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Fri-Mo-PL7-01: Recent Advances in Ultra-High Field Magnet Technology

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If we define ultra-high field magnets as those that provide fields more intense than the 23.4 T available from low temperature superconductors, then we see tremendous progress being made worldwide in recent years. The peak field available for science in pulsed magnets has set a new standard (100 T, 2012) while dc resistive magnets continue to raise the bar as well (41.5 T, 2017). New resistive/superconducting hybrid magnets have been commissioned (Berlin 2015, Hefei 2016, Tallahassee 2016) with higher field ones in Grenoble and Nijmegen under construction. There is also, of course, an absolute revolution underway in superconducting magnets with the high temperature superconductors (HTS) finally finding their way into user facilities (Sendai 2017, Tallahassee 2019) and NMR magnet projects being initiated (MIT 30.5 T, Bruker 28.2 T, RIKEN 30.5 T). Newer applications such as axion detection are also being enabled by this revolution (Daejeon 25 T, 10 cm).
HTS magnets are finally becoming a reality! A Bi-2223 coil has been put into service at 24 T while insulated REBCO has reached 32 T. A test coil using no-insulation REBCO made 14 T in a 31 T background (45 T total) while dramatic improvements in Bi-2212 show great potential as well. The record field from a superconducting magnet rose from 23.5 T to 24 T to 32 T in less than one year. The previous 8 T increase required >40 years! The technology is evolving at an unprecedented rate! At the same time, costs show great promise of dropping which may enable this extraordinary technology to become fairly widespread.
These ultra-high field magnets use dramatically different technologies but still share central challenges such how to manage intense Lorentz forces as well as the required energy and power. The state of the art and challenges associated with further development of a variety of ultra-high field magnet systems if presented.

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