



Magnet and Wiggler Expertise Within STFC

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ASTeC, STFC Daresbury Laboratory

SuperB mini-workshop, Oxford, May 2011

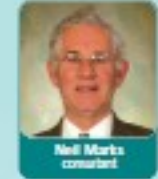
Contents

- Introduction
- Electromagnets
- Permanent Magnets
- Superconducting Magnets
- Facilities & Codes
- Summary



Introduction

MAGNETICS & RADIATION SOURCES



- Key centre of mass for accelerator magnet expertise within the UK resides in the **Magnetics & Radiation Sources Group** at Daresbury Laboratory
- **7 physicists who have all worked actively on various magnet projects**
- Backed up by an experienced **engineering team** at Daresbury and Rutherford



Conventional Magnets

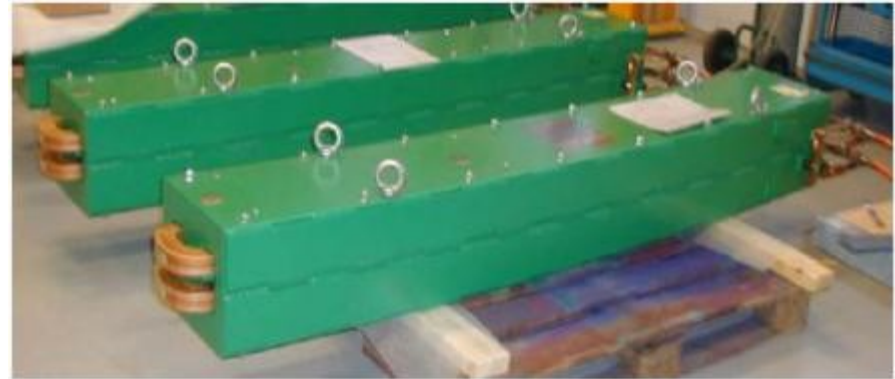
- Dipoles, Quadrupoles, Sextupoles, ...
- Kickers & Septums
- Recent projects
 - Diamond
 - ALICE
 - EMMA
- **DC, AC, & Pulsed**



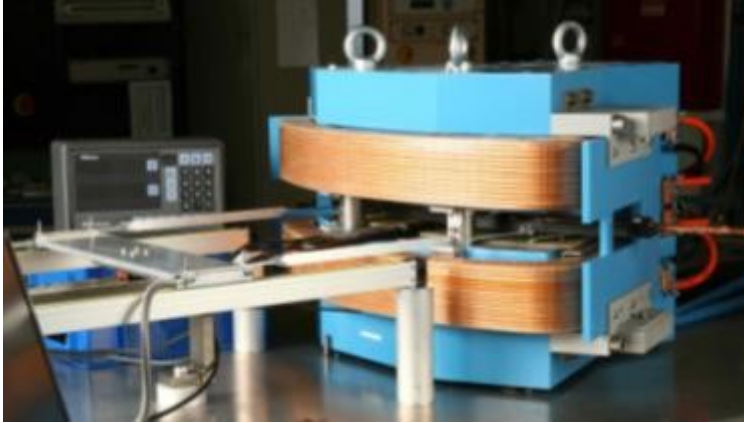
Diamond Storage Ring



Diamond Booster, 5 Hz

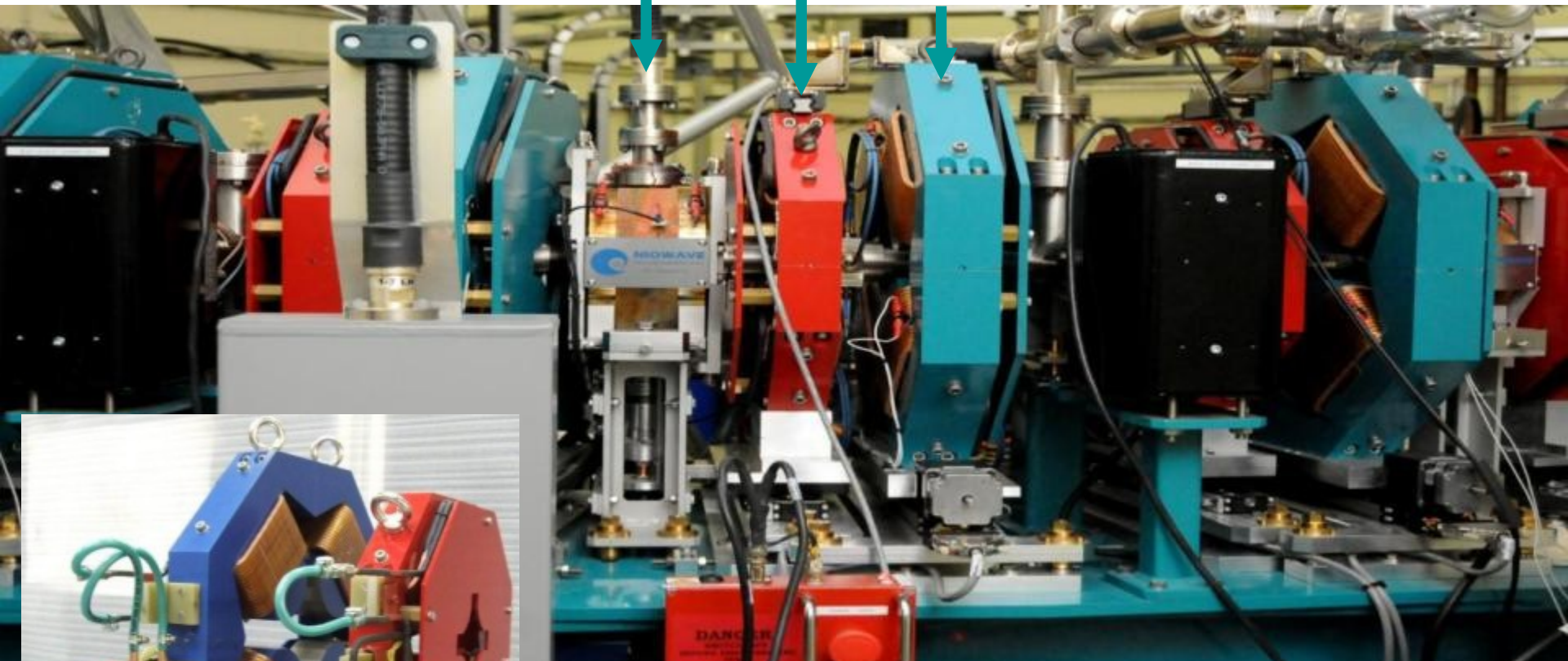


ALICE



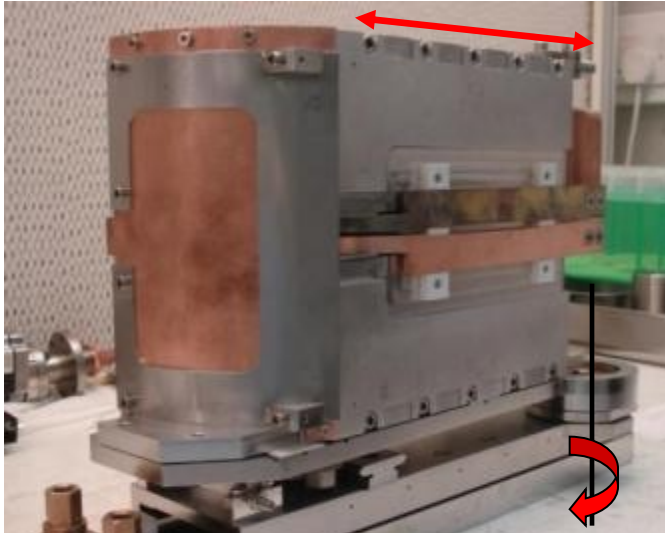
EMMA Quadrupoles

Cavity FQUAD DQUAD



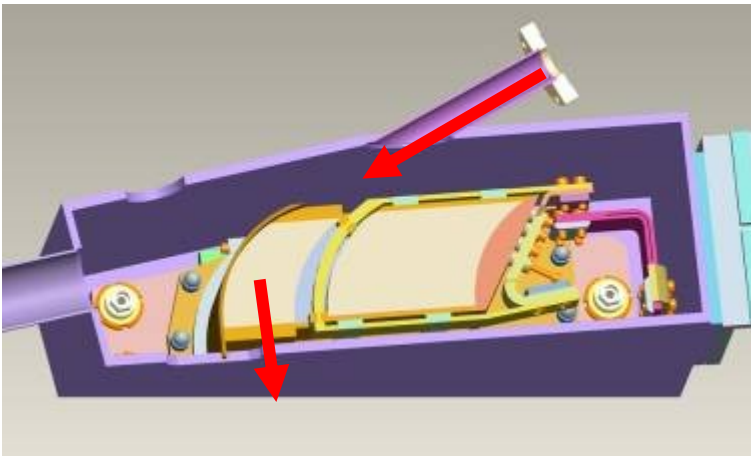
EMMA Septum

Translation



Rotation

Septum out of vacuum chamber



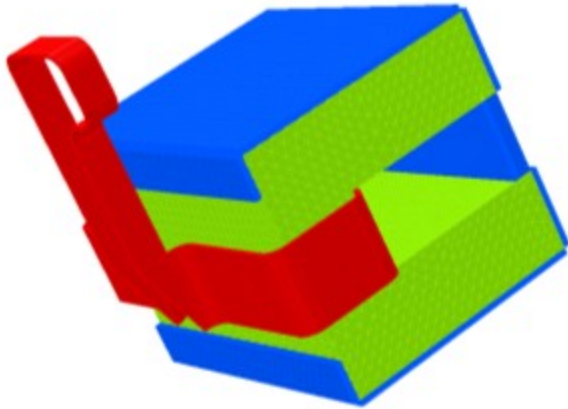
Section view of septum in vacuum chamber

Maximum beam deflection angle	77	degrees
Maximum flux density in gap	0.91	T
C core magnet gap height	22.0	mm
Internal horizontal beam 'stay-clear'	62.5	mm
Turns on excitation coil	2	
Excitation half-sine-wave duration	25	μ s
Excitation peak current	9.1	kA
Excitation peak voltage	900	V
Septum magnet repetition rate	20	Hz

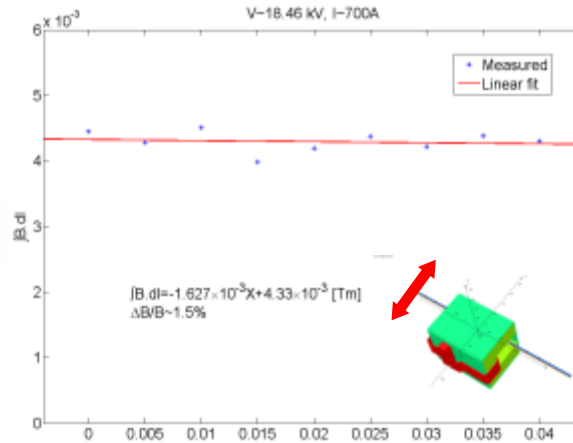


EMMA Kickers

➤ Concept



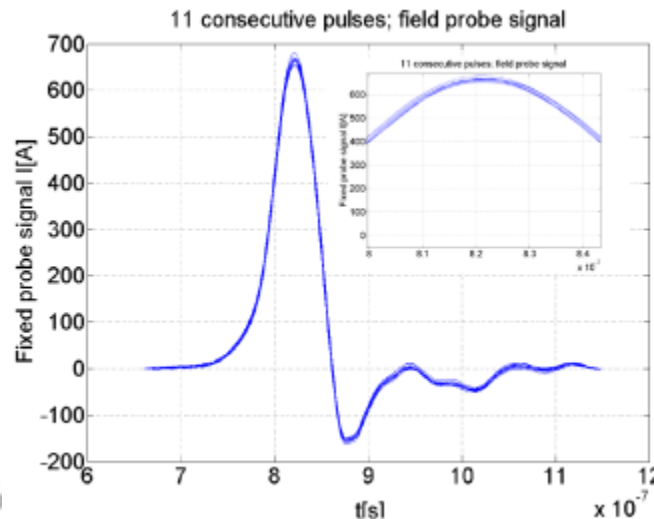
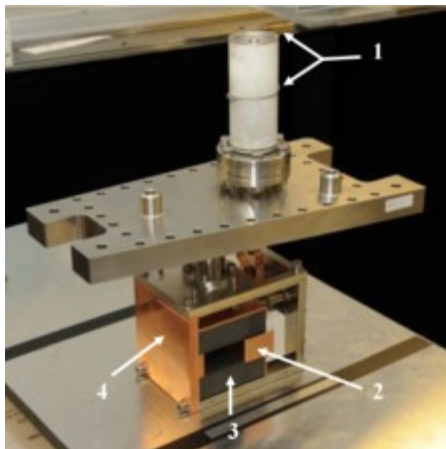
➤ Field quality



➤ In-situ field probe



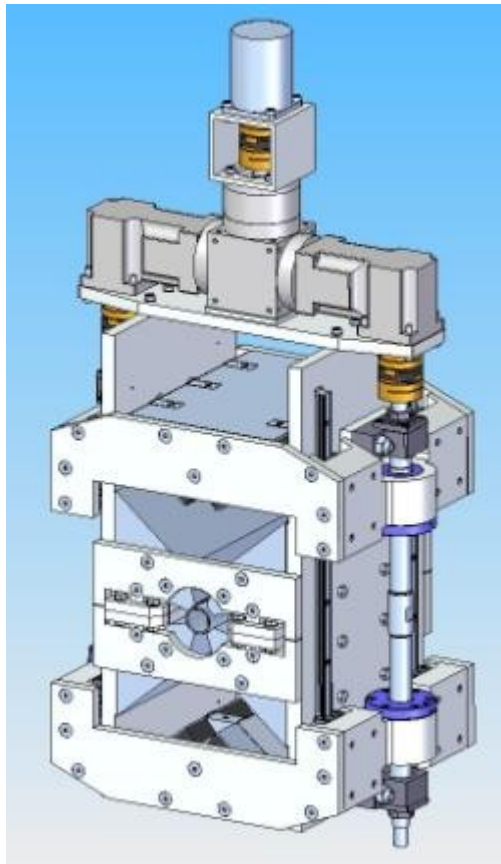
➤ Before installation



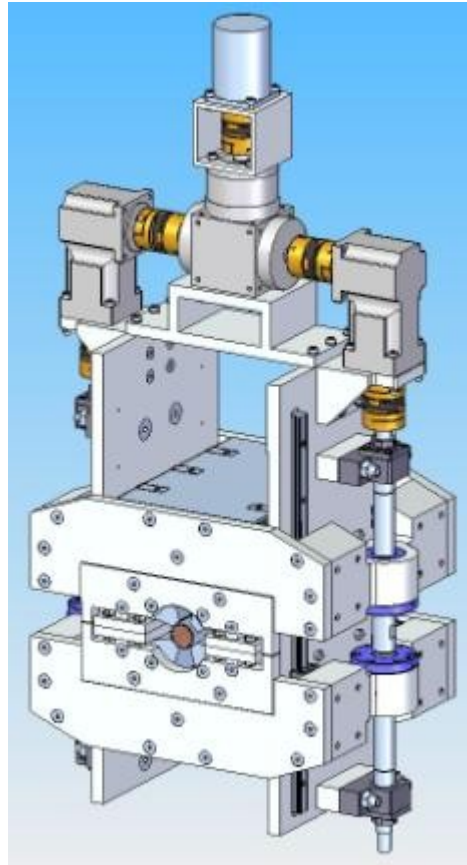
Max. strength	0.007 Tm
Effective length	130 mm
Field variation	1.5%
Fall time	58 ns
Timing jitter	1.7 ns
Amplitude stability	4%

PM Quadrupoles for CLIC

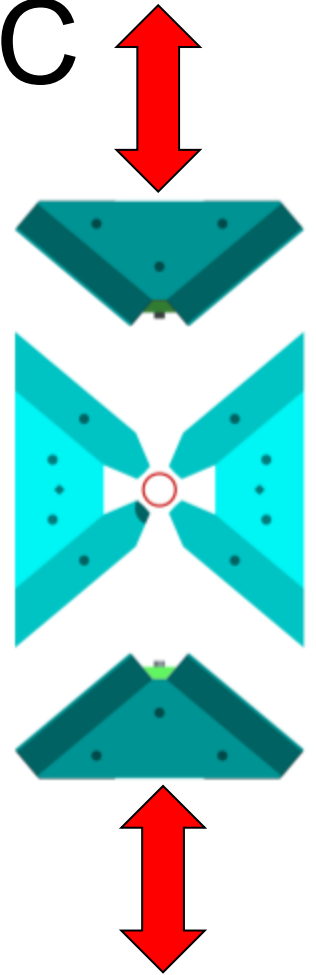
- Wide tunability
- High gradient



Fully Open



Fully Closed



Design has been
patented

Prototype to be
constructed this year

Undulators & Wigglers

- Recent projects include
 - SRS
 - Diamond
 - ALPHA-X
 - ALICE
 - ILC
- **Permanent magnets**
- **Superconducting**

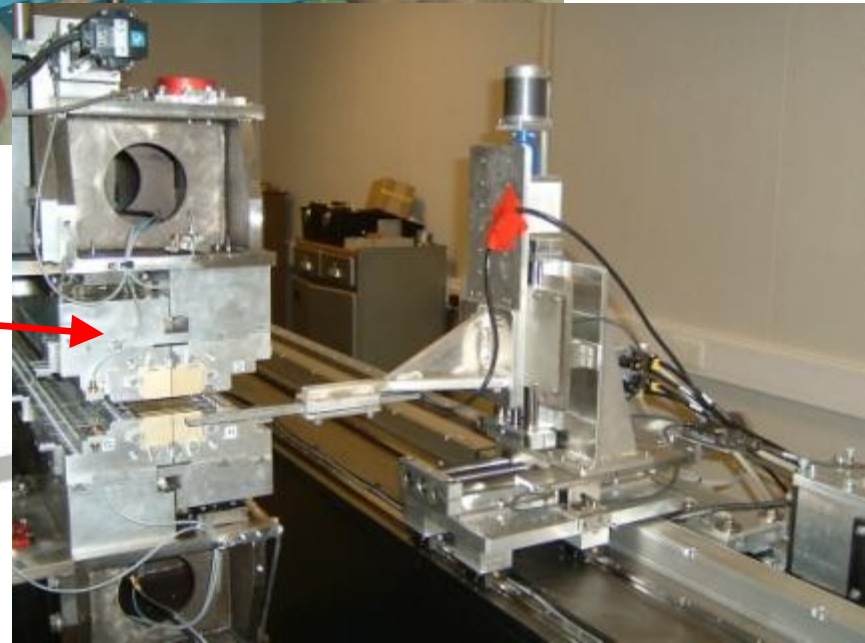
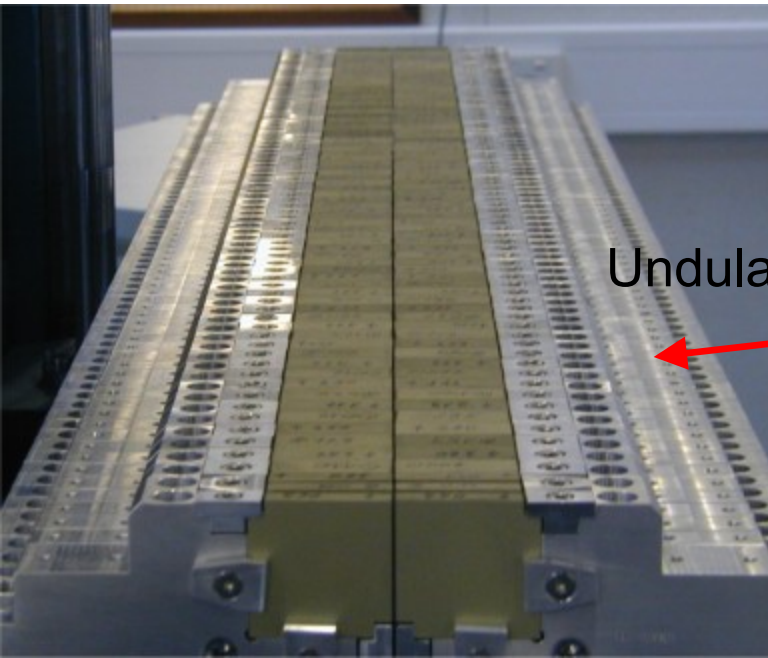


SRS

2.4T PM Wiggler



Undulator



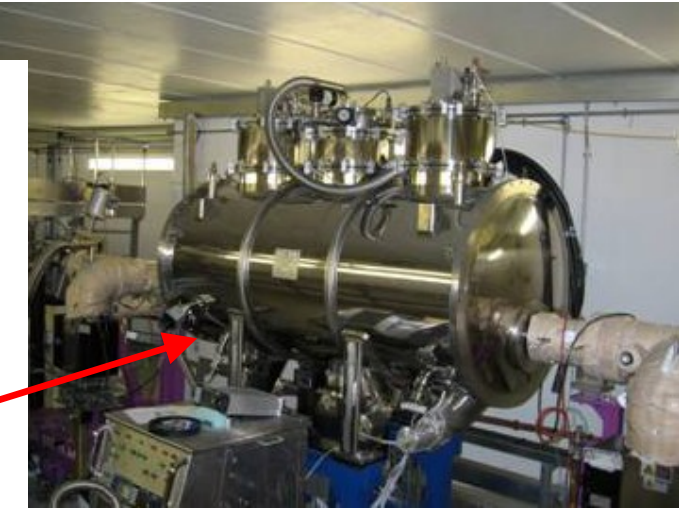
Diamond

In-vacuum undulator

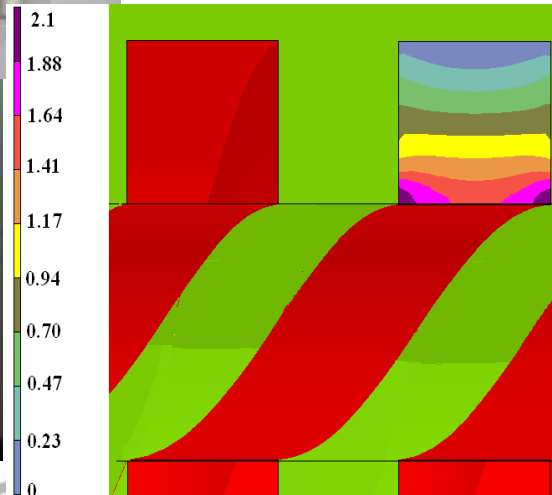


Variable
Polarisation

Superconducting
Wiggler (built by
BINP)



SC Helical Undulators

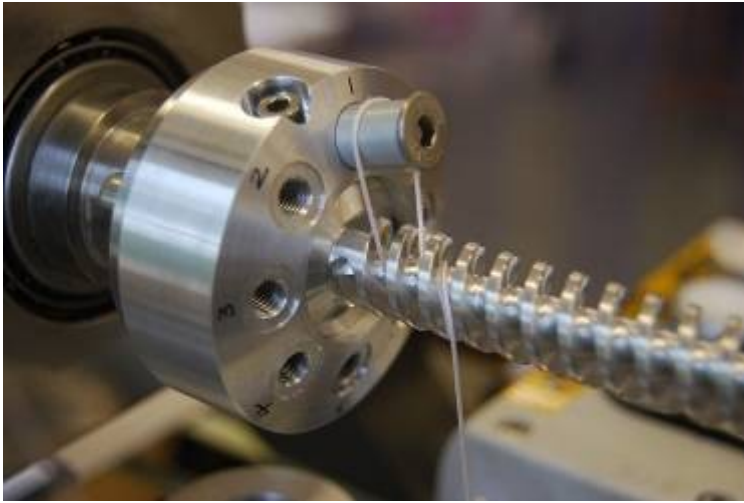


SC Helical Undulator

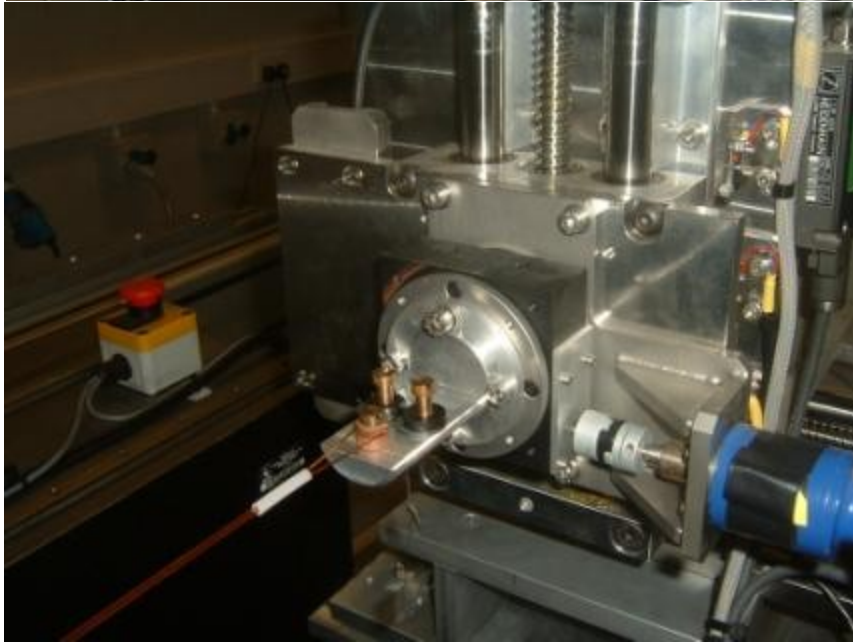
- A 4m module containing 2 x 1.75m helical undulators (11.5 mm period) built by STFC
- Closed loop cryo system with cryocooler



Experience with Nb₃Sn



Magnet Test Facilities at Daresbury



Codes

- We have access to a wide variety of codes for magnet modelling
 - **Opera 2D**
 - **Opera 3D**
 - **Tosca**
 - **Elektra**
 - CST EM Studio (3D)
 - RADIA (3D) - very good for PM undulators
- There are 7 physicists in the MaRS group and they are all proficient with at least one of these codes



General Remarks

- **The Magnetics and Radiation Sources Group within STFC is a key UK centre of mass for accelerator magnet expertise**
- We have skills in all areas of magnets over all technologies
- We have access to powerful magnet design codes
- We operate a state of the art Magnet Test Laboratory

