Hemispherical radiating pattern antenna for radio meteor observation

Bolidozor

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Problem definition

Historically, highly directional antenna designs such as Yagi were used for meteor observations. This approach was the simplest one due to the low sensitivity of receivers and easy mitigation of possible signal interference from other transmitters.

However, if we want to build a multistatic radar network, we need a different antenna design which meets the following requirements:

- All-sky sensitivity
- Stable parameters over hemisphere (polarization, gain)
- Attenuation of signals from very low elevations (terrestrial noise)
- Capability of antenna array construction
- Robust maintenance-free design.

Two types of airspace communication antennas were tested: a patch antenna designed from a wire-mesh and a short-circuited quadrifilar helix.

Patch antenna

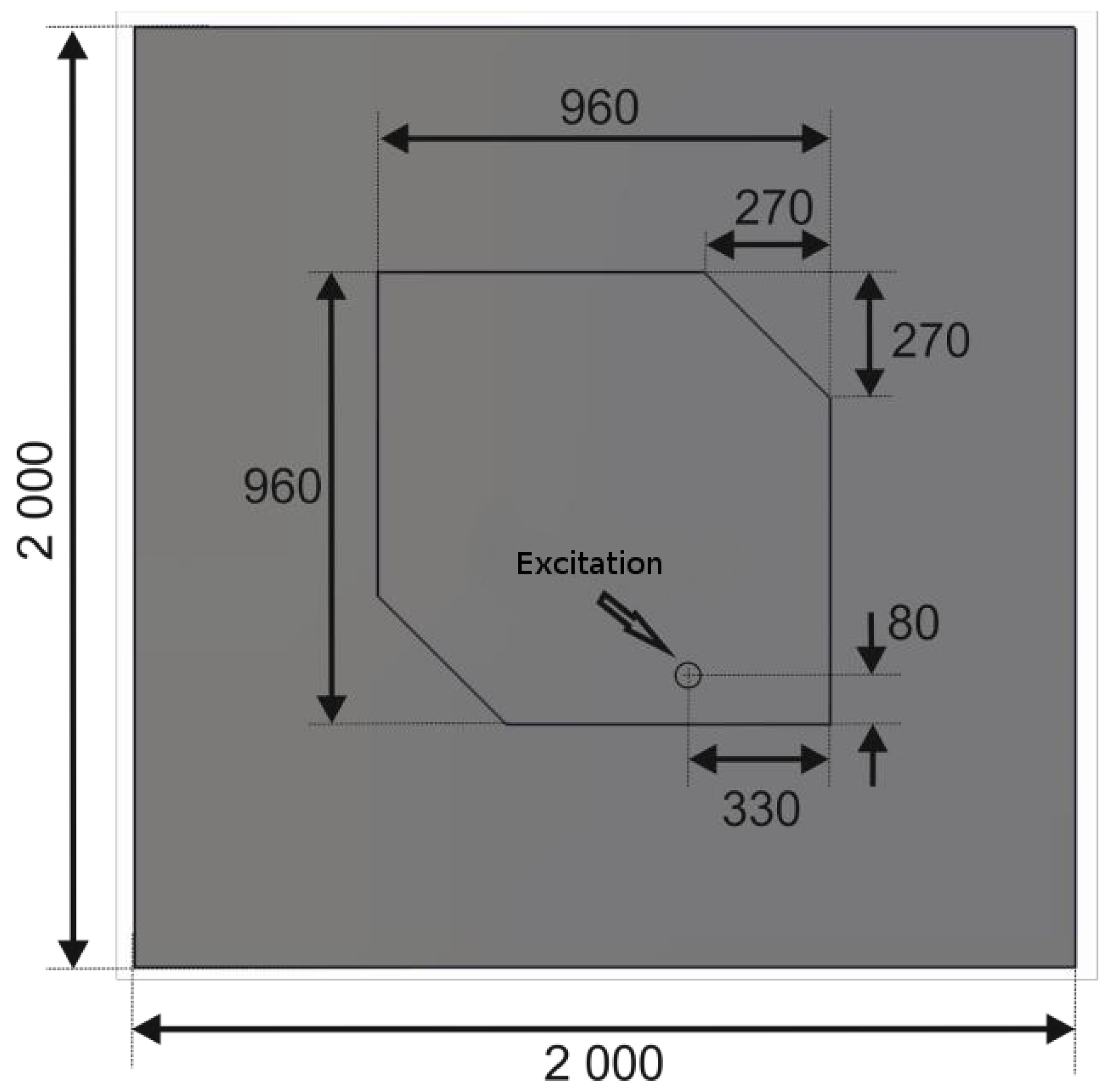

Figure 1 – Simplified drawing of a patch antenna design.

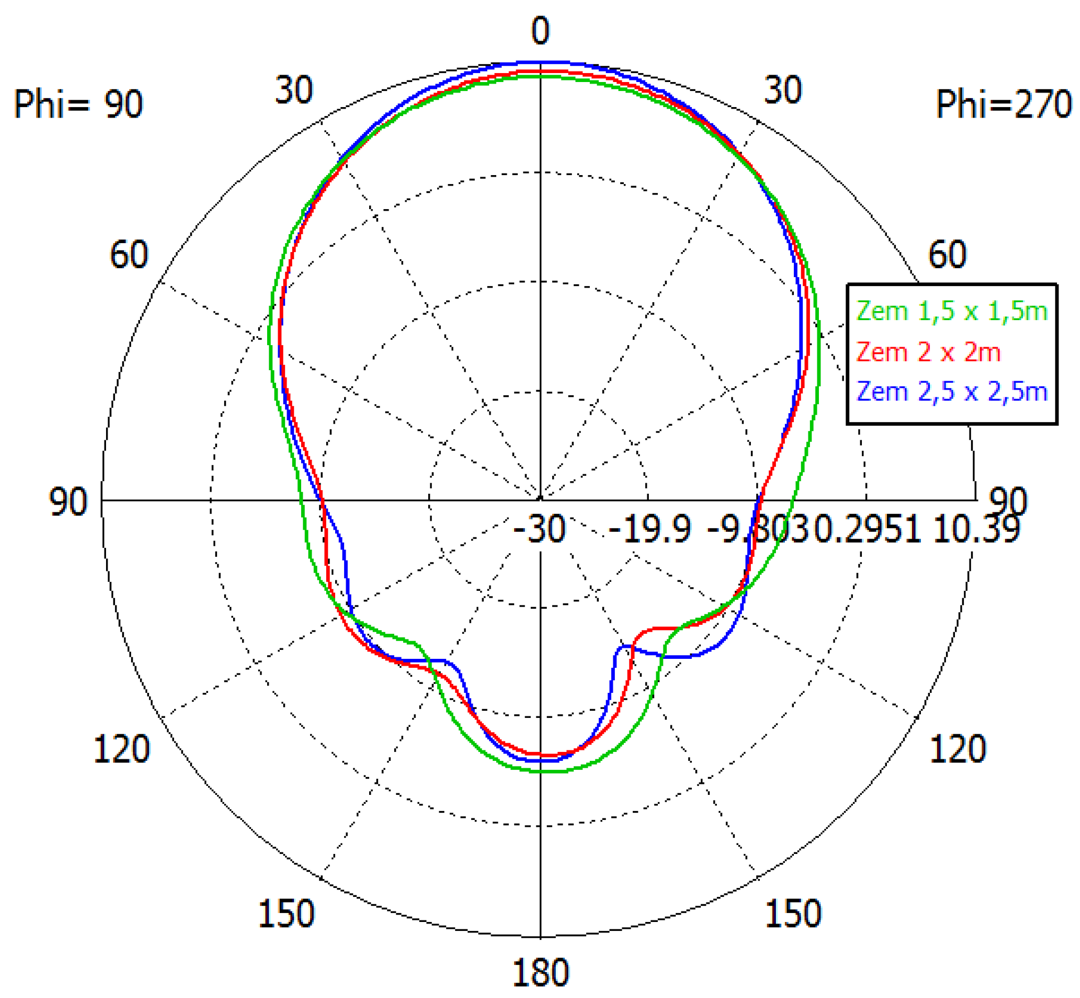

Figure 2 – Expected radiation pattern (vertical plane) of the patch antenna with a given size of reflector.

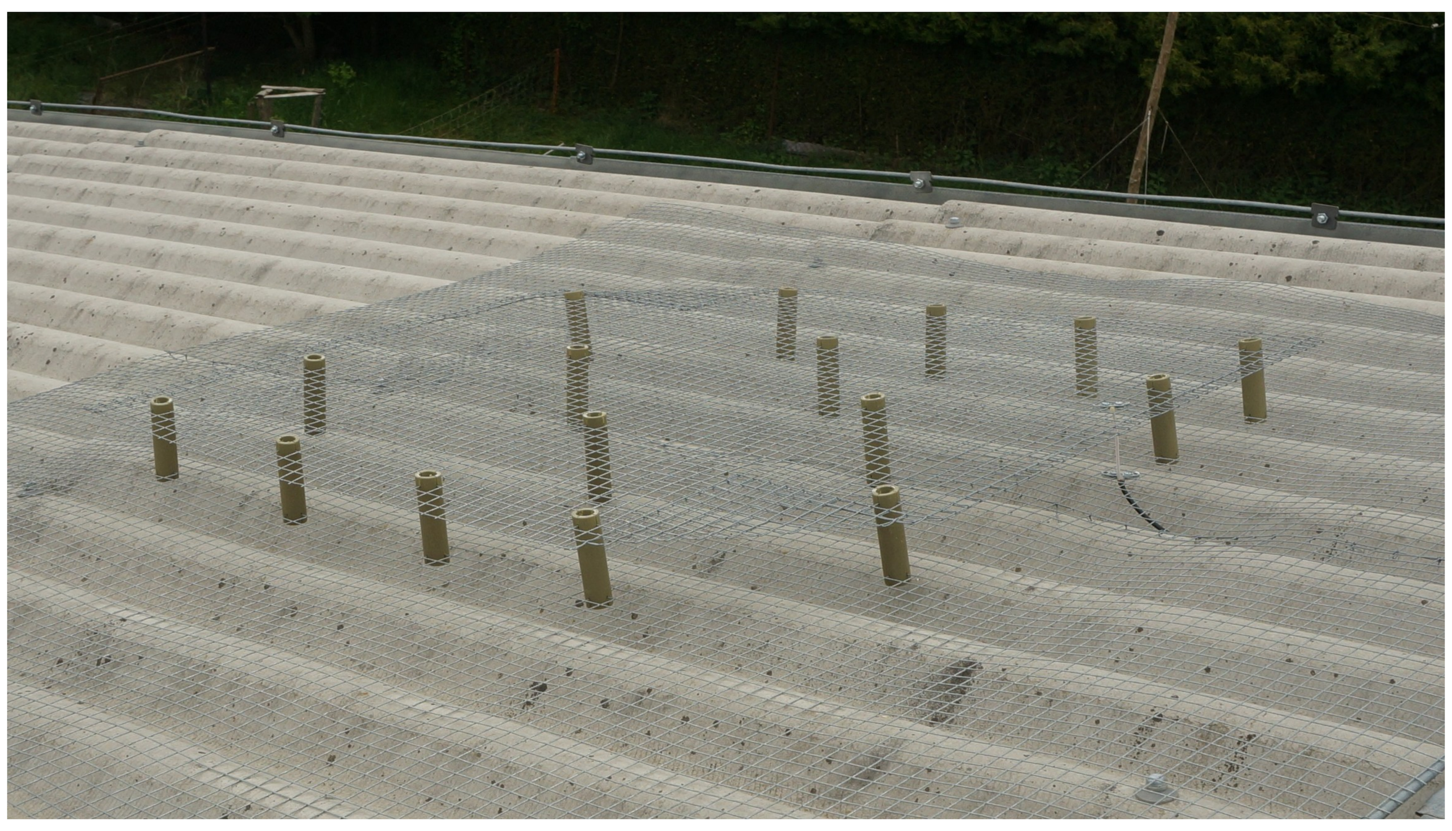

Figure 3 – Implemented form of patch antenna mounted on an observatory roof.

QHA antenna

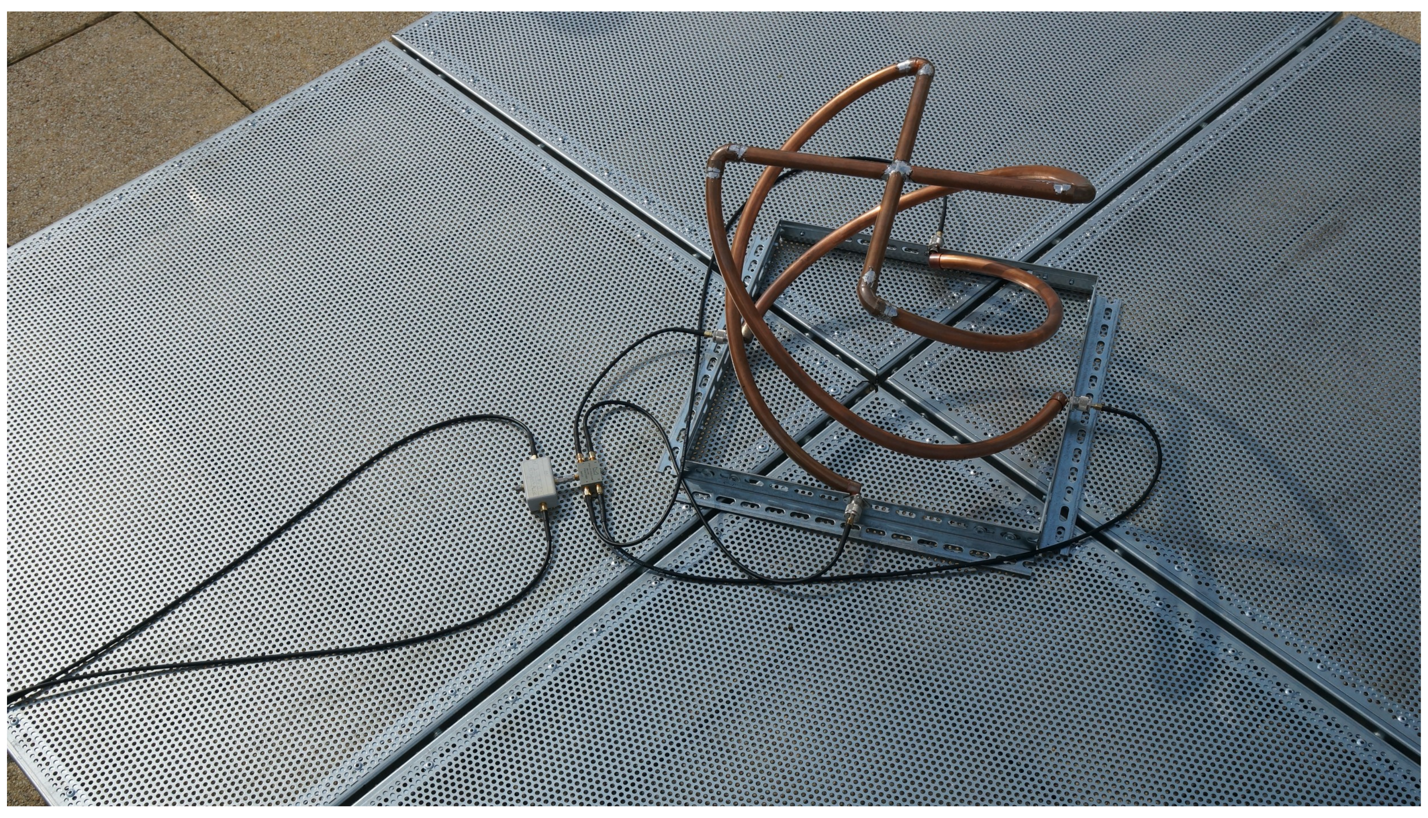

Figure 4 – Implemented form of quadrifilar helix mounted on a metal base.

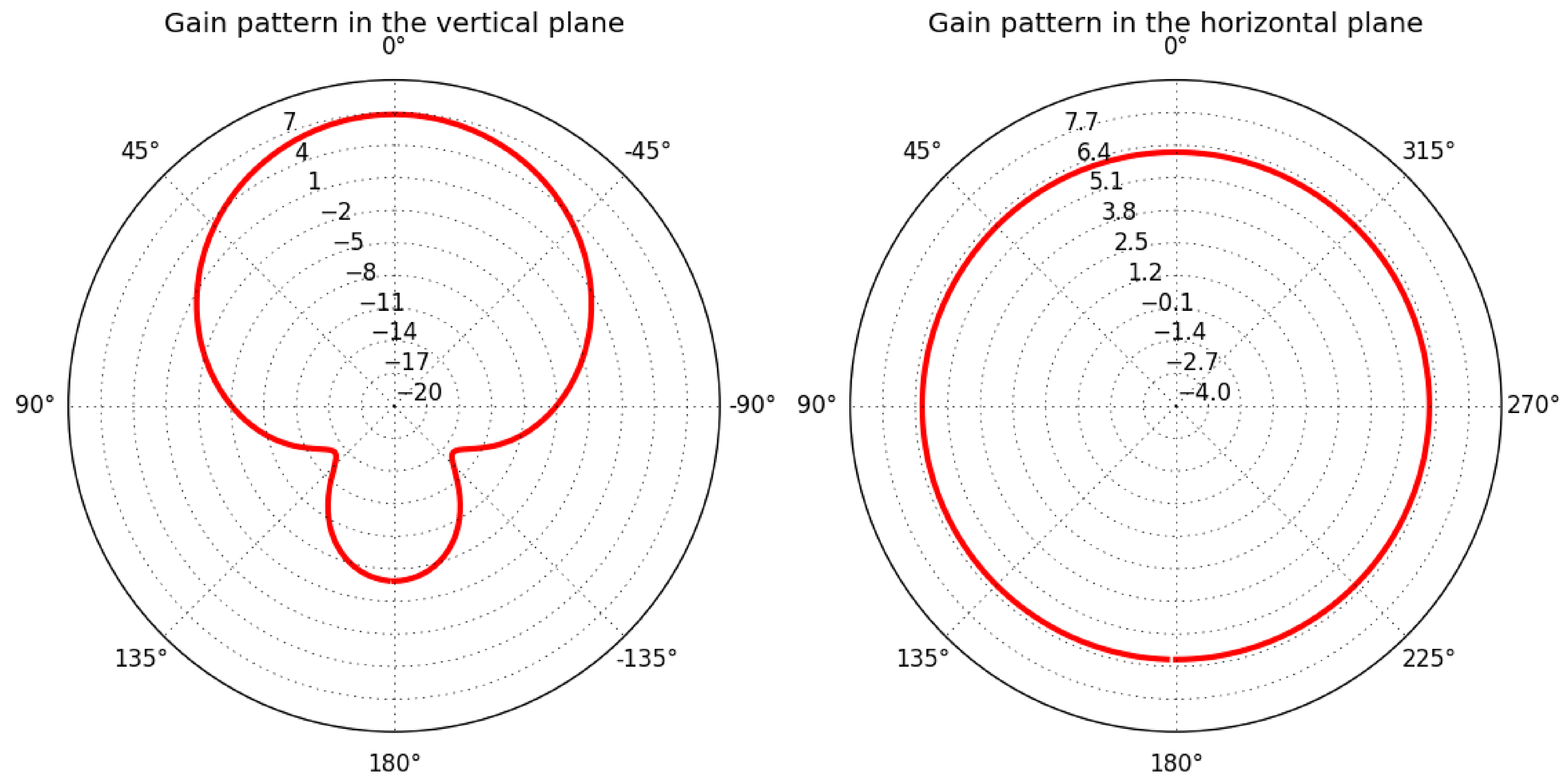

Figure 5 – Expected radiation patterns of the quadrifilar helix antenna.

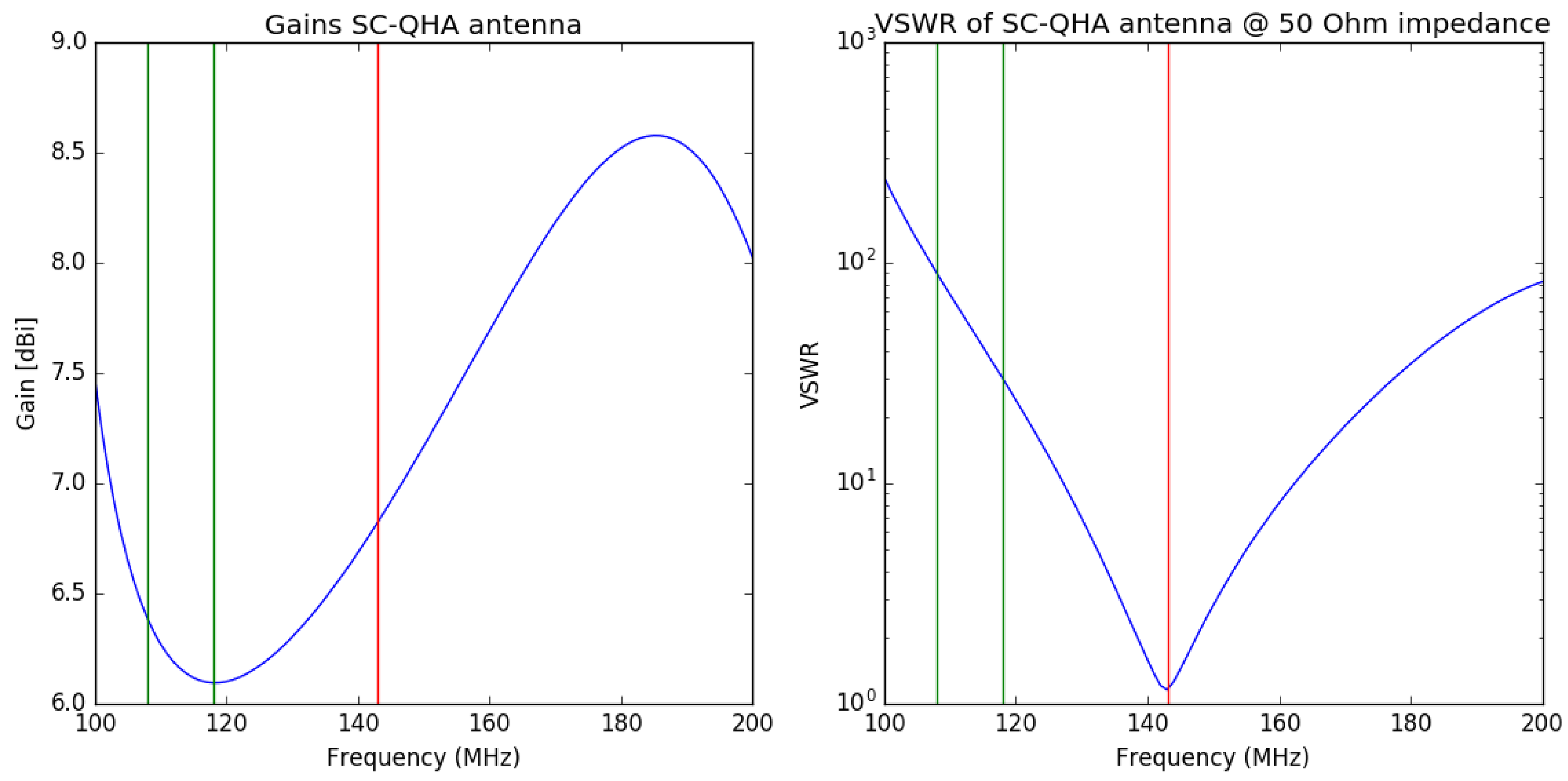

Figure 6 – Expected gain and impedance match of the quadrifilar helix antenna. Red vertical line indicates GRAVES radar carrier frequency.

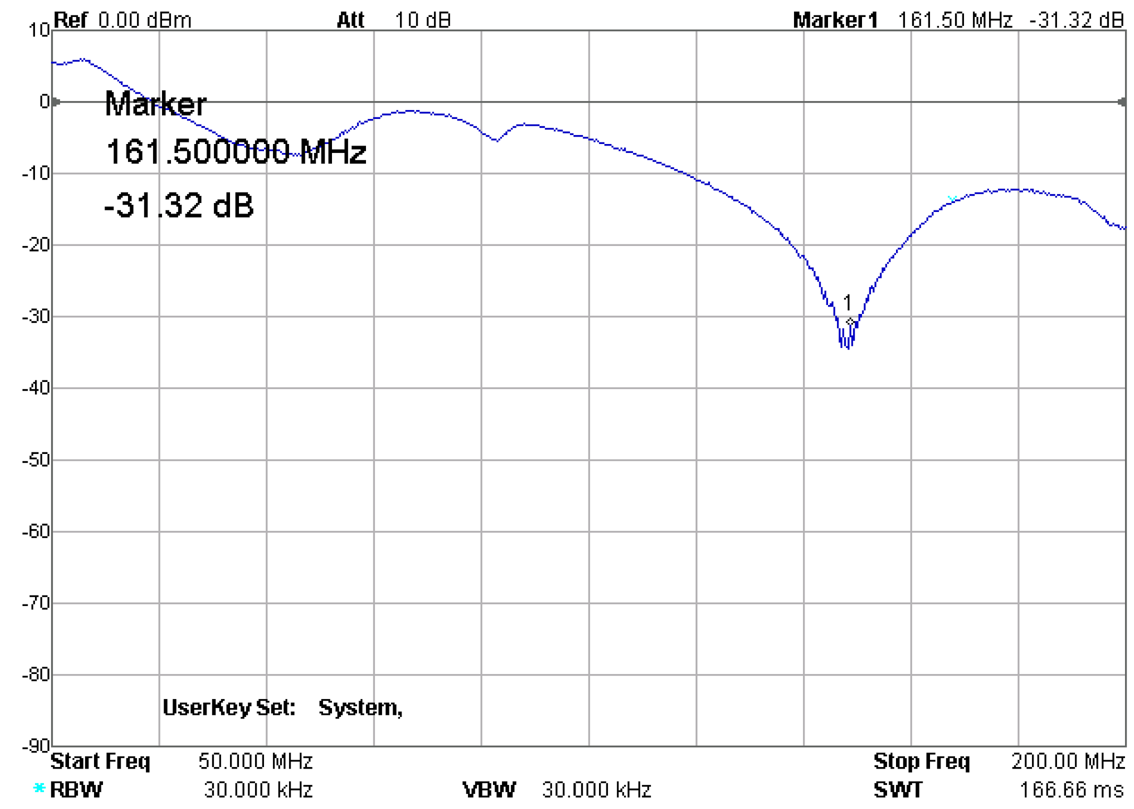

Figure 7 – Measured reflection (impedance match) of the quadrifilar helix antenna.

Conclusion

Both patch and QHA antennas were examined as potential candidates for multistatic observation networks. Unfortunately, the patch antenna was found too much manufacturing labor demanding and the antenna parameters were unstable therefore, it is insufficient for widespread use at Bolidozor stations. QHA antenna seems to be a better option but implemented prototype shows resonance almost 20 MHz above the designed frequency. The precise reason of this error must be further explored.