Lattice QCD Grid

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Computation in Theoretical Physics

Numerical methods are more and more used in Theoretical Physics:

- **To simulate systems to investigate new fields**
- **To evaluate quantities not directly accessible from analytical methods**
- **To compare numerical results with numbers obtained from approximation methods**

Theoretical problem

- Standard Model: theoretical background of High Energy Physics
- Quantum ChromoDynamics (QCD) is the part of the Standard model describing the strong nuclear interaction
- Part of this theory are quarks and gluons
- Main issue is the quark confinement
- Hard to explore analytically

Numerical solution

Numerical investigations:

1. **Euclidean version of the theory**
2. **Discretization on an regular hyper cubic lattice**
3. **Use of the Montecarlo Metropolis algorithm, implementing a importance sampling**

Local updating, parallelizable

Long relaxation time

We are interested to investigate equilibrium properties

⇨big number of iterations to accumulate great statistic

⇨long running time

⇨big amount of memory to store data to be analyzed to extract statistically significant data

The problem

- Study topological properties of the SU(3) field to understand confinement
- Configuration: set of values in all the sites of the lattice at a given step of the simulation
- It is necessary to generate lot of configurations for different values of a parameter and for different lattices
- Once the configurations will be accumulated must be analyzed with statistical procedures to extract physical informations

Giusti et al., Physical Review Letters 94:032003,2005

Running application

The team:

L. Giusti, L. Del Debbio (CERN)

B. Taglienti (INFN Roma1)

S. Petrarca (Univ. La Sapienza, Roma)

The program:

Based on a idea of Martin Lüscher (CERN)

- use of SSE2
- contains parts in assembler
- no parallelism

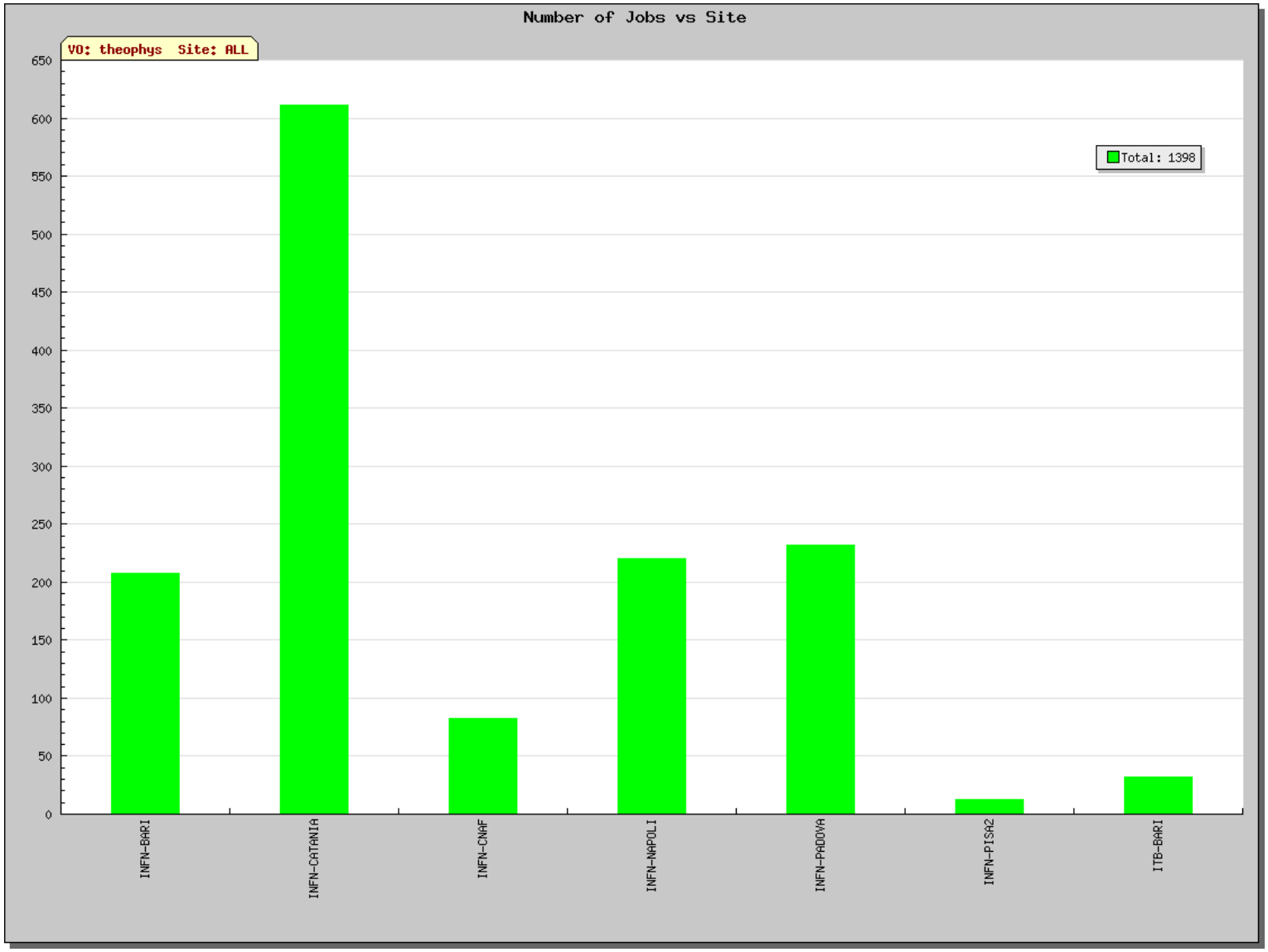
Running environment

The first set of jobs:

- **Lattice 12^4**
- **Each job read 5.7 MB from SE and write the same amount**
- **Extimated cpu time: 10-15 hours**

Infrastructure : INFNGRID

Jobs in the last 28 days



Summary

- From 20/10/2005 more than 20000 CPU hours with 12 hours jobs generating about 36000 configurations
- Good reliability except for short periods with a high failure level
- Planned change in lattice size (14^4) ⇨ jobs about 60 hours long