and see lots of pictures.

