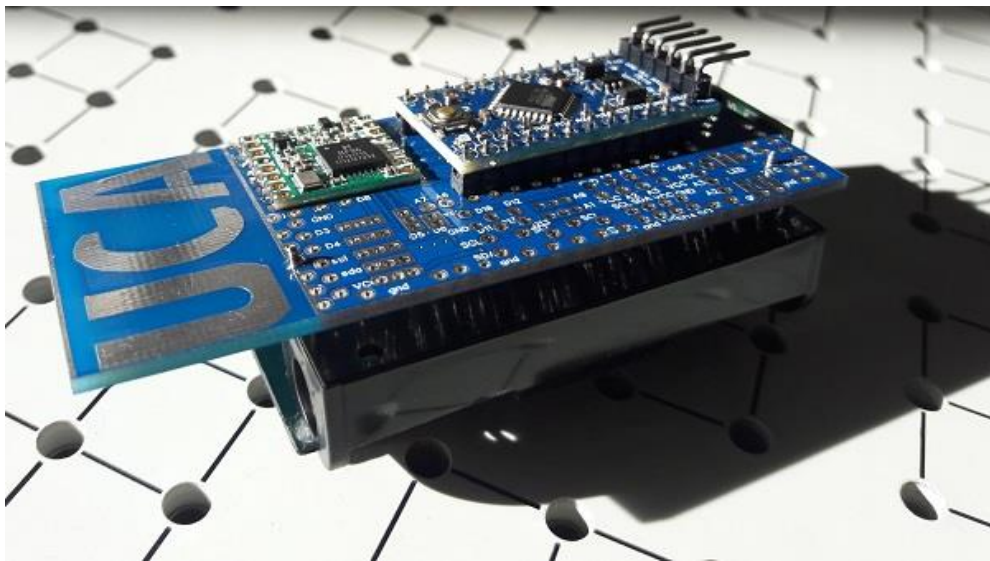


Laboratory of Electronics Antennas and Telecommunications



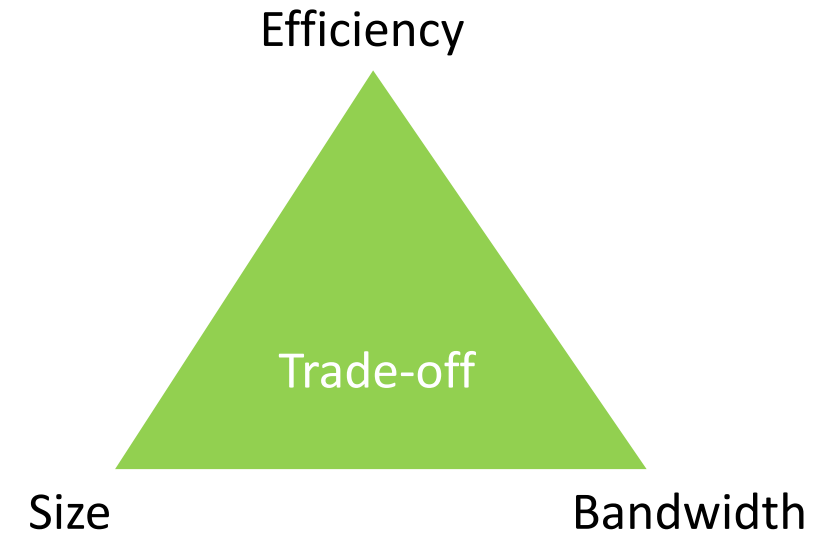
UCA Antenna tutorial

Fabien Ferrero, Université Côte d'Azur



Antenna key parameters

- Antenna is a resonant structure :
 - antenna input impedance is changing with frequency
 - antenna have a limited frequency bandwidth
 - Miniature antenna can have a low efficiency due to metallic or dielectric losses
 - Antenna is an open structure
 - Compare to electronic components, antenna is strongly influenced by its surrounding environment
 - For integrated antenna, the electromagnetic wave is generated by the antenna and by the terminal ground plane
- Small antenna has to be carefully tuned



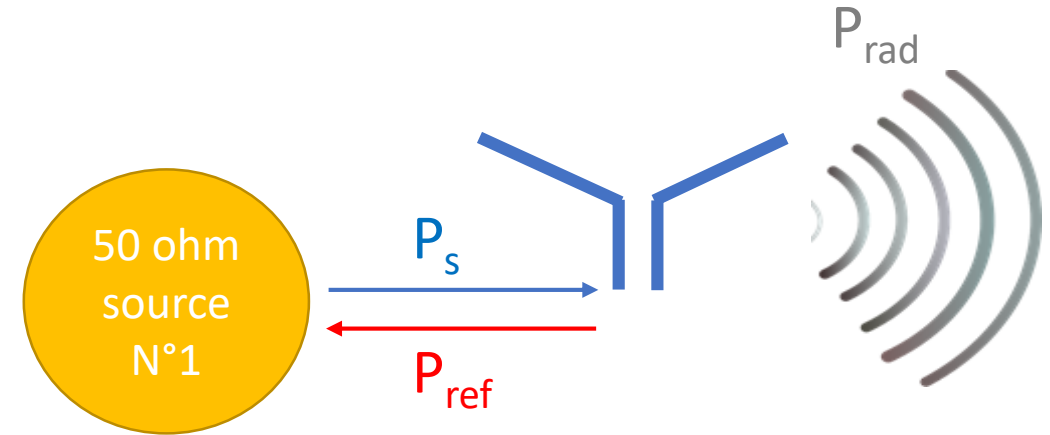
Antenna key parameters

■ Definition :

- P_s : Power from the source
- P_{ref} : Power reflected by the antenna
- P_{rad} power radiated by the antenna

■ Antenna Performance Indicator

- Reflection coefficient
 - S_{11} is usually plotted in dB scale
 - Classical S_{11} criteria is -10 dB (90% transmitted power)
 - For miniature antenna, -6dB is commonly used (75% transmitted power)
- Total Efficiency
 - Include matching loss (from S_{11}) and radiation loss caused by metallic and dielectric losses
 - Can be plotted in linear or dB scale
 - No specific criteria, 30-70% classically observed

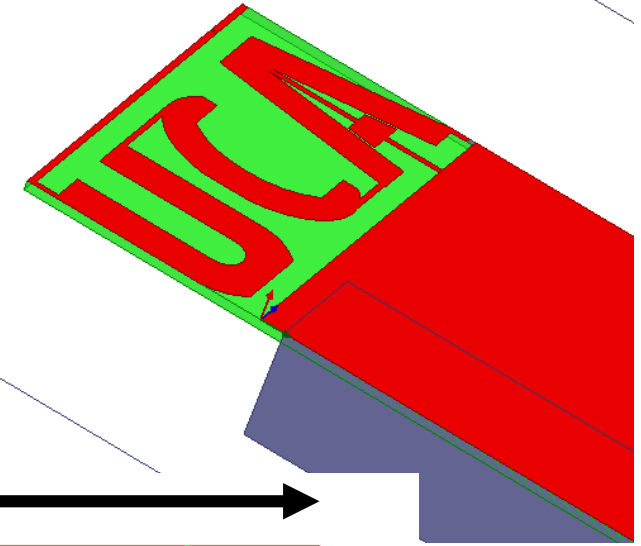
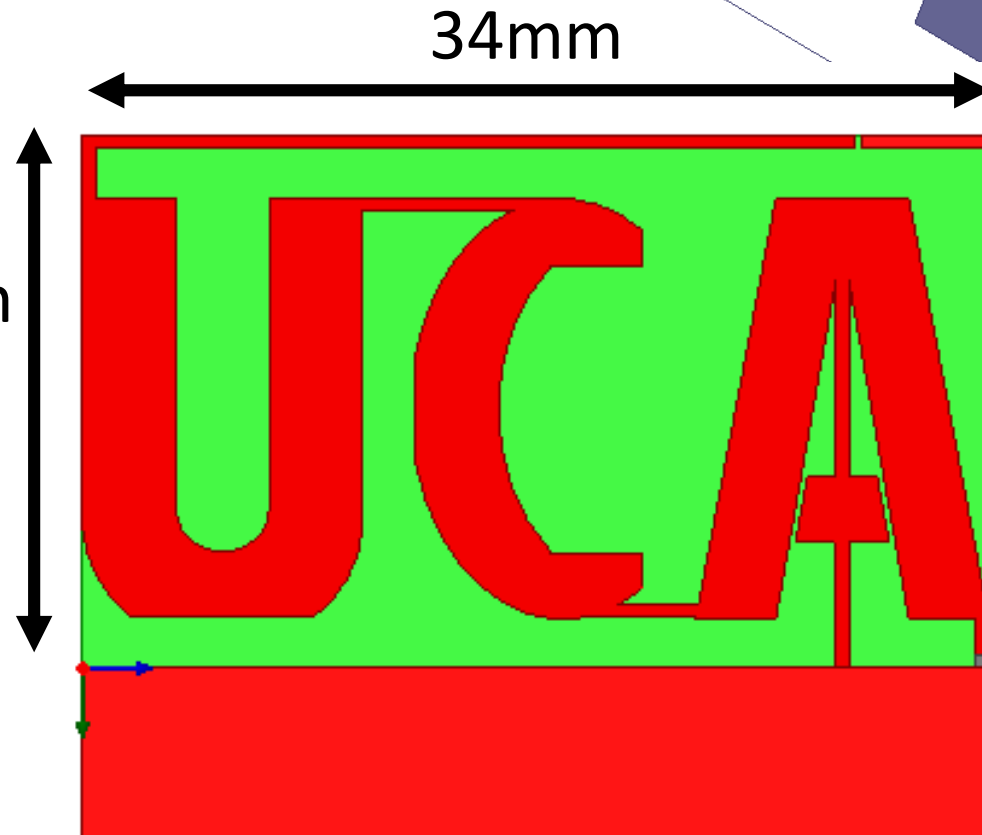
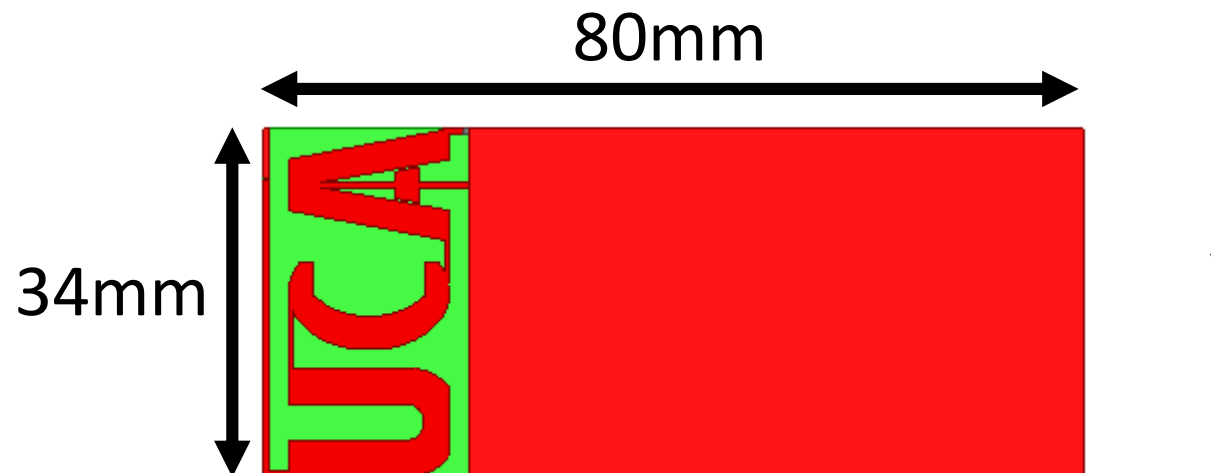


$$|S_{11}|^2 = P_{ref}/P_s$$

$$\eta_t = P_{rad}/P_s$$

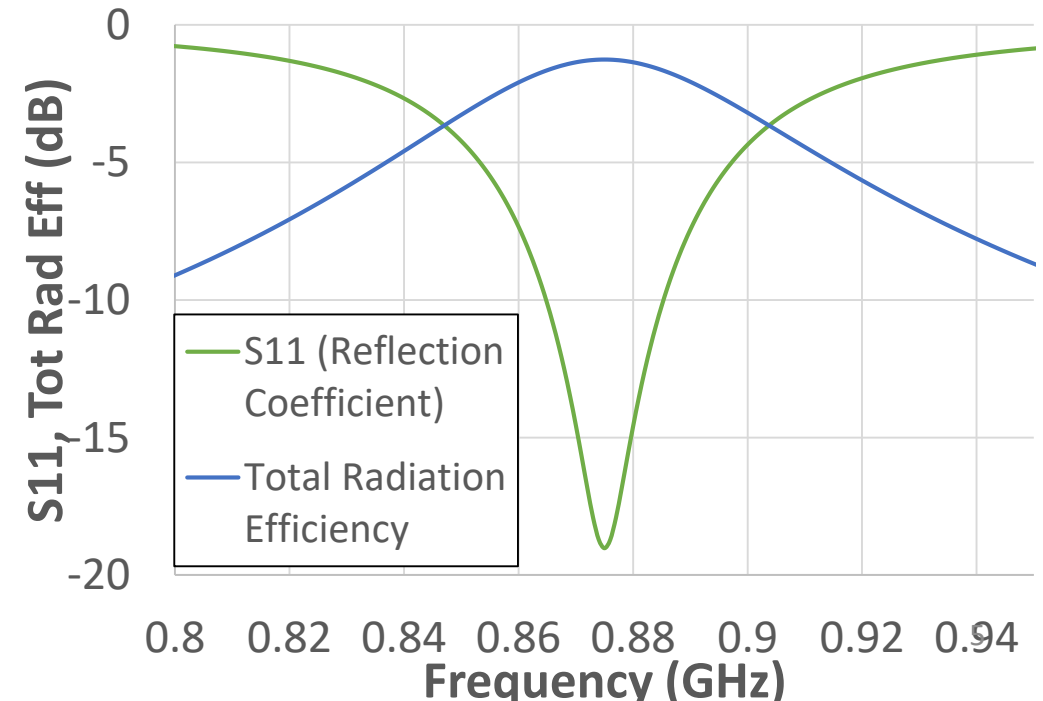
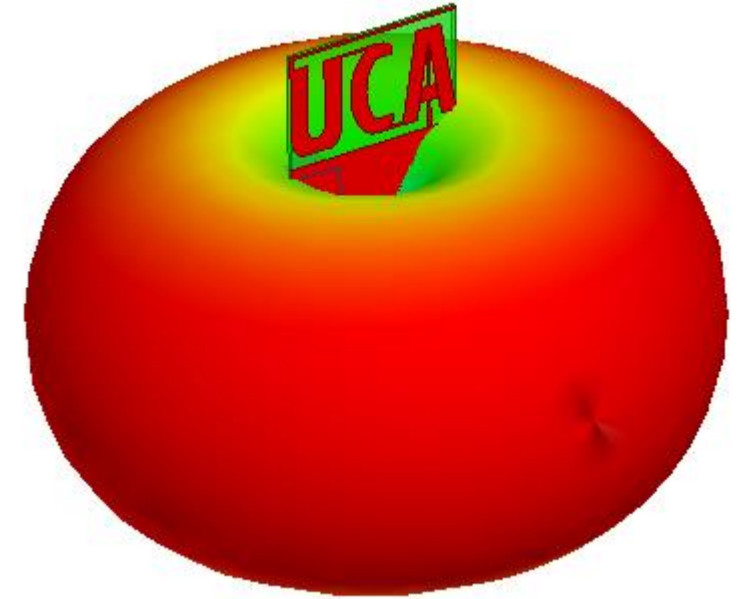
UCA Antenna layout

- Miniaturized Printed Antenna (low cost)
- Based on a meandered Inverted **F** Antenna (**IFA**) Structure
- Mounted on a 80*34mm 0.8mm-thick FR4 PCB



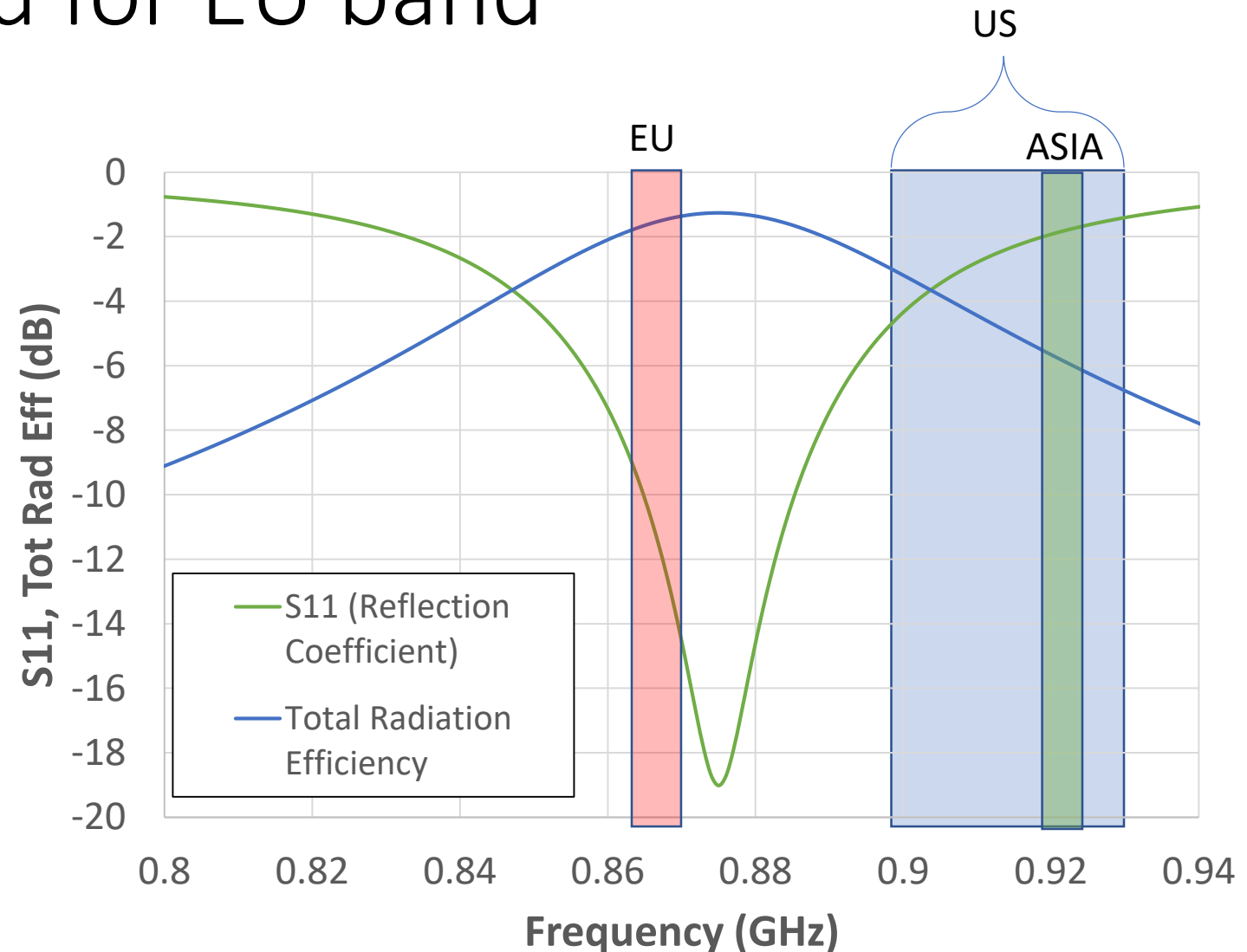
UCA Antenna tuned for EU band

- Antenna simulation
 - Matched to 50 ohm
 - -6dB reflection coefficient between 857 and 888MHz
 - -10 dB reflection coefficient between 863 and 882 MHz
 - -1.2 dB radiation efficiency (75%)
 - Dipole radiation pattern
 - 2.1 dBi peak directivity
 - 0.9 dBi peak Gain



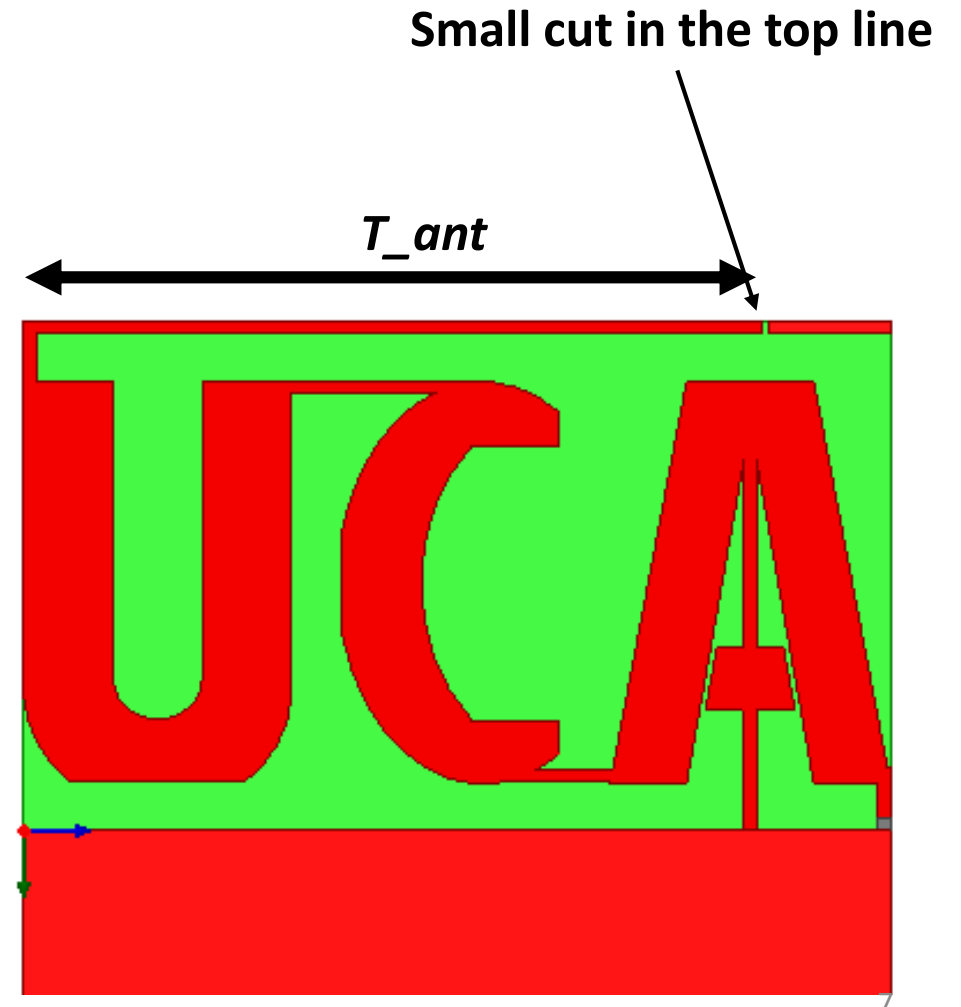
UCA Antenna tuned for EU band

- Miniature antenna
 - Limited frequency bandwidth
 - If the antenna is matched for European band, the antenna has poor radiation performance in US and ASIA bands

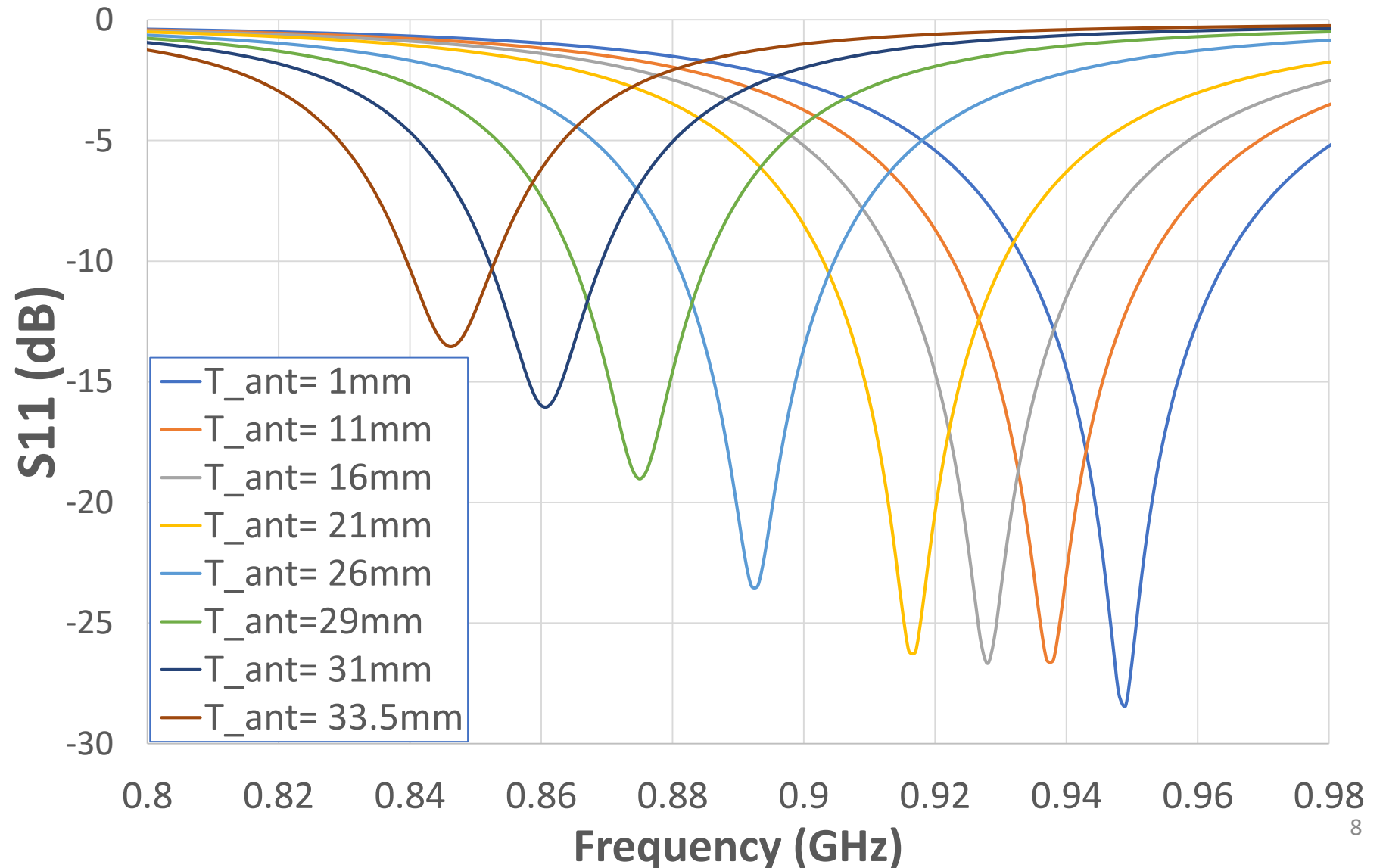


UCA Antenna tuning

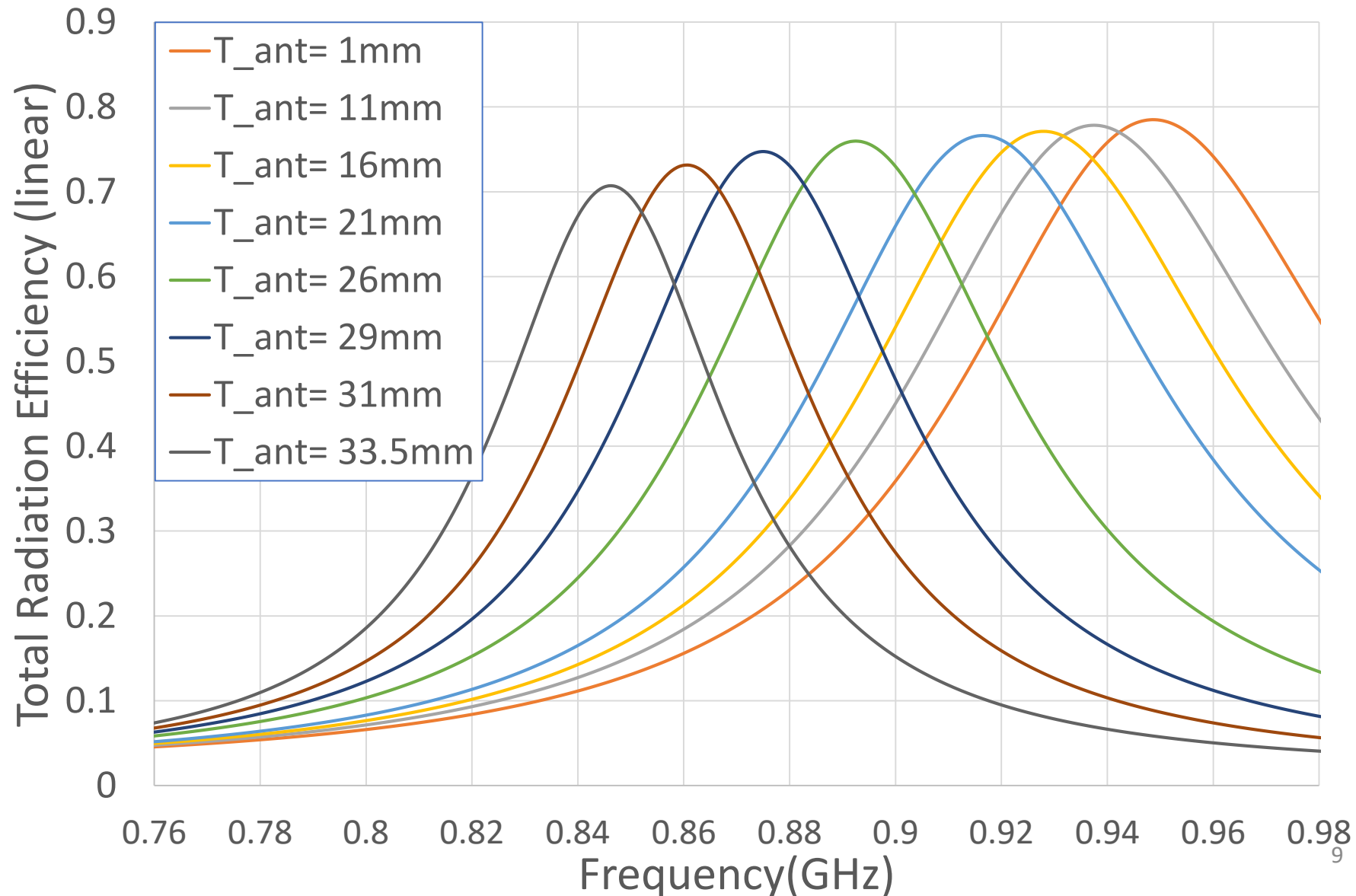
- The antenna shape can be easily tuned to different frequencies
 - The top line can be cut at different position to change the antenna trace length
 - T_{ant} parameter can be tuned from 0 to 34mm
 - Antenna resonance frequency can be tuned from 845 to 950MHz



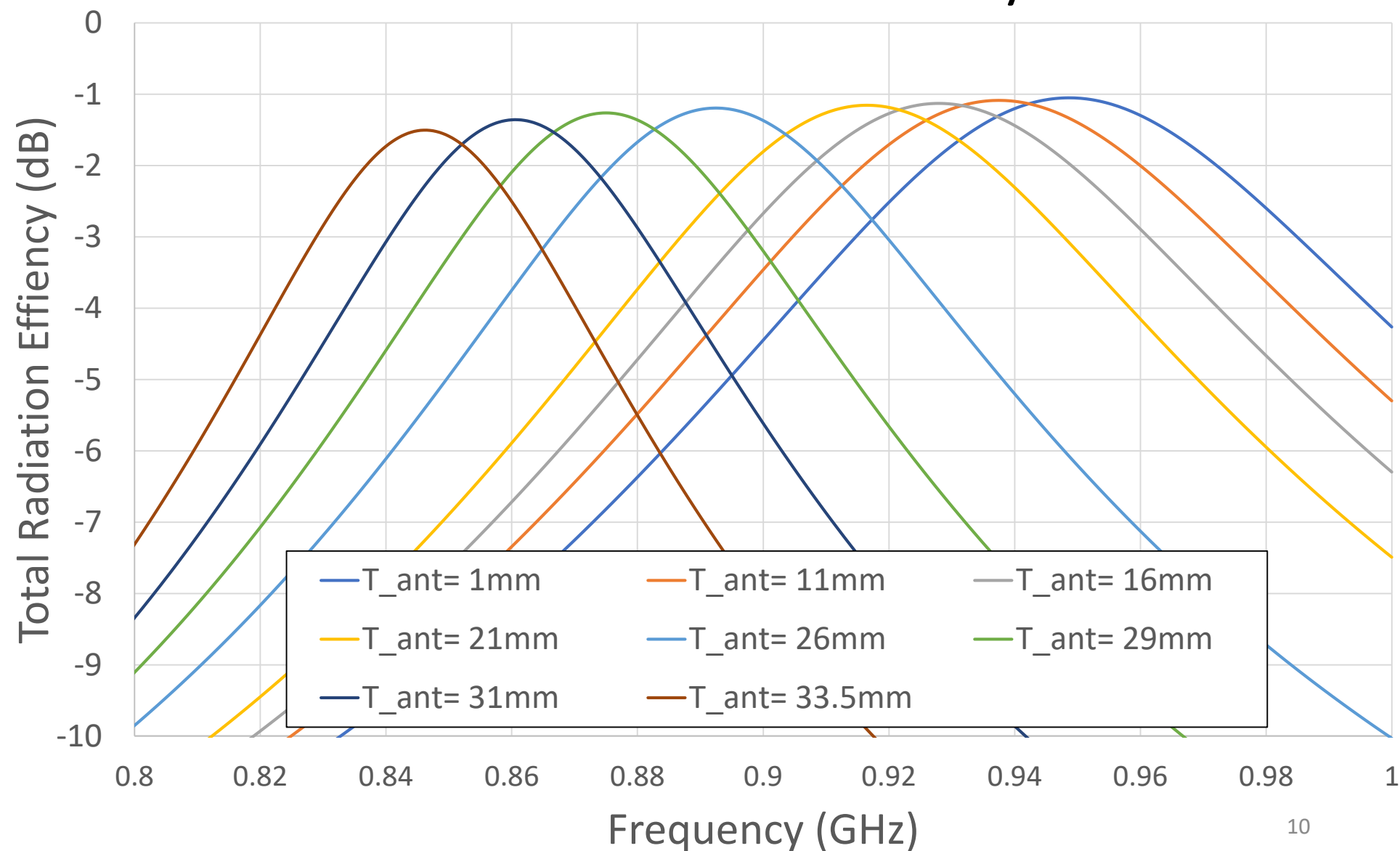
UCA Antenna tuning : Reflection coefficient



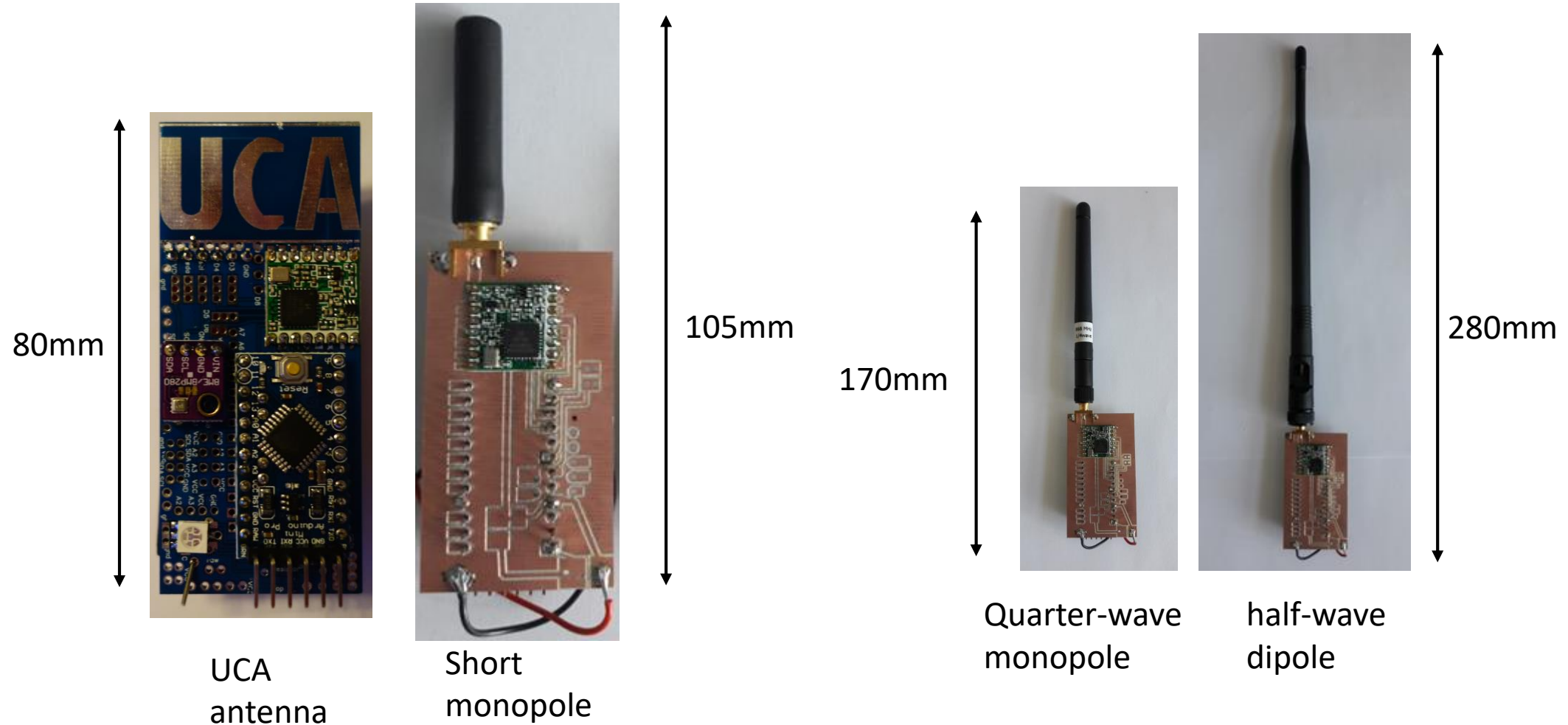
UCA Antenna :Linear Total Radiation Efficiency



UCA Antenna :Total Radiation Efficiency in dB

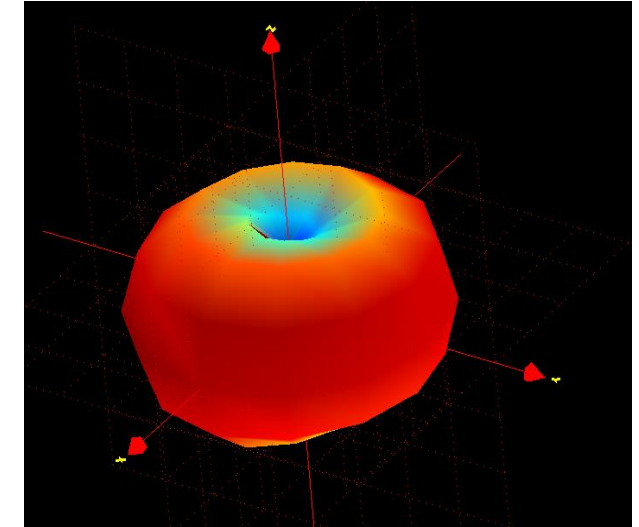


UCA Antenna : Comparison with on-the-shelf antenna



UCA Antenna : Measurements

- Measurement on Satimo Starlab station
 - Continuous wave with 14 dBm power from RFM95W module
 - Efficiency calculated from the 3D antenna measurement



Antenna structure	TRP (dBm)	Total efficiency	Max Dimension
Small monopole	14.7	74%	105 mm
Quarter-wave monop.	15.7	94%	170 mm
Half-wave monop.	13.9	61%	280 mm
UCA untuned	13.8	60%	80mm
UCA after tuning	14.8	76%	80mm