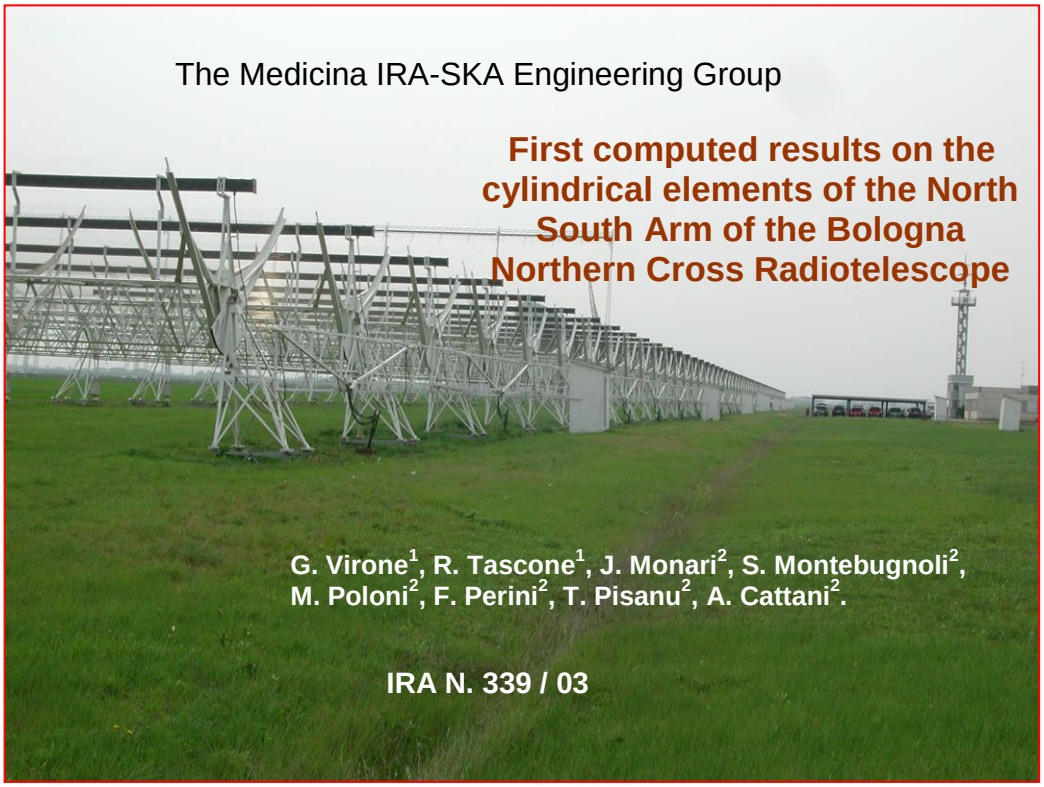

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Abstract.

In this document we summarize the computed results of the already existing North-South arm cylindrical antennas aimed to the evaluation of the radiation patterns at 140MHz, 408MHz, 610MHz and 1410MHz.

1.0 Introduction.

This activity is aimed to evaluate the possibility of widen the working freque ncy range of the cylindrical radiating elements of the North-South Arm of the Northern Cross Array.

Figure 1.1: North-South arm of the Northern Cross Array and single reflector.

Every radiating element consists of a wired cylindrical reflector with a collecting area of 7.5 m x 23.5m and a line source which is composed of an array of dipoles with a proper wired plane subreflector. In this document, simulations have been carried out in order to take into account the mechanical configuration of the single cylindrical reflector.

Figure 1.2: Wires realizing the primary mirror.

The simulation aims to estimate the following parameters:

1. Gain
2. HPBW (Half Power Beam Width)
3. Secondary Lobes Level
4. Front to back ratio: the maximum power level on the back of the reflector with respect to the primary lobe level.
5. Aperture Efficiency: the ratio between the effective collecting area and the geometrical one.

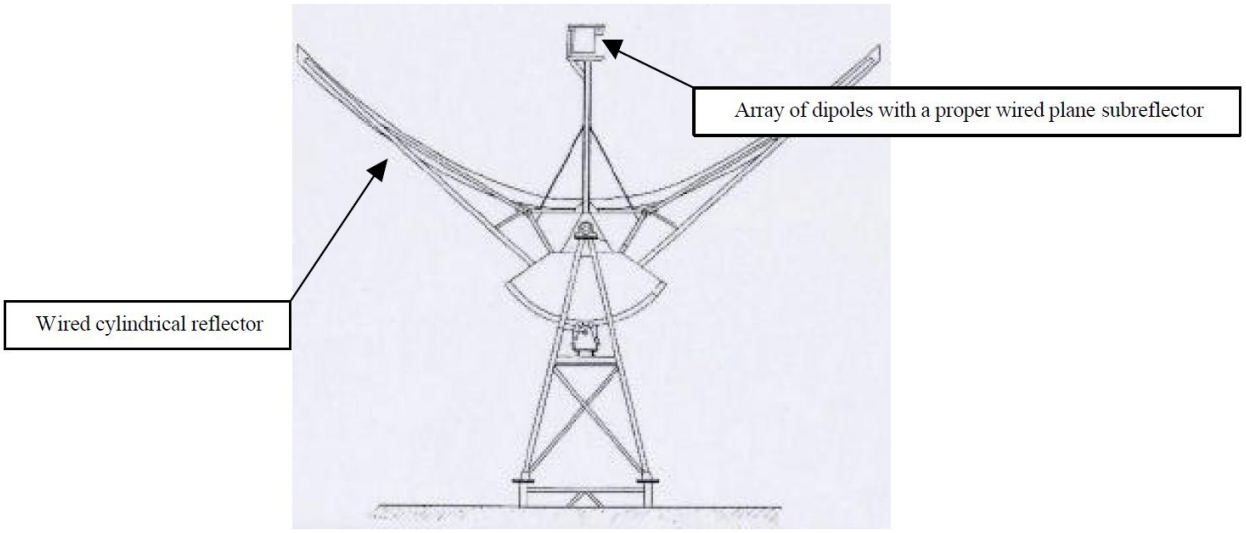

Figure 1.2: Mechanical drawing of the simulated antenna.

2.0 NORTH – SOUTH ARM SINGLE RADIATING ELEMENT ANALYSIS.

An accurate 2D model of the wired cylindrical reflector based on the method of moments applied to Pocklington equations has been developed and used to evaluate the radiation pattern of the single radiating element of the North-South Arm at different frequencies.
As shown in figure 1, at the present operating frequency (408MHz) the radiating element exhibits a 16.8dB gain (which correspond to an aperture efficiency of 76%) with a –15dB secondary lobes level and a front to back ratio of –32dB.

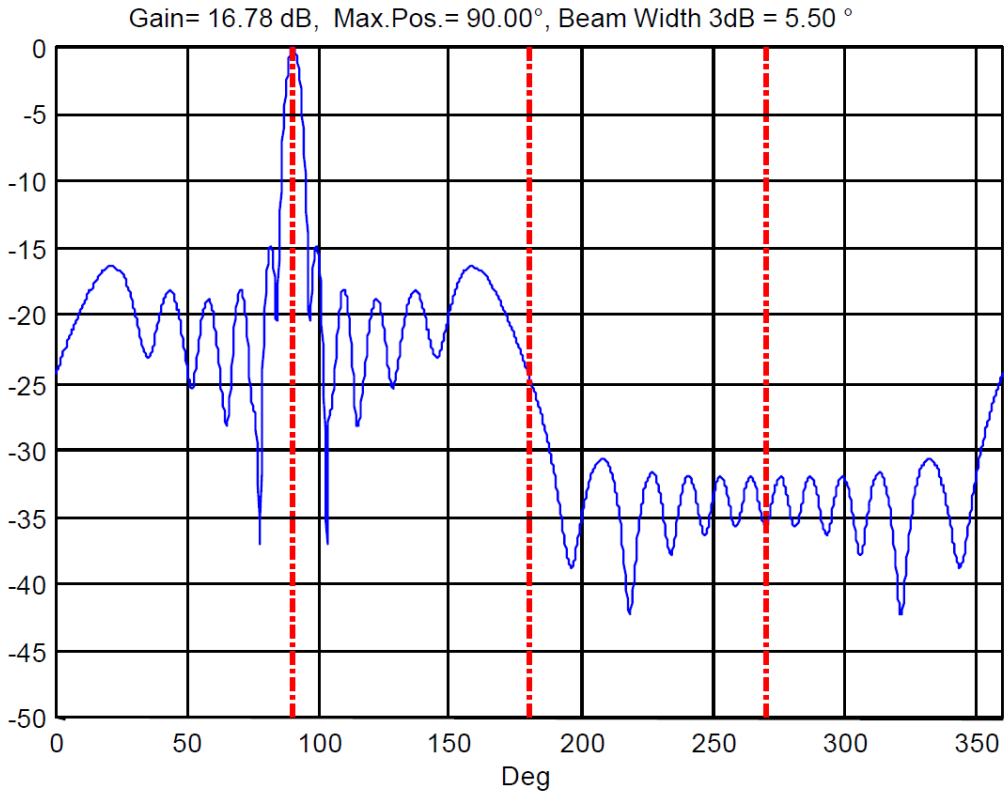

Figure 2.1: Radiation pattern @ 408MHz.

For the further radiation pattern evaluation at 140, 610 and 1410MHz, three feed systems (having the same mechanical configuration of the present one) have been designed by optimizing the position over the axis of the parabola and the distance between the dipole s and the source ground plane. In particular, the wired cylindrical reflector and the wired plane sub-reflector dimensions have not been changed. Figure 2.2, 2.3 and 2.4 report the evaluated radiation patterns at 140MHz, 610MHz and 1410MHz, respectively.

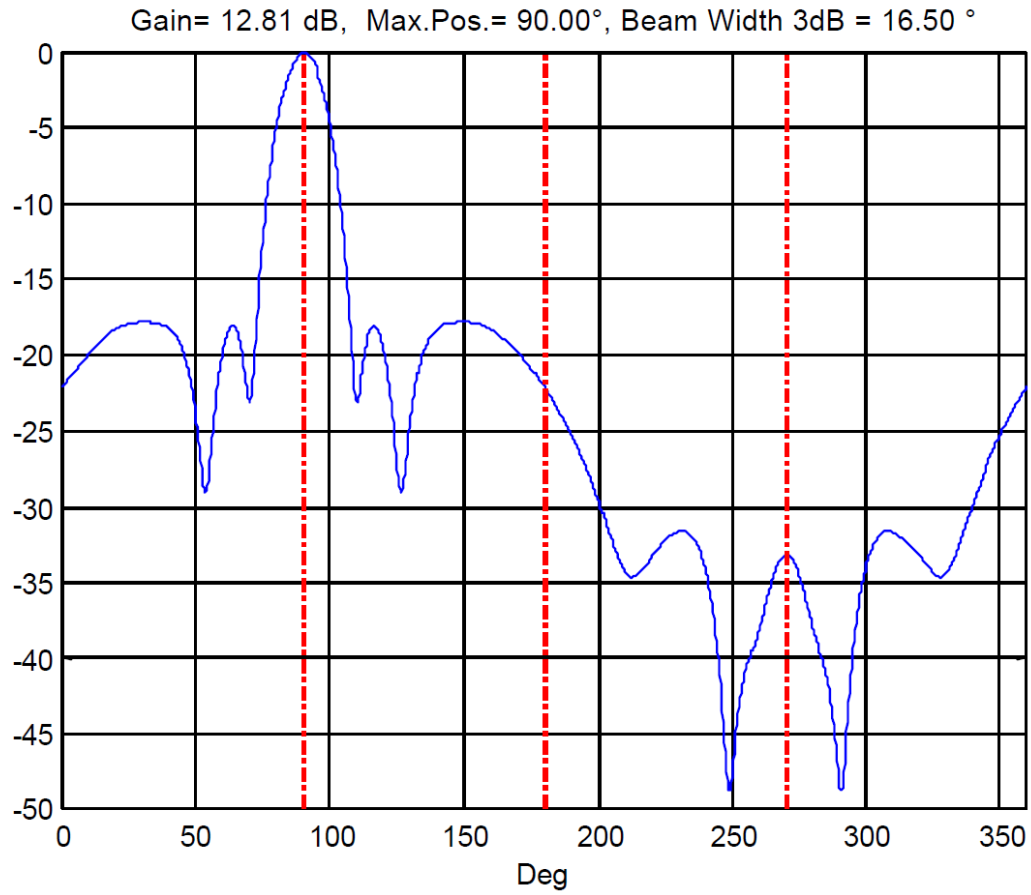

Figure 2.2: Radiation pattern @ 140MHz.

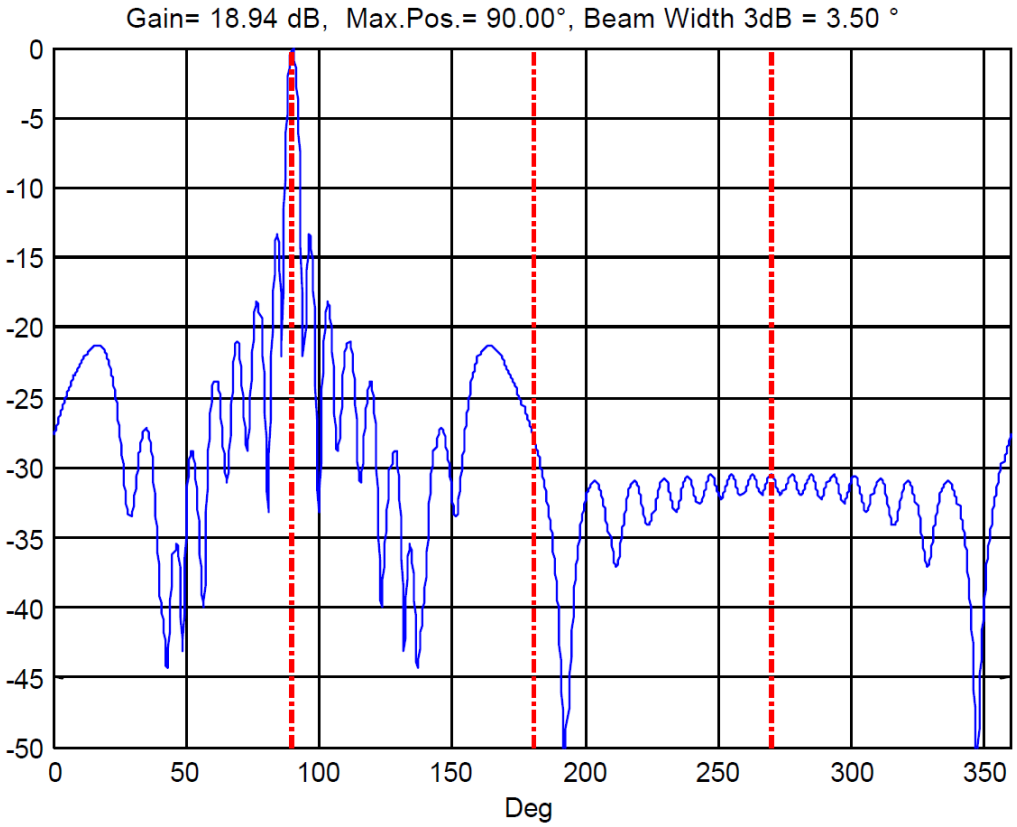

Figure 2.3: Radiation pattern @ 610MHz.

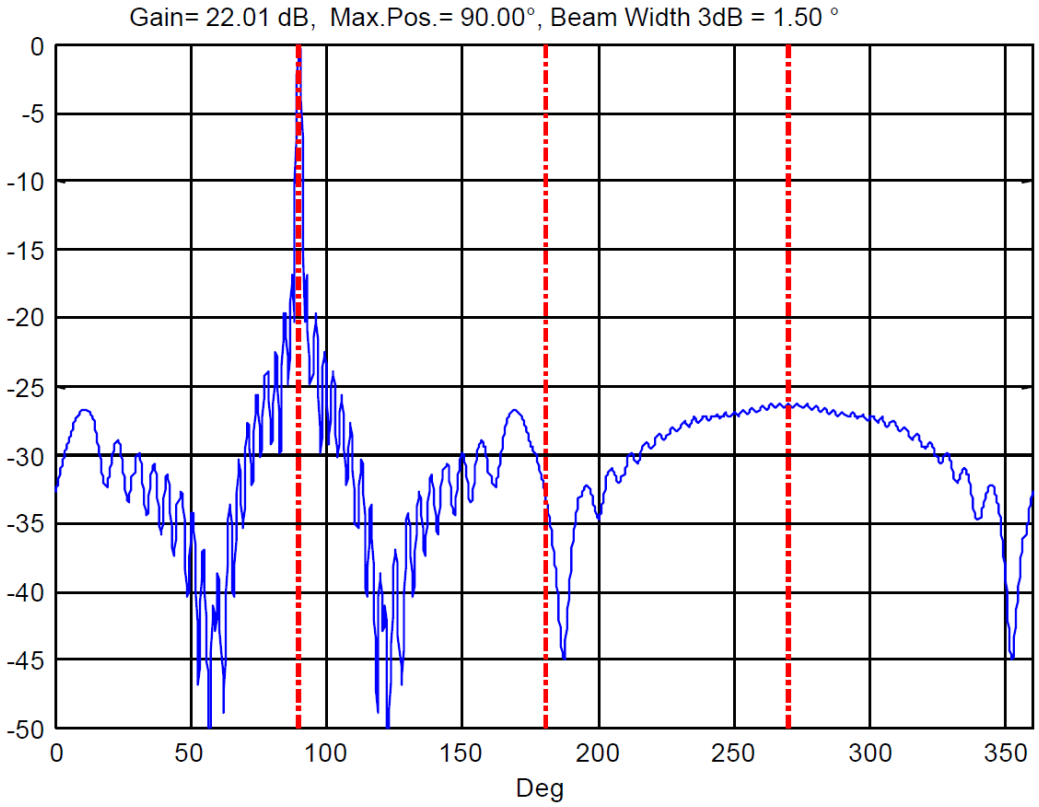

Figure 2.4: Radiation pattern @ 1410MHz.

For clearness, the previous results are also reported in Table 2.1, showing that the single wired cylindrical reflector of the North South Arm of the Bologna Northern Cross Radiotelescope exhibits an aperture efficiency better than 72% in all the frequency bands. It means that the wired reflector solution seems to be still a convenient solution also at frequencies higher than 408MHz.

Frequency	Gain	Efficiency	3dB Beamwidth	Secondary Lobes Level	Front to Back Ratio
MHz	dB	%	Deg	dB	dB
140	12,8	87	15,0	-18	-32
408	16,8	76	5,5	-15	-32
610	18,9	82	3,5	-14	-31
1410	22,0	72	1,5	-17	-26

Table 2.1: Radiation patterns parameters.

10. Conclusions

We demonstrated that the cylindrical element of the N/S arm of the Northern Cross Radiotelescope could potentially be widened in working frequencies range. The already existing cylindrical antennas could allow us to quickly have a very promising demonstrator useful in beam forming, adaptive beam forming, multibeaming, RFIs algorithm rejections and mitigation and science in transient sky investigations. This could play a very important role in a large SKA demonstrator complementary to the European EMBRACE SKA medium-scale prototype.