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An Engineering Perspective on Ultra High-Field Magnets

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High temperature superconductors (HTS) have opened up a new experimental space. Commercially available HTS wires and tapes have now been developed with very high critical current densities at high fields. Large bore, high field “outsert” solenoid magnets that use more conventional NbTi and NbSn conductors have been developed to provide background fields in a cold bore of between 150 and 250 mm diameter with an associated central field of 19 and 15 Tesla respectively. This outsert technology is enabling major steps forwards in ultra high field magnet technology. Magnets are under development in laboratories around the world operating at $T=4.2\text{K}$ with B fields in excess of 25 Tesla.

We will discuss the challenges which have to be met to provide such background magnets, including quench energy management, coil interactions, mechanical support, eddy current forces and cryogen handling. The challenge of incorporating HTS coils within the ultra high field magnet products of the future is described. We look ahead to further developments and to how this emerging technology may enable wider applications for experimentation in the physical sciences.

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