

# HMLQCD Application

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EC FP7 Project HP-SEE  
<http://www.hp-see.eu/>



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# Introduction



**Lattice QCD** - an indispensable tool both for particle and nuclear physics.

## **HMLQCD Application's goal**

Computation of basic properties of matter simulating the theory of strong interactions, Quantum Chromodynamic on the Lattice on massively parallel computers.

Our project aims:

- To test local chiral actions for the calculation of the hadron masses.
- Calculate quark - antiquark potential from Wilson loops.
- On the algorithmic side the project will test new solvers for overlap and domain wall fermions.



## Development Plan

Start of alpha stage: *M01. Construction of an algorithm. Creating of the program.*

Start of beta stage: *M6. Parallelization and Debugging of the application.*

Start of testing stage: *M8. Testing on multiprocessor platforms.*

Start of deployment stage: *M10. Performing calculations.*

Start of production stage: *Calculation of quark-antiquark potential and hadron spectroscopy*

## Technical Features and HP-SEE Implementation

Primary programming language: *C/C++*

Parallel programming paradigm: *MPI/Open MP*

Main parallel code: *MPI*

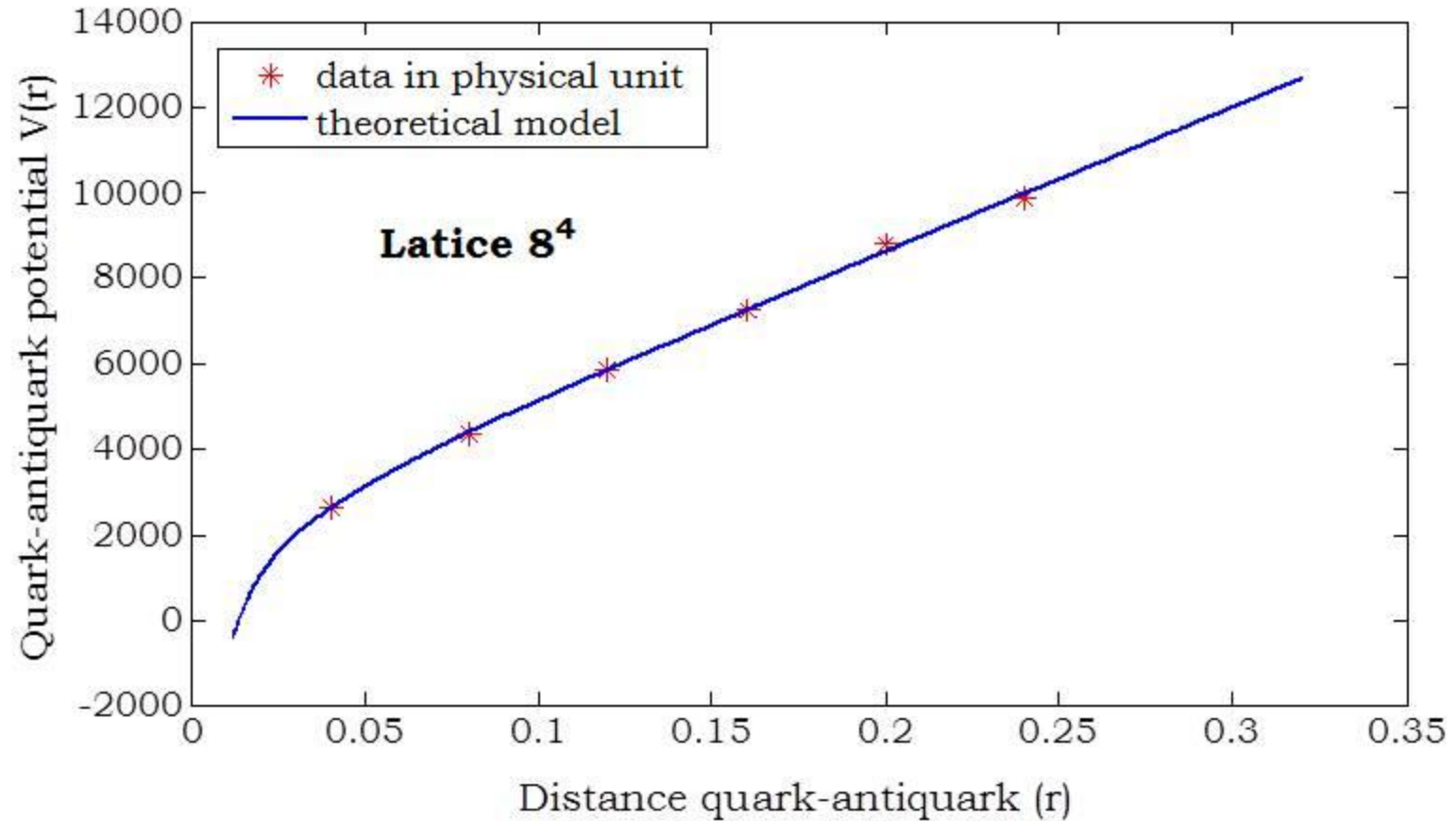
Pre/post processing code: *Own developer*

Application tools and libraries: *FermiQCD, OpenMP*

Home system: *HPC-Bulgaria*



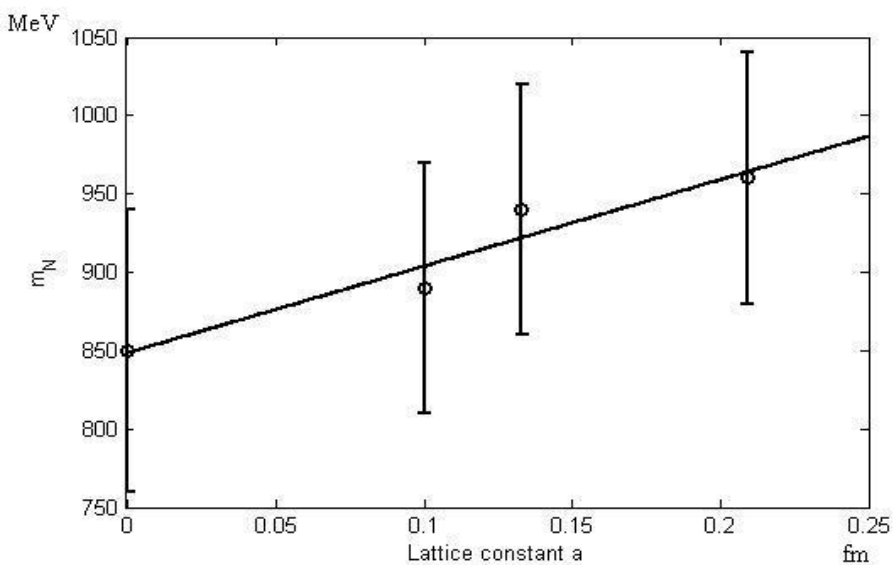
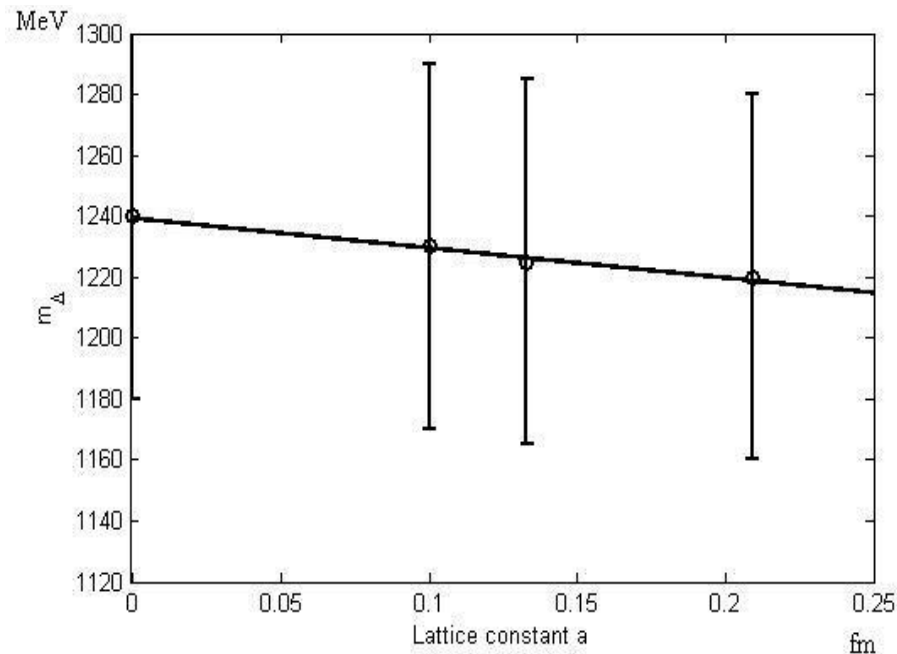
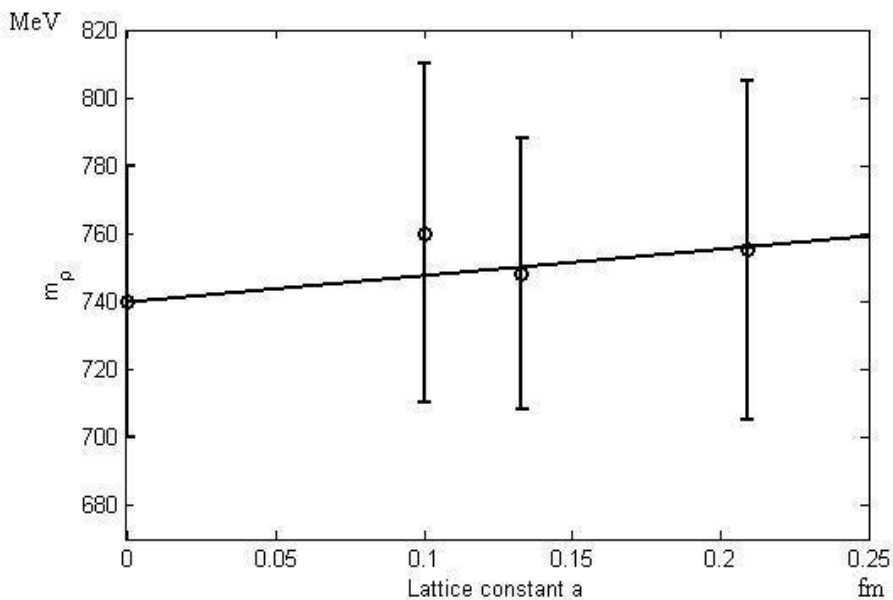
# Results



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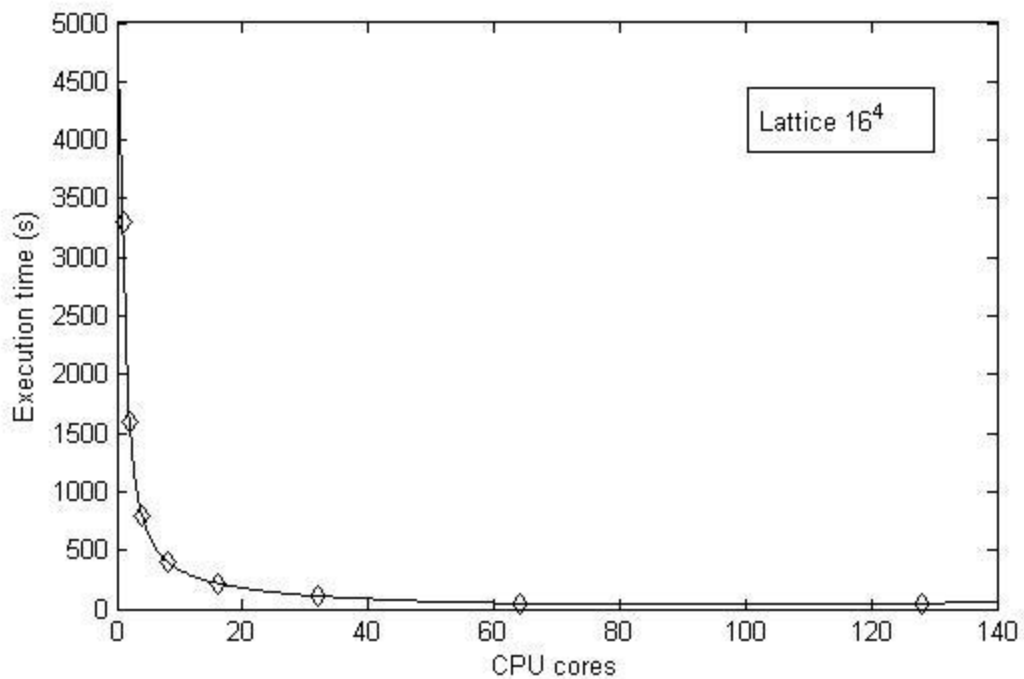


Hadron	Mass (MeV/c <sup>2</sup> )	Error (MeV/c <sup>2</sup> )	Exp. Mass (MeV/c <sup>2</sup> )
Rho - meson	750	± 60	770
Nucleon	855	± 70	938,27
Delta baryon	1240	± 87	1232

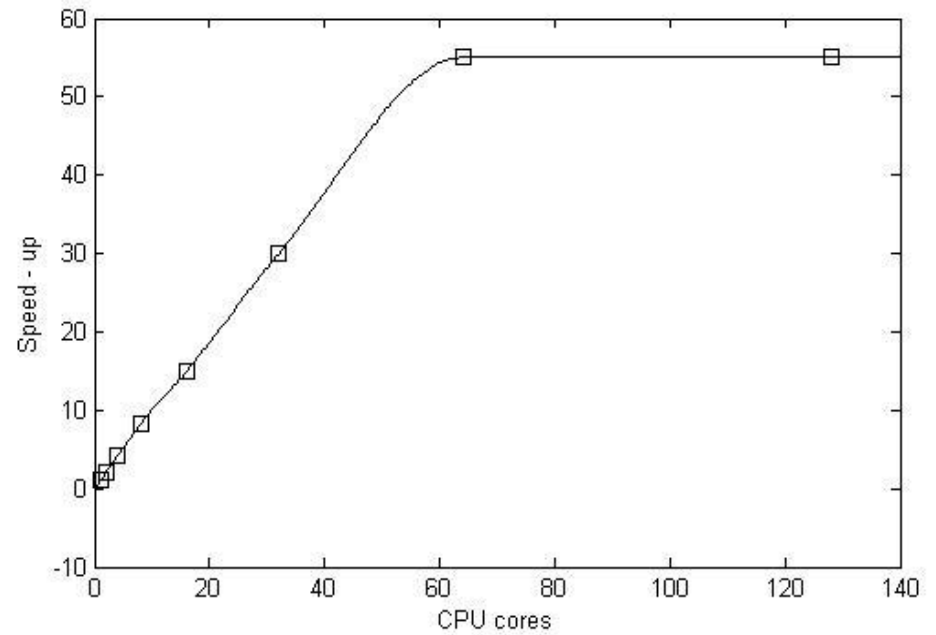
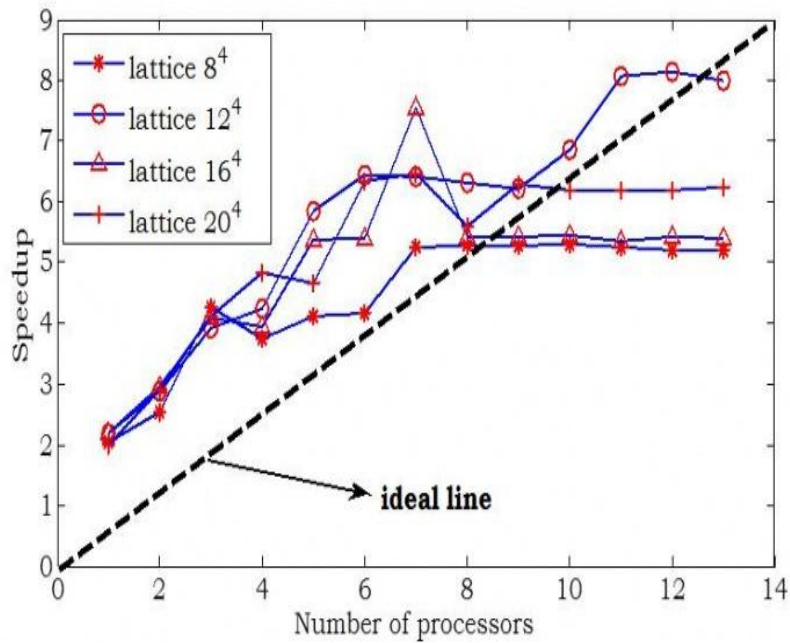
# Results



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# Results



# Plans underway



- Restoration of the broken hypercubic symmetry of the Borici – Creutz action
- Test it for the calculation of the hadron masses.  
The codes for the calculation of specific hadrons are already written and tested for Wilson action
- Implementation of the multigrid algorithm in FermiQCD as a solver for overlap and domain wall fermions.





# **Publications**

## **November 2012 “Fakulteti i Shkencave Natyrore ne 100 vjetorin e pavaresise”, Tirane, Albania**

1. Zeqirllari, R., Xhako, D., Boriçi, A. “Light hadron spectrum for Wilson action”
2. Xhako, D., Zeqirllari, R., Boriçi, A, “Static quark-antiquark potential calculation”

## **October 2012 - HP-SEE User Forum 2012, Belgrade, Serbia**

1. Zeqirllari, R., Xhako, D., Boriçi, A., “Quenched Hadron Spectroscopy Using FermiQCD”,
2. Xhako, D., Zeqirllari, R., Boriçi, A, “Using Parallel Computing to Calculate Static Interquark Potential in LQCD”

# Thank you!

## **Acknowledgments**

This work makes use of results produced by the High - Performance Computing Infrastructure for South East Europe's Research Communities (HP-SEE), a project co-funded by the European Commission (under contract number 261499) through the Seventh Framework Program. HP-SEE involves and addresses specific needs of a number of new multi-disciplinary international scientific communities (computational physics, computational chemistry, life sciences, etc.) and thus stimulates the use and expansion of the emerging new regional HPC infrastructure and its services. Full information is available at <http://www.hp-see.eu/>.