Speck NET

Research Consortium in Speckled Computing

Antennas for Specknet

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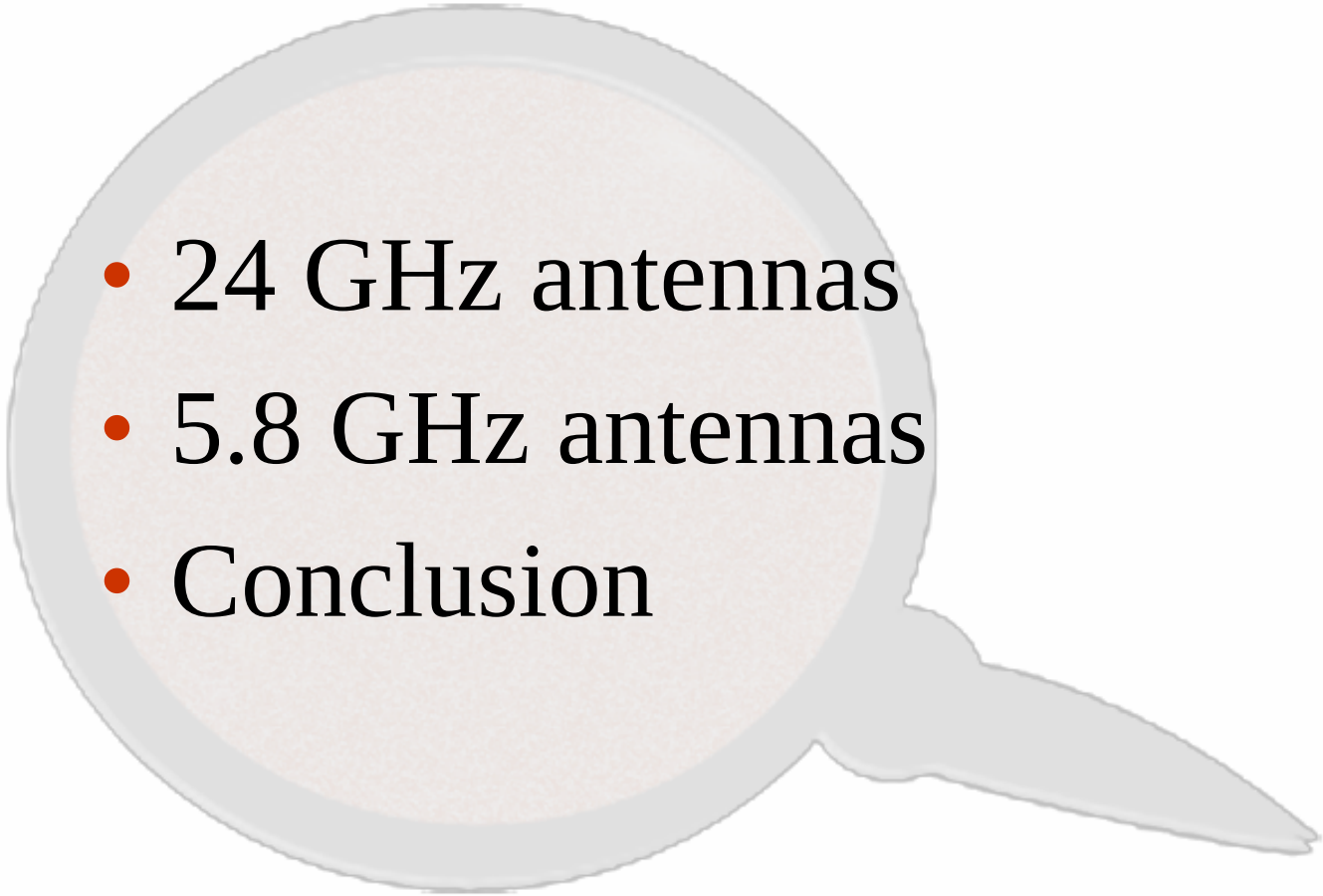
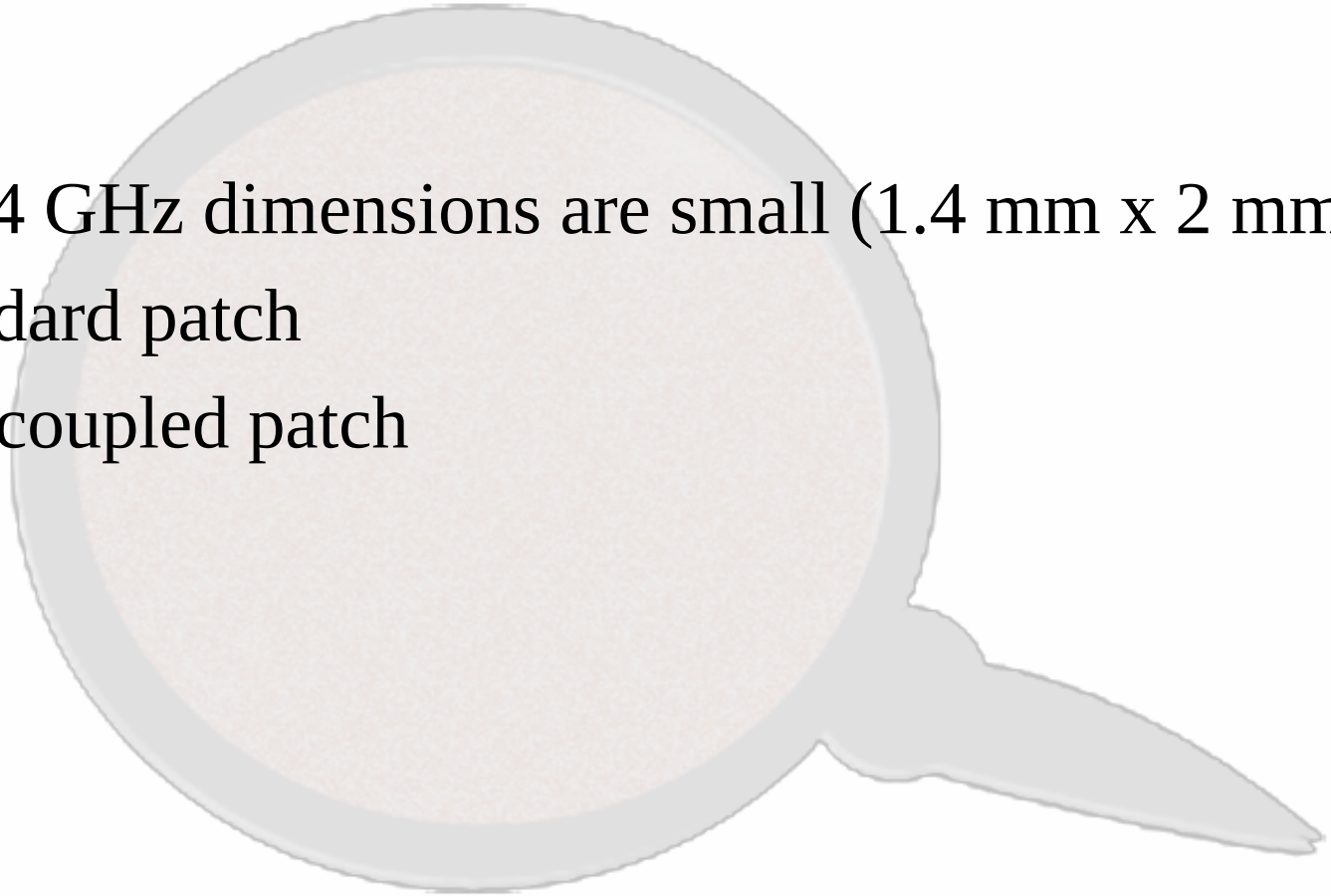
Introduction



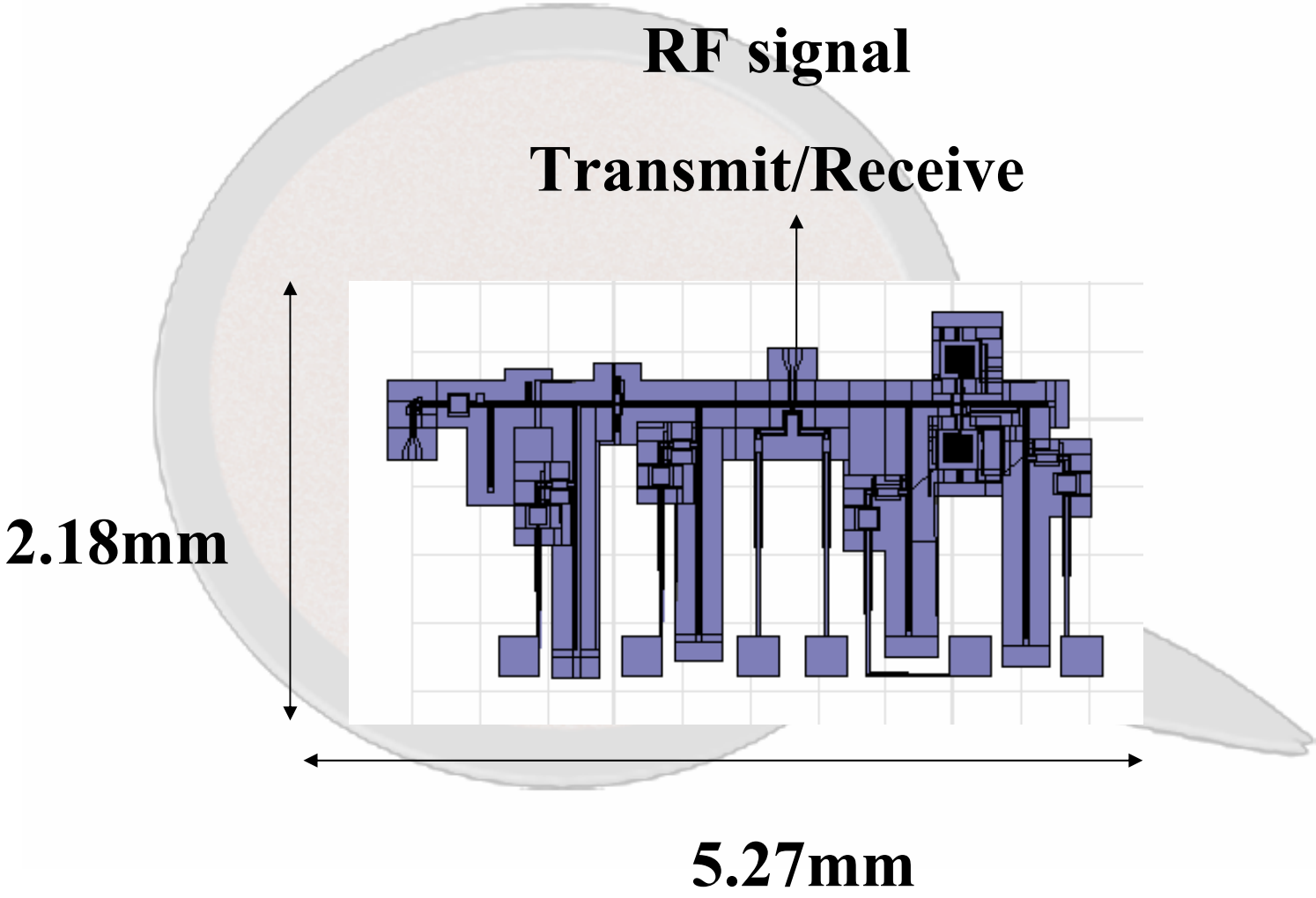
- 24 GHz antennas
- 5.8 GHz antennas
- Conclusion

24 GHz Patch Antenna

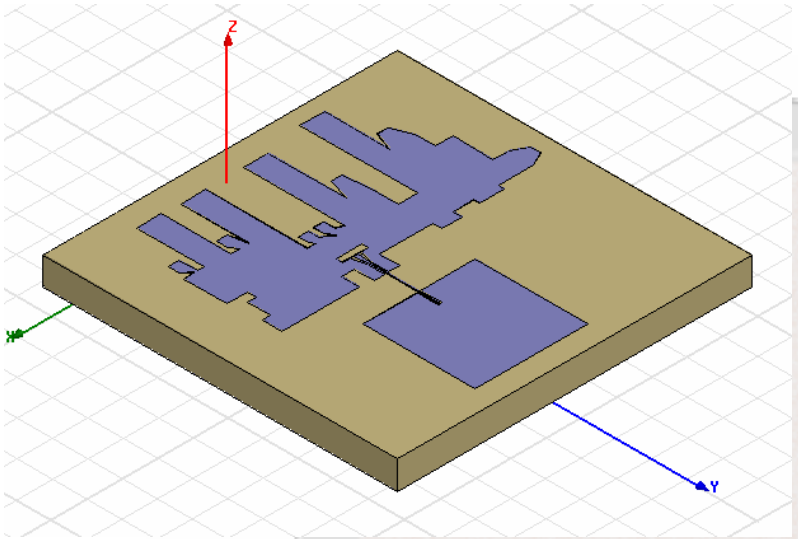
- At 24 GHz dimensions are small (1.4 mm x 2 mm)
- Standard patch
- EM-coupled patch

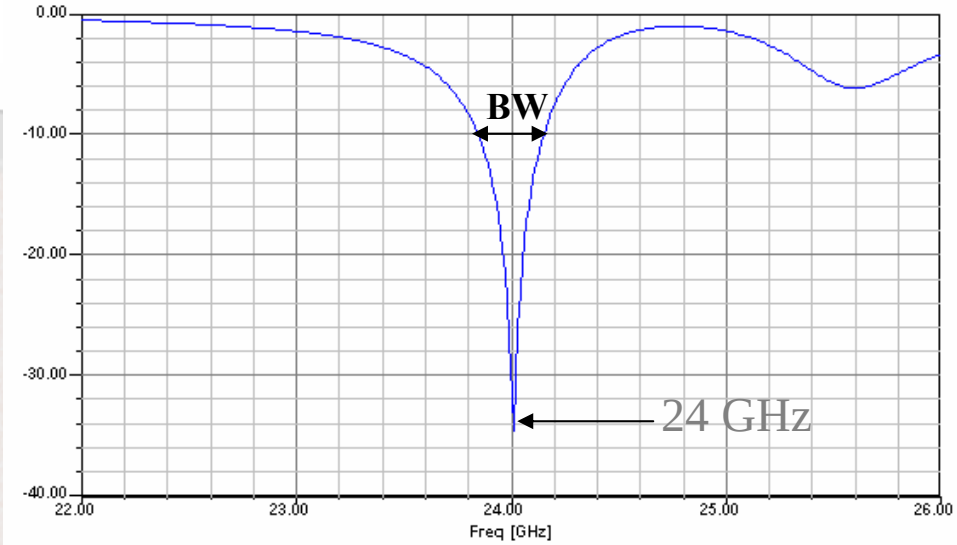


5.8 GHz transceiver



24 GHz patch antenna



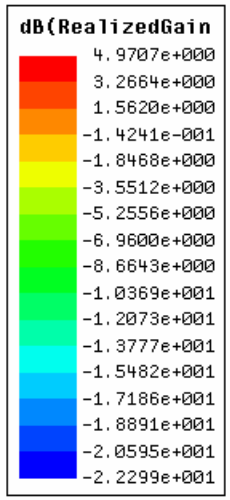


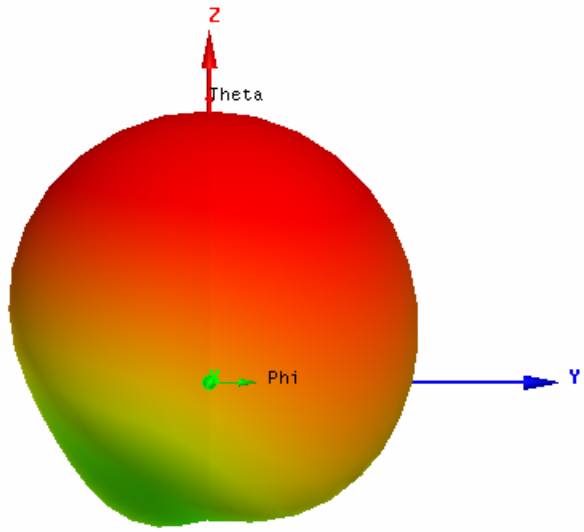
L=W=5mm

Eff = 88%

BW =180 MHz

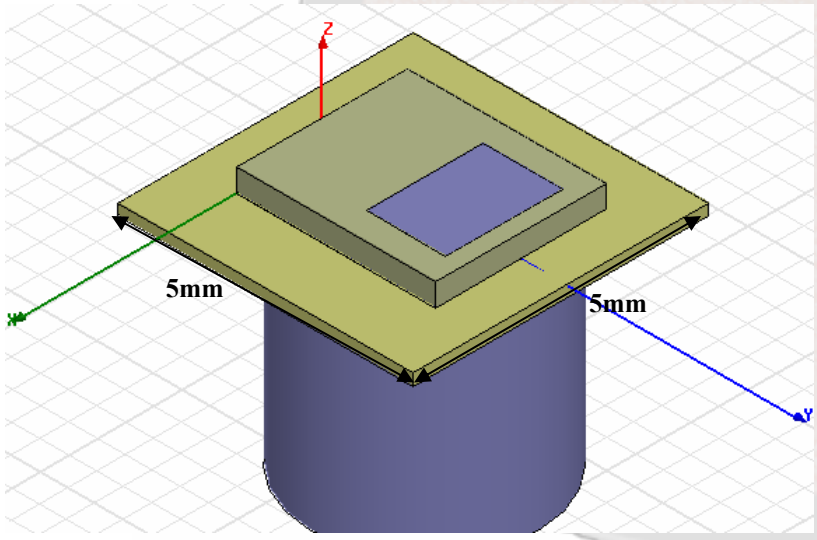
RL = -35 dB

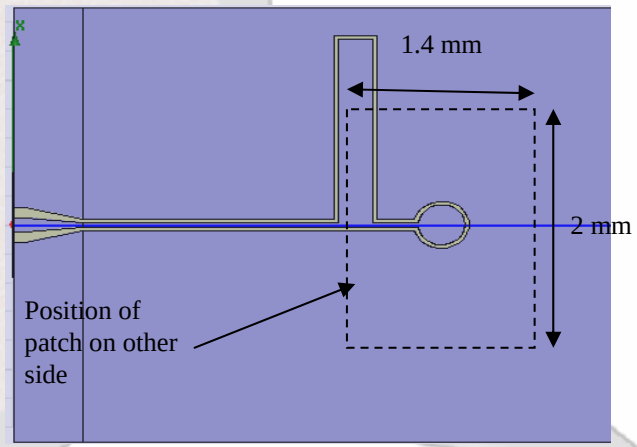




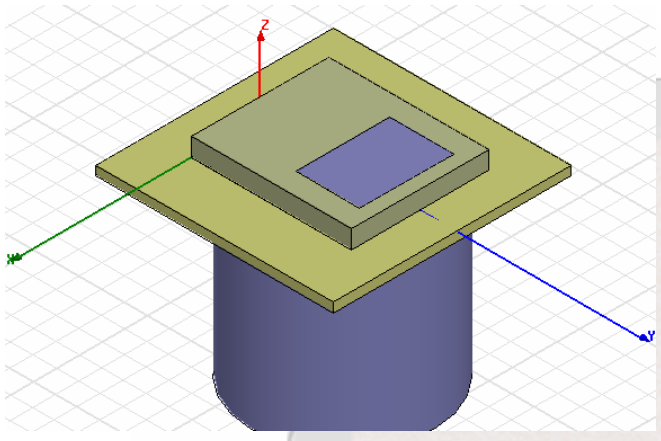
EM coupled Patch Antenna

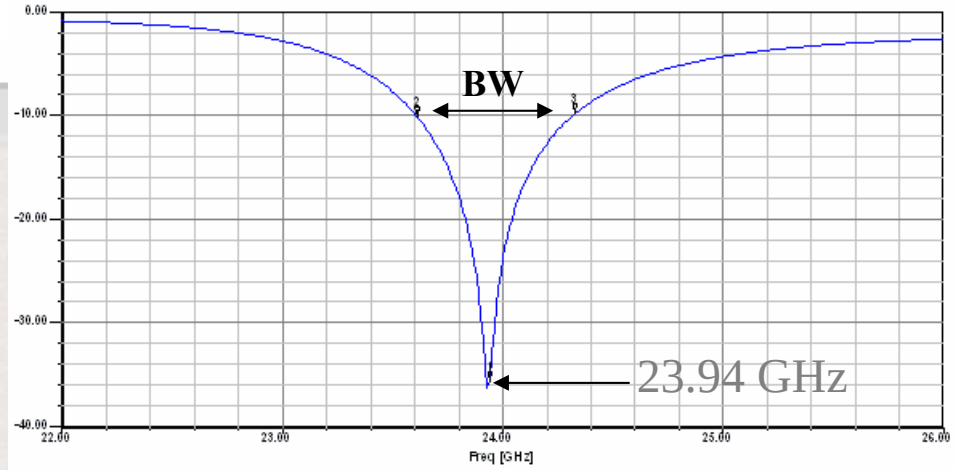
- Electromagnetic coupled feed
- Active circuitry on underside





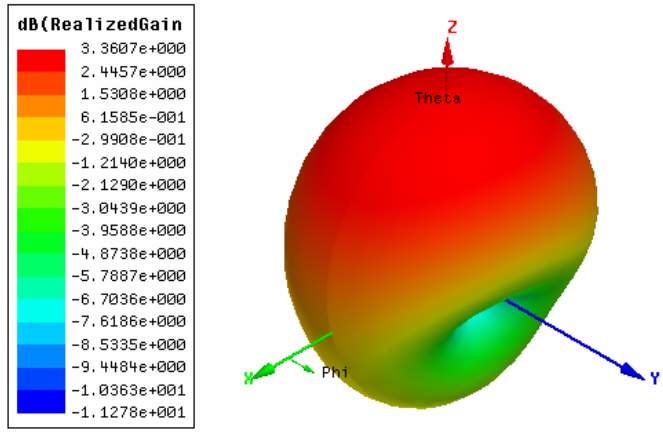
Patch Antenna





Return Loss (dB)

- RL = -35 @ 23.94 GHz
- BW = 720 MHz
- Eff = 86%



3D Plot of Gain (dB)

Link Budget @ 24 GHz

$$P_r = \left(\frac{\lambda}{4\pi R}\right)^2 G_1 G_2 P_t$$

If antennas are line of sight with 10 cm separation and transmitting at 400µW (-4dBm).

For 24 GHz:

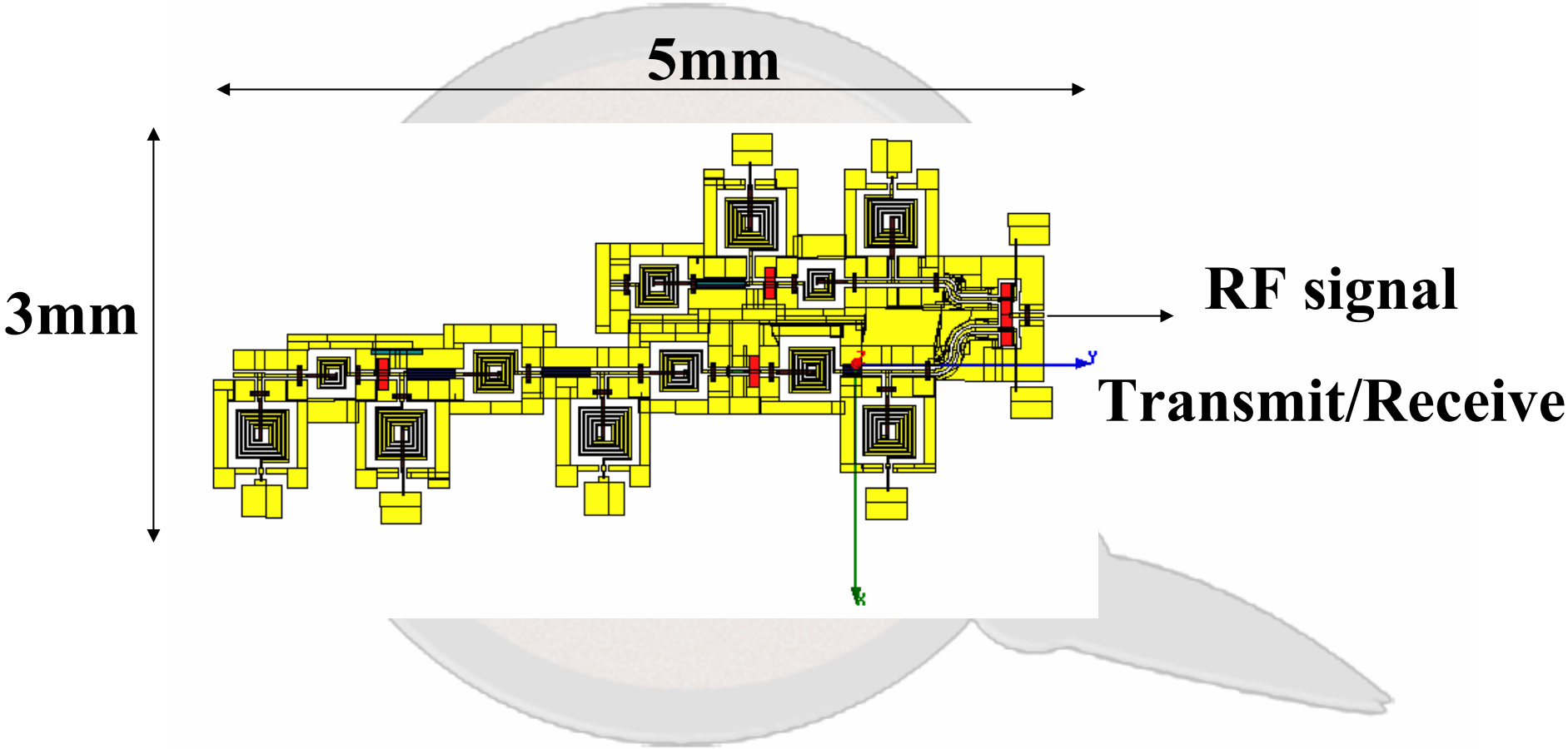
Gain = 5 db

The received power = 0.343µW (-34.36 dBm)

24 GHz antennas

- 24 GHz Antennas simulations satisfy Specknet requirements
- Size
- Good efficiency
- Further testing required

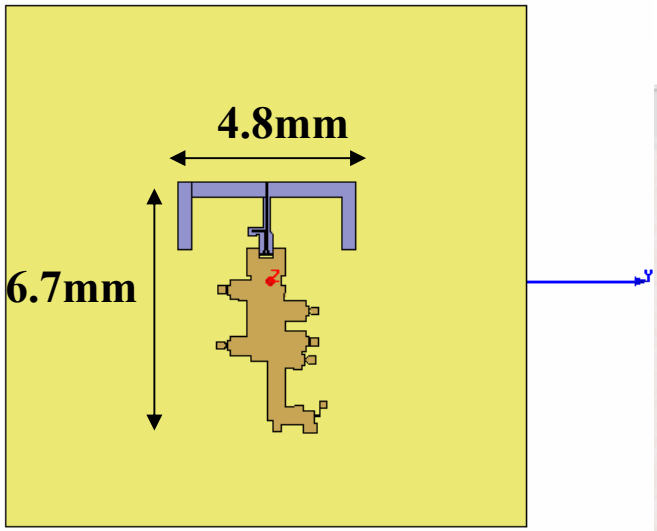
5.8 GHz transceiver

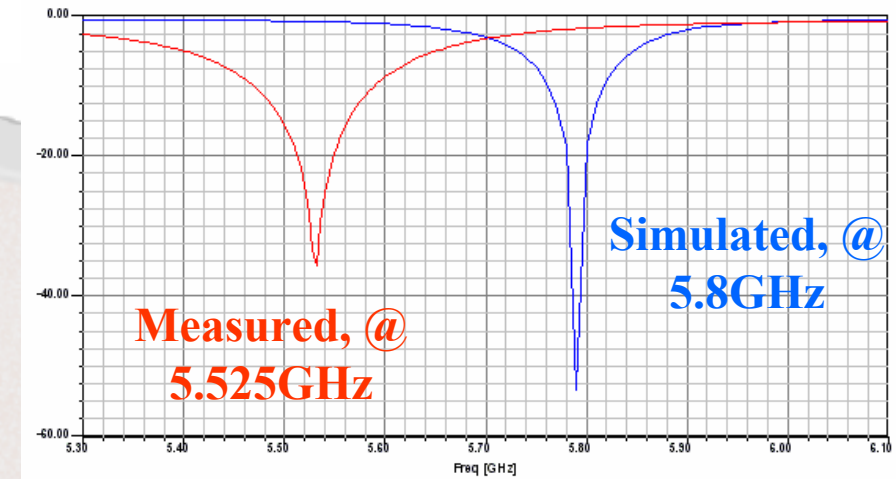


Miniaturisation trade offs

- Reduced efficiency (or Gain).
- Shorter range.
- Smaller useful bandwidth.
- Increased sensitivity to external factors.
- Hence more critical tuning.

Folded Dipole





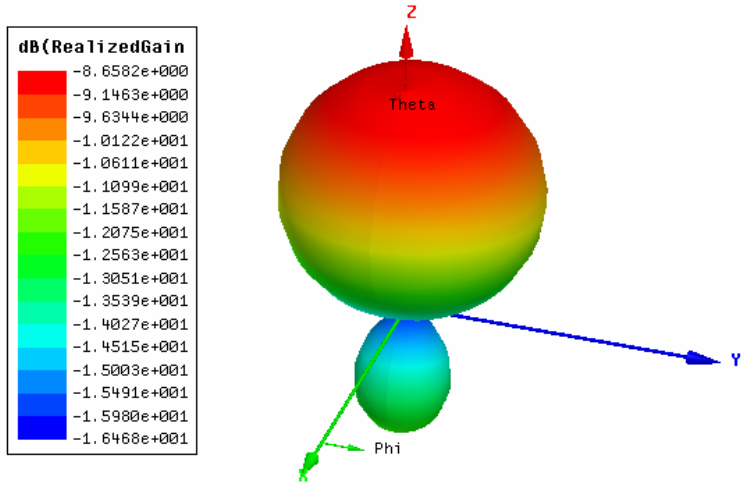
Return Loss (dB)

Poor Efficency (5%)

-8dB Gain

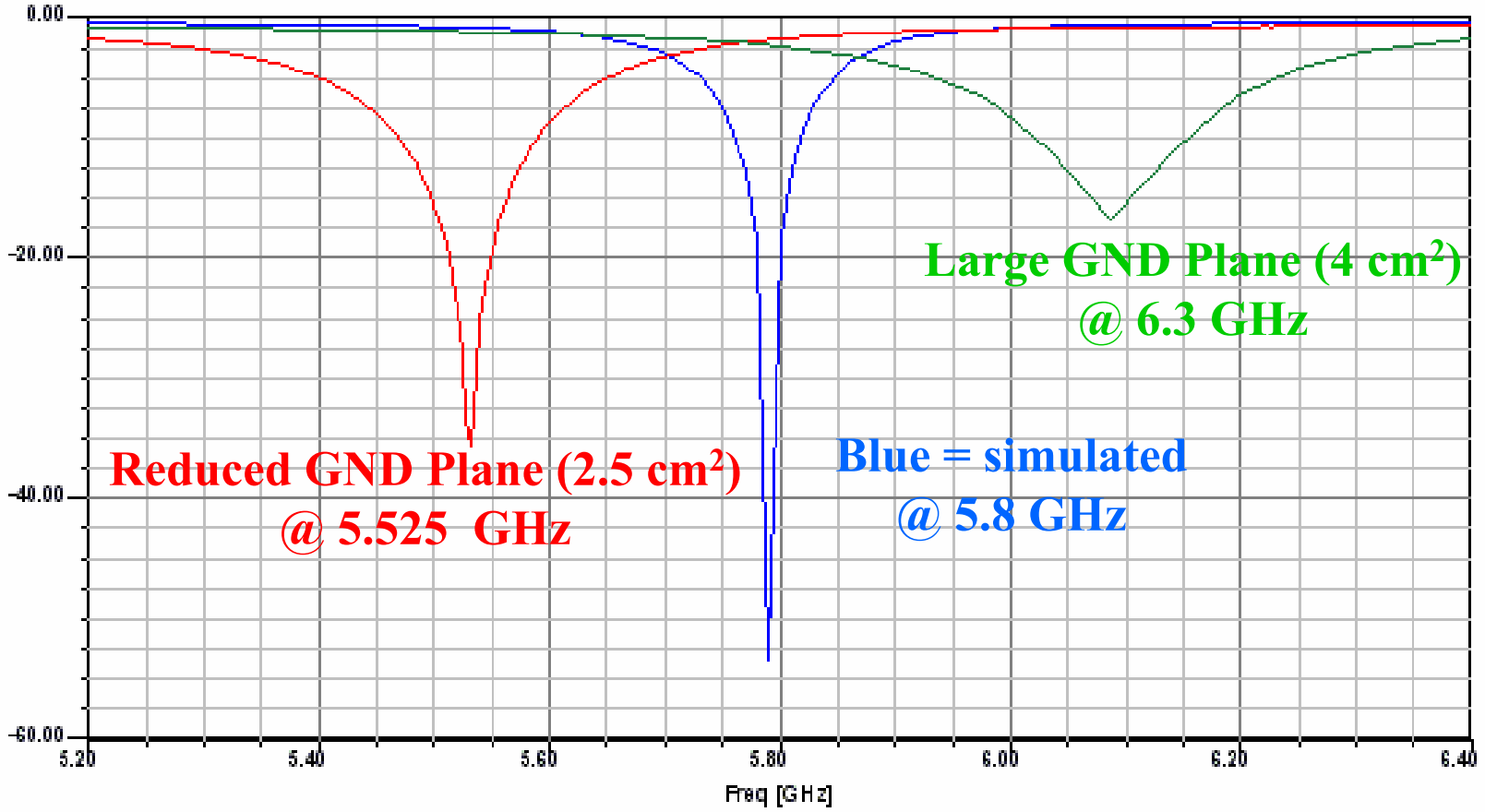
Retrun Loss > -20dB

BW ≈ 20 MHz



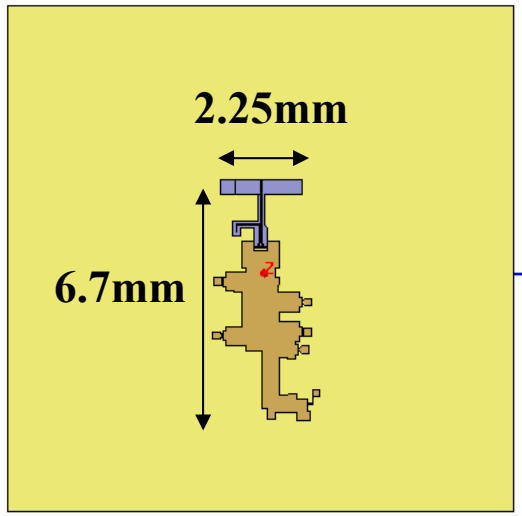
3D Plot of Gain (dB)

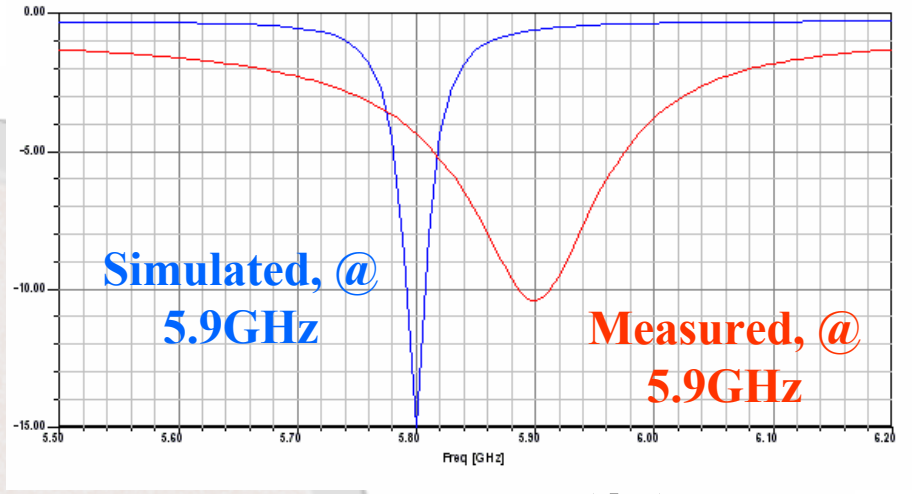
Effect of GND plane + substrate



Antenna printed on substrate with a larger area than the simulation model

‘ Patch ’ @ 5.8 GHz





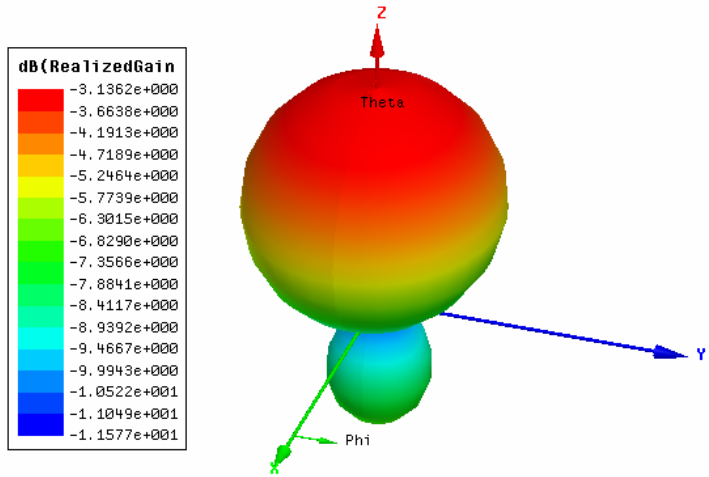
Return Loss (dB)

OK Efficency (28%)

RL < -10 dB

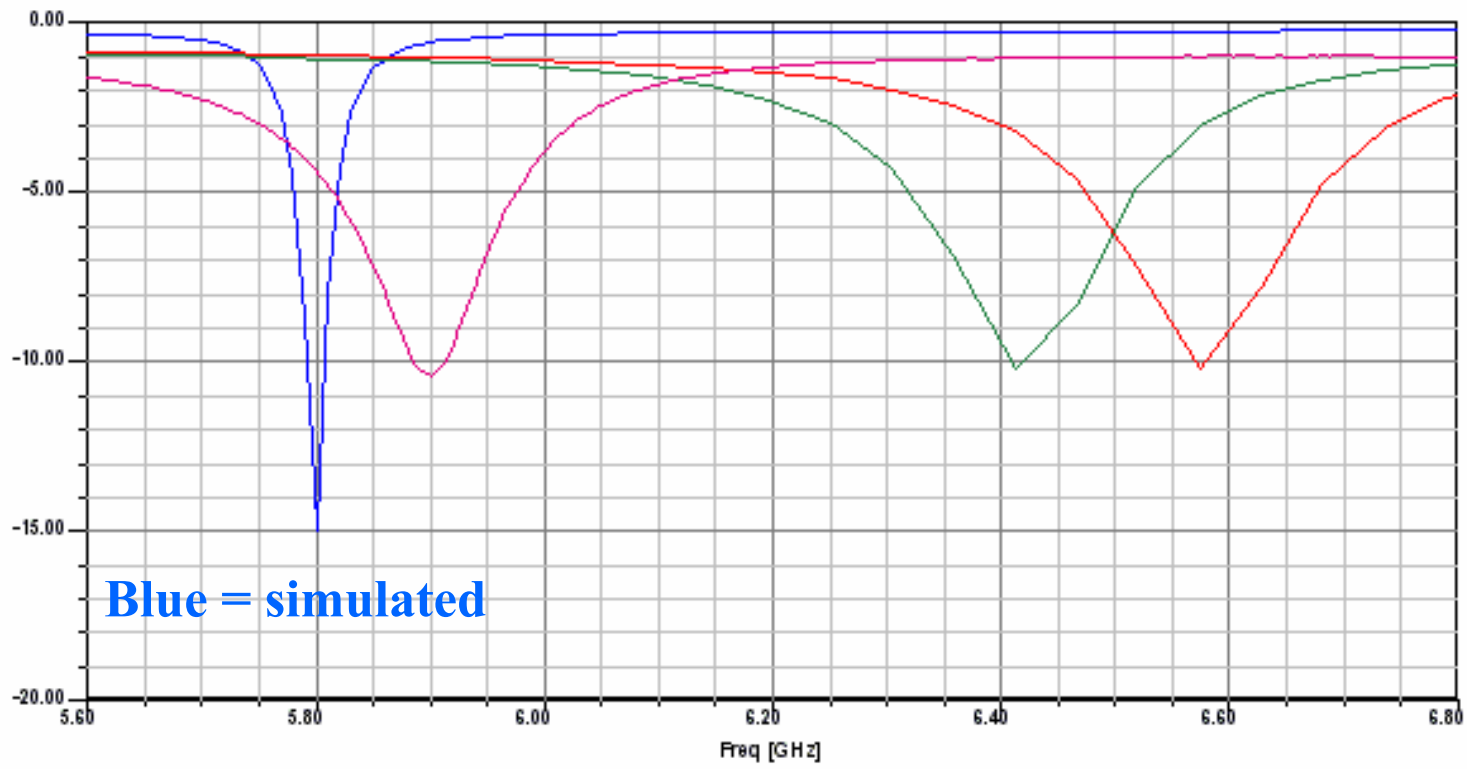
-3dB Gain

BW ≈ 20 MHz



3D Plot of Gain (dB)

Effect of reducing GND plane + substrate

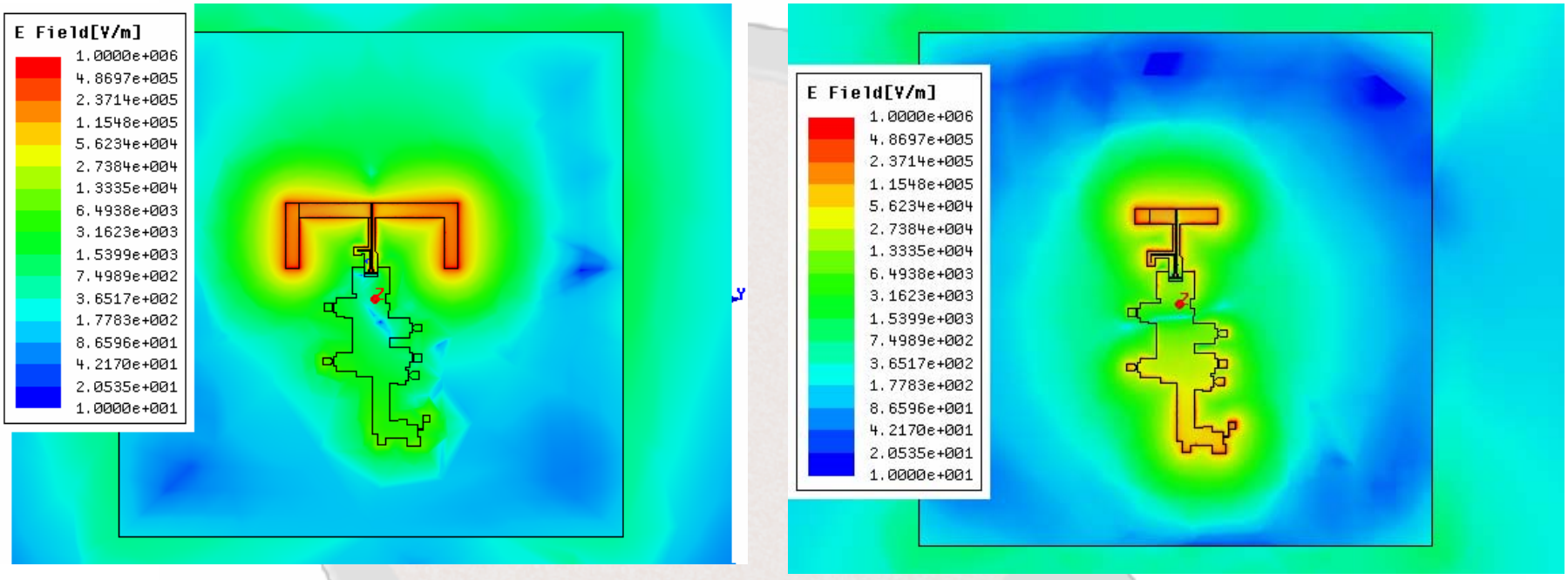


Magenta @ 5.9 GHz = even smaller sub and further reduced GND (2.5 cm^2)

Green @ 6.42 GHz = small sub large GND

Red @ 6.55 GHz = larger sub large GND

Why the difference?



2D Plot of the near E-field (V/m)

Dipole has greater dispersion compared to 'patch'

Design of antenna has to potentially include every external factor (e.g metal, worn on body etc)

Link Budget

$$P_r = \left(\frac{\lambda}{4\pi R}\right)^2 G_1 G_2 P_t$$

If antennas are line of sight with 10 cm separation and transmitting at 400µW (-4dBm).

For 5.8 GHz:

Gain = -3 db

The received power = 0.169µW (-37.711 dBm)

For 24 GHz:

Gain = 5 dB

The received power = 0.343µW (-34.36 dBm)

Future Work / Conclusions

- 24 GHz antenna concept proven
- Testing still required for EM couple patch

- 5.8 GHz antenna concept proven
- Change Tx design = Change antenna dimensions

- Both frequencies fulfil energy requirements

- Antenna designs fulfil Specknet requirements

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