KMI Special Lecture

"Conformal and near-conformal strongly coupled fermion-gauge systems"

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January 28-30, 2014; 10:00-12:00,
KMI Science Symposia (ES-635)

Abstract:

In these lectures I will cover various topics important in the non-perturbative lattice studies of strongly coupled systems. I want to keep the lectures open for discussion and questions. The topics I plan to cover include:

1. Why do we need to look beyond the Standard Model?
    1.1. Naturalness
    1.2. Triviality of the ϕ^4 model
    1.3. Composite Higgs
2. Wilson renormalization group
    2.1. Renormalization group transformation
    2.2. Fixed points, relevant and irrelevant operators, critical exponents
    2.3. Universality and lattice actions
    2.4. Finite size scaling and Wilson RG
3. The conformal window and systems nearby
    3.1. What questions can lattice studies answer?
    3.2. Why are lattice studies of near-conformal systems difficult?
4. Lattice studies, lattice methods and recent results
    4.1. Phase diagram at zero and finite temperature
    4.2. Universality and lattice actions (again)
    4.3. Step scaling function methods
        4.3.1. Monte Carlo renormalization group technique
        4.3.2. Renormalized running coupling from gradient flow
    4.4. Spectral density of the Dirac operator
        4.4.1. Predicting the anomalous dimension of a conformal fixed point
        4.4.2. The running (effective) anomalous dimension
    4.5. Finite size scaling with correction
5. Speculations & outlook