



**NATEP 71772**

## **High Functionality Small, Composite Antennas**

Dr Michael Sloan

Director – Technical Composite Systems Ltd



# Project background

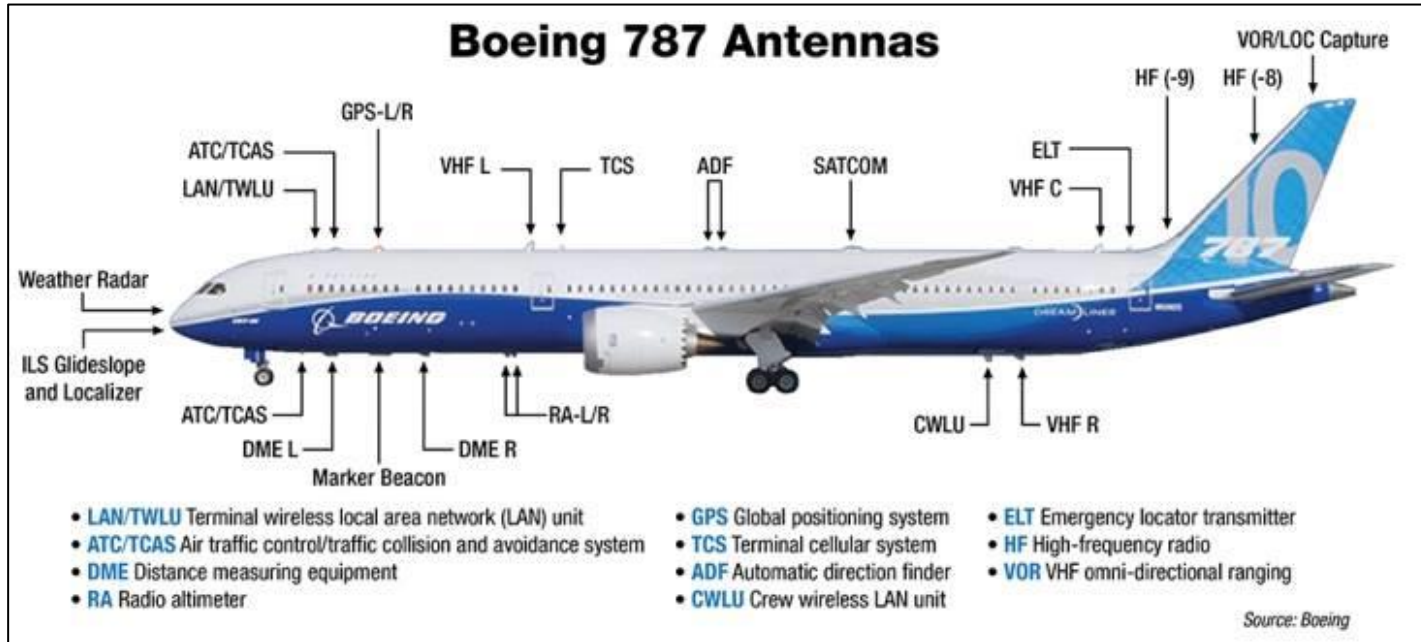


## Project partners:



Aerospace Prime  
(UK)

# Project background



## Design and make novel composite materials

- Tuneable electric and magnetic properties
- Repeatable manufacture
- Scalable manufacture

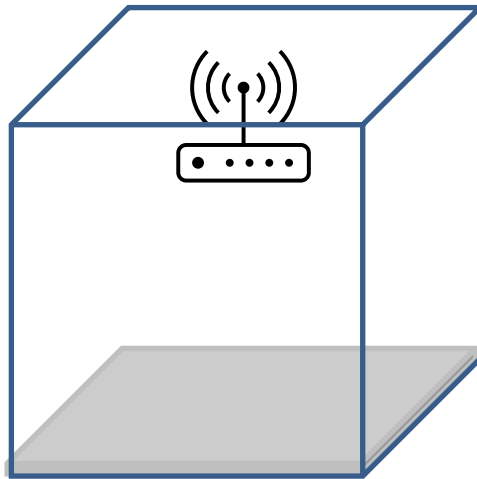
# New Composite Materials – Why?

## Design and make novel composite materials

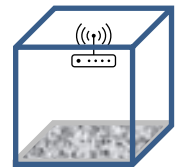
- Tuneable electric and magnetic properties

$\epsilon$  = Permittivity = Electrical response

$\mu$  = Permeability = Magnetic response



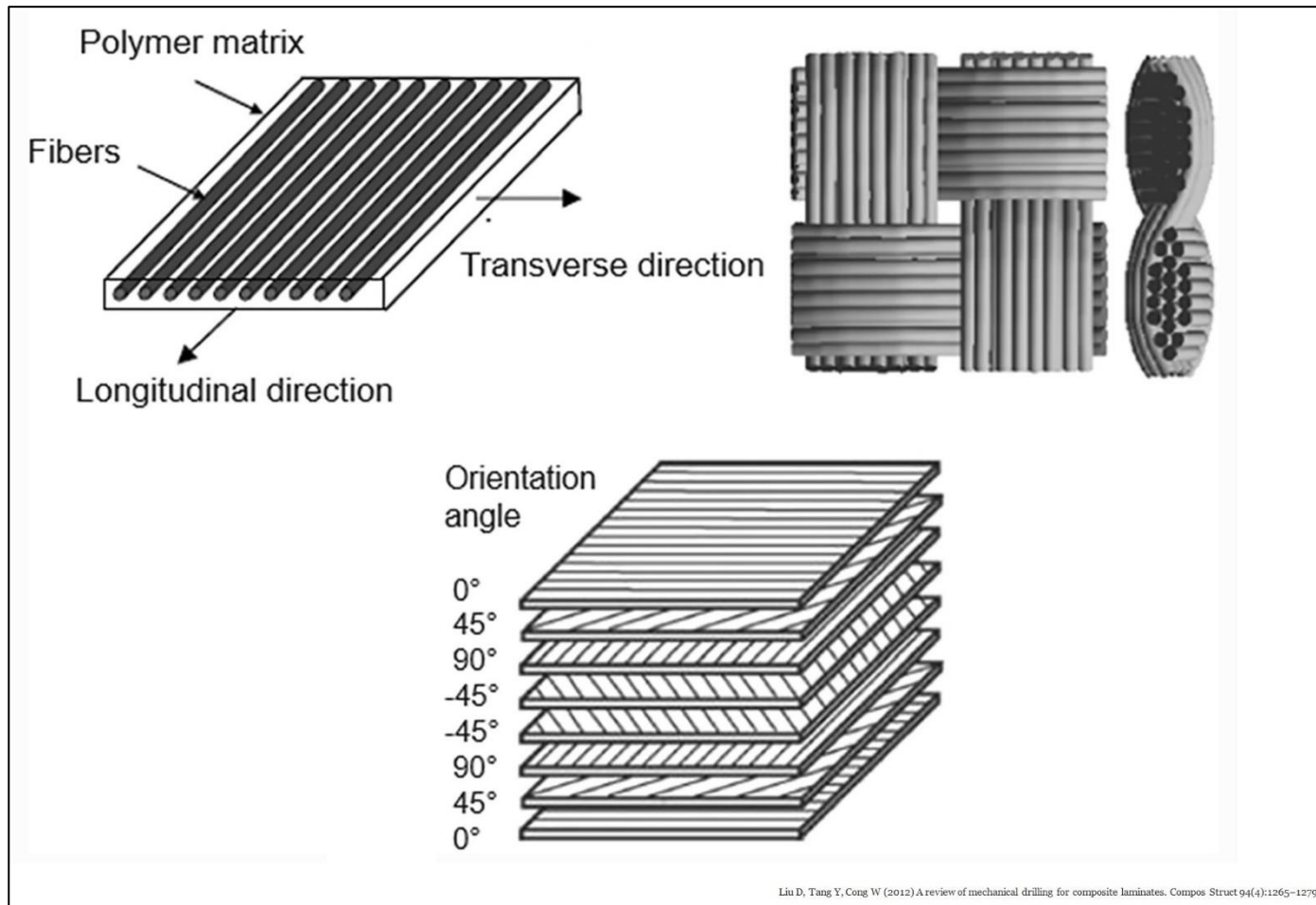
When  $\epsilon = \mu$ , the system can be miniaturised by the scaling factor



# New Composite Materials – What?

## Design and make novel composite materials

- Repeatable manufacture



# New Composite Materials – What?

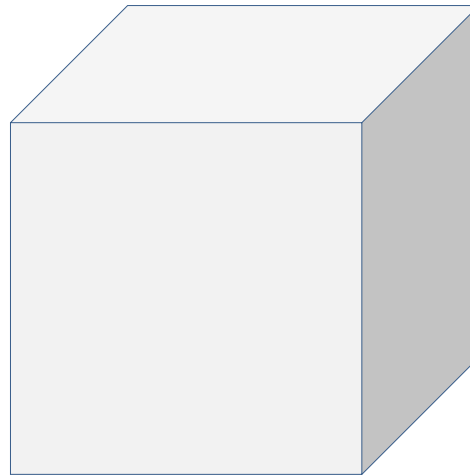
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## Design and make novel composite materials

- Repeatable manufacture



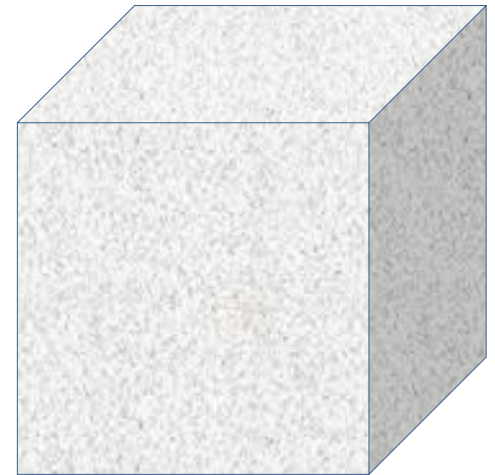
+



Matrix

=

Composite

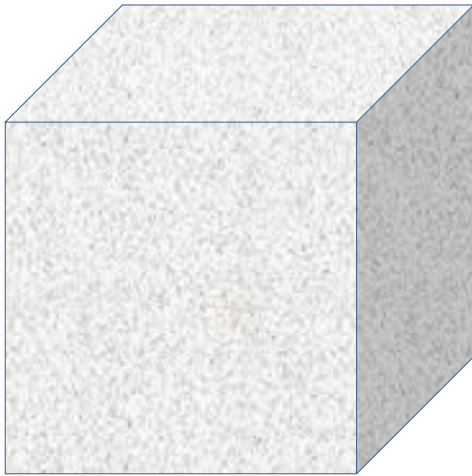




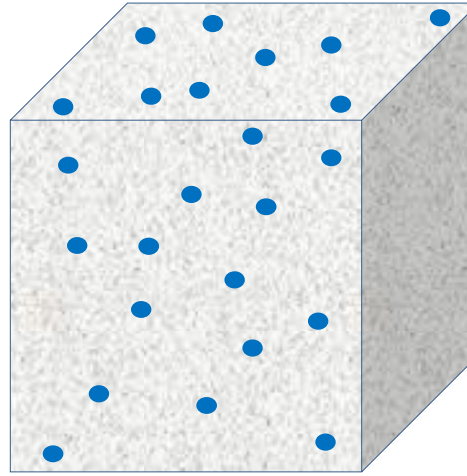
# New Composite Materials – What?

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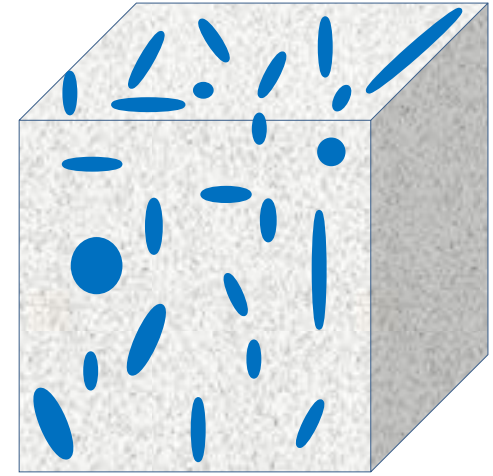
**Design and make novel composite materials**



Particles



Particles  
& Fillers



Flakes

# New Composite Materials – How?

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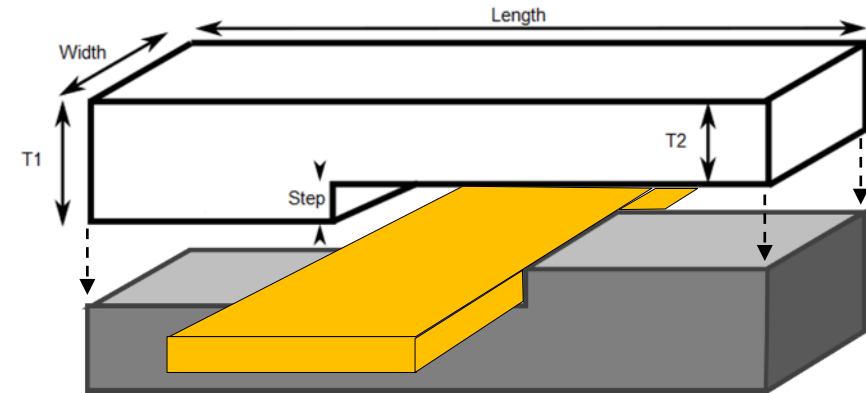
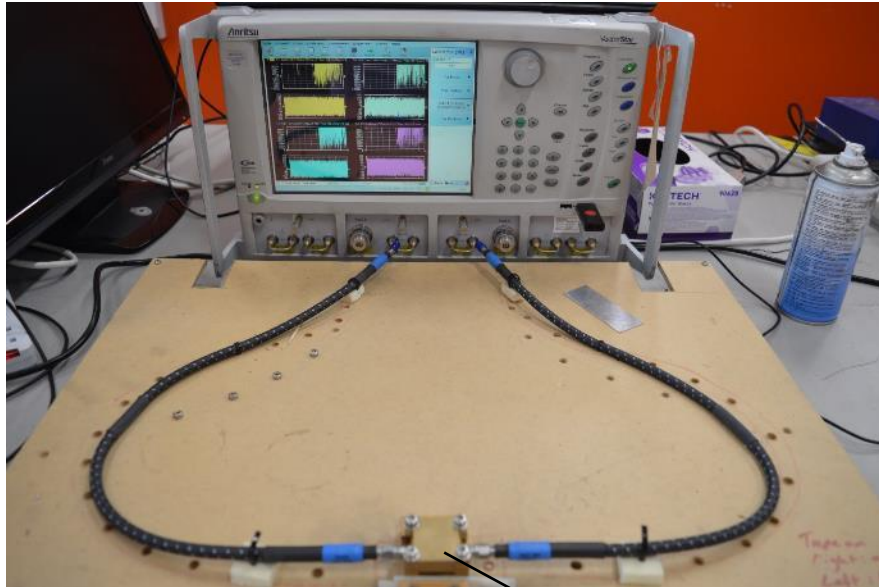
- **Detailed literature review magnetic particles and applications**
- **Constant communication – Formal review and ad hoc Brainstorming**
- **Document and create a systematic test plan**
- **Test and allow time to digest and review/understand results**
- **Repeat test iterations..... and again!**



# New Composite Materials – How?

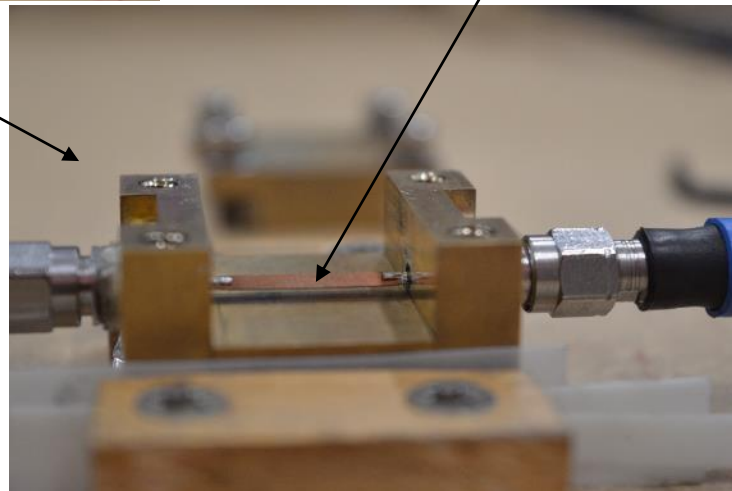


# Composite Materials – How?



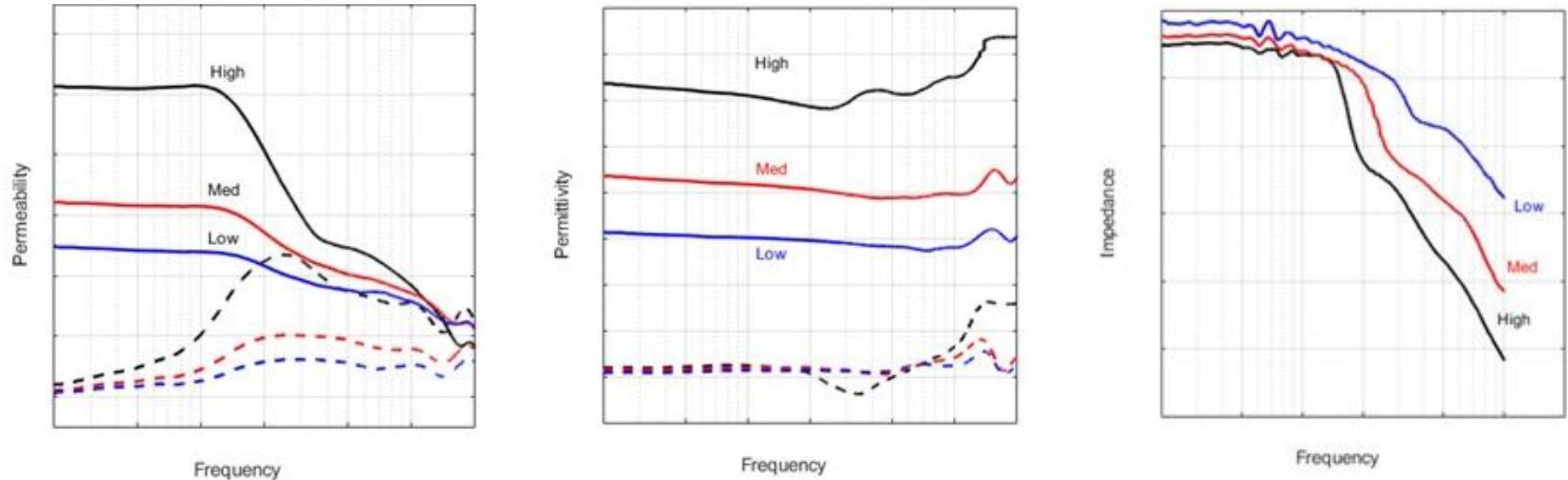
## Stripline test

- VNA up to 70 GHz
- Matched dimensions essential
- Air gaps influence permittivity and permeability
- Block width influences scattering parameter spectrum



Photos: Dr Cameron Gallagher  
University of Exeter

# New Composite Materials – How?



- **Control of both electrical and magnetic response of composite**
- **Impedance of laminate of immediate practical use**
- **Stable behaviour over frequency range**

## Highlights of the Project

- Collaboration of a new team with bespoke skills.
- Novel Science!
- Pursuing a challenge through protected activity.
- Documenting Knowledge.
- IP Generation.
- Opportunity to engage with aerospace prime contractor and understand their wants/needs.

## Difficulties of the Project

- Initial target very challenging.
- Identifying and sourcing raw materials.
- Protecting resource from production demands
- Responding to unexpected events/data.

# Benefits To Partners

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- What were the direct benefits of undertaking this project ?
  - Opportunity to progress concept idea into test articles/demonstrators
  - Applying skills to a new technical arena
  - Demonstrating technical capability and programmatic control
  - Raising capability profile for partners
  - Support from the NATEP program – Technology Managers
- Any Planned Next steps –
  - Detailed exploitation plan in place with End user
  - Continue the development of the technology
  - Spin off ideas (from unexpected results)

# How to Contact Us...

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**TECHNICAL COMPOSITE SYSTEMS**