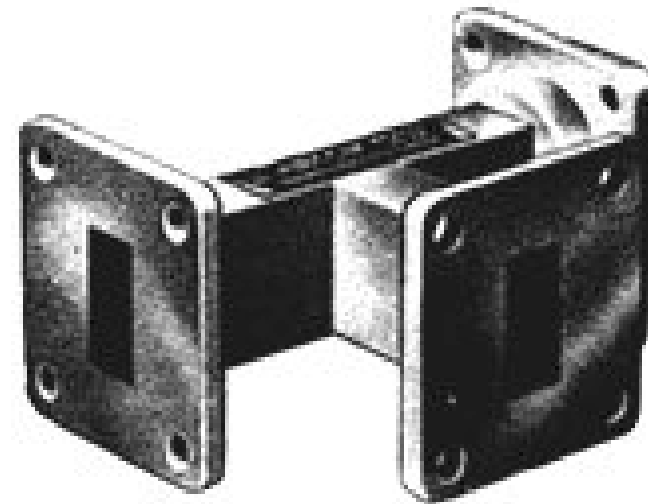# Simulations of Combined IOTs

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Why Combine IOTs

- Ease of repair.
- Smaller system.
- Greater confidence in efficiency.
- To simplify phase matching.

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Methods of Combining

Hybrid Tee

– Large Structure.
– Failure of 1 input results in loss of symmetry and failure of the system.

Combining Cavity

– Small/Compact.
– Failure of 1 or more components gives graceful degradation of power.

Previous modelling

- H. Bohlen of CPI has modelled a combining cavity in 1D using 6 inputs.

- Thales at Thonon have built a working model cavity using 5 inputs.

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Setting up the model

- Modelled in CST Microwave Studio.
  - With either: 2,3 or 4 IOTs.
  - At either: 0.5, 1.0 or 1.5GHz.
- 1st step - modelling the cavity at the required frequency.
- 2nd step – Optimising the IOT inputs into the cavity by varying their width and length within the cavity.
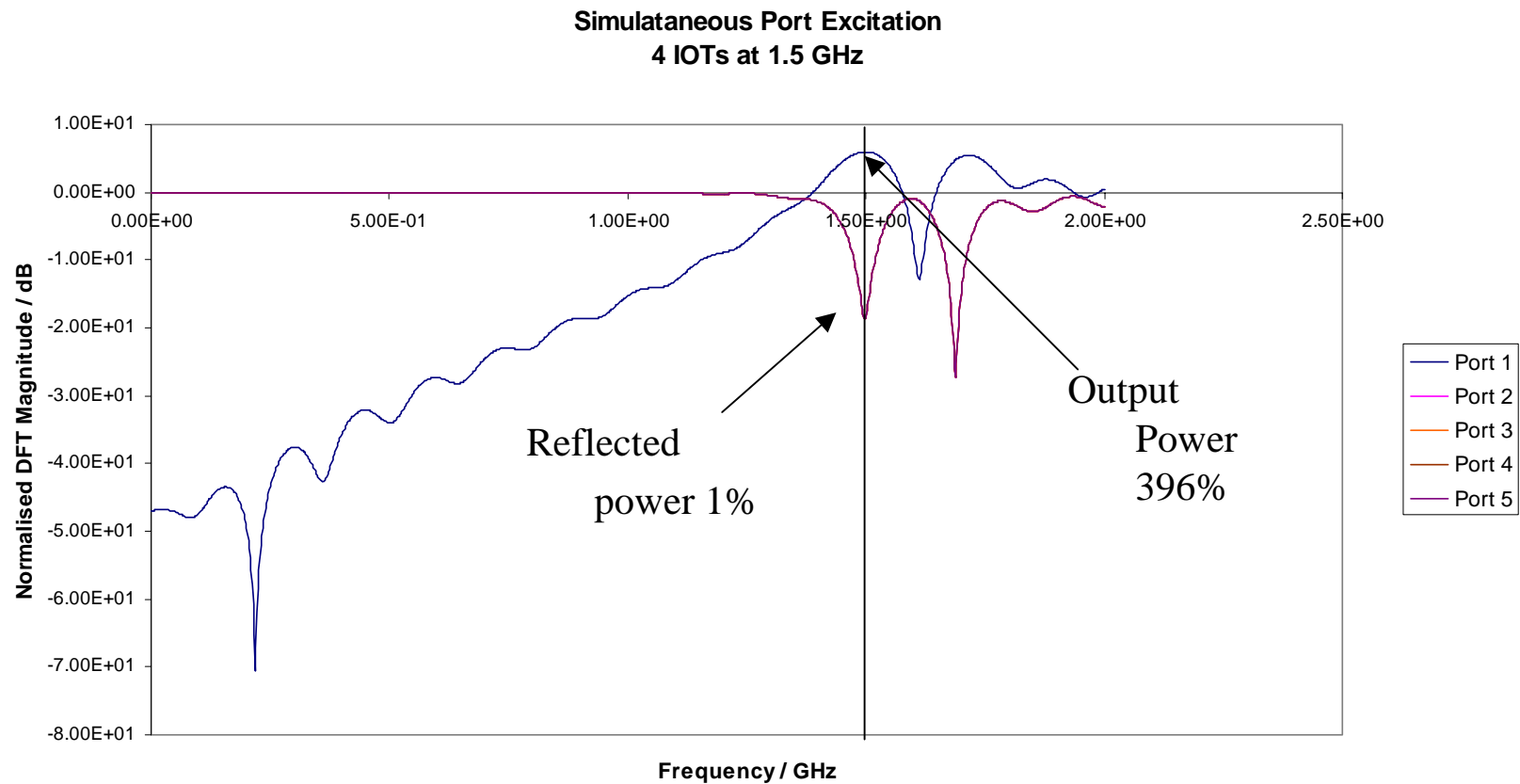
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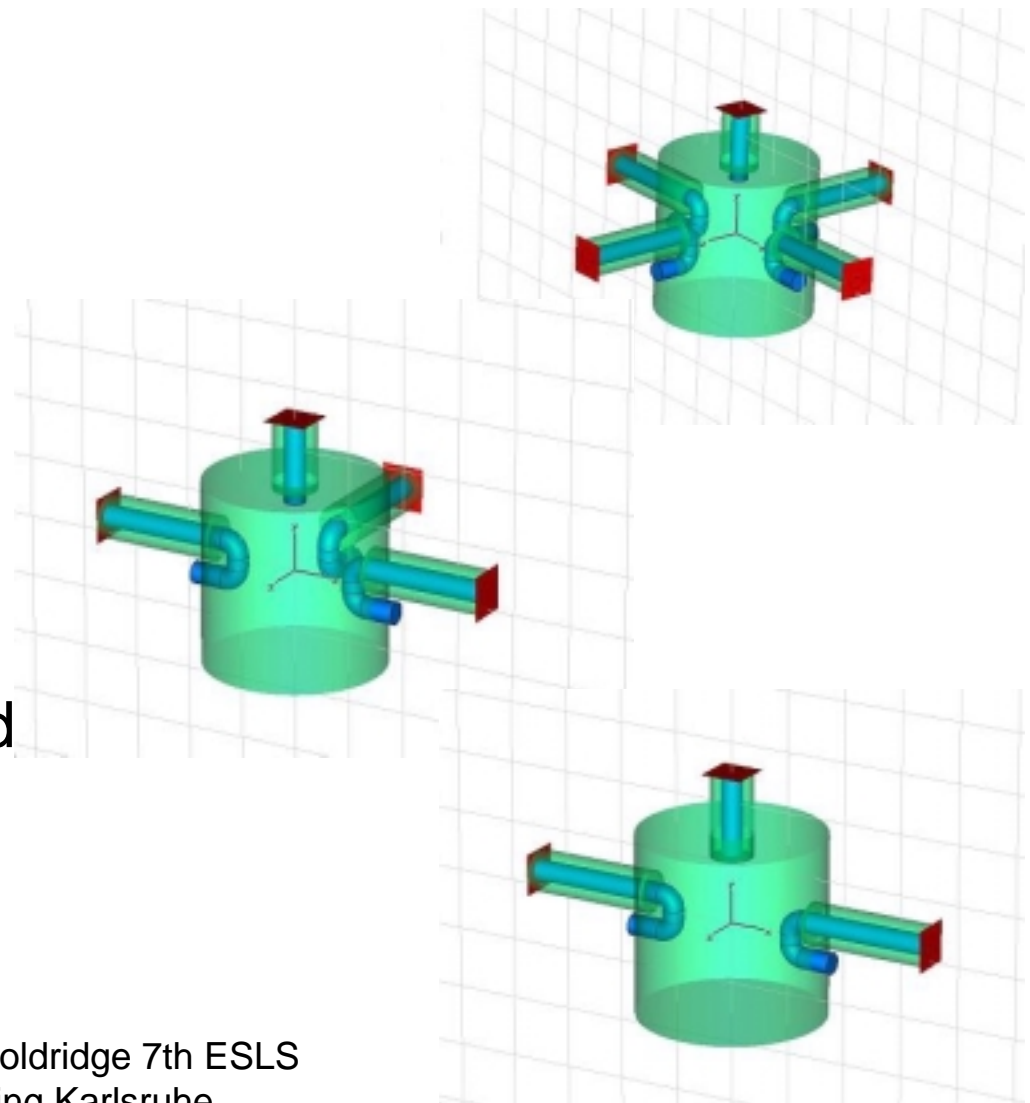
Results

- Efficiency of all models between 65%-99%.

Frequency	Number of IOTs	Radius of Cavity	Radius of Coax	Efficiency
1.5GHz	4	76mm	18mm	99%
1GHz	4	114mm	20mm	68%
0.5GHz	4	226mm	56mm	81%
1.5GHz	3	76mm	18mm	72%
1.0GHz	3	109mm	36mm	95%
1.5GHz	2	76mm	16mm	65%
1GHz	2	114mm	28mm	73%

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4 IOT plot

- For the 2 and 4 IOT models the output for each IOT is identical.

Simulataneous Port Excitation
4 IOTs at 1.5 GHz

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3 IOT plot

- Due to constraints on the way the ports are defined the asymmetry of the 3 IOT model led to it not being optimised fully.

Simulataneous Port Excitation
3 IOTs at 1.5 GHz

Reflected power 52%

Reflected power 12%

Output Power 208%

Port 1
Port 2
Port 3
Port 4

Normalised DFT Magnitude / dB

1.00E+01
0.00E+00
-1.00E+01
-2.00E+01
-3.00E+01
-4.00E+01
-5.00E+01
-6.00E+01
-7.00E+01
-8.00E+01

0.00E+00   5.00E-01   1.00E+00   1.50E+00   2.00E+00   2.50E+00

Frequency / GHz

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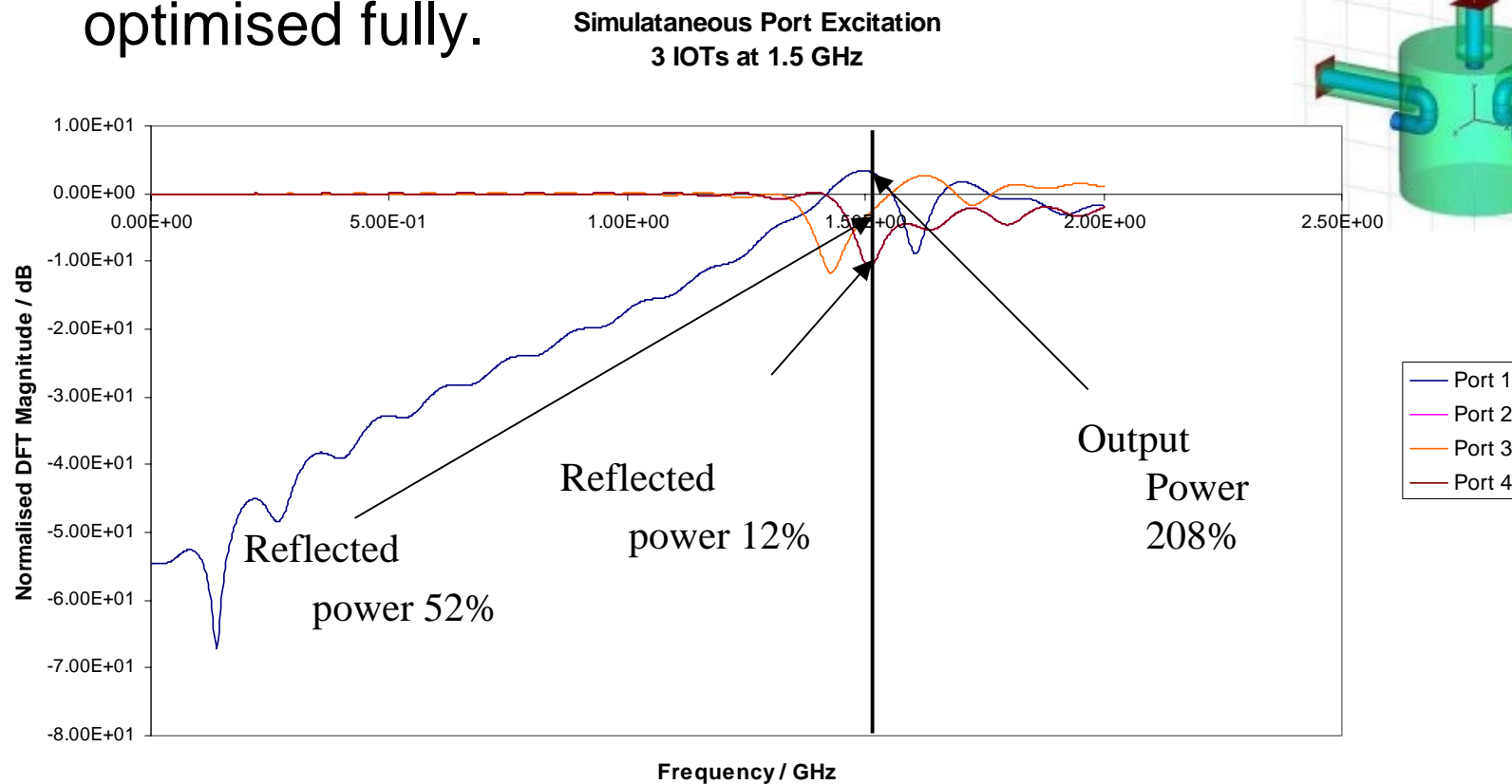
IOT Failure

- If an IOT was to fail it could be removed.

- The modelling of the asymmetrical 3 IOT design shows that the IOT opposite the removed one will have a slight drop in efficiency. The other 2 IOTs will continue working as before.

- With only 2 IOTs working there is no drop in efficiency as long as the system is symmetric.

Future Work

- Modelling at 1.3GHz for all 3 models.

- Model to be built at 1.3 GHz.

- To be tested using signal generators, initially with 2, then adding more.

Conclusions

- Modelling suggests that an efficient IOT combining cavity can be created.

- For optimum performance IOTs should be regularly spaced and symmetric around the cavities.