Functional renormalization group for signal detection

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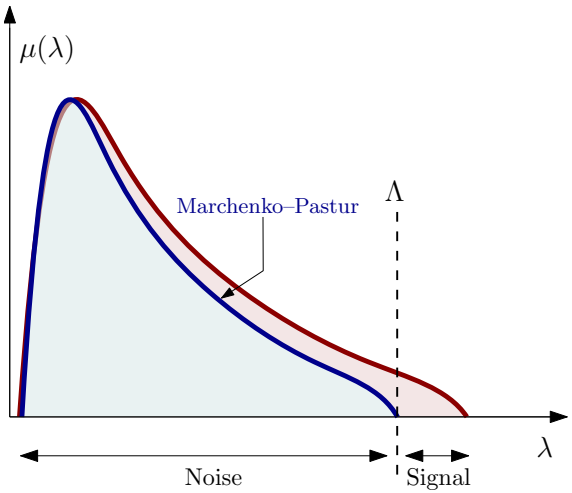
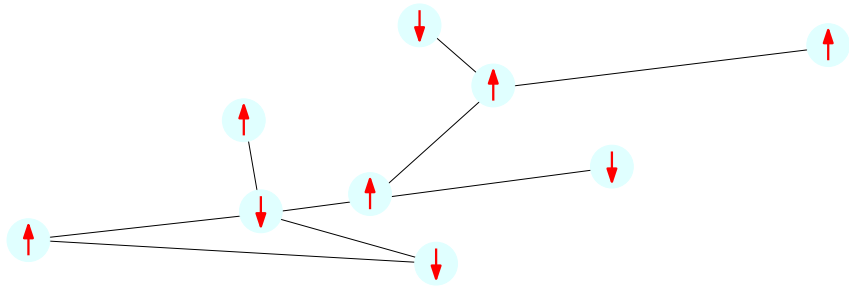
Field theory and signal detection

- The RG techniques can be used to study signal detection in nearly continuous positive spectra. Data analysis can be also viewed as a physical problem involving an non conventional Euclidean field theory.
- Equilibrium fluctuations of the field ϕ is described through the Gibbs measure

$$p[\phi] = \exp(-S[\phi]) \tag{1}$$





FRG General formalism

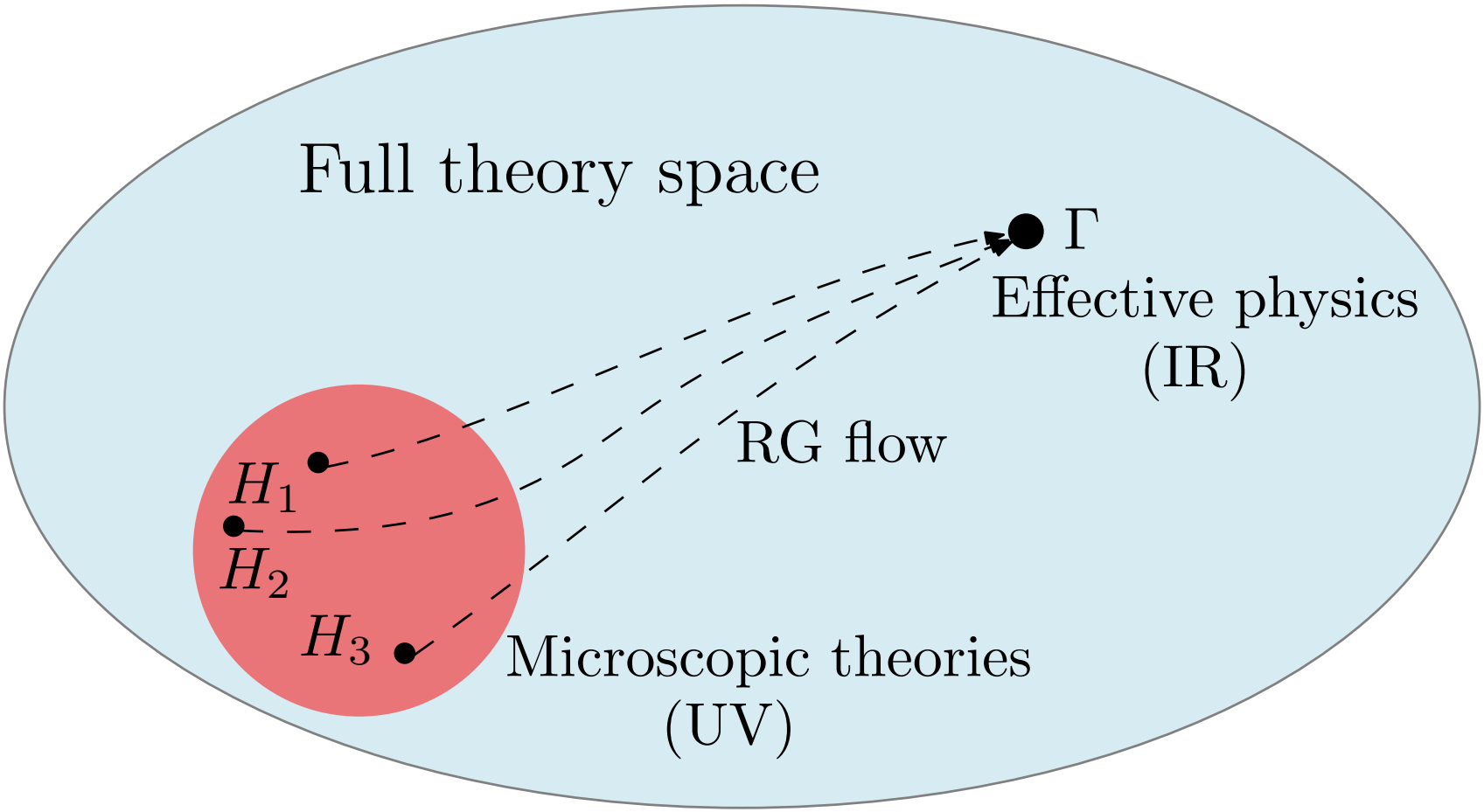
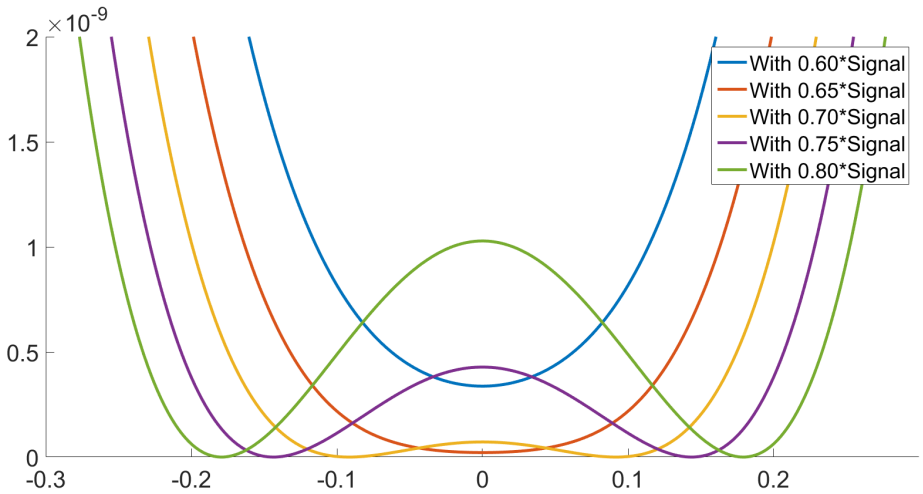
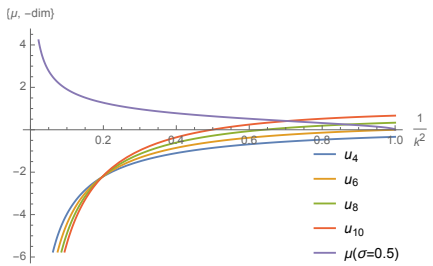


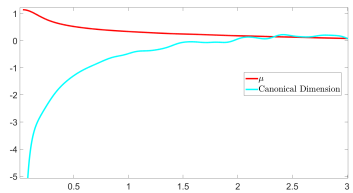
Figure: caption....

Numerical results (Equilibrium theory)

$$P(\Phi) = \frac{1}{Z} \exp\left(-\frac{1}{2} \sum_{i,j}^{N} \phi_i (K_{ij}^{-1} - \delta_{ij}) \phi_j - \frac{1}{12} \sum_{i=1}^{N} \phi_i^4 + \mathcal{O}(\phi_i^6) \right), \quad (2)$$

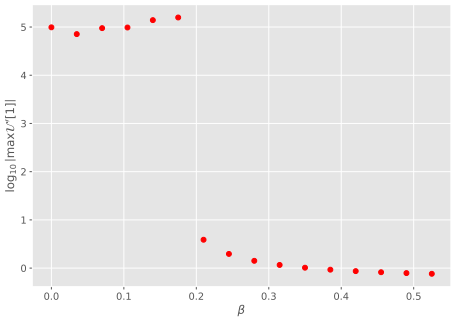


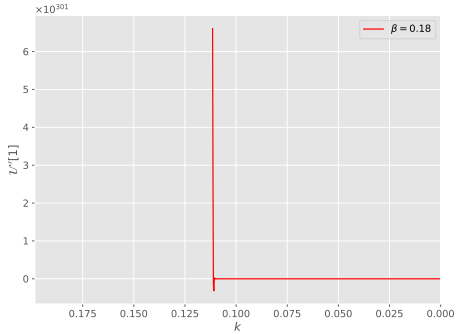


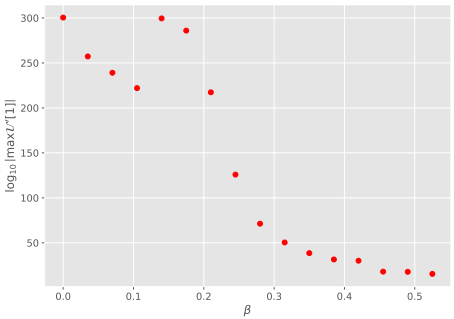


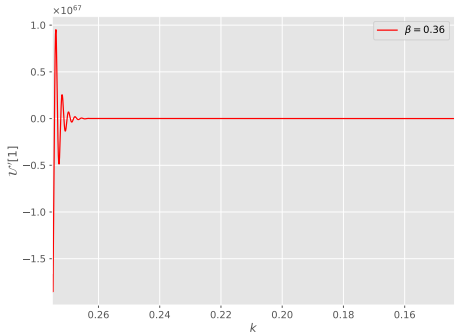
Numerical results (Stochastic dynamics approach)

$$\partial_t \varphi(p,t) = -(p^2 + m^2)\varphi(p,t) - \frac{\partial U[\varphi]}{\partial \varphi(-p,t)} + \eta(p,t), \tag{3}$$









References I

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[2] Vincent Lahoche, Dine Ousmane Samary, Mohamed Tamaazousti, Signal Detection in Nearly Continuous Spectra and Z2-Symmetry Breaking, Symmetry 2022, 14, 486.
[3] Vincent Lahoche, Dine Ousmane Samary, Mohamed Ouerfelli, Mohamed Tamaazousti, Field Theoretical Approach for Signal Detection in Nearly Continuous Positive Spectra II: Tensorial Data, Entropy 2021, 23, 795.
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