



UNIVERSITY OF
CAMBRIDGE
DEPARTMENT OF ENGINEERING



Electrical
Engineering
CAMBRIDGE

Flux Pumps

Superconducting Wireless Power

Superconducting Power Switches

James Gawith

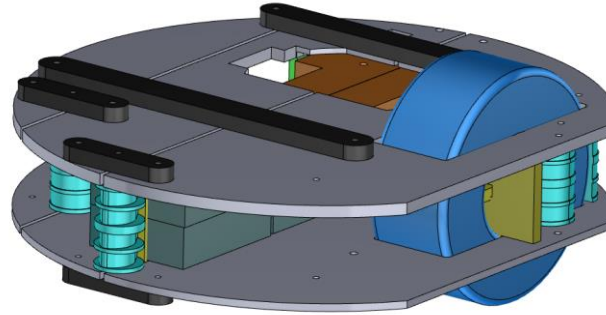
University of Cambridge

Electrical Power and Energy Conversion Group

Flux Pumps

- **Wireless power supplies** for superconducting magnets
- Provide **thermal, mechanical, electrical isolation** of magnet
- **No high-current DC supply or current leads** required

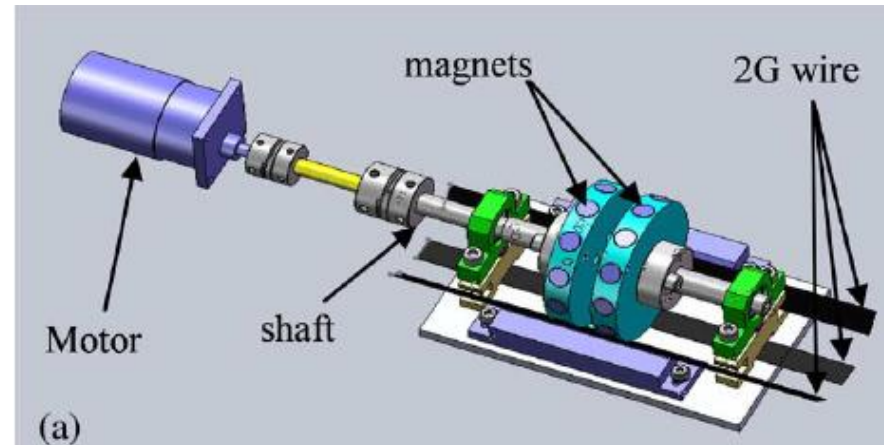
University of Cambridge/NHMFL
Application: High Field Magnets



University of Cambridge
Application: Compact MRI

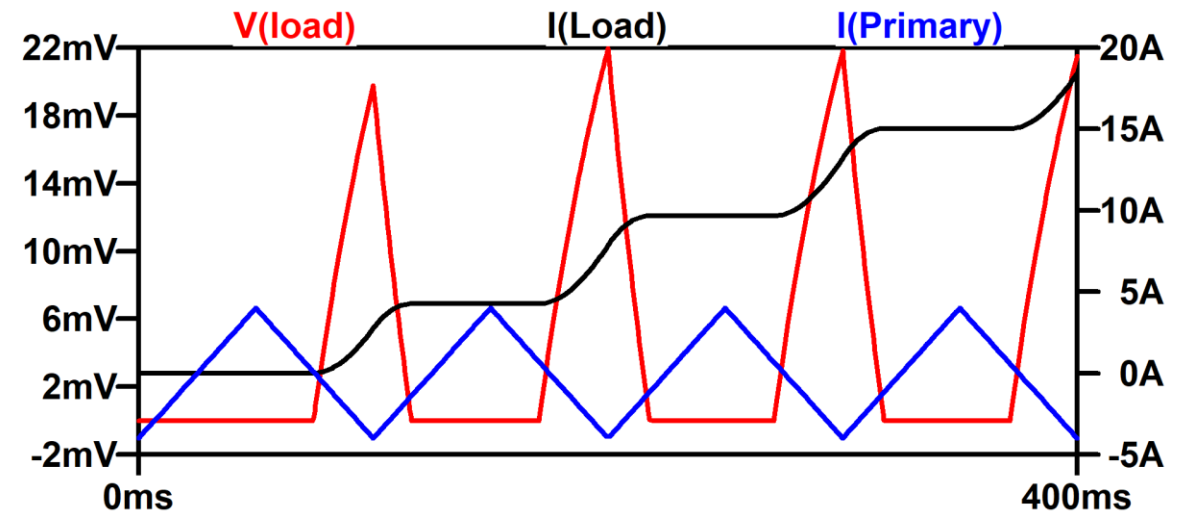
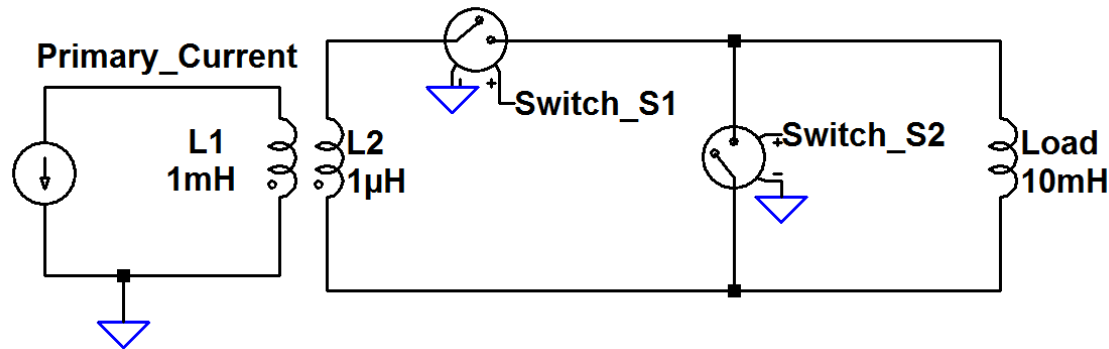


Victoria University Wellington
Application: Rotating Machines



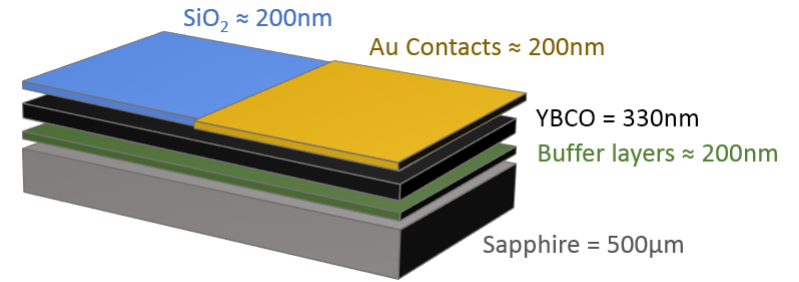
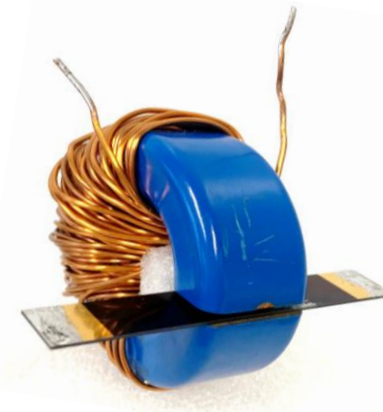
'Transformer-Rectifier' Flux Pump

- Normal to HTS transformer -> HTS rectifier -> Load magnet
- SPICE simulation developed for optimisation
- Key components are superconducting switches

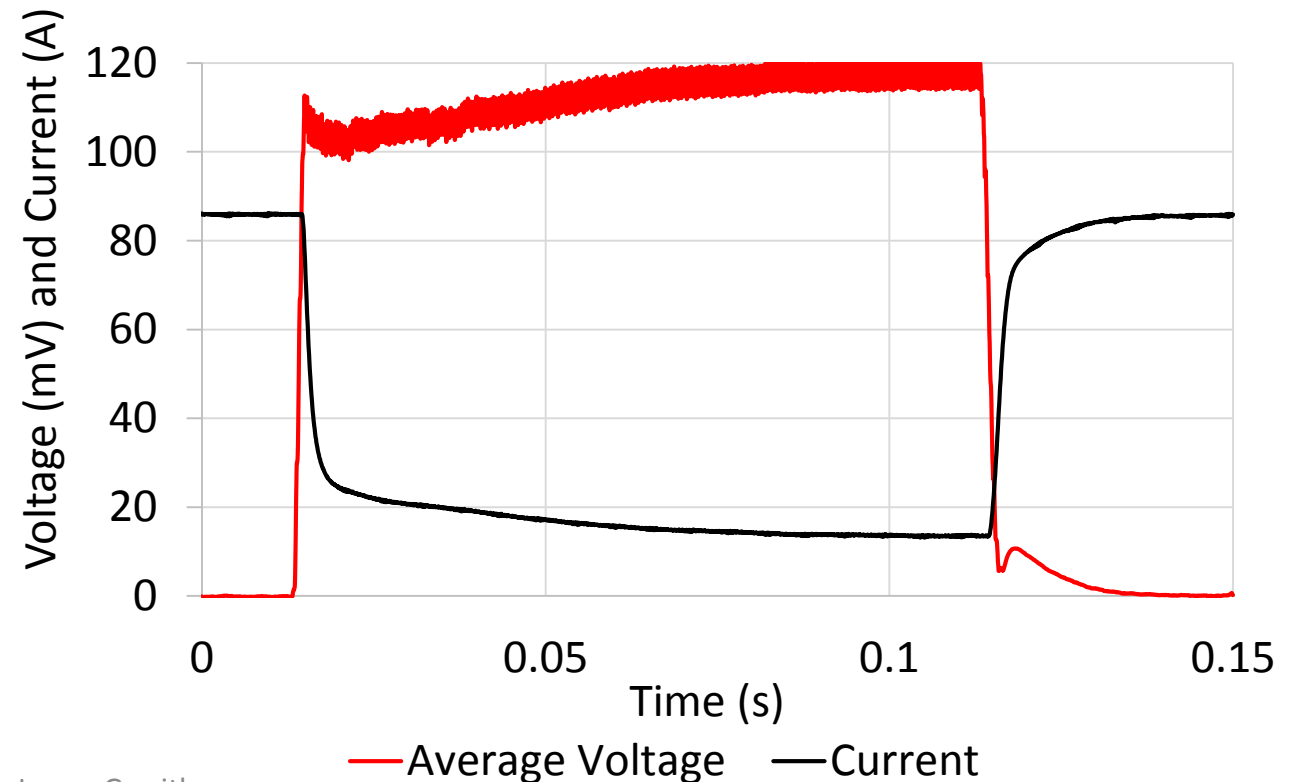


HTS AC Field Switch

- Off-state by **dynamic resistance**
- Does not exceed J_C , T_C , or B_C
- **100A** I_C to **9m Ω** off-state with **2cm²** active material
- **<10ms** transition times



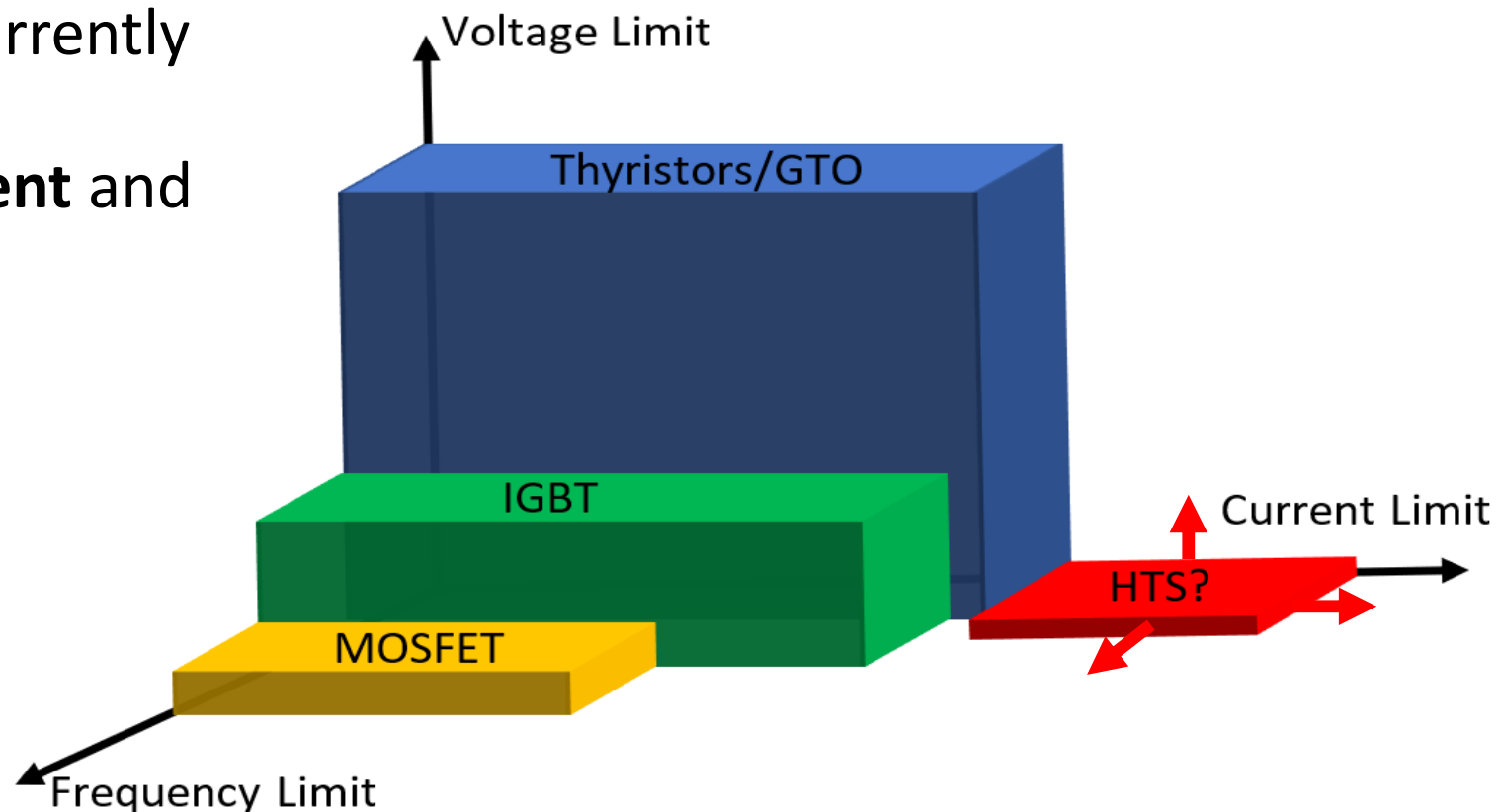
Switch Characteristic at 8.8kHz, 50mT



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HTS Power Electronics?

- **Semiconductors** dominate currently
- HTS competitive at **high current** and **low voltage/frequency**
- Widen applicability
 - Improve **materials**
 - Improve **design**
 - Explore **actuation** methods



Thanks for Listening!

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Wolf Fisher Trust

Fitzwilliam College

Talk later this morning:

Wed-Mo-Or12 - Flux Pump and Cryostats



Cambridge EPEC Superconductivity Group

Supervised by Dr Tim Coombs