Critical phenomena in uniaxial antiferromagnets and superconductors

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A wealth of data supporting the fluctuation - mediated progress of phase transitions appeared since the seminal M.Smolukhovsky description of critical opalescence (Lviv 1908). Meantime, the Helium liquification promoted a discovery of new quantum states, like superconductivity (SP) and antiferromagnetism (AF), revealed by measurements at cooling down to critical temperatures of continuous phase transition. In this way, the study of phase transitions extended more to the solid state. Their diversity gained common consideration in terms of the spontaneous breaking-symmetry approach of L.D. Landau (Kharkov 1937) developed in his thermodynamic phenomenology of continuous transitions within the mean field consideration (MFC). In a result, the modern insight in phase transitions emerged after clear empirical indication to the crucial role of the order-parameter fluctuations in the ordering processes of finite systems. Then, the order-parameter and space dimensionalities come in game along with symmetry. Hence, the common scaling behavior between the fixed points for different systems, pertained to the same universality class, was disclosed and critical indices for many of them were established. It had the most important implication in the study of spatially inhomogeneous systems, featured by different length- and time- scales. Among them, the uniaxial AF and SP are distinguished by their practical significance and correspondence to solvable models. The present studies stem from V. Eremenko (Kharkov 1972) observations of similarities in critical behavior of AF and SP in a magnetic field. The magnetization and dynamic susceptibility measurements on single crystals of layered AF LaMnO3 with weak ferromagnetism and the mixed-state SP 2H-NbSe2 in the phase-transition vicinity reveal common features of H-T phase diagrams regarding the irreversibility line and slow-down dynamics. Such a fingerprint of frustration has different origin in LaMnO3 and 2H-NbSe2 due to magnetic couplings and weak pinning by quenched disorder, respectively. The similar critical indices derived from magnetization measurements together with relaxation times prove their relevance to the same universality class.