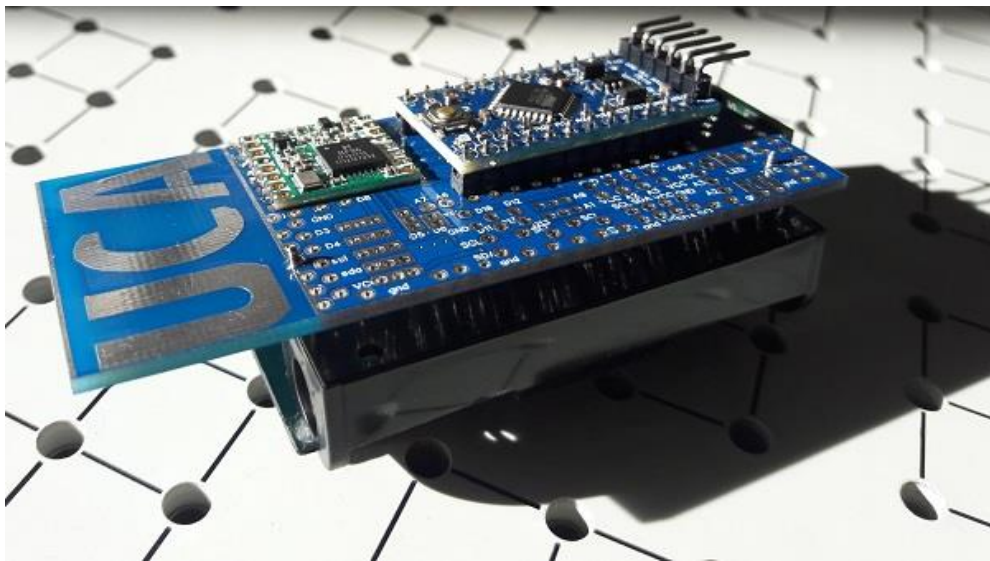


# Laboratory of Electronics Antennas and Telecommunications



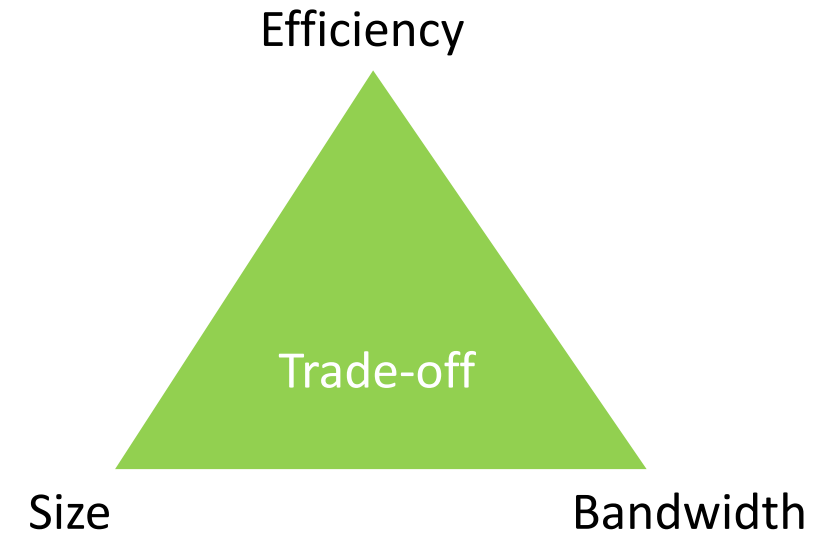
## UCA Antenna tutorial

Fabien Ferrero, Université Côte d'Azur



# Antenna key parameters

- Antenna are 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 are 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 have to be carefully tuned



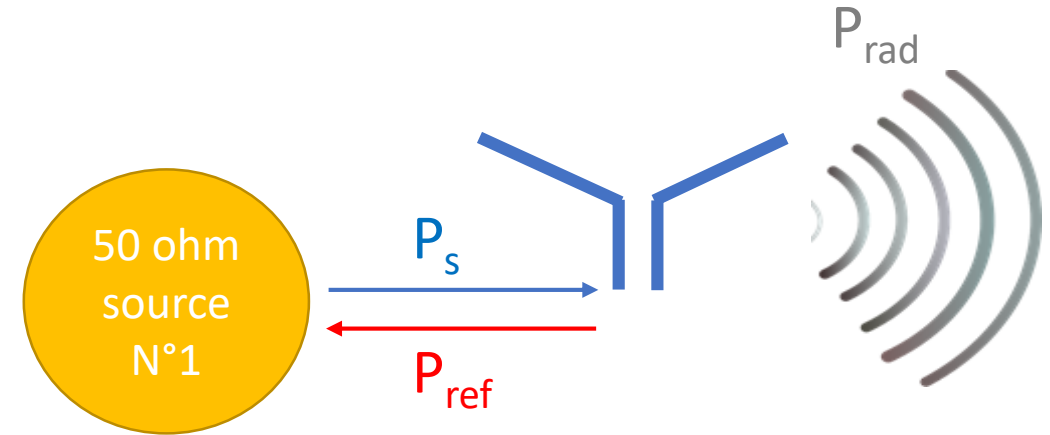
# Antenna key parameters

## ■ 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

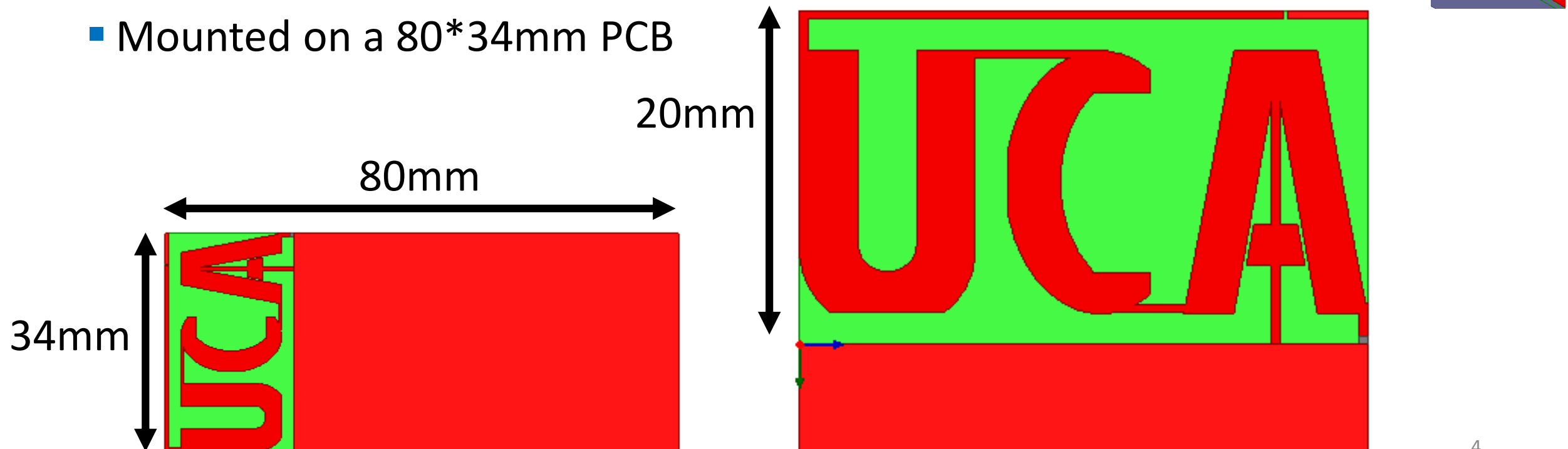


$$|S_{11}|^2 = P_{ref}/P_s$$

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

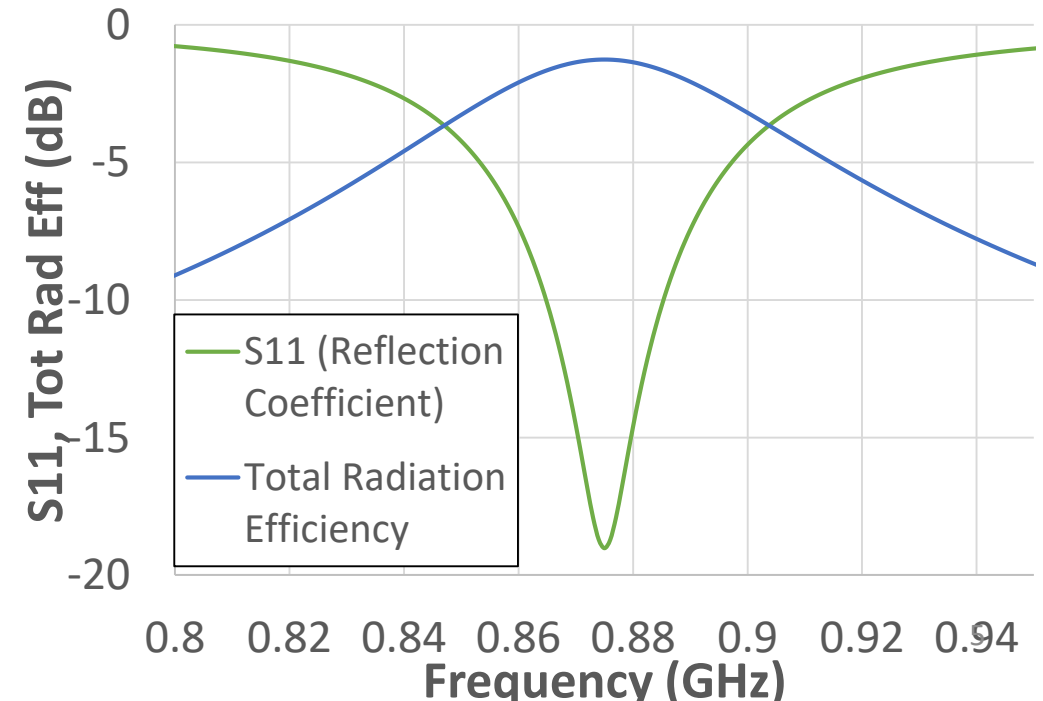
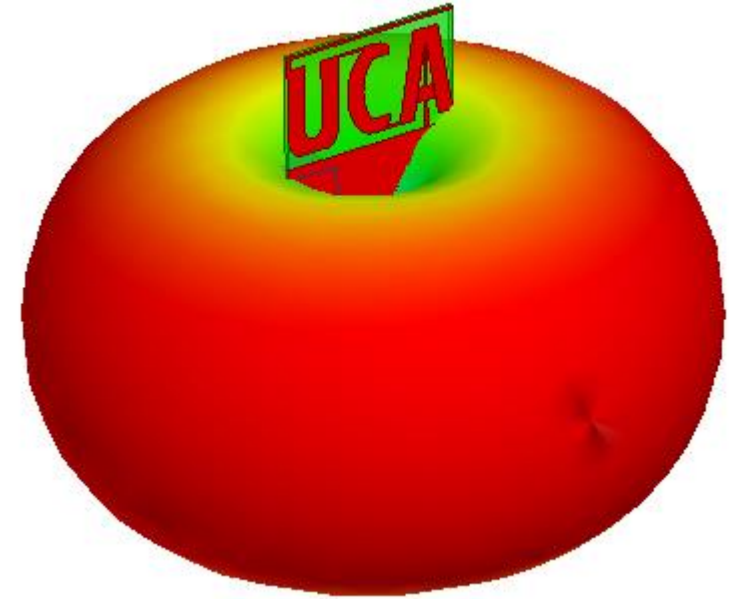
# UCA Antenna layout

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



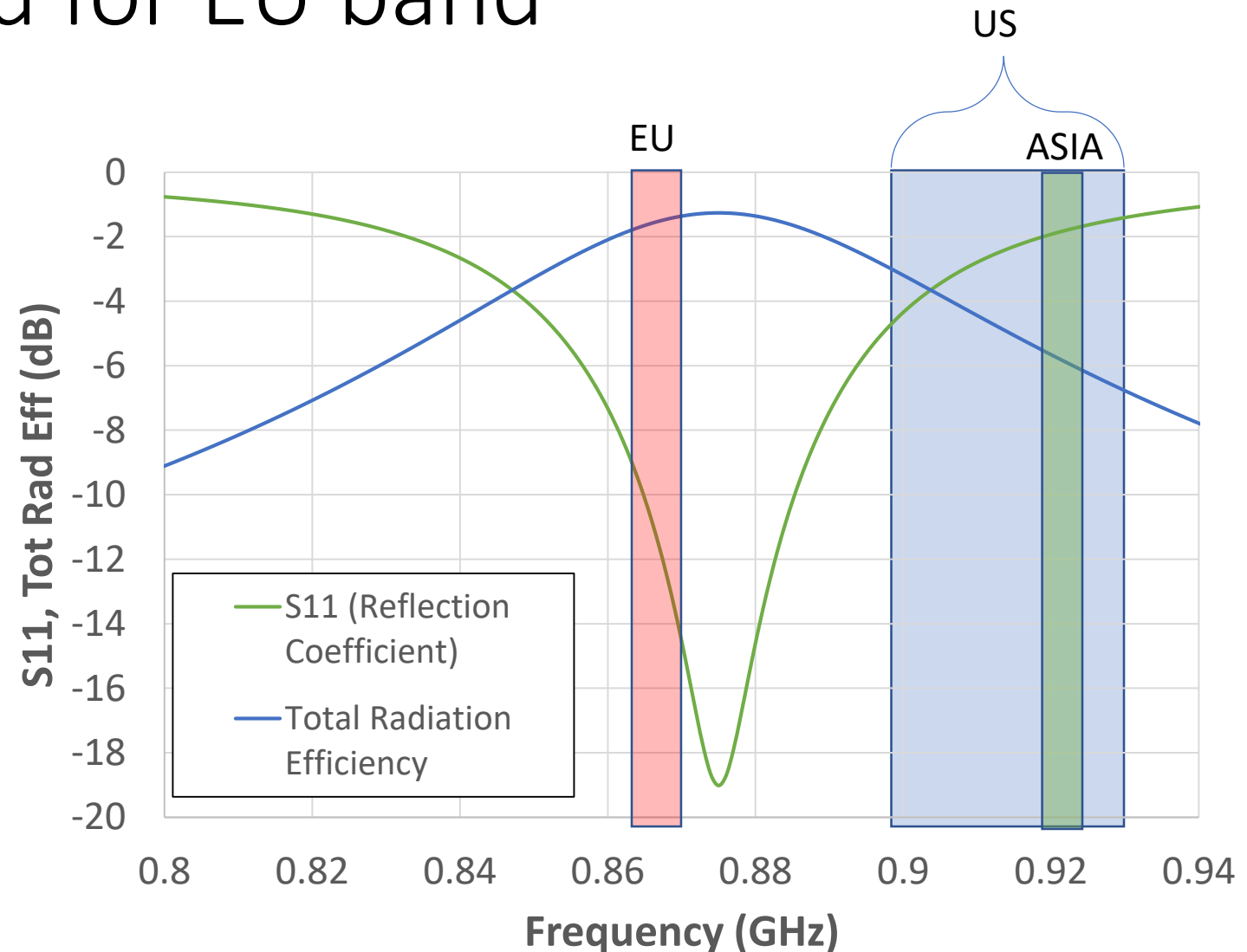
# UCA Antenna tuned for EU band

- 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

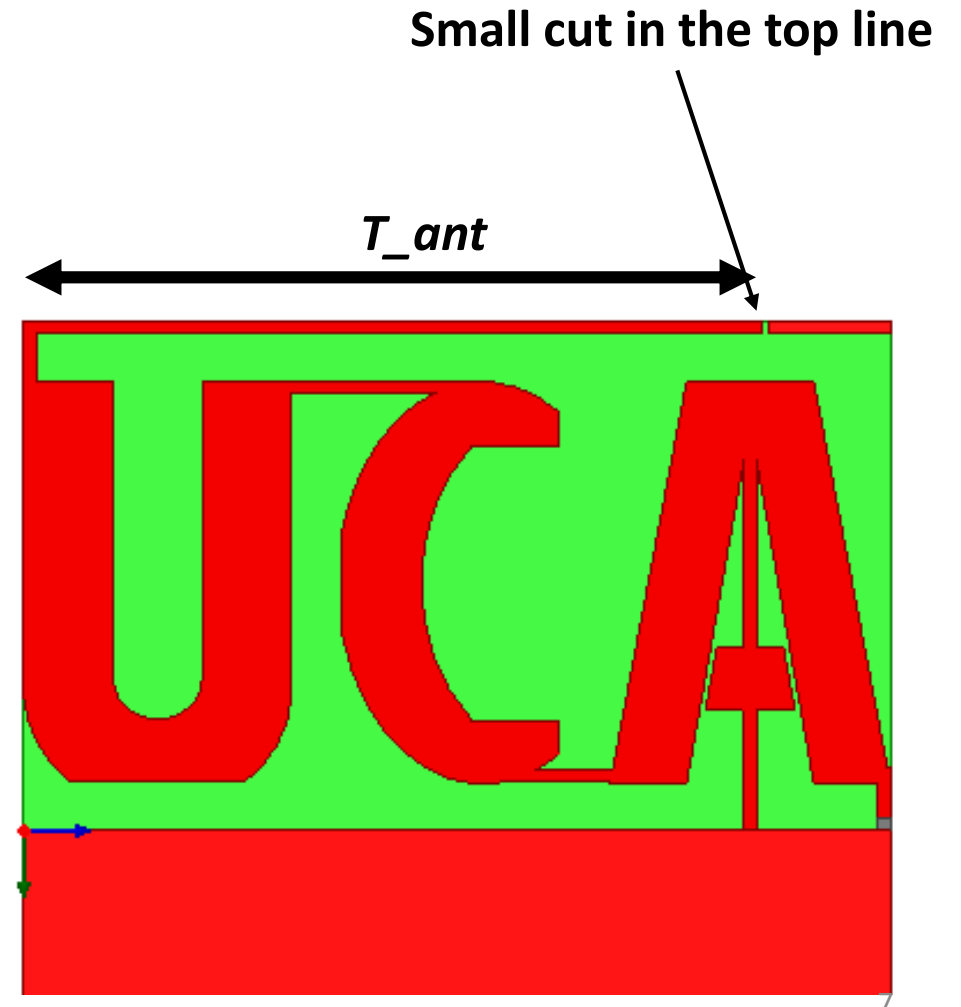
- Miniature antenna
  - Limited frequency bandwidth
  - If the antenna is matched for European band, the antenna has poor radiation performance in US and ASIA bands



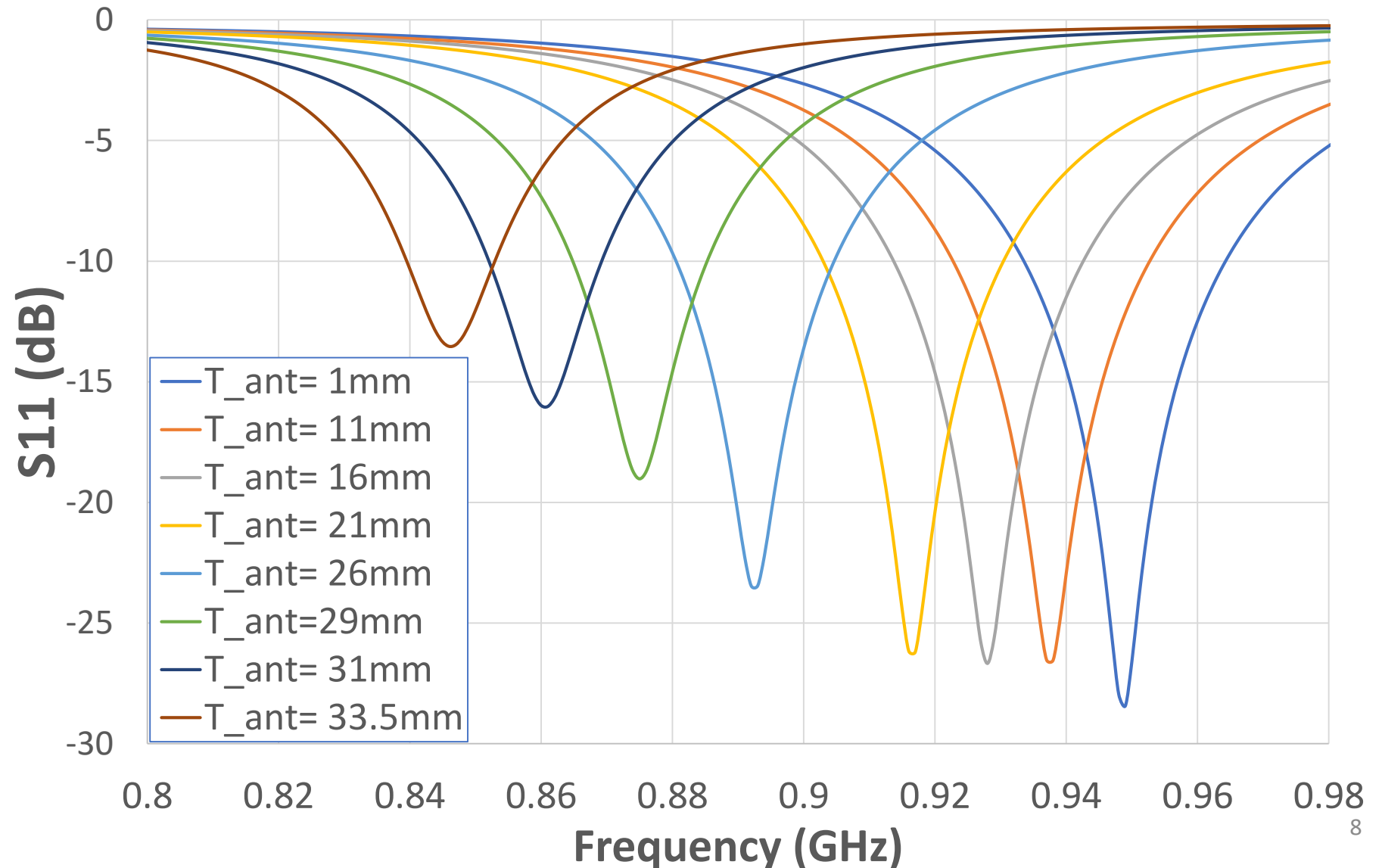


# UCA Antenna tuning

- 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

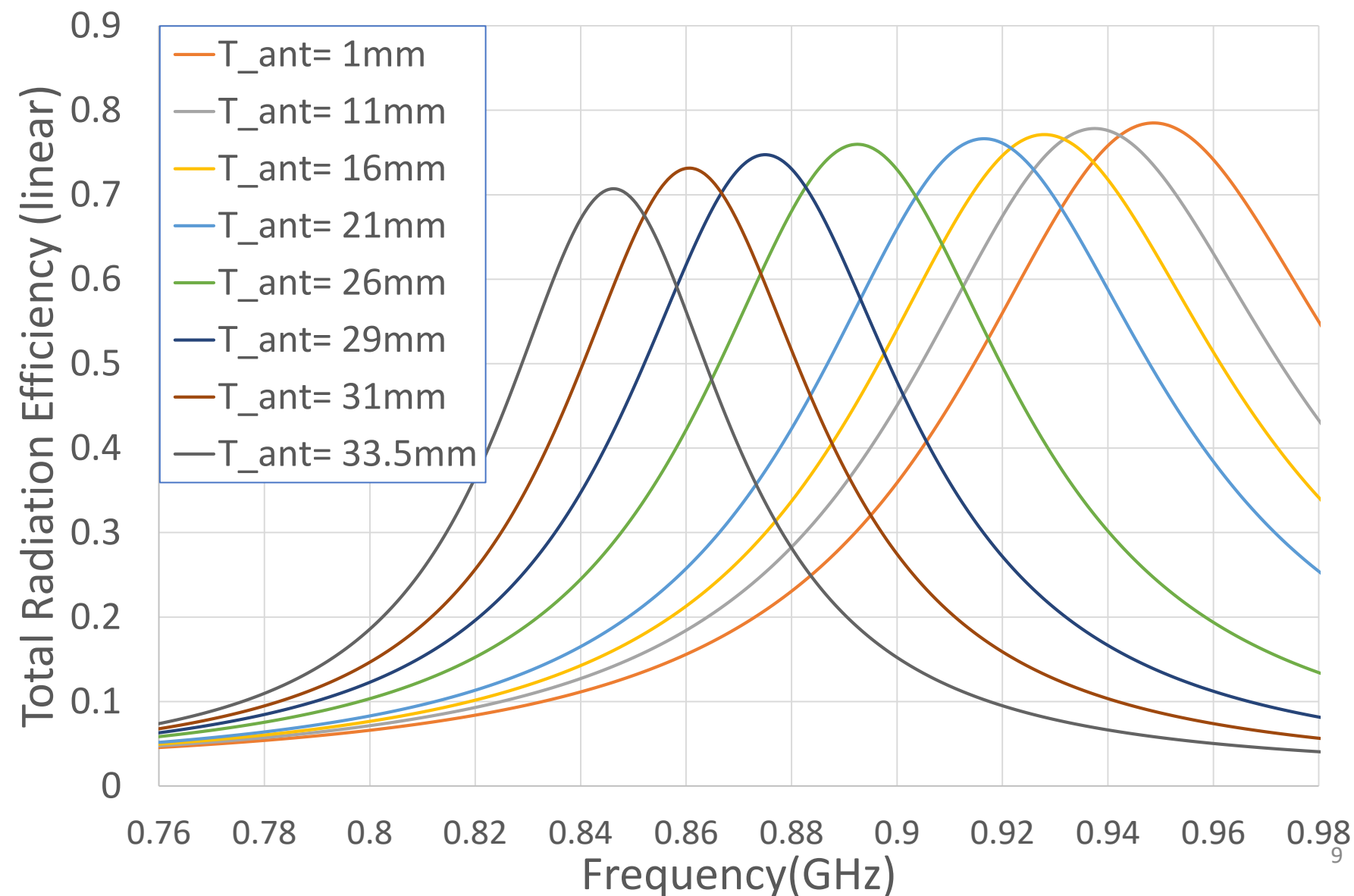


# UCA Antenna tuning : Reflection coefficient

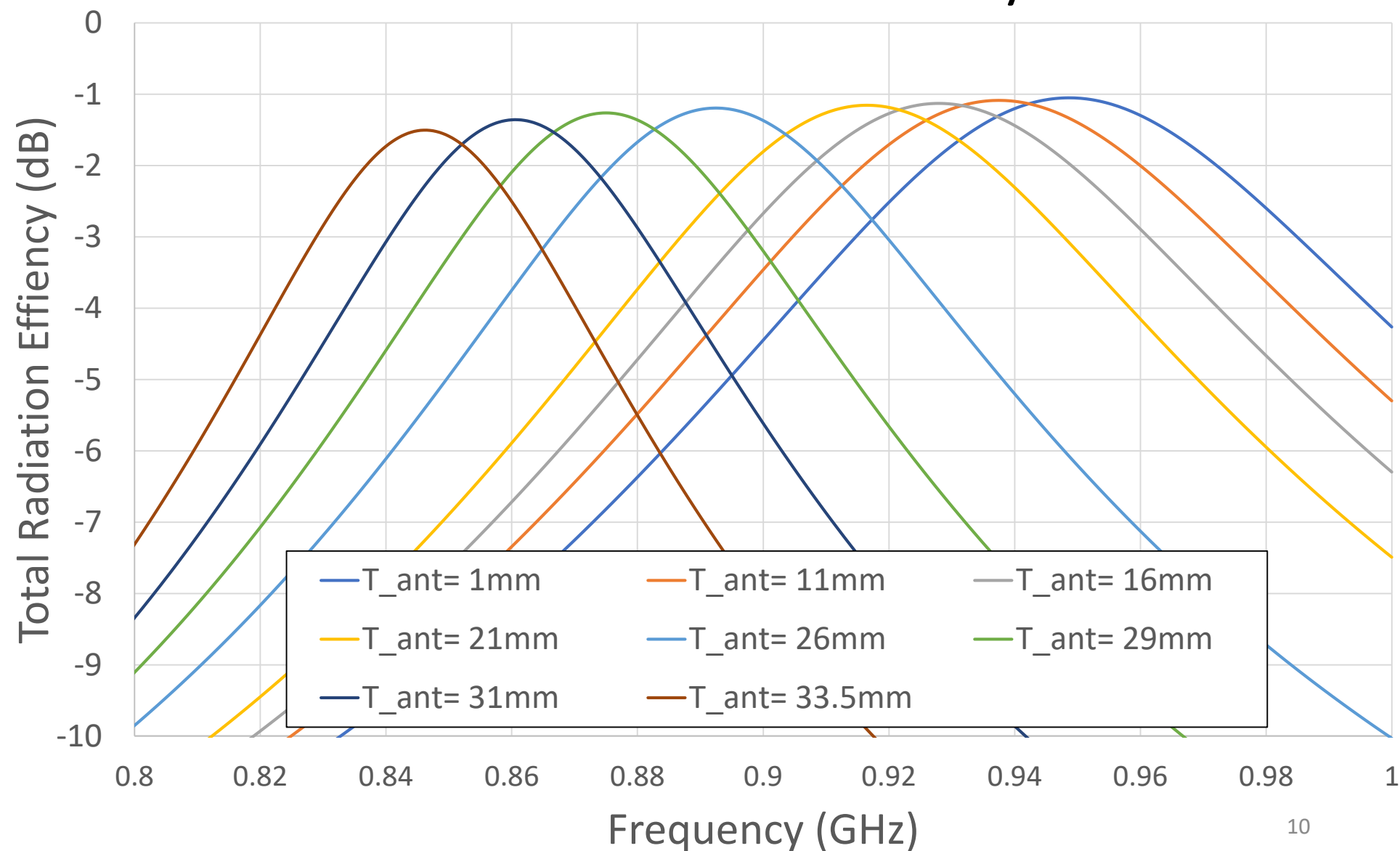




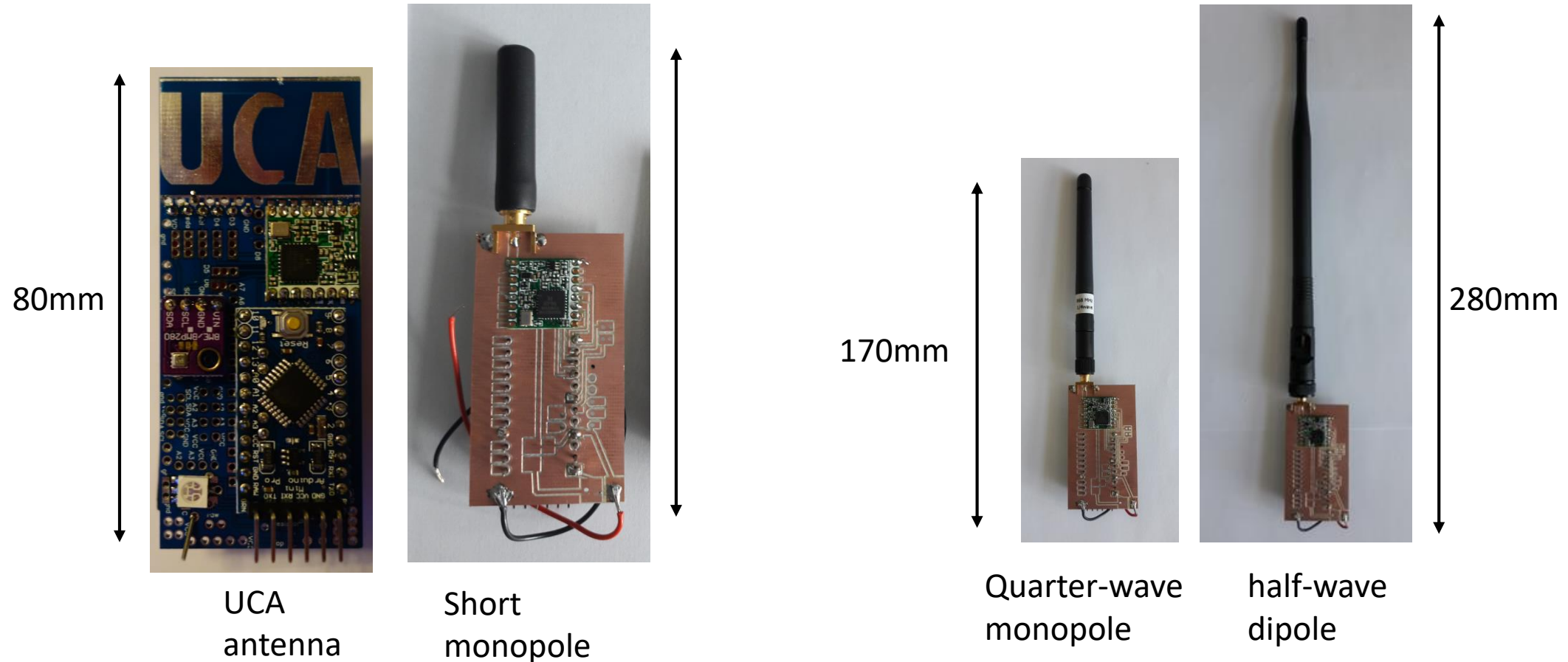
# UCA Antenna :Linear Total Radiation Efficiency



# UCA Antenna :Total Radiation Efficiency in dB

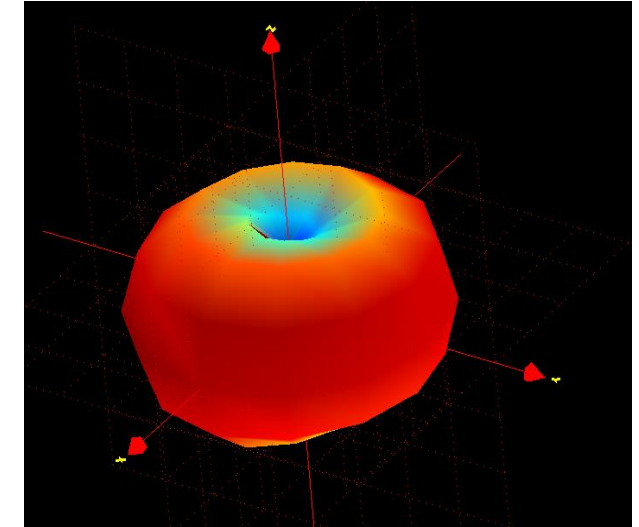


# UCA Antenna : Comparison with on-the-shelf antenna



# 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