A 1.3 GHz NMR Magnet Design under High Hoop Stress Condition

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Abstract - NMR magnets using high-Tc superconductors (HTS) to generate high magnetic fields exceeding 25 T are currently being designed by several organizations. In these designs, the HTS is used for the inner coils, and the other coils consist of NbTi and Nb3Sn wires. The YBCO wire, which is a typical HTS, has excellent critical current performance over a wide range of magnetic fields and tolerates high tensile stress of up to 700 MPa. These properties make it possible to realize a high-field NMR magnet. In particular, the superior mechanical strength allows for the high-stress criterion of the electromagnetic force to be applied to the design of the magnets. In this study, we show the conceptual design of 1.3 GHz (30.5 T) NMR magnets under the condition of high hoop stress of 500 MPa. To achieve high magnetic field homogeneity in these designs, we propose three magnet design plans that have different arrangements of the compensation coils. We assumed that the magnet would be operated by the driven mode at 4.2 K. We also considered the strong angular dependence of the critical current of the YBCO wires to design the magnet.

Index Terms - electromagnetic force, hoop stress, HTS, NMR magnet, YBCO.

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