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Title:Simplified THz Instrumentation for High-Field DNP-NMR Spectroscopy

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Abstract:We present an alternate simplified concept to irradiate a nuclear magnetic resonance sample with terahertz (THz) radiation for dynamic nuclear polarization (DNP) experiments using the TE_{n0} circular waveguide mode for transmission of the THz power and the illumination of the DNP sample by either the TE_{n0} or TE_{n1} mode. Using finite element method and 3D electromagnetic simulations we demonstrate that the average value of the transverse magnetic field induced by the THz radiation and responsible for the DNP effect using the TE_{n1} or the TE_{n0} mode are comparable to that generated by the HE_{n1} mode and a corrugated waveguide. The choice of the TE_{n1}/TE_{n0} mode allows the use of a smooth-walled, oversized waveguide that is easier to fabricate and less expensive than a corrugated waveguide required for transmission of the HE_{n1} mode. Also, the choice of the TE_{n0} mode can lead to a simplification of gyrotron oscillators that operate in the TE_{n0} mode, by employing an on-axis rippled-wall mode converter to convert the TE_{n0} mode into the TE_{n0} mode either inside or outside of the gyrotron tube. These novel concepts will lead to a significant simplification of the gyrotron, the transmission line and the THz coupler, which are the three main components of a DNP system. © 2012 Springer-Verlag.

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Main heading:Terahertz waves

Controlled terms:Finite element method - Gyrotrons - Nuclear magnetic resonance spectroscopy - Three dimensional computer graphics - Waveguides

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