

# Multi-Functional Magnetic Composite Materials for use in Magnetic Gear Systems

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*Jason Yon, Ian Bond, Phil Mellor*

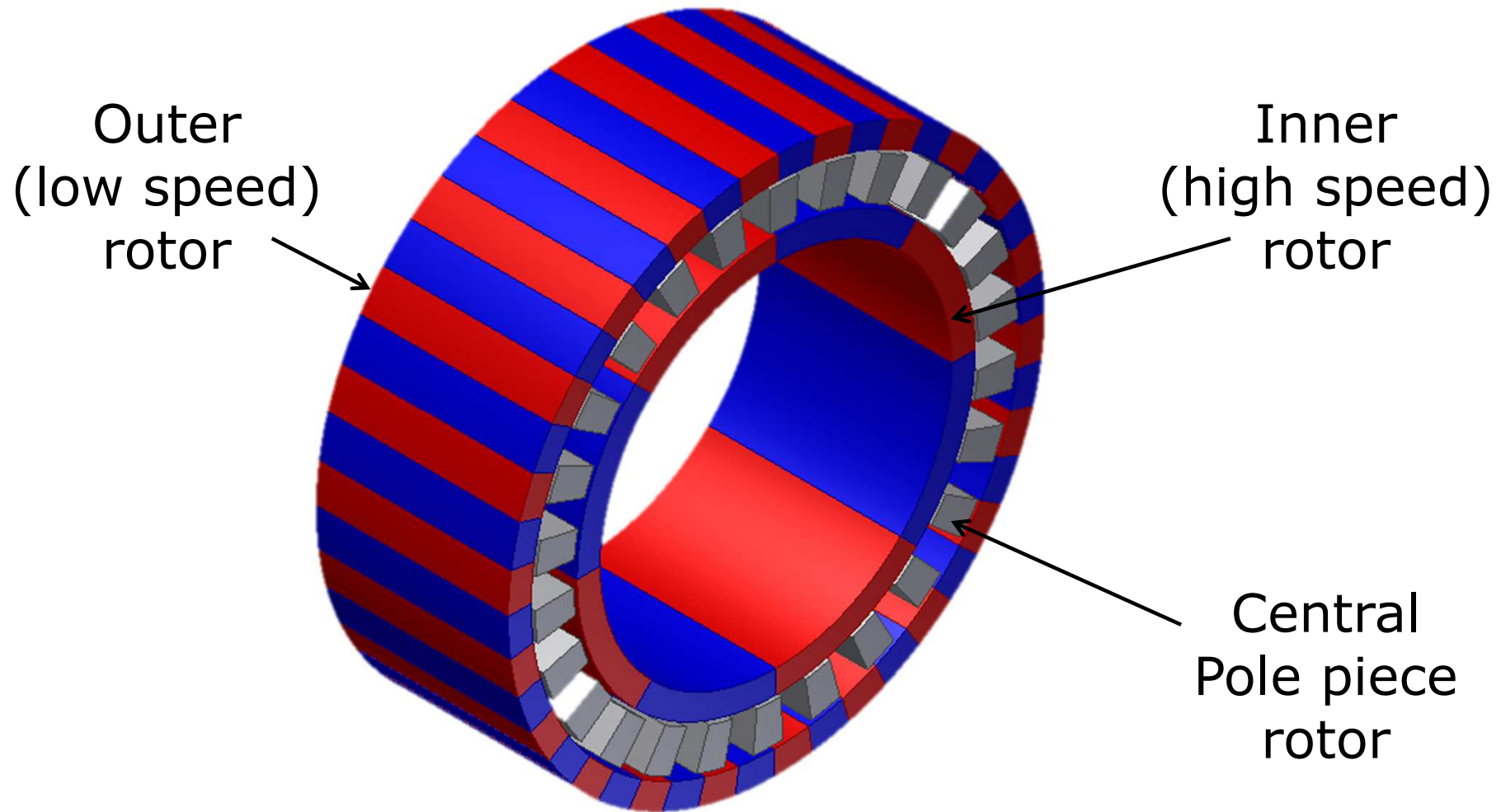
# Introduction

- What is a magnetic gear?



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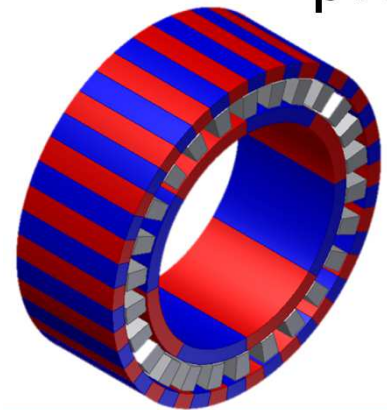
# Why the Magnetic Gear?

- Pros

- Low maintenance, noise and vibration
- Improved Reliability
- No lubrication
- Physical isolation between shafts
- Inherent overload protection

- Cons

- Difficult to manufacture
- Over banding required to protect brittle permanent magnet material
- 'Block' construction limits design freedom



# Why the Magnetic Gear?

- Pros

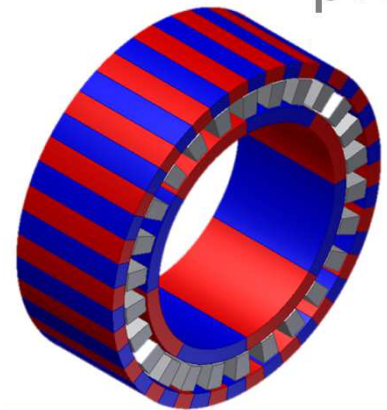
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## **PROJECT AIM:**

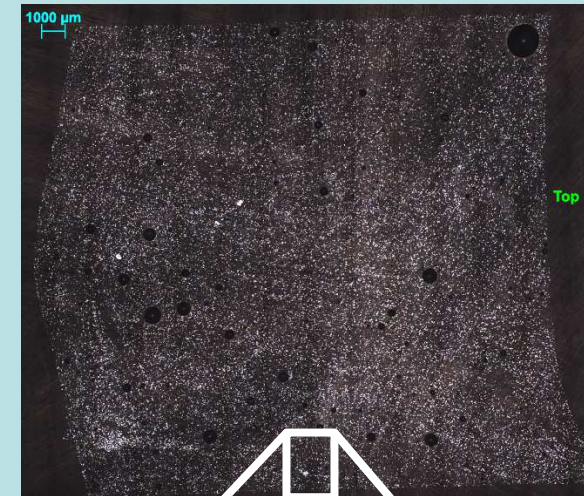
- Incorporate ferromagnetic material into a fibre composite central magnetic gear rotor
- In order to:
  - Simplify manufacture
  - Reduce cogging torque
  - Generate a self-supporting structural component without compromising gear performance





# Central Rotor Design

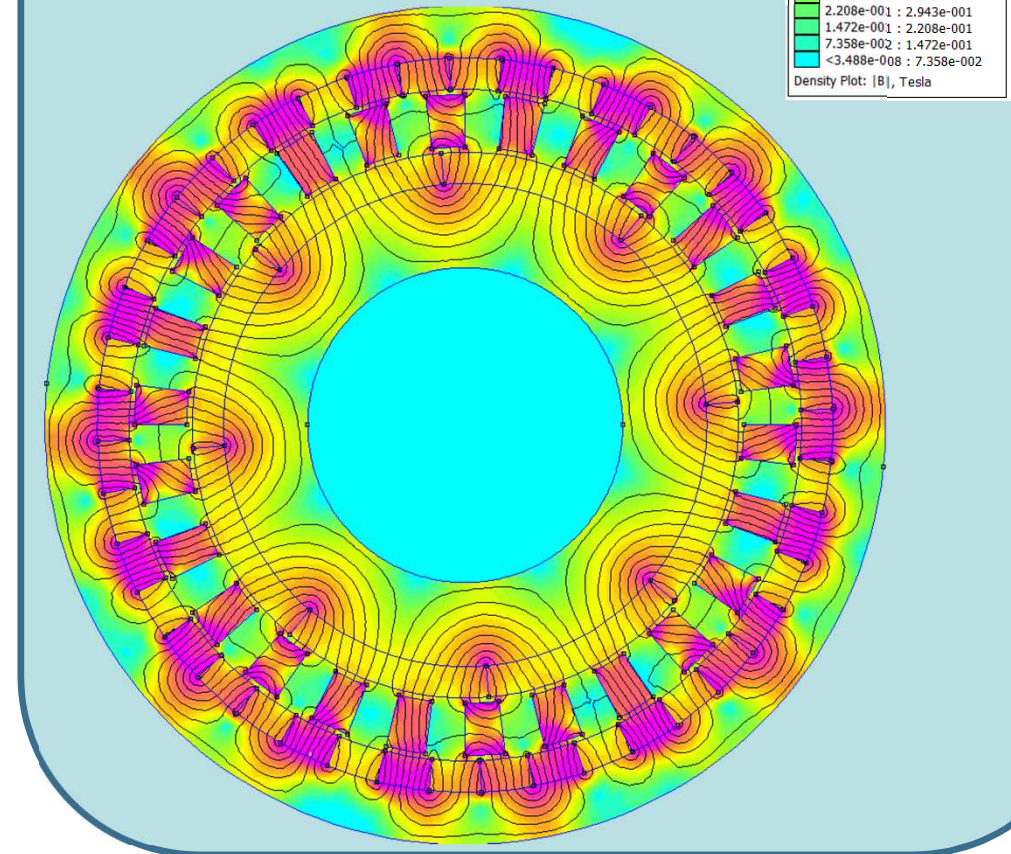
- Stage 1
  - Material property data
- Stage 2
  - Forces acting on central rotor during operation
- Stage 3
  - Generate lay-up designs to meet both the mechanical and electromagnetic requirements of the central rotor



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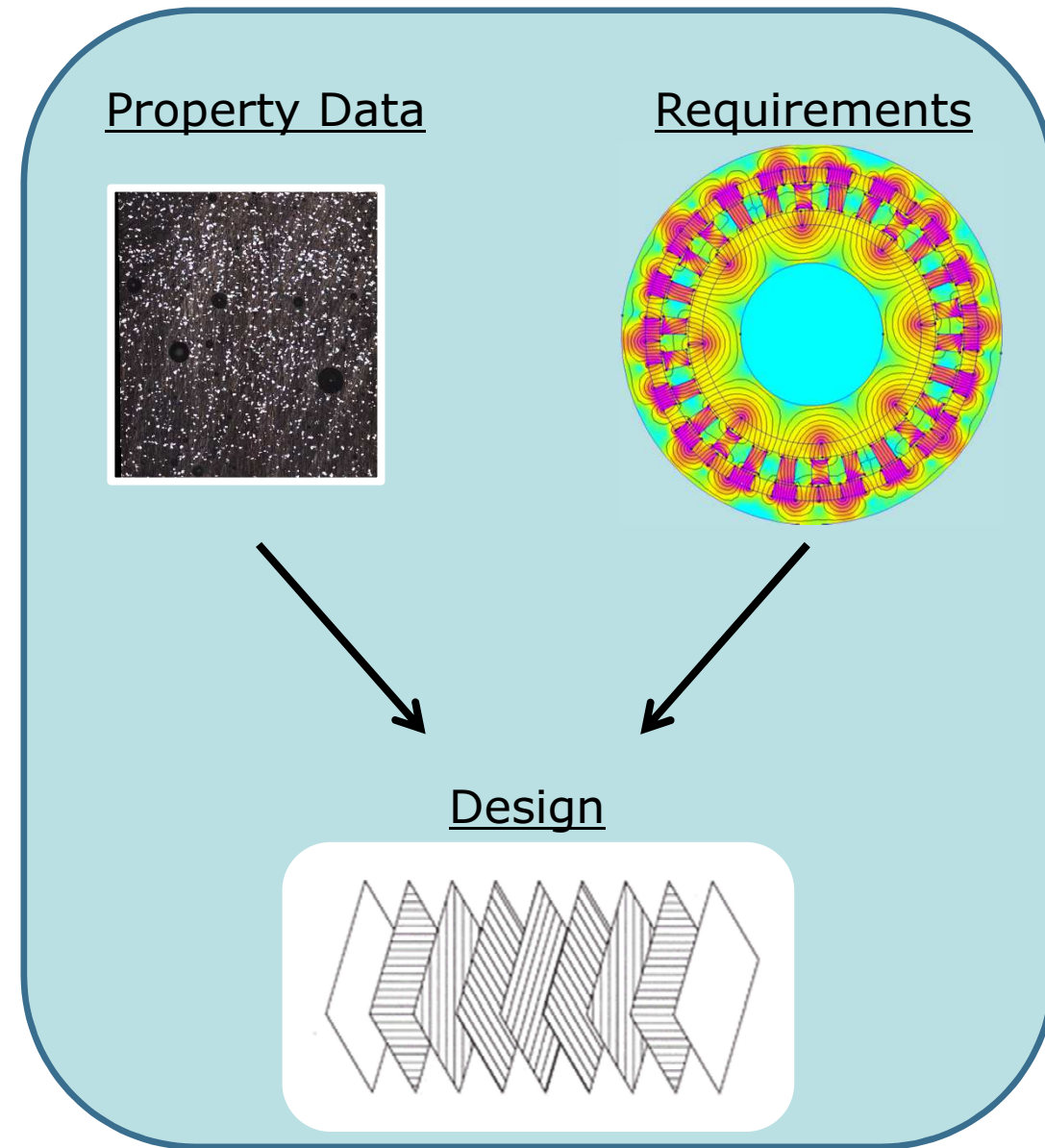
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- Using FEMM finite element software



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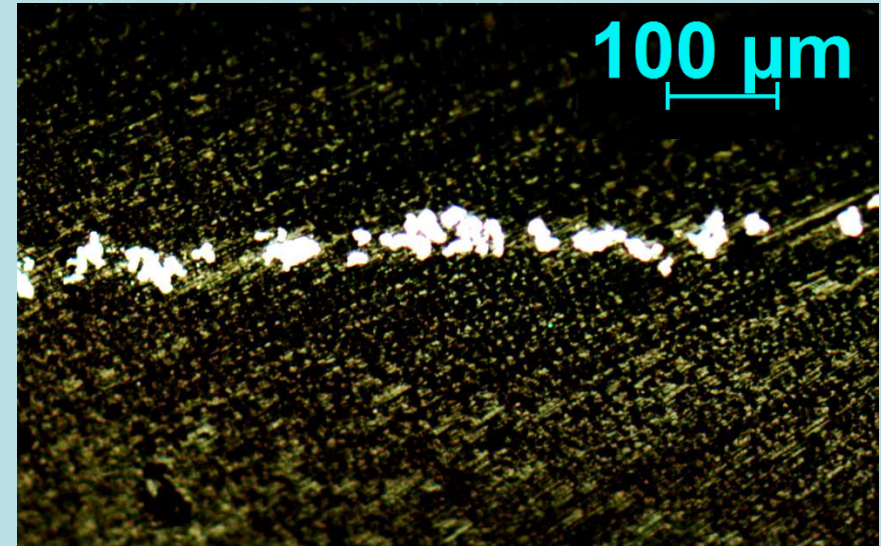
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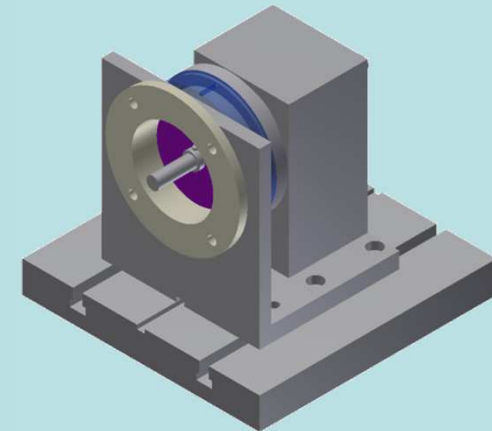
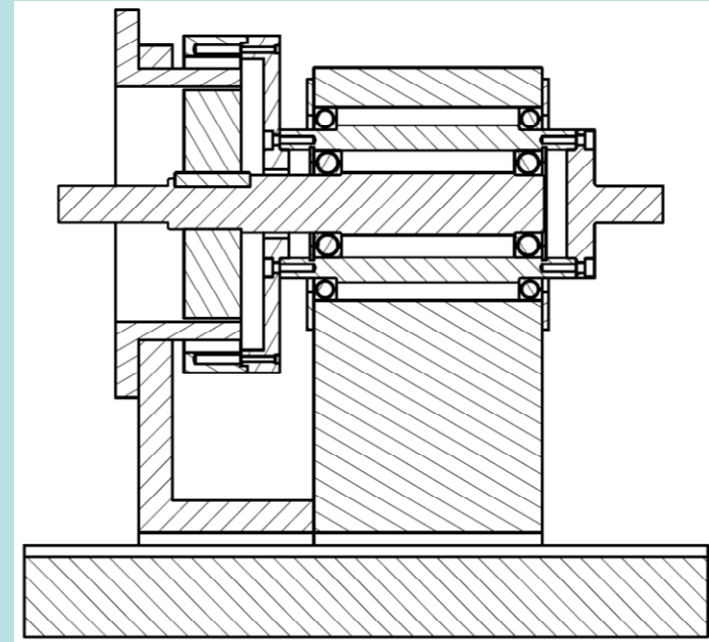
# Manufacture and Testing

- Incorporating ferromagnetic material into fibre composite toroid
  - Bulk particulate composite
  - Inter/Intra layer incorporation
- Need repeatable method with controlled particle  $V_f$
- Gear Test Rig
  - Test rotor designs
  - Compare with theoretical models



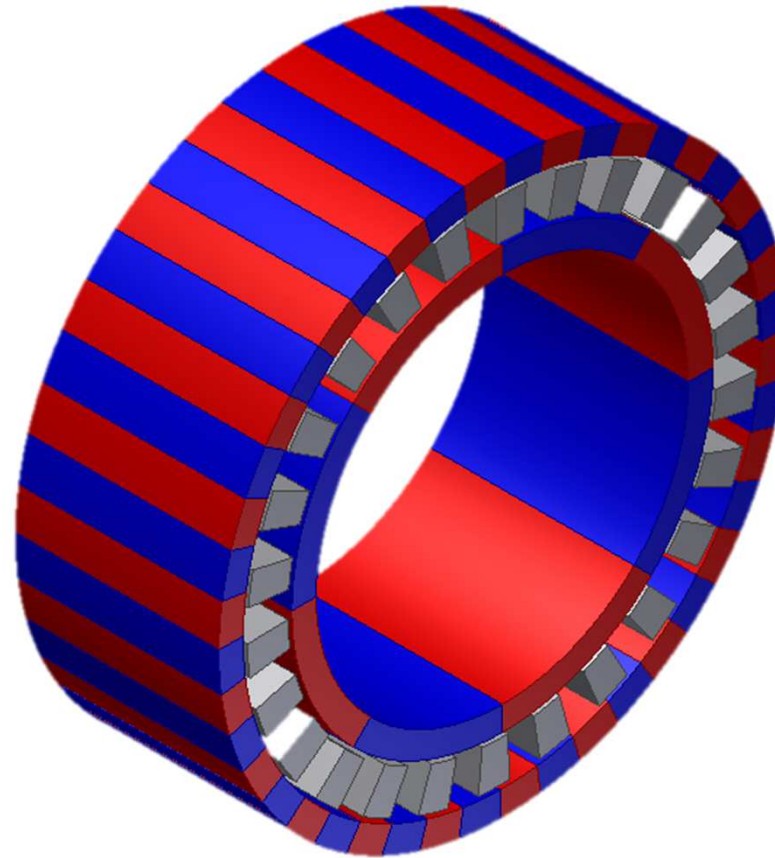
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# Acknowledgements

- Thanks to
  - Jason Yon, Ian Bond and Phil Mellor
  - ACCIS
  - EPSRC
- Thank you for listening
- Questions?



## EPSRC

Engineering and Physical Sciences  
Research Council