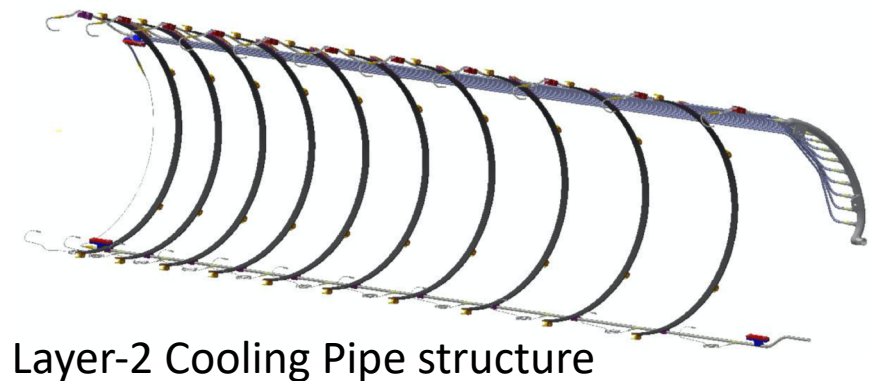
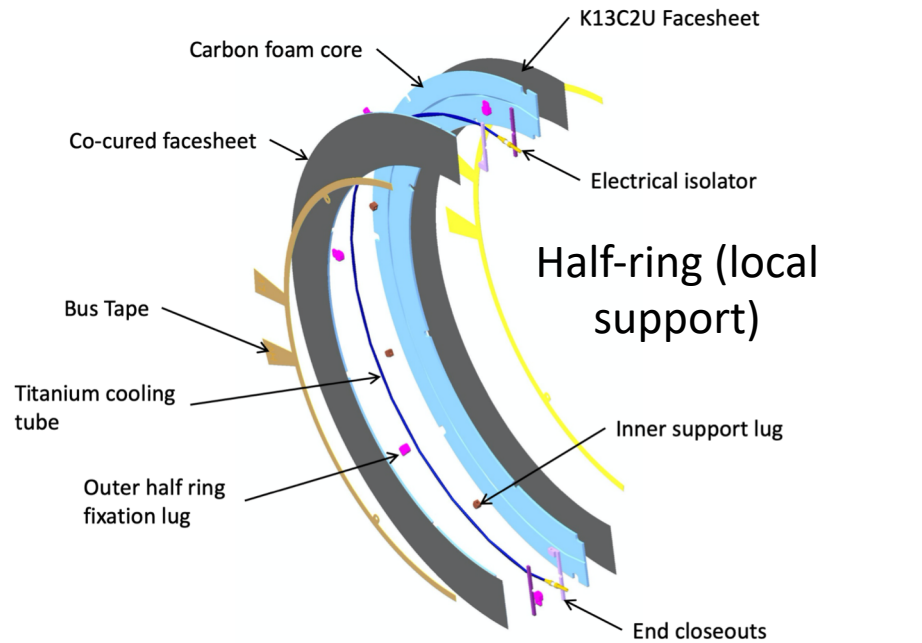


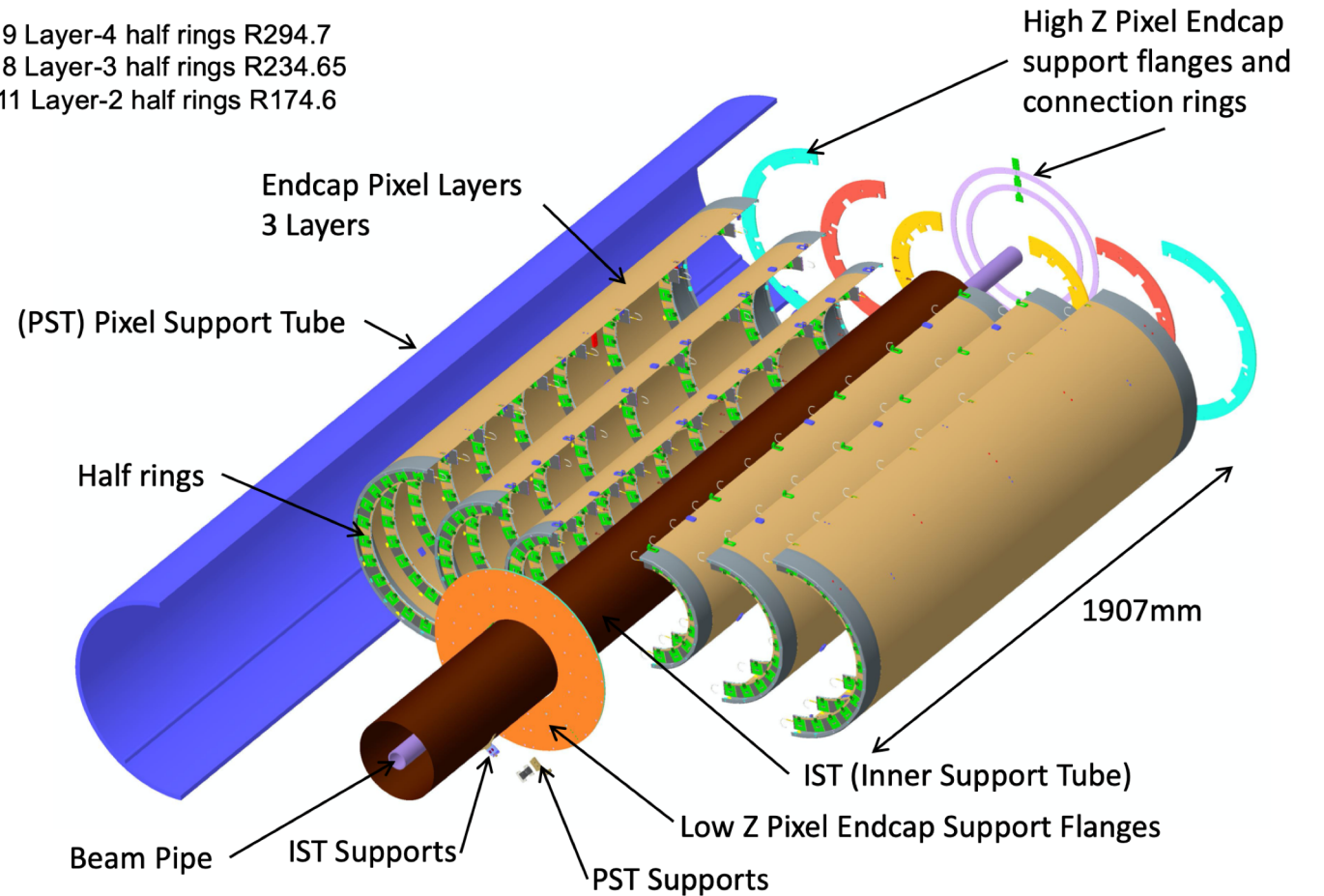
Mechanical and cooling aspects of UK ATLAS-ITk pixels

F.Munoz, J.Pater on behalf of the UK-ATLAS-pixels collaboration:
Edinburgh, Glasgow, Lancaster, Liverpool, Manchester, Oxford, RAL,
Sheffield, QMUL

Overview of the ITk-Pixel Outer Endcaps



- 9 Layer-4 half rings R294.7
- 8 Layer-3 half rings R234.65
- 11 Layer-2 half rings R174.6



UK ATLAS ITk pixels - cooling

- Here we list the main contributors / lead institutes
- Design:
 - Thermofluidic: Manchester, aided by Oxford
 - Mechanical layout: QMUL, Liverpool , Glasgow
 - Design and development of fittings, electrical breaks, etc:
 - Sheffield, QMUL
 - Prototyping requires fairly standard (but skilled) machining
 - QMUL, Manchester workshops did some
- Prototyping and production of system:
 - Pipe cutting and bending: Lancaster
 - Welding including addition of electrical breaks: Sheffield
 - Small parts (sleeves, electrical breaks) done in industry, managed by Sheffield

UK ATLAS ITk pixels – design

- Endcap mechanical design was led by Liverpool and Manchester, with contributions from all institutes
 - CAD modelling / FEA: Liverpool, Glasgow, QMUL
- Transport and handling: Glasgow (half-rings), Liverpool (full endcap)
- Module loading: RAL, Oxford
- Materials expertise:
 - Foam properties / manufacturers: Manchester, Liverpool, QMUL
 - Carbon fibre: Liverpool (also Oxford but for strips)
 - Glues, dopants: Manchester, RAL, Oxford
 - Irradiation effects testing: Liverpool, Manchester
 - High-performance plastics: Liverpool
- Electrical services: Manchester, Edinburgh, QMUL

UK ATLAS ITk pixels – mechanics prototyping, production and quality control

- Tooling design and manufacture:
 - Half-rings: Manchester
 - Co-curing: Liverpool
 - Endcap assembly: Liverpool, Edinburgh, QMUL
- Foam machining: Manchester
 - cutting raw foam into precise thin shapes
 - Machining the foam surface of co-cures to precise thickness and adding indentations for cooling pipes, lugs, closeouts
 - No 'special' equipment - standard band saw, CNC milling machine
 - Foam processing could be made more efficient with a diamond-wire saw
- Co-curing foam slices to c-fibre – Liverpool
 - Special facilities: composites lab with freezers, autoclave, etc
- Half-ring assembly: Manchester
 - Special equipment: climate chambers with integral thermal video capability, CO₂ cooling, pressurizing and leak-testing kits, SmartScope and Keyence for metrology
- Half-ring handling frames: Glasgow
 - Well-equipped mechanics workshop, metrology for QC
- Module loading: RAL, Oxford
 - Special equipment: bespoke gantries / pick-and-place; metrology
- Endcap assembly: Liverpool (aided by all)
 - Special facilities: large dedicated spaces including climate-chamber room, CO₂ cooling