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Recent Progress on Spherical Torus Research and Implications for Fusion Energy Development Path[1]

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The spherical torus or spherical tokamak (ST) is a member of the tokamak family with its aspect ratio ($A = R_0/a$) reduced to A near 1.5, well below the normal tokamak operating range of A equal to 2.5 or greater. As the aspect ratio is reduced, the ideal tokamak beta (radio of plasma to magnetic pressure) stability limit increases rapidly, approximately as *1/A*. The plasma current it can sustain for a given edge safety factor q-95 also increases rapidly. Because of the above, as well as the natural plasma elongation which makes its plasma shape appear spherical, the ST configuration can yield exceptionally high tokamak performance in a compact geometry. Due to its compactness and high performance, the ST configuration has various near term applications, including a compact fusion neutron source with low tritium consumption, in addition to the longer term goal of an attractive fusion energy power source. Since the start of the two mega-ampere class ST facilities in 2000, the National Spherical Torus Experiment (NSTX) in the US and Mega Ampere Spherical Tokamak (MAST) in the UK, active ST research has been conducted worldwide. More than sixteen ST research facilities operating during this period have achieved remarkable advances in all areas of fusion research, including fundamental fusion energy science as well as technological innovation. These results suggest exciting future prospects for ST research in both the near and longer term. The talk will summarize the key physics results from worldwide ST experiments, and describe ST community plans to provide the database for FNSF design while improving predictive capabilities for ITER and beyond.

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