



HPC-LEAP Mid-term Meeting

ESR1

Alessandro Gabbana

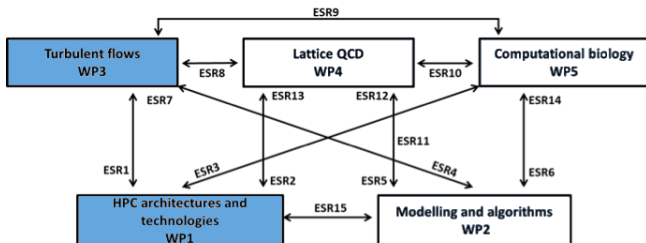
Università degli studi di Ferrara
Bergische Universität Wuppertal

Zeuthen - April 18, 2017



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No' 642069

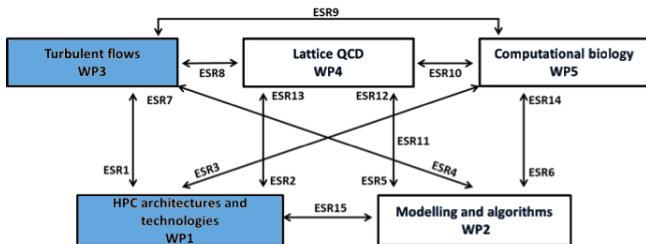
Work Packages



ESR 1 is involved in

- ▶ WP1: HPC architectures and technologies
- ▶ WP3: Turbulent flows

Work Packages



Objectives

- ▶ To study and develop new numerical lattice Boltzmann schemes for the study of turbulent flows (WP3)
- ▶ To implement and optimize such tools on massively parallel HPC architectures (WP1 & WP3)
- ▶ To evaluate and benchmark modern HPC architectures and technologies also providing a set of pilot applications (WP1)

Workpackage 1

WP1

- ▶ Milestone 1: Architectural models established.
 - Deliverable *D1.1*: "Report on HPC architecture and technology trends". Identification of the most relevant trends in HPC to guide the next research steps. (Due to M12)
- ▶ Milestone 2: Performance optimisations completed.
Implementation and optimisation of a set of pilot applications for which performance will be analysed for available high-end HPC systems.
 - Deliverable *D1.2*: "Report on LBM codes". (Due to M48)

Workpackage 1

WP1

- ▶ Milestone 1: Architectural models established. ✓
 - Deliverable *D1.1*: "Report on HPC architecture and technology trends". Identification of the most relevant trends in HPC to guide the next research steps. (Due to M12) ✓
- ▶ Milestone 2: Performance optimisations completed.
Implementation and optimisation of a set of pilot applications for which performance will be analysed for available high-end HPC systems.
 - Deliverable *D1.2*: "Report on LBM codes". (Due to M48)

Workpackage 1

Contributions to peer-reviewed journals

- ▶ Massively parallel Lattice Boltzmann codes on large GPU clusters - E. Calore, A.Gabbana, J.Kraus, E. Pellegrini, S.F.Schifano, R.Tripiccone, Parallel Computing, Vol 58, 1-24 (2016)
- ▶ Performance and portability of accelerated lattice Boltzmann applications with OpenACC - E. Calore, A.Gabbana, J.Kraus, S.F.Schifano, R.Tripiccone. Concurrency and Computation Practice and Experience, Volume 28, Issue 12, 3485-3502 (2016)
- ▶ Optimization of Lattice Boltzmann Simulations on Heterogeneous Computers - E. Calore, A.Gabbana, S.F.Schifano, R.Tripiccone, International Journal of High Performance Computing Applications (2017)
- ▶ Evaluation of DVFS techniques on modern HPC processors and accelerators for energy-aware applications - E. Calore, A.Gabbana, S.F.Schifano, R.Tripiccone, Concurrency and Computation: Practice and experience (2017)

Contributions to Conference/Workshops

- ▶ A portable heterogeneous implementation of the D2Q37 Lattice Boltzmann Method, ScalPerf - Bertinoro 18-23 Sept 2016
- ▶ Heterogeneous implementation of the D2Q37 Lattice Boltzmann Method - Perspectives of GPU computing in science - Rome 26-28 Sept 2016
- ▶ Benchmarking performances of the Xeon-Phi KNL with a CFD code, IXPUG Spring 2017 - Cambridge 10-14 Apr 2017

Workpackage 3

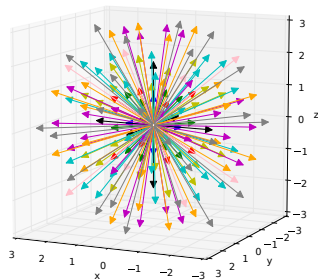
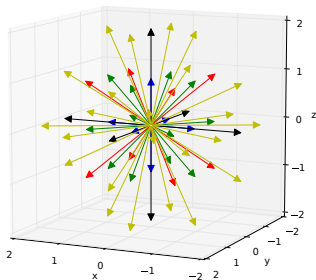
WP3: Turbulent flows

- ▶ Deliverable *D3.4*: "Turbulence models in LBM". (Due to M40)

Workpackage 3

WP3: Turbulent flows

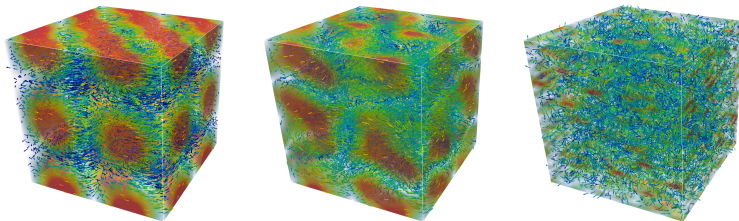
- ▶ Deliverable *D3.4*: "Turbulence models in LBM". (Due to M40)
- ▶ A new relativistic Lattice Boltzmann Model: conceptually bridging from the ultra-relativistic ($v/c \rightarrow 1$) down to the classical regime ($v/c \rightarrow 0$).



Workpackage 3

WP3: Turbulent flows

- ▶ Deliverable *D3.4*: "Turbulence models in LBM". (Due to M40)
- ▶ A study on dissipative effects in relativistic hydrodynamics: an attempt to bring new insight in the link between kinetic theory and hydrodynamics at a macroscopic level.



Workpackage 3

Contributions to Peer-reviewed journals

- ▶ Towards a unified lattice kinetic scheme for relativistic hydrodynamics - A. Gabbana, M.Mendoza, S. Succi, R.Tripiccone, Physical Review E, submitted 2016.
- ▶ Kinetic approach to relativistic dissipation - A. Gabbana, M.Mendoza, S. Succi, R.Tripiccone, Physical Review Letters, submitted 2017.

Contributions to Conference/Workshops

- ▶ On LBM in the relativistic regime - HPC Applications to Turbulence and Complex Flows - Rome 10-14 Oct 2016
- ▶ Towards a unified lattice kinetic scheme for relativistic hydrodynamics - International Conference on Discrete Simulation of Fluid Dynamics - Erlangen, Germany, 10-14 July 2017.

Secondments

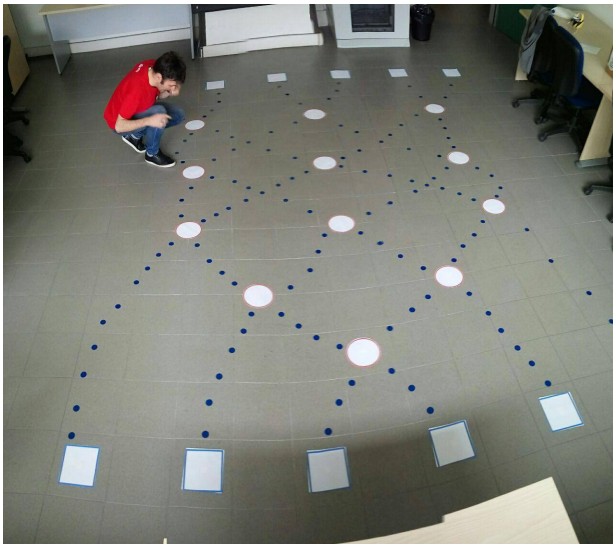
Apr - Sep 2017

- ▶ NVIDIA Lab (Juelich)
- ▶ JSC (Juelich Supercomputing Center)

May - Jul 2018

- ▶ TOV (University of Rome Tor Vergata)

Outreach



Outreach

- ▶ “Computer Science Unplugged” - Cycle of lectures and labs for primary schools of Ferrara municipality - 21-29 March, 7 April 2017.
- ▶ “Porte aperte al Polo Scientifico Tecnologico” - Open days at Ferrara University with presentations and guided tours - 11-16 October 2016.
- ▶ “Stage Estivo a Fisica” - Summer school for high-school students at UNIFE Physics department - 13-17 June 2016.
- ▶ “University counselling for high school students at Liceo Scientifico Antonio Roiti - Ferrara” 4 November 2015.

Currently working with other ESR's in the preparation of new material to be presented next year in high-schools.

Outlook

from my motivational letter while applying for HPC-LEAP

I'm looking for a PhD position where aspects of HPC and computational physics are equally important. Currently LB methods and the study of new HPC architectures represents my main interests. I would like to join a research group where I could study **algorithmic** and **programming aspects** with the ultimate goal of contributing in **achieving physics results**. I believe that such a PhD position would enhance my knowledge and experience giving me the possibility of either setting up *a high-level research career or work in academia*.

Thank for your time and consideration.



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