Achievement of 1020 MHz NMR


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We have successfully developed a 1020 MHz (24.0 T) NMR magnet shown in Figure 1, establishing the world’s highest magnetic field in high resolution NMR superconducting magnets. The magnet is a series connection of LTS (low-Tc superconductors NbTi and Nb3Sn) outer coils and an HTS (high-Tc superconductor, Bi-2223) innermost coil, being operated at superfluid liquid helium temperature such as around 1.8 K and in a driven-mode by an external DC power supply. The drift of the magnetic field was initially ±0.8 ppm/10 h without the 2H lock operation; it was then stabilized to be less than 1 ppb/10 hr by using an NMR internal lock operation. The full-width at half maximum of a 1H spectrum taken for 1% CHCl3 in acetone-d6 was as low as 0.7 Hz (0.7 ppb), which was sufficient for solution NMR. On the contrary, the temporal field stability under the external lock operation for solid-state NMR was 170 ppb/10 hr, sufficient for NMR measurements for quadrupolar nuclei such as 17O; a 17O NMR measurement for labeled tri-peptide clearly demonstrated the effect of high magnetic field on solid-state NMR spectra, as can be seen in Figure 2.

Reference