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### **The quasiparticle spectrum termination in a quantum spin liquid**

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The crossover from a single quasi-particle to a spin-continuum response was recently observed in the spin dynamics of the Haldane-chain antiferromagnet CsNiCl<sub>3</sub> [1,2]. It can be understood as a manifestation, in the particular case of the quantum spin liquid, of the peculiar property of the quantum Bose liquids, the quasiparticle spectrum termination point. The spectrum termination was first predicted for the superfluid helium-4 [3], where it was extensively studied both theoretically and experimentally. The quantum-spin-liquid (QSL) state of the two-dimensional (2D) S=1/2 Heisenberg antiferromagnet (HAFM) is of particular interest, as it may be relevant to the type of high-temperature superconductivity found in the cuprates. An organo-metallic material piperazinium hexachlorodocuprate (PHCC) is among the best known examples of the 2D QSL [4]. The spin excitations in this material have spectral gap of about 1 meV above which they follow a nearly 2D- isotropic dispersion with a bandwidth slightly larger than the gap. Recent experiments indicate that a quasiparticle spectrum termination point also exists in the excitation spectrum of the 2D quantum spin liquid existing in PHCC [5]. It signals the failure of the Bose-quasiparticle description in an extended region of the system's phase space. REFERENCES [1] I. A. Zaliznyak, S.-H. Lee, in Y. Zhu (Ed.), *Modern Techniques for Characterizing Magnetic Materials*, Kluwer Academic, New York (2005). [2] I. A. Zaliznyak, S.-H. Lee and S. V. Petrov, *Phys. Rev. Lett.* 87, 017202 (2001); *Phys. Rev. Lett.* 91, 039902 (2003). [3] Landau & Lifshitz, *Course of Theoretical Physics (Statistical Physics, Part 2, by Lifshitz, E. M. & Pitaevskii, L. P.)* Vol. 9, 125-139 (Pergamon Press, Oxford, 1981). [4] Stone, M. B., Zaliznyak, I., Reich, D. H., and Broholm, C., *Phys. Rev. B* 64, 144405 (2001). [5] M. Stone, I. A. Zaliznyak, et. al., in preparation (2004).