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High Temperature Superconductor Prospects for Accelerators

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In spite of the great interest in applying HTS cuprate superconductors or MgB_2 to electrotechnology, virtually all superconducting magnets made to date have been made from Nb-Ti or Nb_3Sn. Despite their need for helium cooling, there are very good reasons for this – Nb-base wires are available in many designs and current capacities, twisted and filamentary, with overall current densities that are generally higher than any higher T_c materials, while also being strong and easily reinforced if greater strength is needed. They can operate in fields up to about 23T at 2K. But new demands for even higher fields beyond the upper critical field (H_{c2}) of any Nb compound are focusing new attention on the Bi-2212 and YBCO cuprates and perhaps MgB_2 too. Following the recommendations of the recent National Research Council Panel COHMAG (Committee on High Magnetic Fields) and recent strong interest from the high energy physics community, new grand challenges of 30T NMR, 60T hybrid magnets and >50T solenoids for muon colliders are before the magnet community. To make such materials as practical conductors requires understanding and solutions to several grand challenges in the physics and materials science of vortex pinning, and grain boundary structure and properties, and the associated materials processing challenges required to make conductors that are km long. I will discuss some of the physics and materials challenges that such magnets pose and the recent progress that has got superconducting magnets to almost 30 T.