Bottle in the Sauna

Real-world application using Elmer/ElmerGUI

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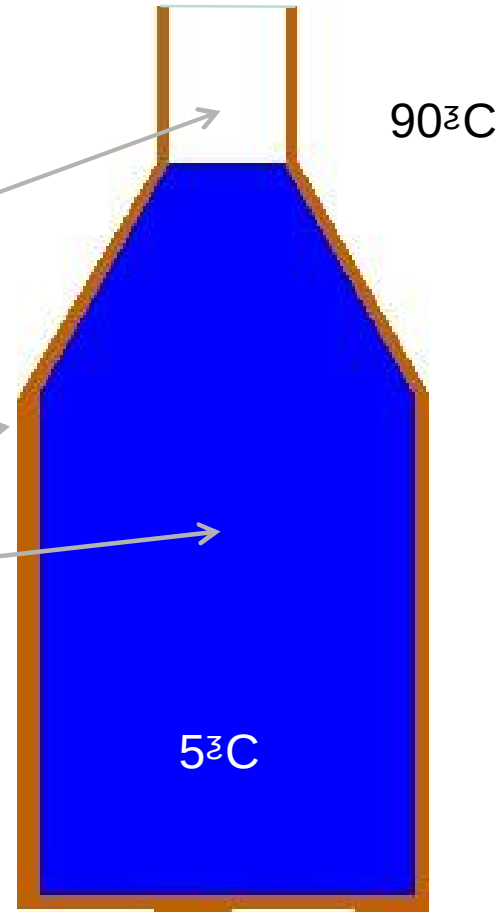
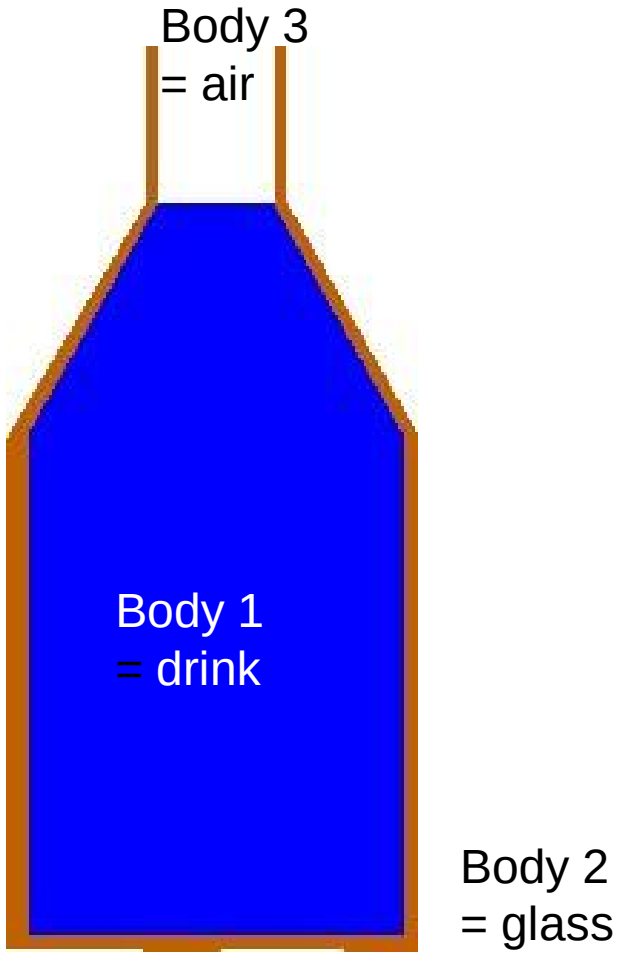
Problem Outline

- Chilled drink (5³C) from fridge in Sauna (90³C)
- Bottle:
  - Air on top
  - Glass (2 mm)
  - Drink
- Task: Temperature after 5 minutes in Sauna?



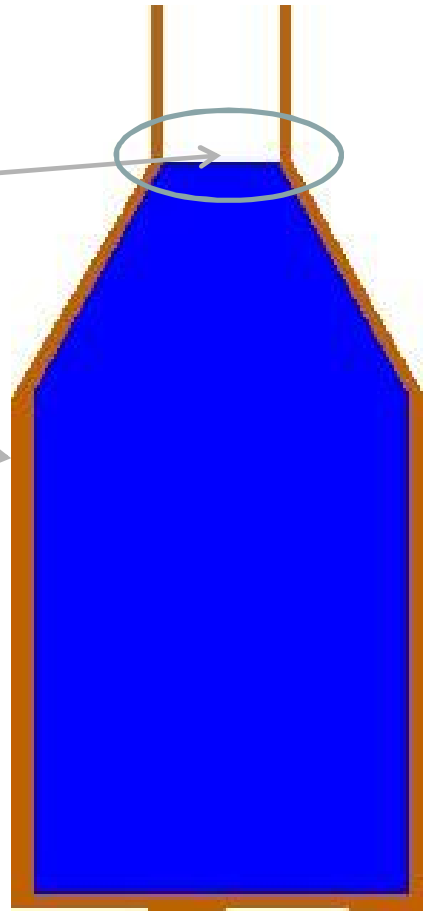
On Bodies and Boundaries

- A **body** is a **distinct region of the model**
- Characterized by **different material** and/or different **physical models**



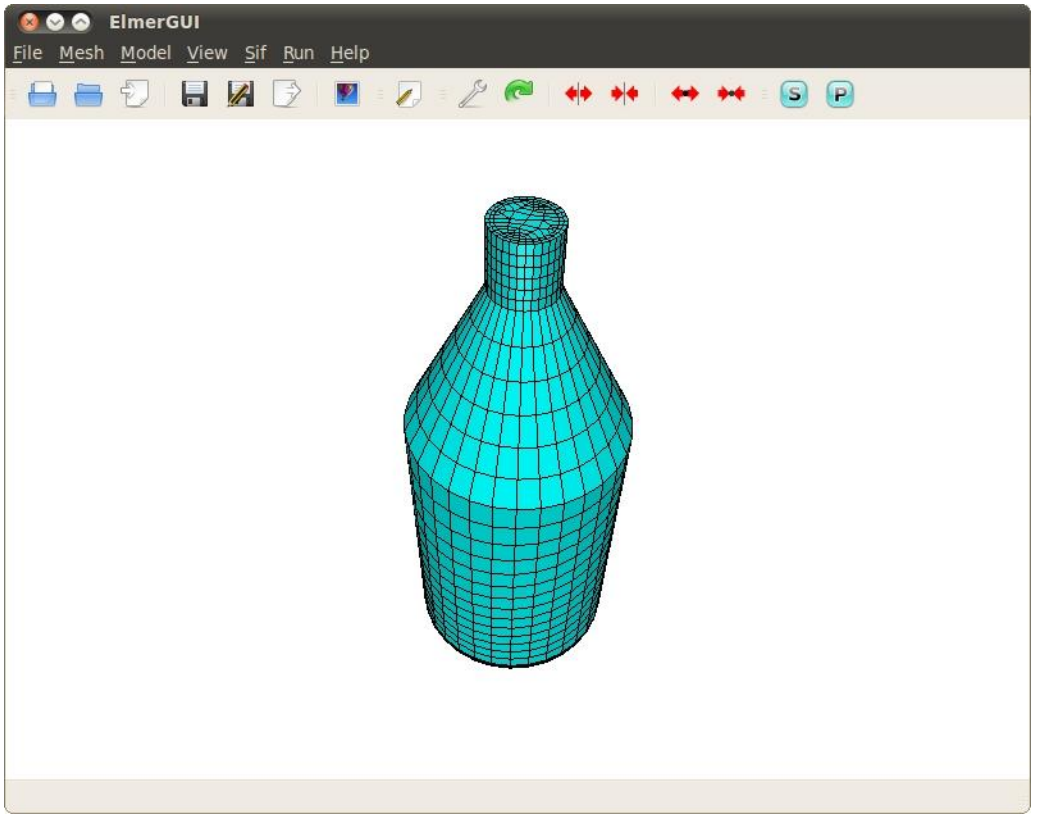
On Bodies and Boundaries

- A **boundary** is a lower dimensional entity between **two bodies** or the **confinement of a body**
- **Boundary conditions:**
  - Dirichlet (value)
  - Neumann (gradient)



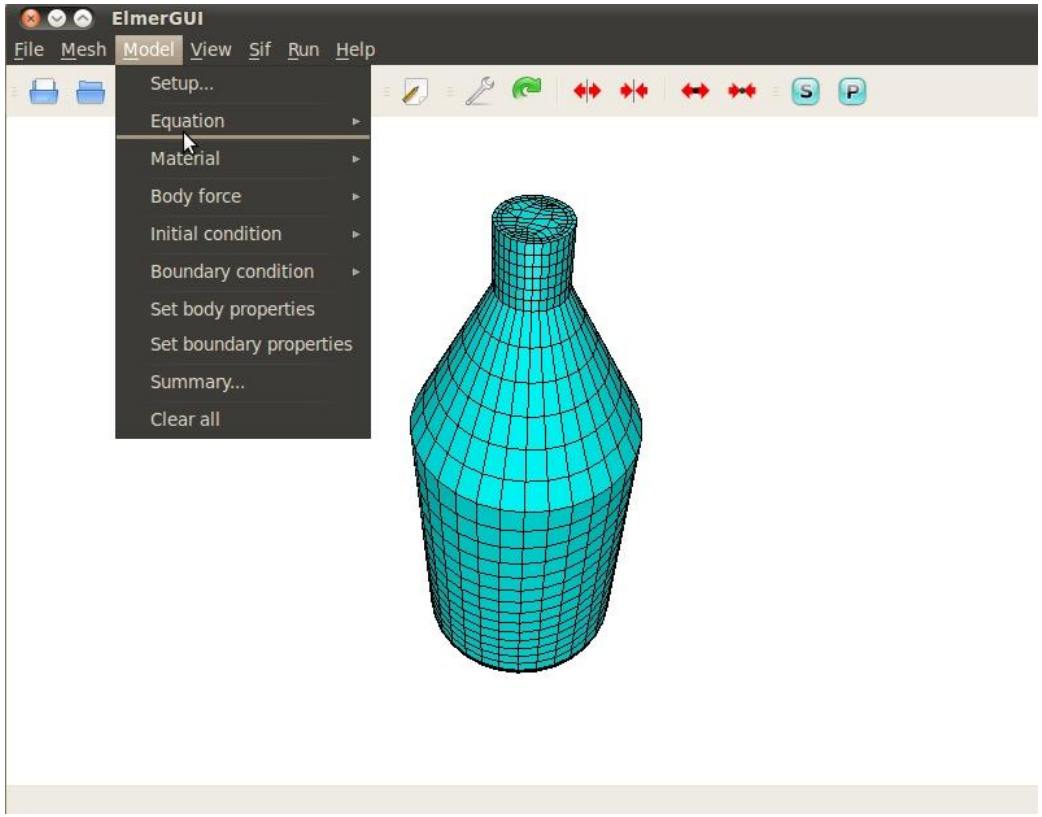
Read the model

- **File Ÿ Open**
- Look for folder containing your files
- Choose (Fidap neutral) `beerbottle.FDNEUT`



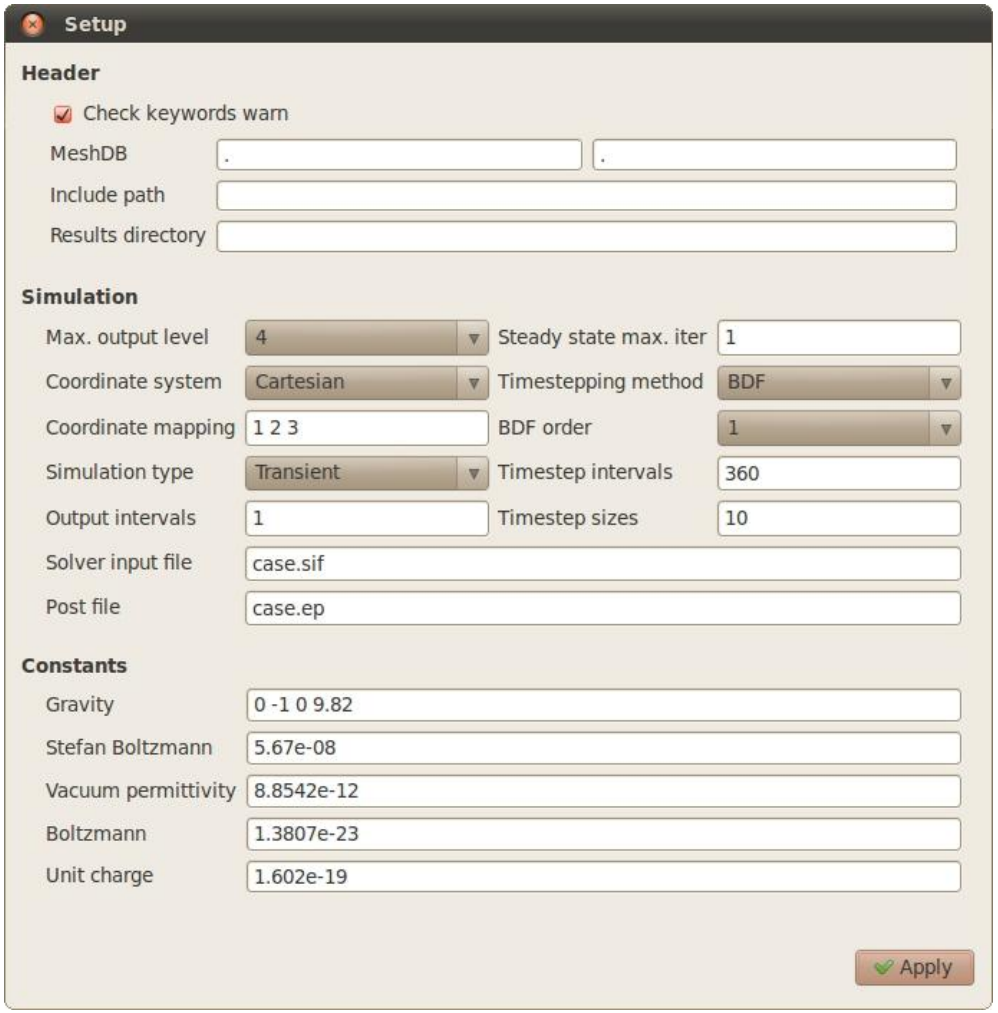
Setup of model

- Chronological order
- Accessed via **Model Ÿ Setup/Equation/...**



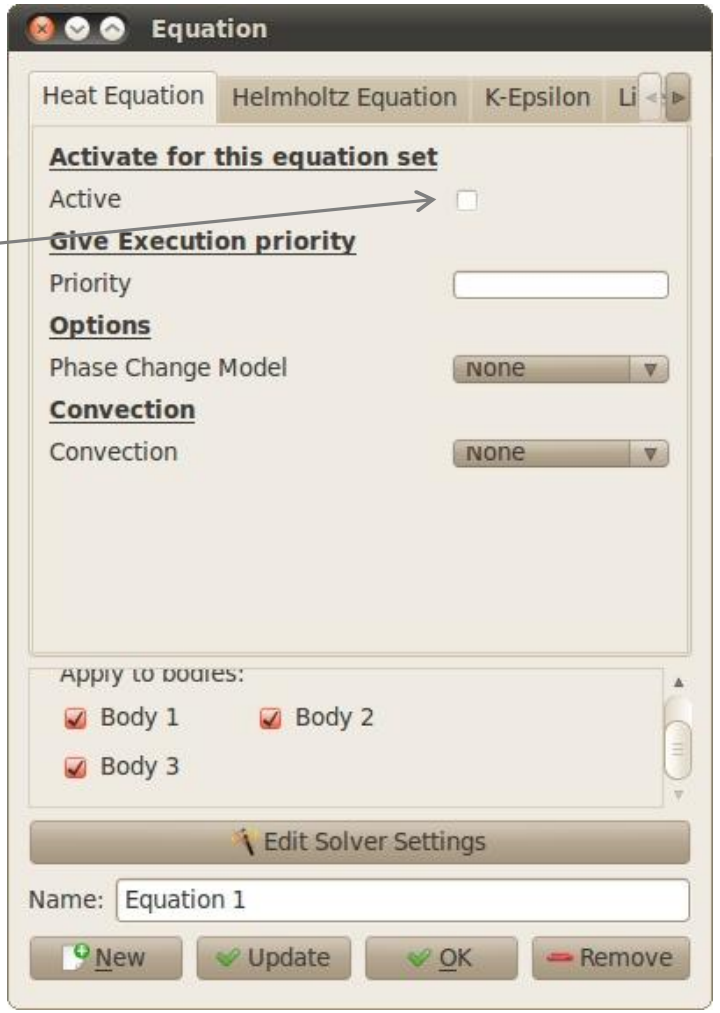
Setup of model

- **Model Ÿ Setup**
- Choose Transient
- Timestep sizes 10
- Timestep intervals 360 (one hour)
- Rest: default
- **Apply**



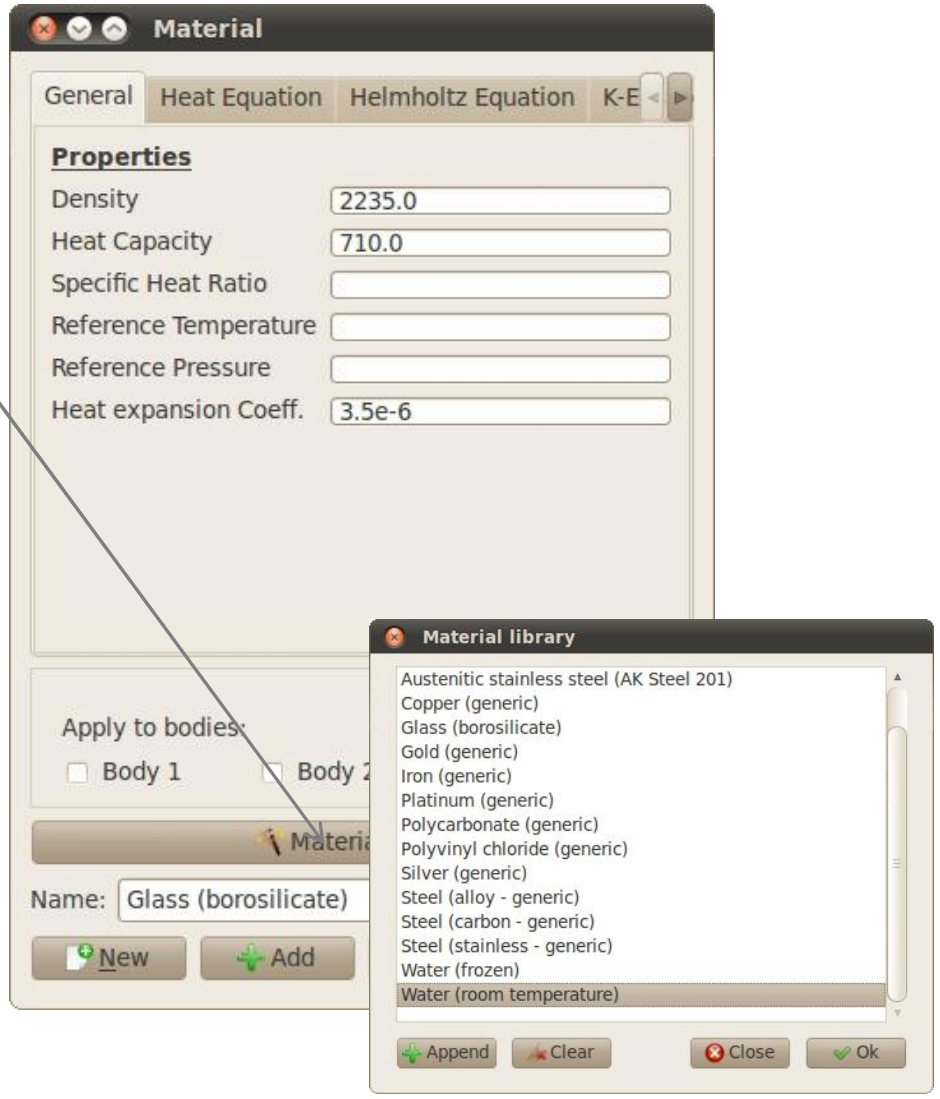
Setup of equation(s)

- **Model Ÿ Equation**
- Tick *Active (!!)*
- Apply to all bodies
- **Update**
- **OK**



Setup of material(s)

- **Model Ÿ Material**
- Use *Material library*
  1. Water(room temperature) for drink
  2. Glass (borosilicate)
  3. Air (room temperature)
- After each, press
  - **OK**
  - **Model Ÿ Material Add...**



Setup of body force(s)

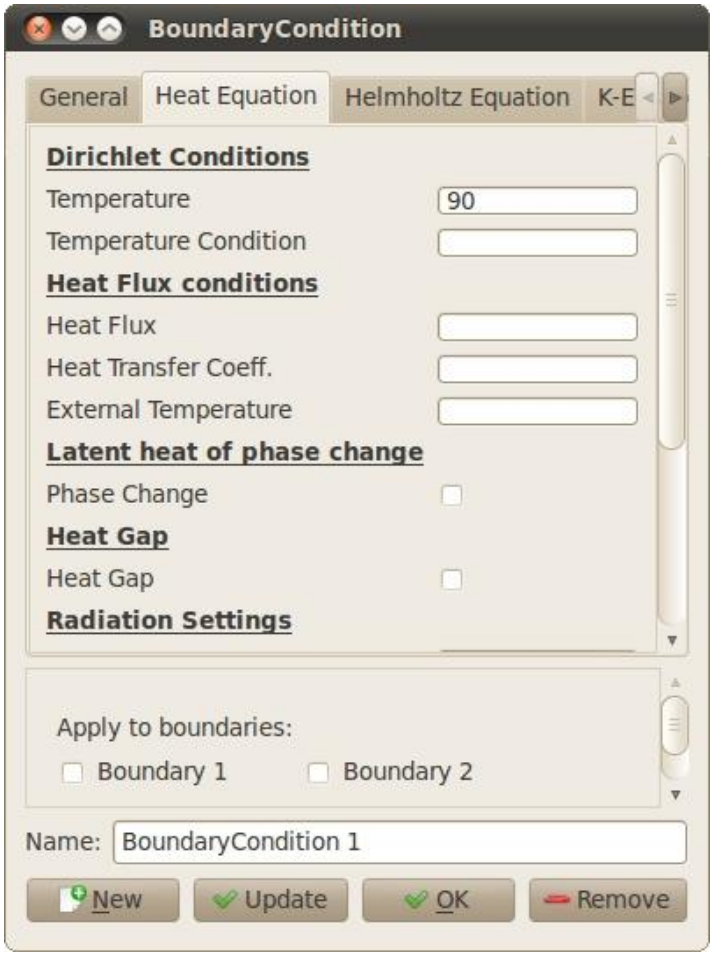
- **Model Ÿ Body Force**
- Use to add òright-hand-sideò of PDE
- For example*:*
  - FlowSolve: gravity
  - HeatSolver: volumetric heat source
  - FreeSurfaceSolver: accumulation/ablation flux
- Not needed this time (so skip it)

Setup of initial condition(s)

- **Model Ÿ Initial condition** Add
- *Heat Equation*
- *Temperature* 5
- Apply to all bodies
- **OK**

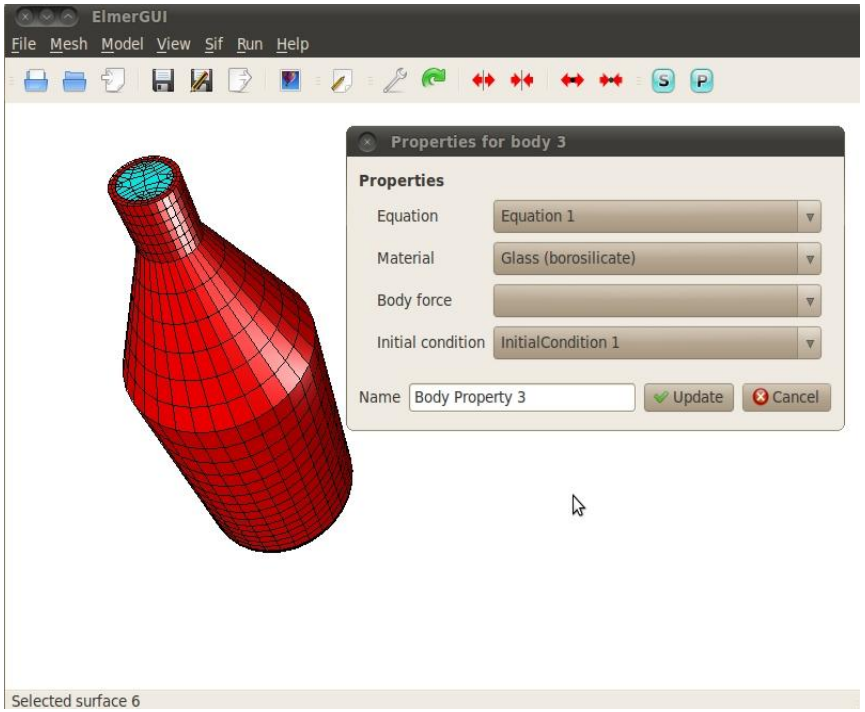
Setup of boundary condition(s)

- **Model Ÿ Initial condition** Add
- *Heat Equation*
- *Temperature* 90
- Do not apply to any boundary
- **Update**
- **OK**



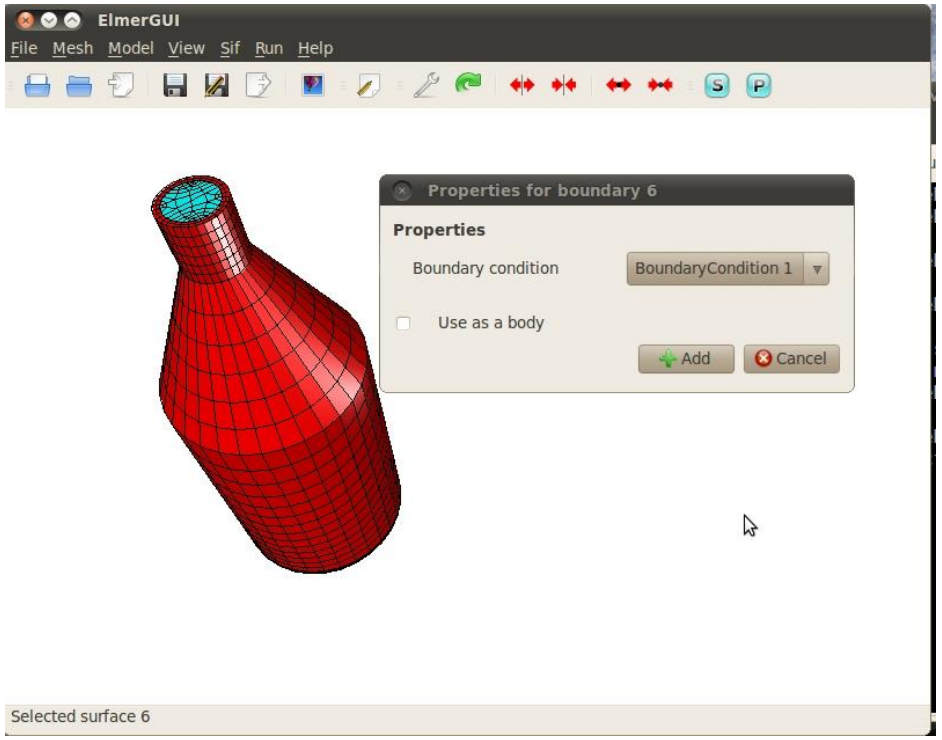
Assignement of bodies boundary conditions

- **Model Ÿ Set body properties**
- Double click on glass
  - ï Assign Material *Glass*
  - ï Assign *Initial Condition 1*
- Same with air and water
- Hint: hide active bodies with Ctrl+H
- **Update**



Assignement of bodies boundary conditions

- **Model Ÿ Set boundary properties**
- Double click on outside of glass
  - Assign *Boundary Condition 1*
- **Add**



Towards the simulation

- **Model Ÿ Summary ...**
  - Checks for consistency of input
- **SIF Ÿ Generate** (Ctrl+G)
  - SIF = Solver Input File
- Save (mesh and SIF) 
- Save (project) 
- Congratulations! You are done.
- Run the simulation by pressing 

Controll the simulation

- A log-window and a graphical convergence history is opening
- During the simluation, the symbol  stays red
- Kill the simulation by:

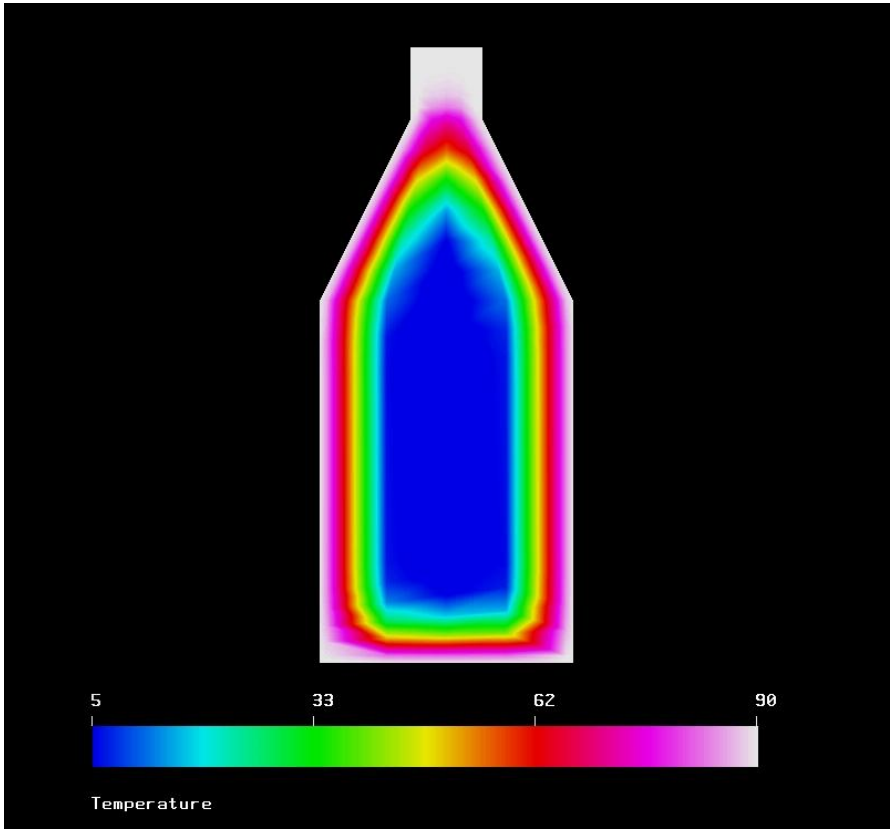
  Run Ÿ  **Kill Solver**

Post-processing

- Press the symbol 
- ElmerPost is launched
- In order to load all timesteps:
  - Read Model File + *Select Time Steps*: All
  - **Use Edit Ÿ Timestep Controll**

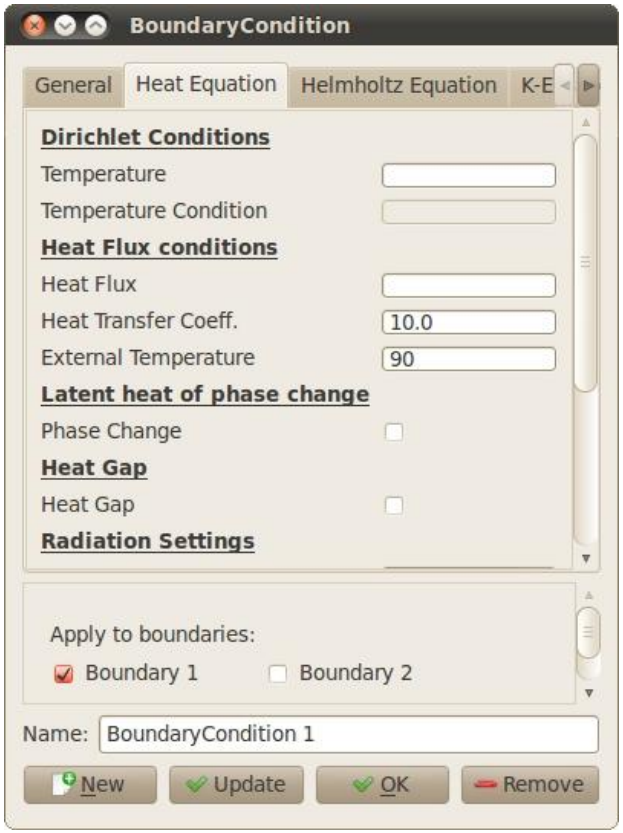
Post-processing

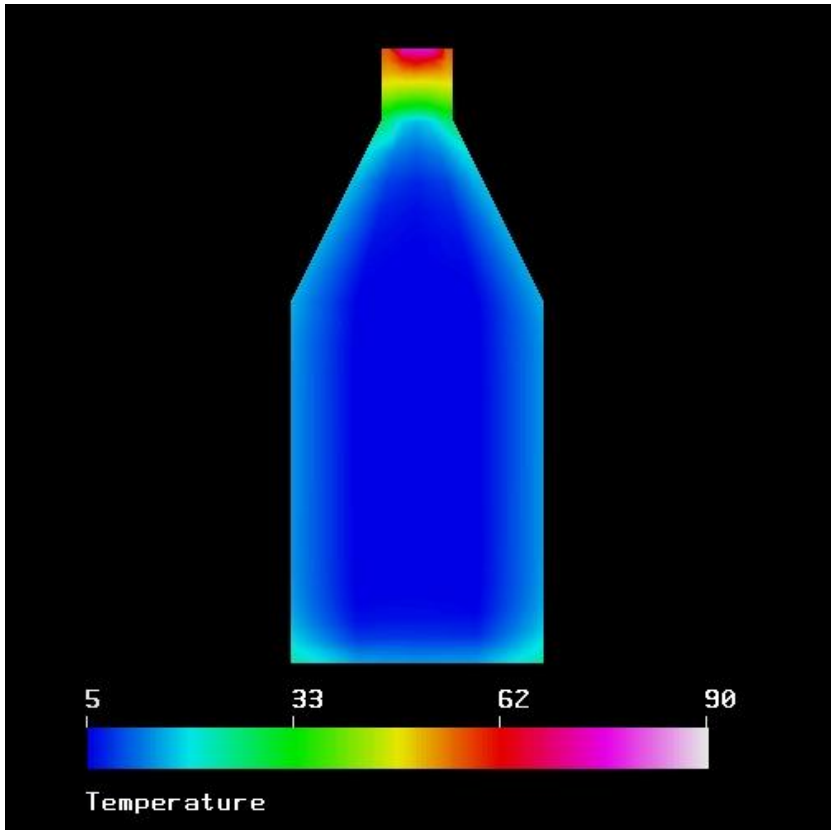
- Temperature is much to quickly rising
- Wrong physics in boundary condition?



Temperatures after 5 minutes

Physically more sane boundary condition





Temperatures after 5 minutes