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Magnetic Phases of λ-(BETS)$_2$FeCl$_4$ investigated by proton NMR spectroscopy. GUOQING WU, W.G. CLARK, P. RANIN, S.E. BROWN, UCLA Physics and Astronomy, L. BALICAS, NHMFL Tallahassee, L.K. MONTGOMERY, Indiana U. Chem. — The organic conductor λ-(BETS)$_2$FeCl$_4$, is of interest because of its unusual phases, which include a paramagnetic metal (PM), an antiferromagnetic insulator (AFI), and a field-induced superconducting phase. Important drivers for these phases are the 3d Fe^{3+} moments (spin $S_d = 5/2$) from the $FeCl_4^-$ anions and the π conduction electrons (spin $S_\pi = 1/2$) in the BETS donor molecules, which generate a correlated π-d electron system. Here, we report a proton NMR spectroscopy study of these phases in a small ($\sim$3 μg) single crystal of λ-(BETS)$_2$FeCl$_4$ using an applied field of 9 T over the temperature (T) range 2-180 K. The results show a complex spectrum that broadens and is shifted as T is lowered in the PM phase, and additional changes associated with the PM-AFI transition. The main spectral features at all T are attributed to the large dipolar field from the 3d Fe^{3+} ions at the proton sites. A phenomenological model provides a reasonable fit to them. On lowering T through the PM-AFI transition at 3.5 K, the spectrum smears and its second and first moments change discontinuously. These features indicate that the transition is first order and that the π-d interaction is important for its properties. The work at UCLA is supported by NSF Grants DMR-0334869 (WGC) and 0203806 (SEB).

Guoqing Wu
UCLA Physics and Astronomy

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