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Superconductors for superconducting magnets

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Even in 1913 Kamerlingh Onnes envisioned the use of superconductors to create powerful magnetic fields well beyond the capability provided by cooling normal metals with liquid helium. Only some "bad places" in his Hg and Pb wires seemed to impede his first attempts at this dream, one that he imagined would be resolved in a few weeks of effort. In fact, of course, resolution required another 50 years and development of both a true understanding of the difference between type I and type II superconductors and the discovery of compounds such as Nb_3Sn that could remain superconducting to fields as high as 30 T. And then indeed, starting in the 1960s, Onnes's dreams were comfortably surpassed. In the last 45 years virtually all superconducting magnets have been made from just two Nb-base materials, Nb-Ti and Nb_3Sn. Now it seems that a new generation of magnets based on cuprate high temperature superconductors with fields well above 30 T are possible using Bi-Sr-Ca-Cu-O and the RE-Ba-Cu-O compounds. We hope that a first demonstration of this possibility will be an all-superconducting 32 T magnet with RE-Ba-Cu-O insert that we are building for NHMFL users. The magnet application potential of this new generation of superconducting conductors will be discussed.