LaMEM short course

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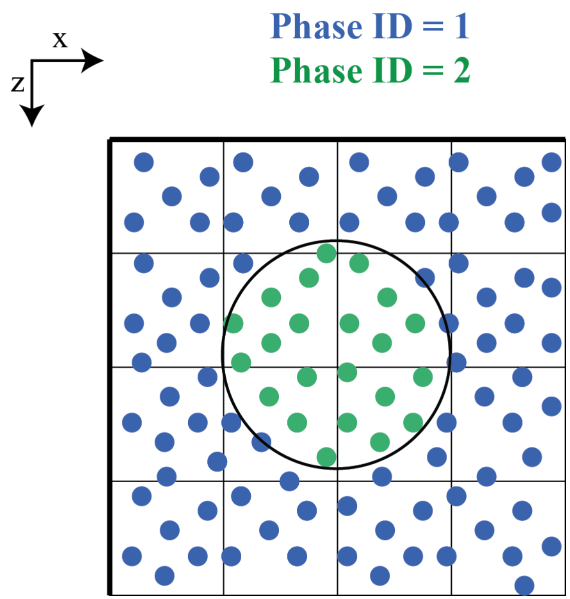
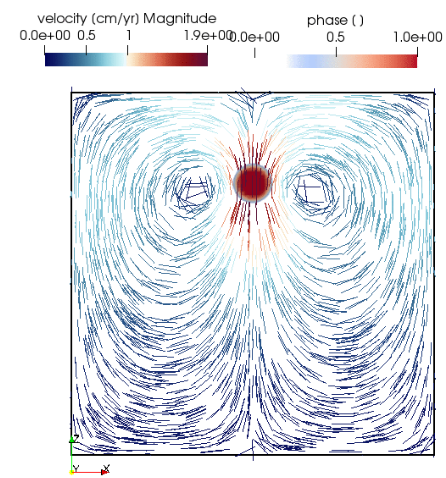
Nicolas Riel- nriel@uni-mainz.de

Material definition (internal condition)

- **Particles store**
  1. Phase ID
  2. Initial Temperature



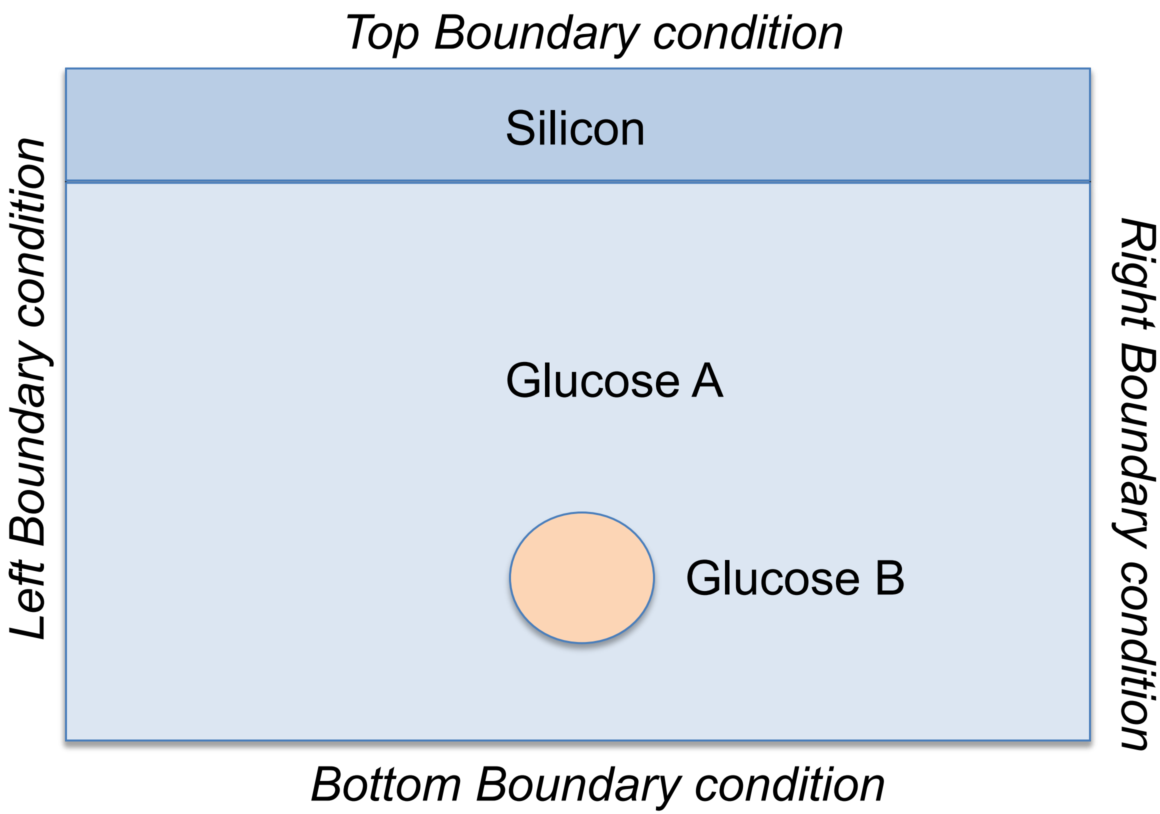


Particles are transported using the velocity field

Phase() is a “rock” with a unique ID to which is attached:

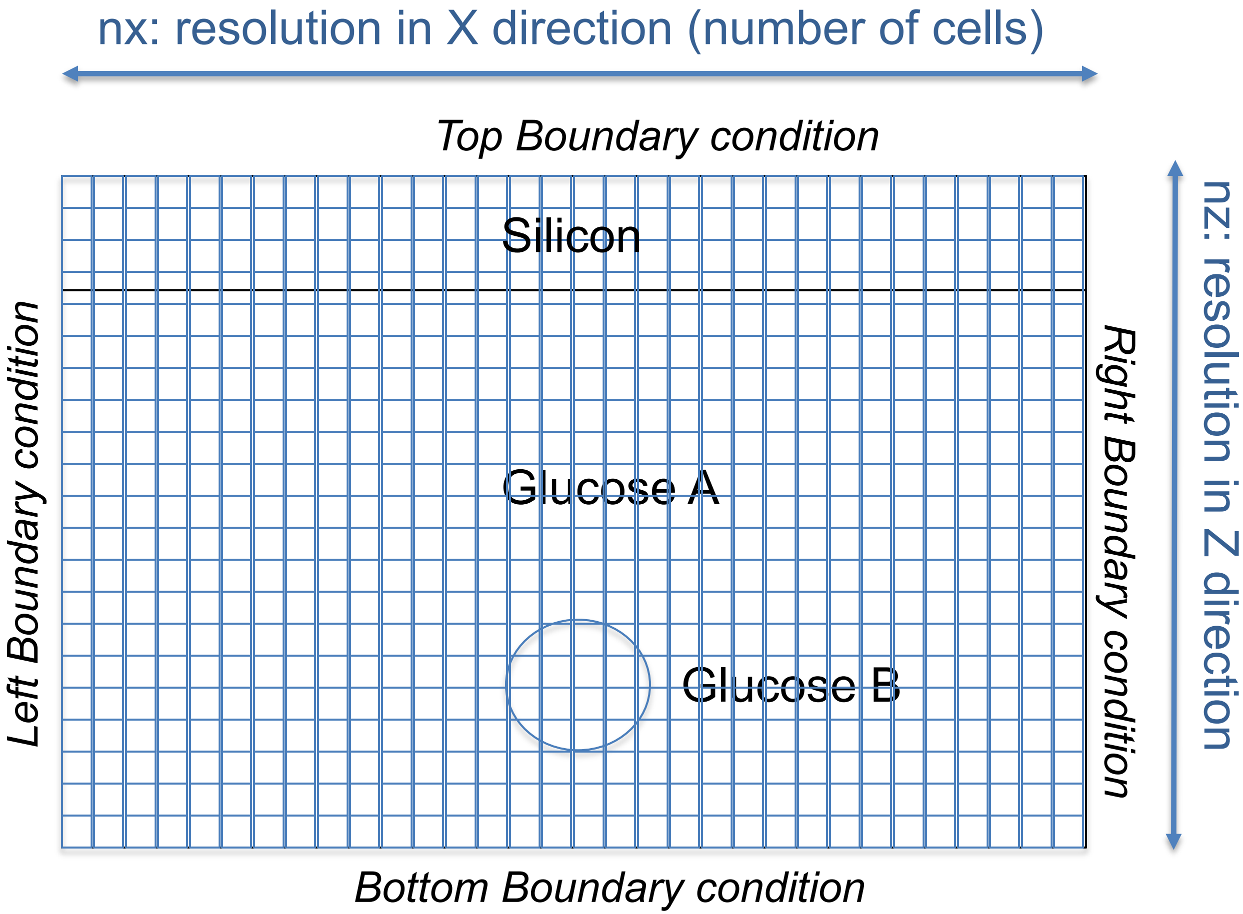
- Phase ID: A geometry defined by a set of particles
- Rheology: visco-elasto-viscoplastic
- Density: P and/or T dependent or a diagram
- Thermal properties: alpha, cp, k
- Elastic bulk modulus...

Model setup



- 3 materials with own mechanical (and thermal) properties: Density, Viscosity, Elasticity…
- Silicon
- Glucose A
- Glucose B

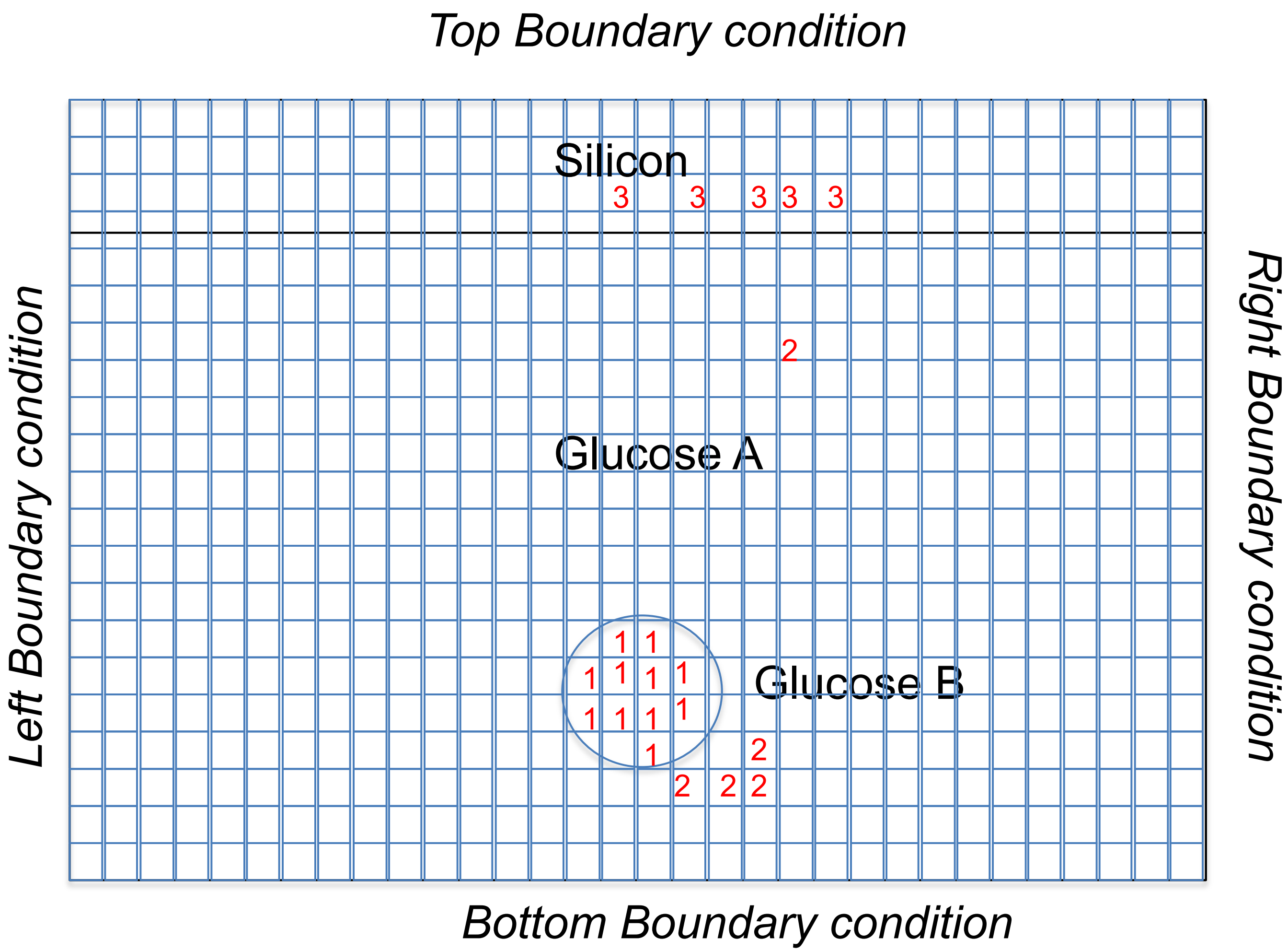
Model setup



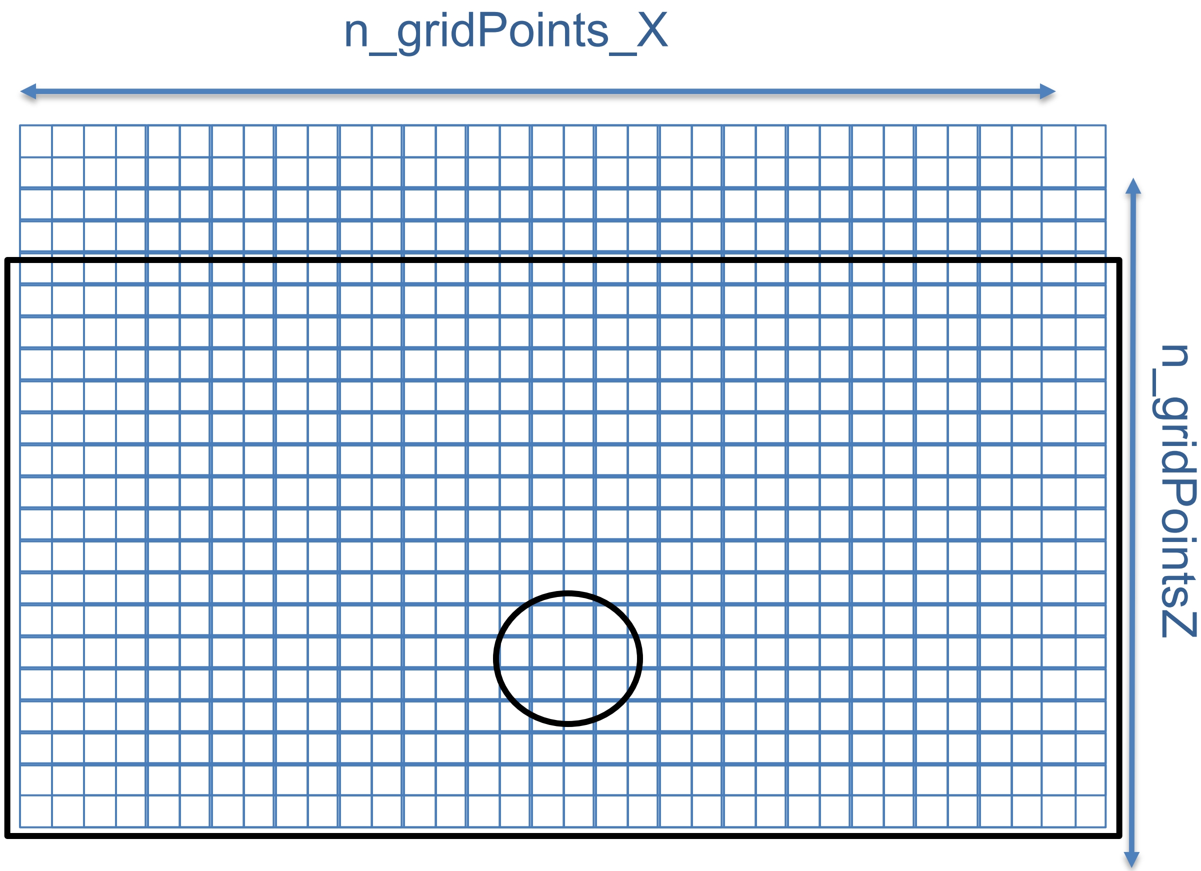
- Resolution is defined by the number of "cells" or grid-points
- Setting up a model boils down to:

1. Assigning boundary conditions
2. Initializing 2 grid point information:
   - Initial temperature
   - Phase ID (can be seen as material ID or rock-type)

Phase and Temperature definition i.e. Phase ID array initialization



Note: array manipulation and model setup

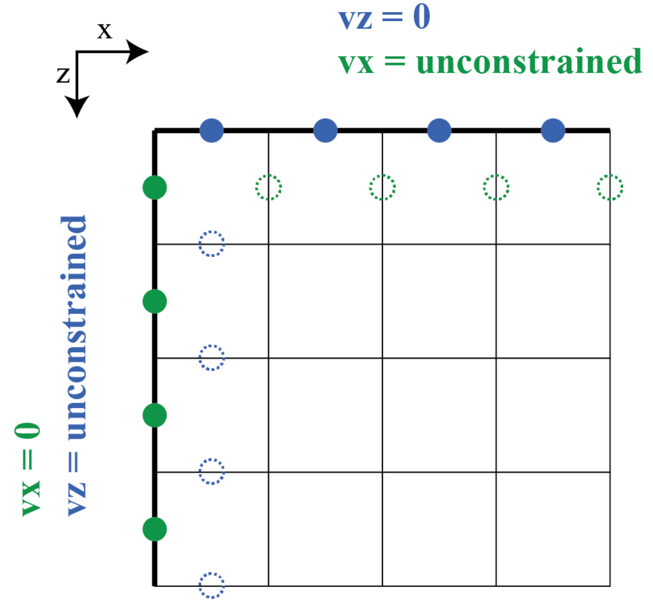


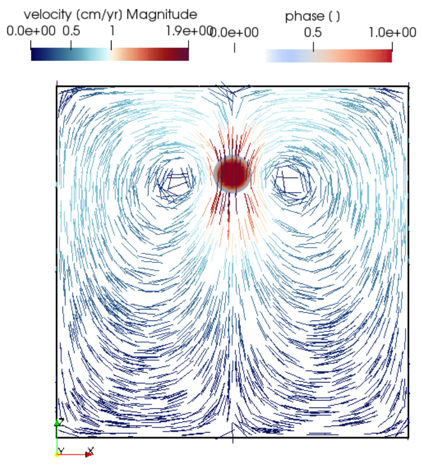
- Assume 3 coordinates arrays and phase array:
  grid_X
  grid_Y
  grid_Z
  phase
- we first initialize Phase with 0
- Then we need select regions to attribute the different "material" or phase ID's

This is done as: phase[Z .> val1 .&& Z .< val2 …]
In Julia, given Z is the array storing grid_Z coordinates

Mechanical Boundary conditions

- **Free slip**

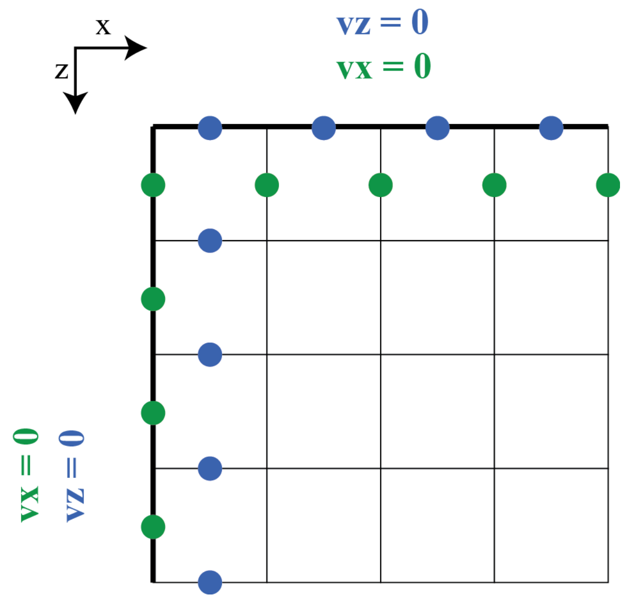




- Material is bound the box but can freely move along boundaries

Mechanical Boundary conditions

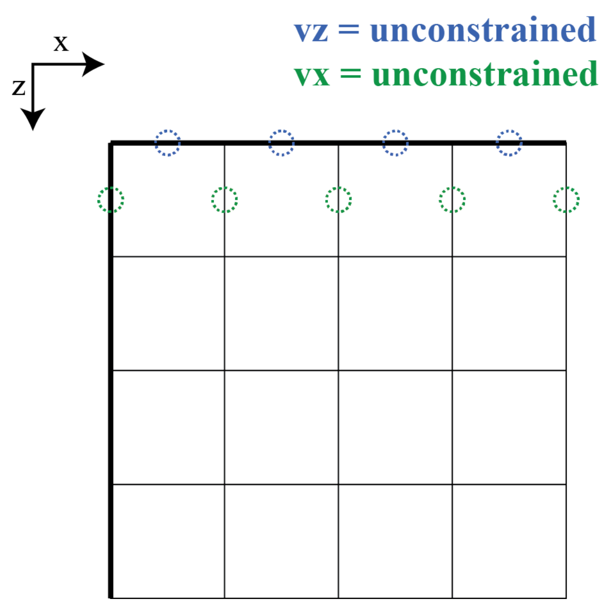
- **No slip**



- Material is bound the box but has a zero velocity along boundaries

Mechanical Boundary conditions

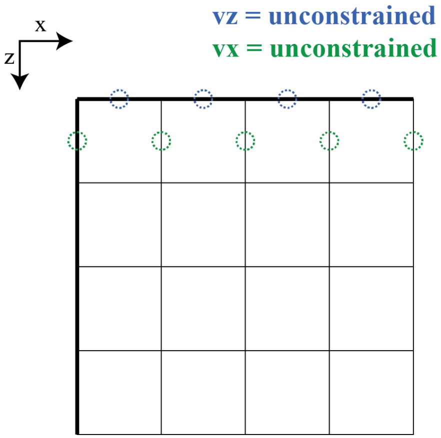
- **Open top (for free surface)**

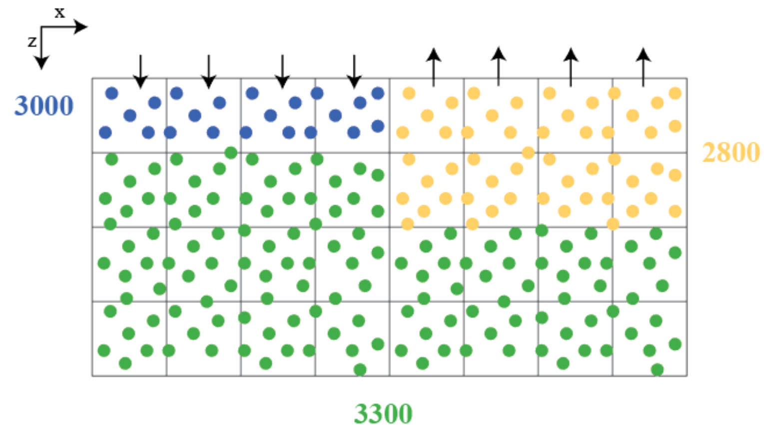


- At the top boundary material is allowed to exit and enter
- This is done together with a low viscosity/density “air” layer

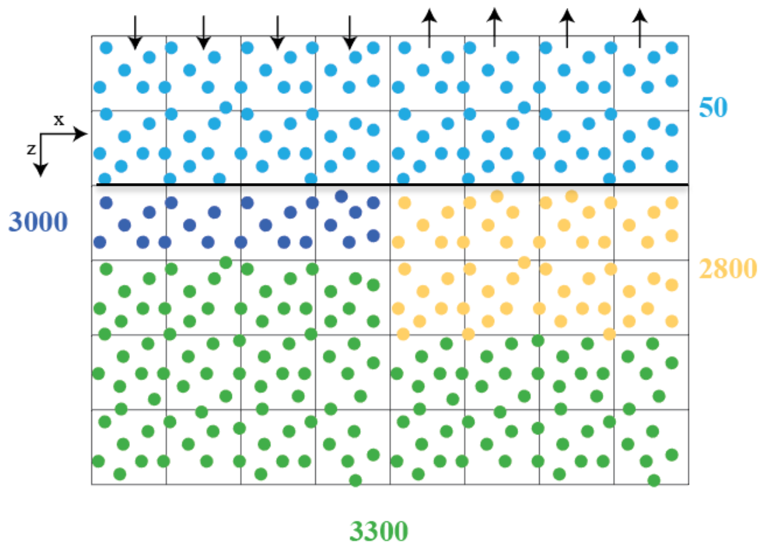
Mechanical Boundary conditions

- **Free surface: “sticky air”**





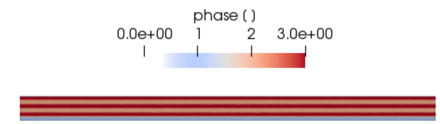
Not ideal!

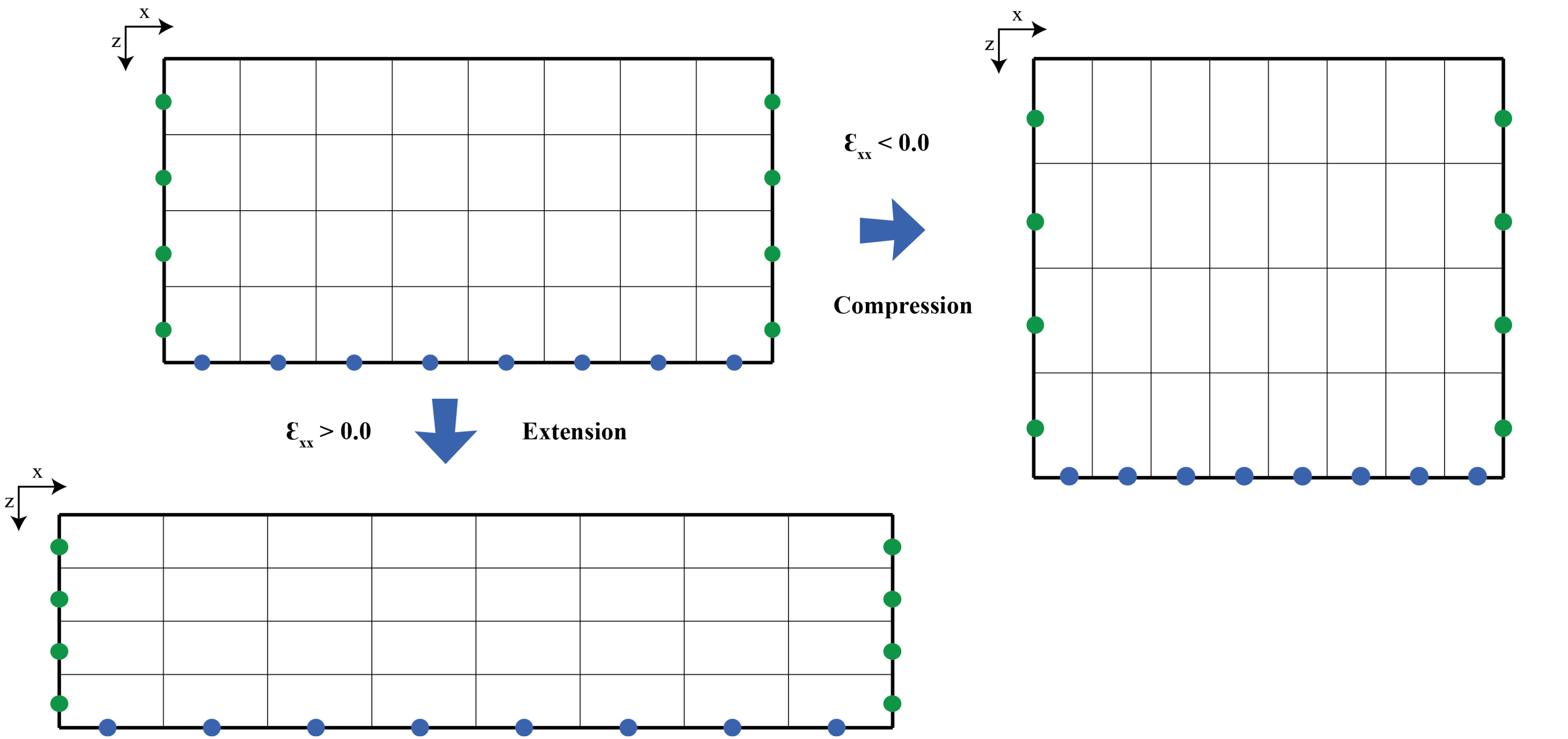


Better!

Mechanical Boundary conditions

- **Strain-rate [1/s] = velocity/distance**

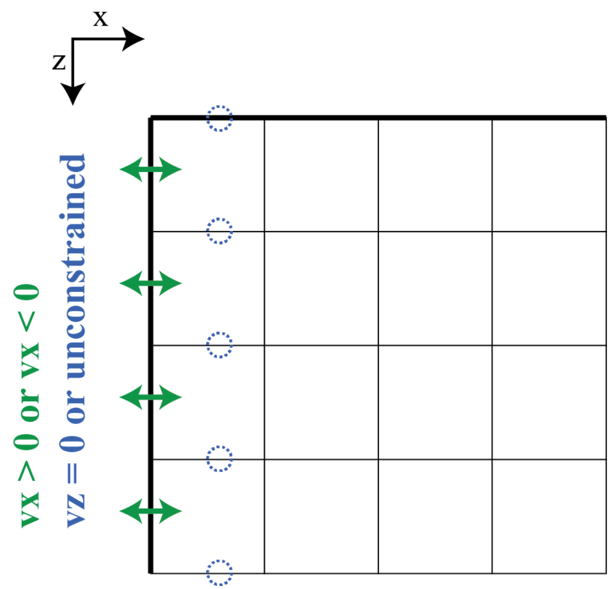




- Whole box is deformed according to given direction
  while keeping top boundary at a constant vertical coordinate

Mechanical Boundary conditions

- **flux**



- This allow to prescribe an “inflow” or “outflow” velocity across boundaries