



The
University
Of
Sheffield.



Multi-GPU implementation of finite-size particle in a pipe flow

HPC-Leapers: Xiao Xue^{1,2}, Felix Milan^{1,2}, Teodor Nikolov³

Mentors: Guray Ozen⁴, Paul Richmond⁵

1. Eindhoven University of Technology

2. University of Rome "Tor Vergata"

3. Juelich Supercomputing Centre

4. NVIDIA

5. University of Sheffield

Lugano, 02.10.2018



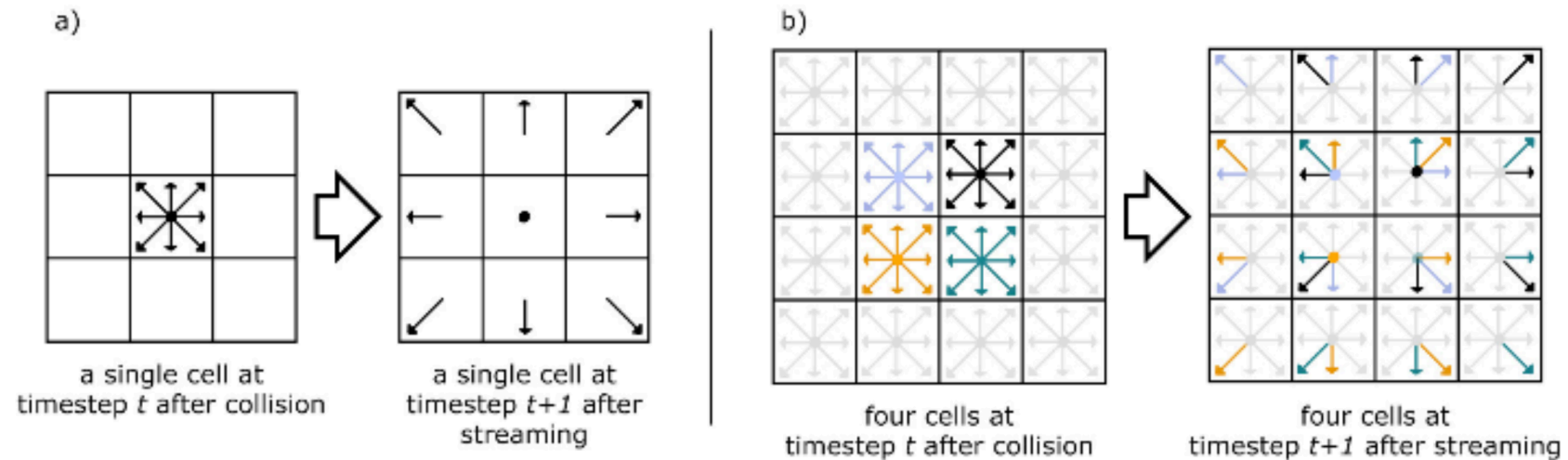
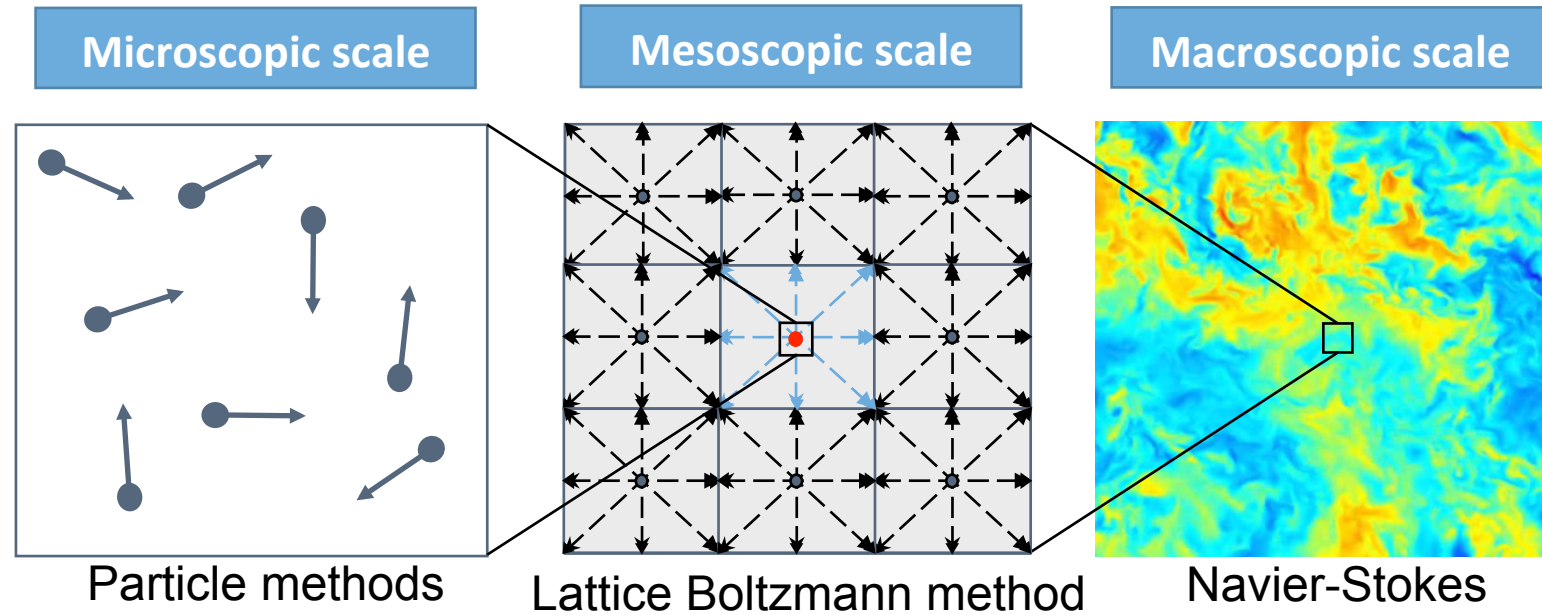
Finite-size particle in fluid



Study transportation behavior
particles in the sand storm



Algae population dynamics

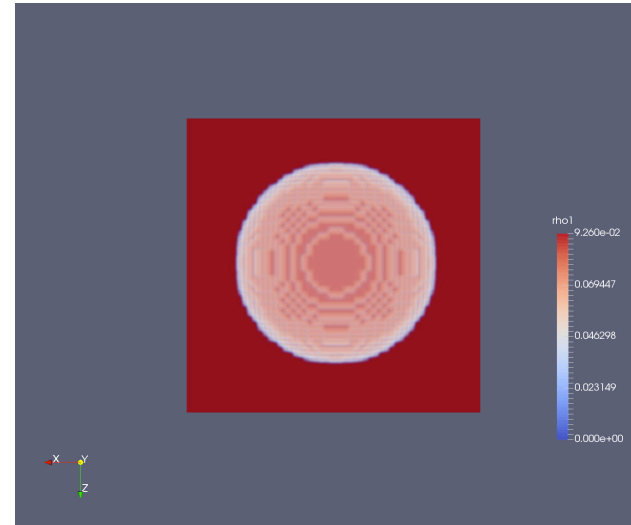


Test case:

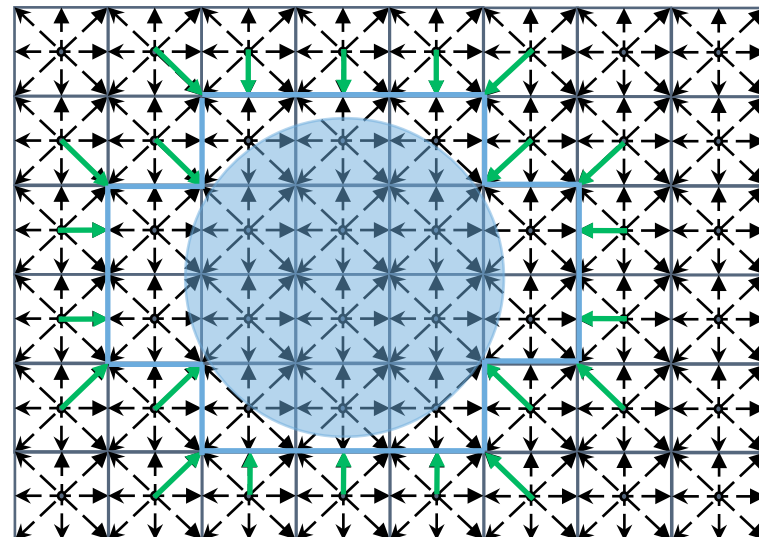
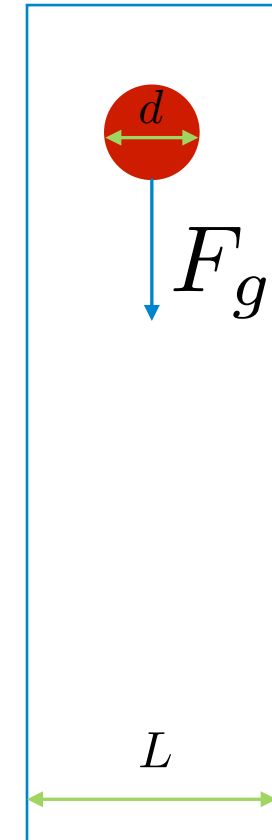
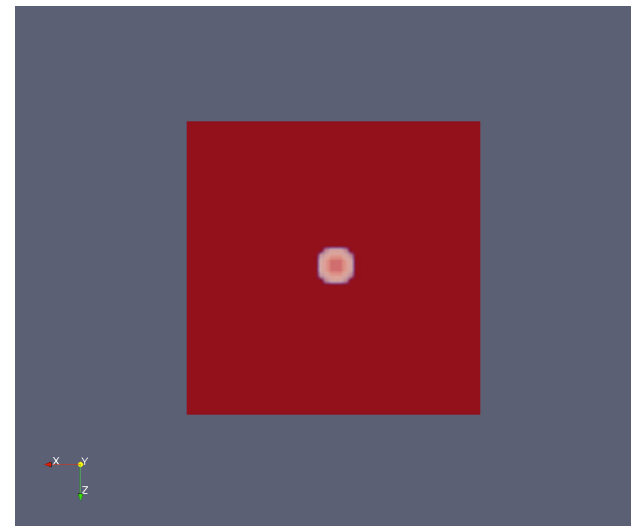
Drag simulation: settling particle

Single component fluid
C. K. Aidun results

$R_p = 20$



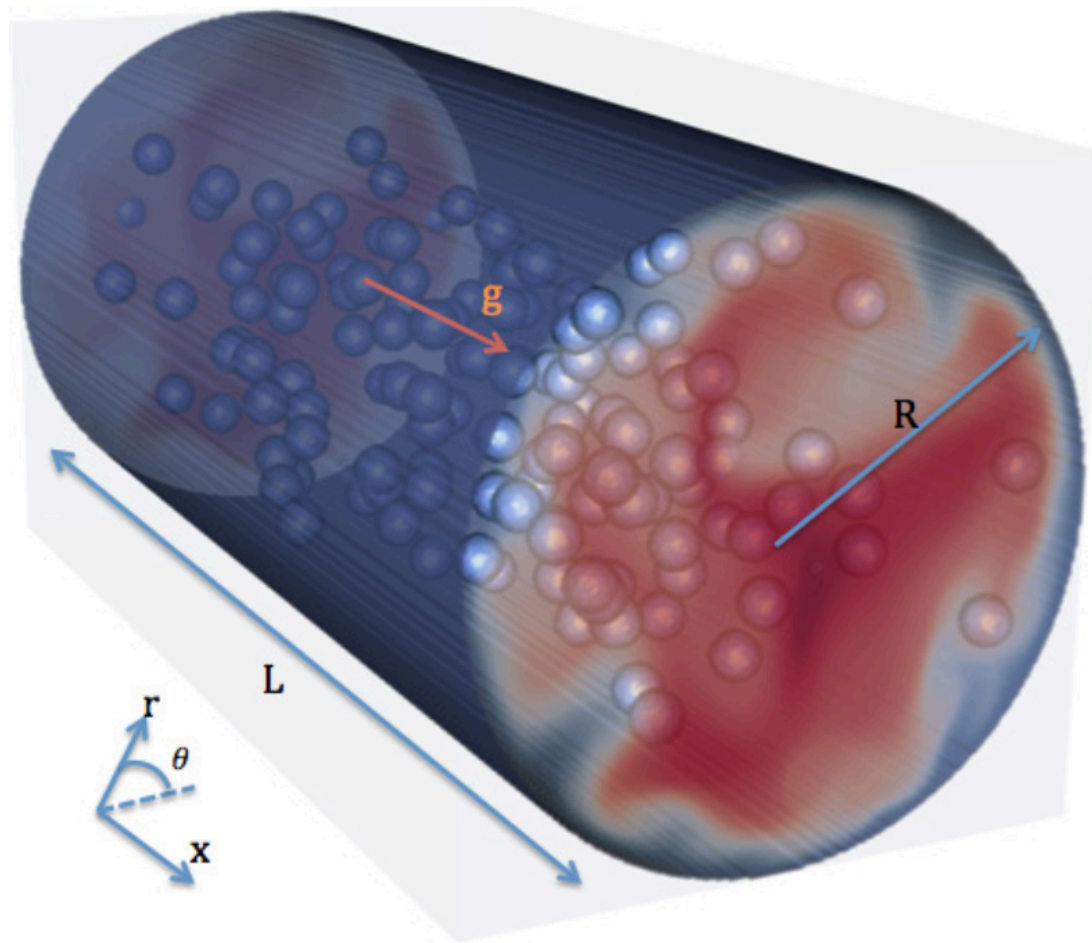
$R_p = 6$



Hackathon Plan

- Flow without particle (mini app)
 - Single GPU building correctly on Piz Daint (bug fixes, build configs)
 - Single GPU running correctly on Piz Daint (mass conservation)
 - Single GPU optimization (block size, memory hierarchy, data layout)
 - Multi-GPU optimization (CUDA aware MPI testing, halo exchange optimization)
- Flow with particle (separate code)
 - Embed particle method in mini app (requires some debugging)
 - Algorithm design for finite-size particle (data layout, efficiently linking between neighboring cells)

Goal



- Multi-GPU implementation for lattice Boltzmann
- Multi-GPU implementation for particle-fluid interaction and particle-particle interaction

A Gupta, HJH Clercx, F Toschi
 Communications in Computational Physics 23 (3), 665-684 2018

A Gupta, HJH Clercx, F Toschi
 The European Physical Journal E: Soft Matter 2018

A Gupta, HJH Clercx, F Toschi
 The European Physical Journal E 41 (3), 34 2018