4ᵗʰ International Conference on

Condensed Matter and Materials Physics

August 16-17, 2018 | London, UK

Primary scaling densities in the critical adsorption of Ising systems

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Critical adsorption of Ising systems in the presence of normal surface universality class is considered along the critical isochore, near coexistence and along the critical isotherm in cases of energy density and order-parameter and energy density, respectively. The problem is treated theoretically and by Monte-Carlo simulation method in spatial dimensions d=2, d=3 and theoretically in the mean-field limit. Excellent agreement between theory and the Monte-Carlo method is achieved within the study in d=3. Primary scaling densities such as order parameter and energy density manifest monotone behaviors with the relevant exception of non-monotone behaviors of energy density whenever an interface is present in systems. Two-dimensional analysis along the critical isotherm points to a new characteristic of low-dimensional Ising systems consisting of the interface de-localization. Above results are relevant to binary liquid mixtures, liquid-gas systems, ferromagnets, binary alloys and other physical systems of the Ising universality class near their corresponding critical points.
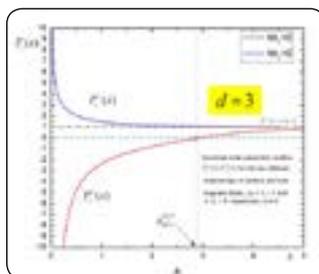

Figure 1: Universal order-parameter profiles along the critical isotherm near the surface of the standard normal universality class, $P_c^>(x)$ and $P_c^<(x)$ in cases $hh_1>0$ and $hh_1<0$, respectively, where $h_1=+\infty$ is the surface magnetic field, and h is the weak bulk magnetic field.

Recent Publications:

1. Borjan Z (2016) Critical Casimir effect in the Ising strips with standard normal and ordinary boundary conditions and the grain boundary. Physica A. 458:329-341.

2. Borjan Z (2015) Crossover aspects in Ising strips under the influence of variable surface fields and a grain boundary. Phys. Rev. E Stat. Nonlin. Soft Matter Phys. 91(3):032121.

3. P J Upton and Z Borjan (2013) Off-critical Casimir effect in Ising slabs with antisymmetric boundary conditions in d=3. Phys. Rev. B. 88:155418.

Biography

Zoran Borjan is an Associate Professor in Faculty of Physics, University of Belgrade and his works in the theory of phase transitions and critical phenomena. He uses continuum formulations in analysis of surface critical phenomena. Special emphasis is on the derivation of accurate results for systems of the Ising universality class in the experimentally most relevant spatial dimension d=3.

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Research & Reviews: Journal of Material Sciences
ISSN: 2321-6212

Materials Physics 2018
August 16-17, 2018

Volume 6

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