EXACTLY SOLVABLE MODELS: THE ROAD TOWARDS A RIGOROUS TREATMENT OF PHASE TRANSITIONS IN FINITE NUCLEAR SYSTEMS

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S u m m a r y

We discuss exact analytical solutions of a variety of statistical models recently obtained for finite systems by a novel powerful mathematical method, the Laplace–Fourier transform. Among them are a constrained version of the statistical multifragmentation model, the Gas of Bags Model and the Hills and Dales Model of surface partition. Thus, the Laplace–Fourier transform allows one to study the nuclear matter equation of state, the equation of state of hadronic and quark gluon matter, and surface partitions on the same footing. A complete analysis of the isobaric partition singularities of these models is done for finite systems. The developed formalism allows us, for the first time, to exactly define the finite-volume analogs of gaseous, liquid, and mixed phases of these models from the first principles of statistical mechanics and demonstrate the pitfalls of earlier works. The found solutions may be used for building up a new theoretical apparatus to rigorously study phase transitions in finite systems. The strategic directions of the future research opened by these exact results are also discussed.