

## Non commutative simulations on GRID

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Here we present a first implementation in the GRID framework, using the parametric job tool, of a set of simulations in the field of the non commutative geometry. Such calculus (typically Monte Carlo like simulations) are usually done on

local resources such as local clusters, our goal here is to open the way to the GRID paradigm to such models or even to the “fuzzy” community.

We will study then a quantized  $\phi^4$  scalar field theory approximating field with  $N \times N$  matrices. We are interested in particular to the phase transitions

of the theory as we change the parameters of the action. The quantity of interest are susceptibility and specific heat, as well as other order parameters,

which we will describe below.

Is worthwhile compare the present method with the simulations of such theories on the lattice. In general the simulations of scalar theories on fuzzy spaces are slower than in their lattice counterparts since the fuzzy models due to the self-interaction term  $\phi^4$  are intrinsically non local and for higher power of the self-interacting the number of operations to calculate each Monte Carlo step  $\delta S$  grows even faster. However, we can expect some advantages with the simulations of other symmetric field theories.

### Wider impact and conclusions

The implementation of the GRID paradigm in this field of theoretical research could push the complexity of the simulations (aka the matrix rank) in such a way to obtain a much better result of even new results in the same amount of time spent in the current local simulations.

### Description of work

The fuzzy disk is a discretization of the algebra of functions on the two-dimensional disk using finite matrices which preserves the action of the rotation group. We define a  $\phi^4$  scalar field theory on it and analyse numerically three different limits for the rank of the matrix going to infinity. The numerical simulations reveal three different phases: uniform and disordered phases already present in the commutative scalar field theory and a non-uniform ordered phase as non commutative effects. Since this simulations have an high grade of parallelism the use of the GRID allow us to process all considered different configurations of the model (approx 10000 cases) potentially completely in parallel. All the submissions can be achieved using a parametric job together a suitable wrapper script which allows to use multiple parameters.

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