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Pressure-induced ordering in the model quantum magnet DTN

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We experimentally demonstrate pressure-induced ordering in the model $S = 1$ quantum paramagnet $\text{NiCl}_2\text{SC(NH}_2)_2$ (DTN) [1,2]. Employing TDO susceptibility and ultrasound techniques at high magnetic fields and low temperatures, we show that the spin gap vanishes and the magnetic order appears at a critical pressure $P_{c1} = 4.2(3)$ kbar [3]. Powder neutron diffraction reveals an undistorted tetragonal symmetry at the magnetic criticality. At even higher pressures, we find an irreversible structural transition. We describe the obtained phase boundaries employing linear spin-wave theory (for the second critical field, H_{c2}) and a quasi-1D numerical approximation (for the first critical field, H_{c1}), circumventing quantum renormalization effects for spin-Hamiltonian parameters. The studies are complemented by high-pressure ESR measurements.

[1] V. Zapf *et al.*, Phys. Rev. Lett. **96**, 077204 (2006)

[2] V. Zapf, M. Jaime, C. Batista, Rev. Mod. Phys. **86**, 563 (2014)

[3] K. Povarov *et al.*, Nat. Commun. **15**, 2295 (2024)

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