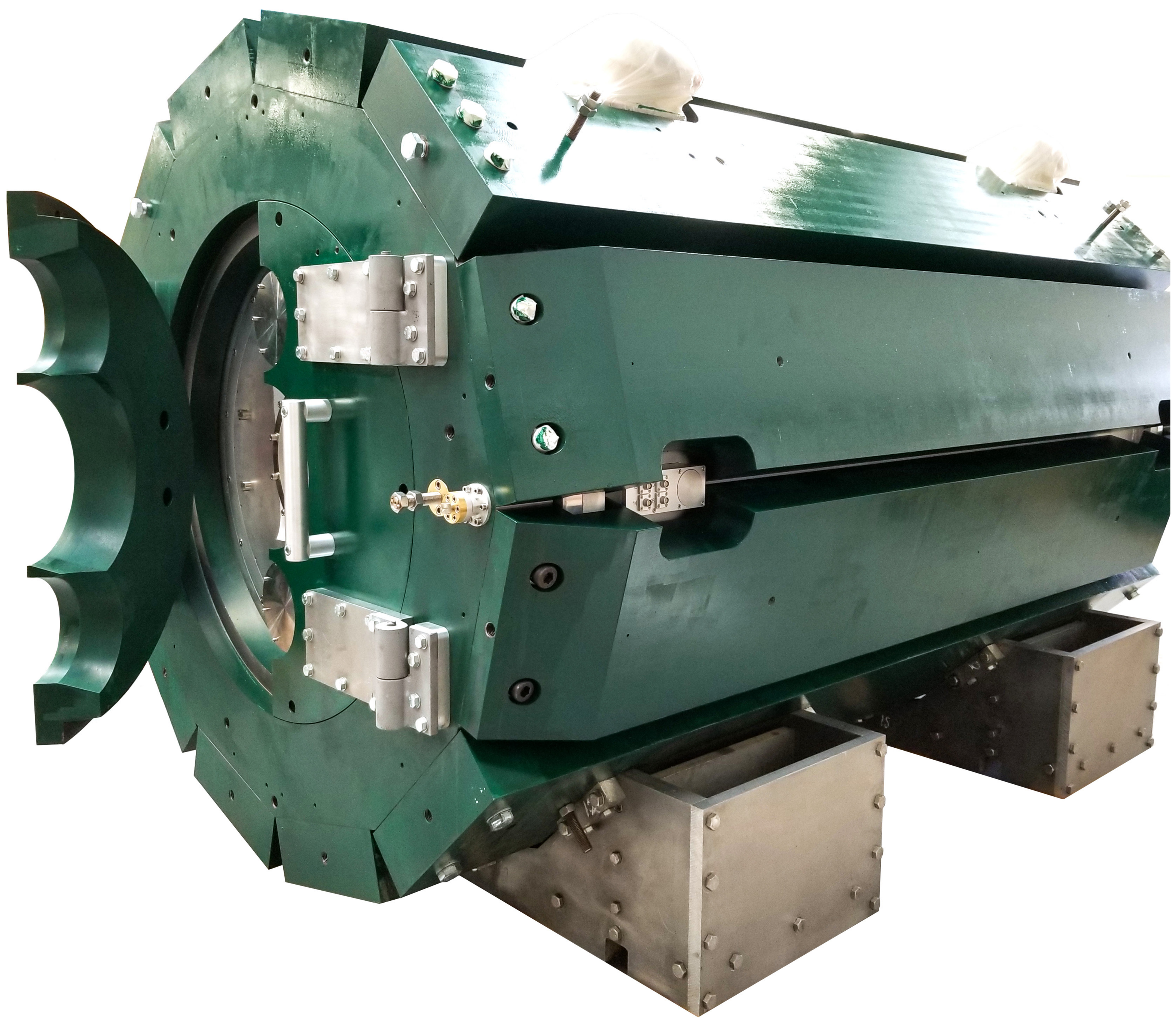
2.6 tesla cryogen free Mu3e magnet system for investigation of muon decay beyond the Standard Model



The magnet produces a homogeneous field profile with a maximum 2.6 T over a large cylindrical volume of Ø70 cm × 200 cm. The field is generated using four individually controllable solenoids. Subtle changes in the field profile are possible by varying the individual coil currents.

A 25-tonne steel shield surrounds the magnet and cryostat to shunt the magnetic flux generated by the magnet, thus reducing the stray field outside the cryostat. The shield is constructed using two dodecagon endplates separated by twelve flux return bars running between the endplates. Access to the room temperature bore is via semi-circular steel doors located at both ends of the system.

The magnet and shield are supported using two cradles manufactured from aluminium. The cradles are themselves supported by a total of four wedges which enable the complete system mass of 28.5 tonnes to be raised and lowered by 10 mm.

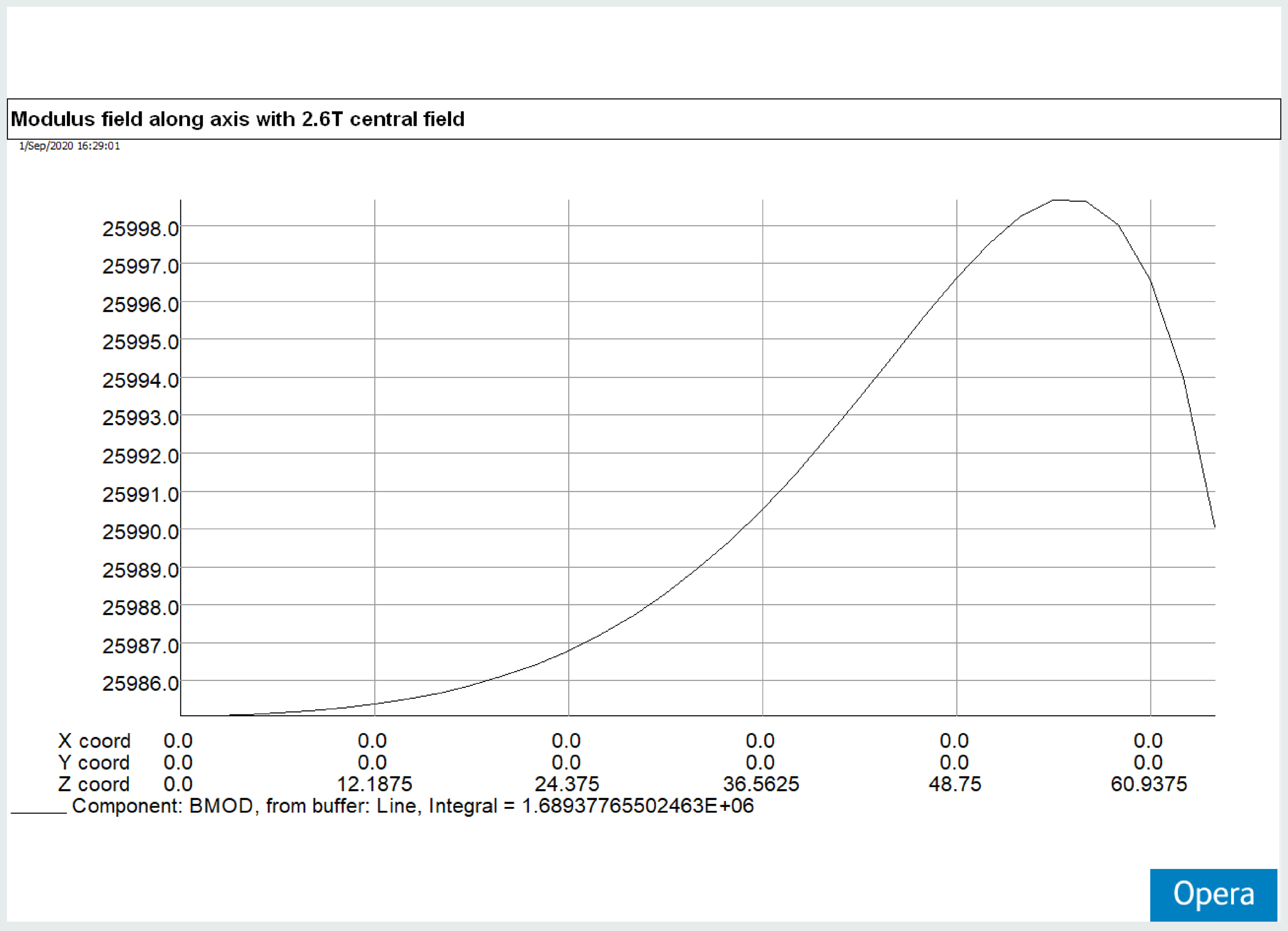
The system uses four two-stage Gifford-McMahon cryocoolers to produce coil temperatures of approximately 3.2 K. The magnet coils are wound using NbTi conductor, supported by an aluminium former.

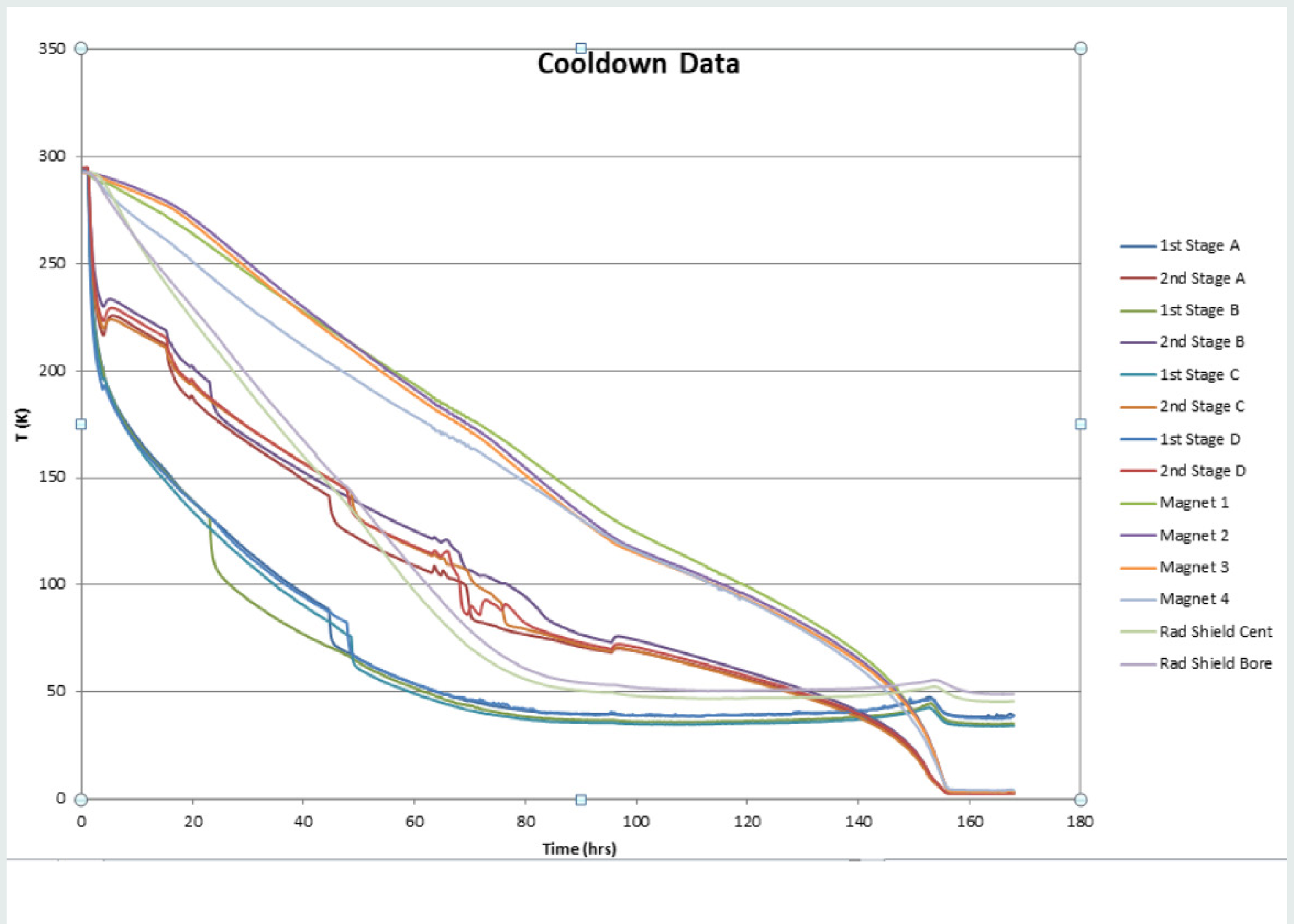
Specifications

- 1 m diameter room temperature bore
- 2.6 T superconducting solenoid magnet
- 3% field homogeneity over a cylindrical volume of 70 cm diameter by 200 cm length
- Magnet cooled by four GM cryocoolers
- Passive iron shielding to reduce stray magnetic field
- Access to the bore via 500 kg steel swing doors

Application

The Mu3e experiment is dedicated to searching for physics beyond the Standard Model, in particular to verify or exclude the lepton-flavour violating decay $\mu \rightarrow e^+e^+e$ at branching fractions above 10^{-16}. A first phase of the experiment, using the piE5 muon beamline at the Paul Scherrer Institute (PSI), is designed to reach a single event sensitivity of 2×10^{-15}. The high muon decay rate of up to 10^8 s^{-1}, combined with the low momenta of the decay electrons and positrons, poses a unique set of challenges, addressed using an ultra-thin tracking detector based on high-voltage monolithic active pixel sensors combined with scintillating fibres and tiles for precise timing measurements.





Unit 6 Acton Park Industrial Estate, The Vale, London W3 7QE, United Kingdom
Tel: +44 (0)20 8743 6049 Fax: +44 (0)20 8749 5315 Email: sales@cryogenic.co.uk