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High Field Research and Astrophysics

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***Abstract*–Superconducting magnets have significantly underpinned physics, chemistry, and materials science research since the late 1950s. Today they are a research laboratory staple, providing fields in the range of 15 T to 18 T in a number of labs around the world. While dc magnets at higher fields exist, they are scarce resources that are typically shared on a national or international level.**

Since 1987 the "high temperature" superconductors (HTS) have held out the prospect of all-superconducting magnets at ultra-high fields (UHF) beyond what has been achieved previously. In 2017 the first HTS magnets at UHF were tested and subsequently put into operation with the highest being 32 T.

Unlike NMR magnets, UHF research magnets must be capable of sweeping between extreme positive and negative values within an hour or two and do not have requirements for high homogeneity and stability. Unlike fusion magnets, they are intended to provide peak magnetic field (30 T to 40 T) in a small volume (1 cm sphere) as opposed to more modest fields in volumes up to several cubic meters.

There are also a few superconducting magnets being employed in astrophysics in particle detectors for dark matter and other searches. The new wave of HTS magnets at higher field also show great promise for enabling searches across broader frequency spaces in faster times.

UHF superconducting magnets offer much improved sustainability, better stability and lower noise than the resistive magnet they promise to displace.

***Keywords (Index Terms)*–Superconductivity Global Alliance (ScGA), superconducting magnet, ultra high field, NMR, particle detector**

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