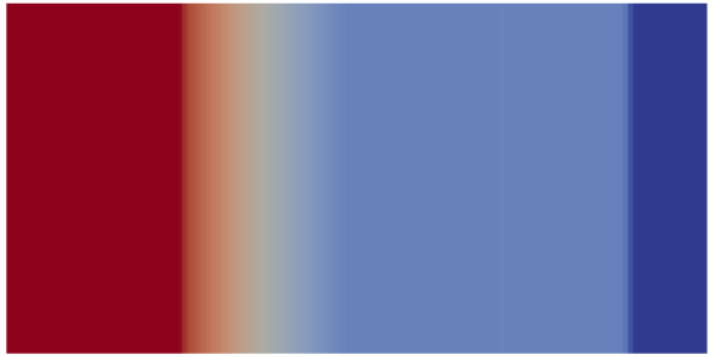
Shock Tube with *rhoCentralFoam*, *sonicFoam*, Lax-Friedrichs and MacCormacks



Hypothesis

- Compressible flow
- Viscous flow
- Bi-dimensional flow $\left(\frac{\partial}{\partial z} = 0\right)$
- Laminar

Temperature

$$P = \rho RT$$

$R = 286.9$ J/Kg.K.

$P_1 = 100{,}000$ N/m^2
$\rho_1 = 1$ kg/m^3

$P_2 = 10{,}000$ N/m^2
$\rho_2 = 0.125$ kg/m^3

Hence,

$T_1 = 348.432$ K

$T_2 = 278.746$ K

Respectively,

$\mu_1 = 2.099e\text{-}05$

$\mu_1 = 1.764e\text{-}05$

$\mu_{avg} = 1.932e\text{-}05$

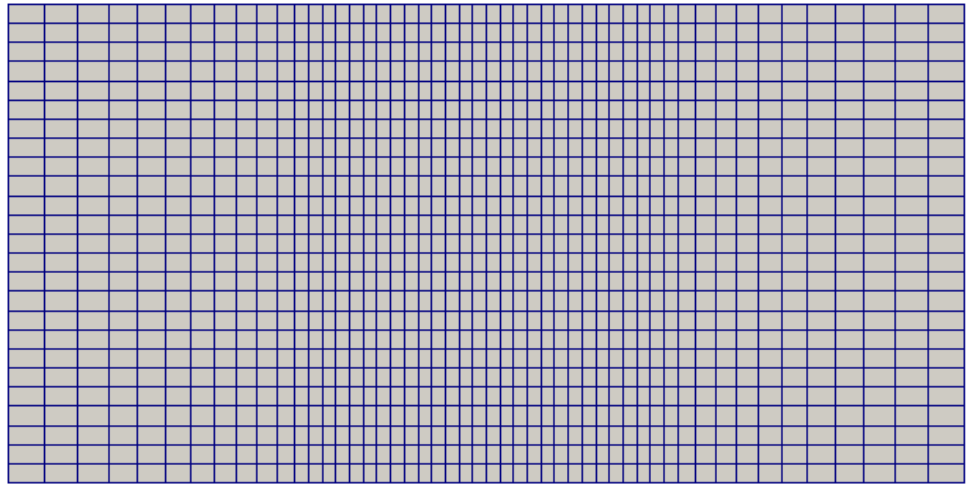
Mesh

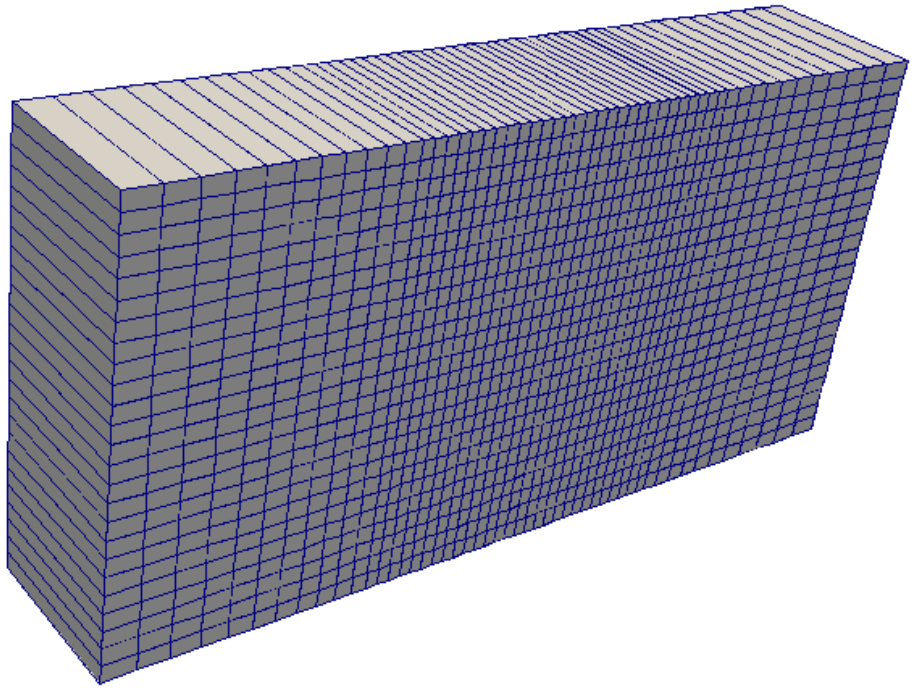
Geometry size is 10*5*2

[-5 -2.5 -1] to [5 2.5 1]

```
vertices
(
    (-5 -2.5 -1)
    (5 -2.5 -1)
    (5 2.5 -1)
    (-5 2.5 -1)
    (-5 -2.5 1)
    (5 -2.5 1)
    (5 2.5 1)
    (-5 2.5 1)
);

blocks
(
    hex (0 1 2 3 4 5 6 7) (300 150 1)
    simpleGrading
    (
      (
            (30 22.5 0.5)
            (40 55 1)
            (30 22.5 2)
      )
      1
      1
    )
);
```

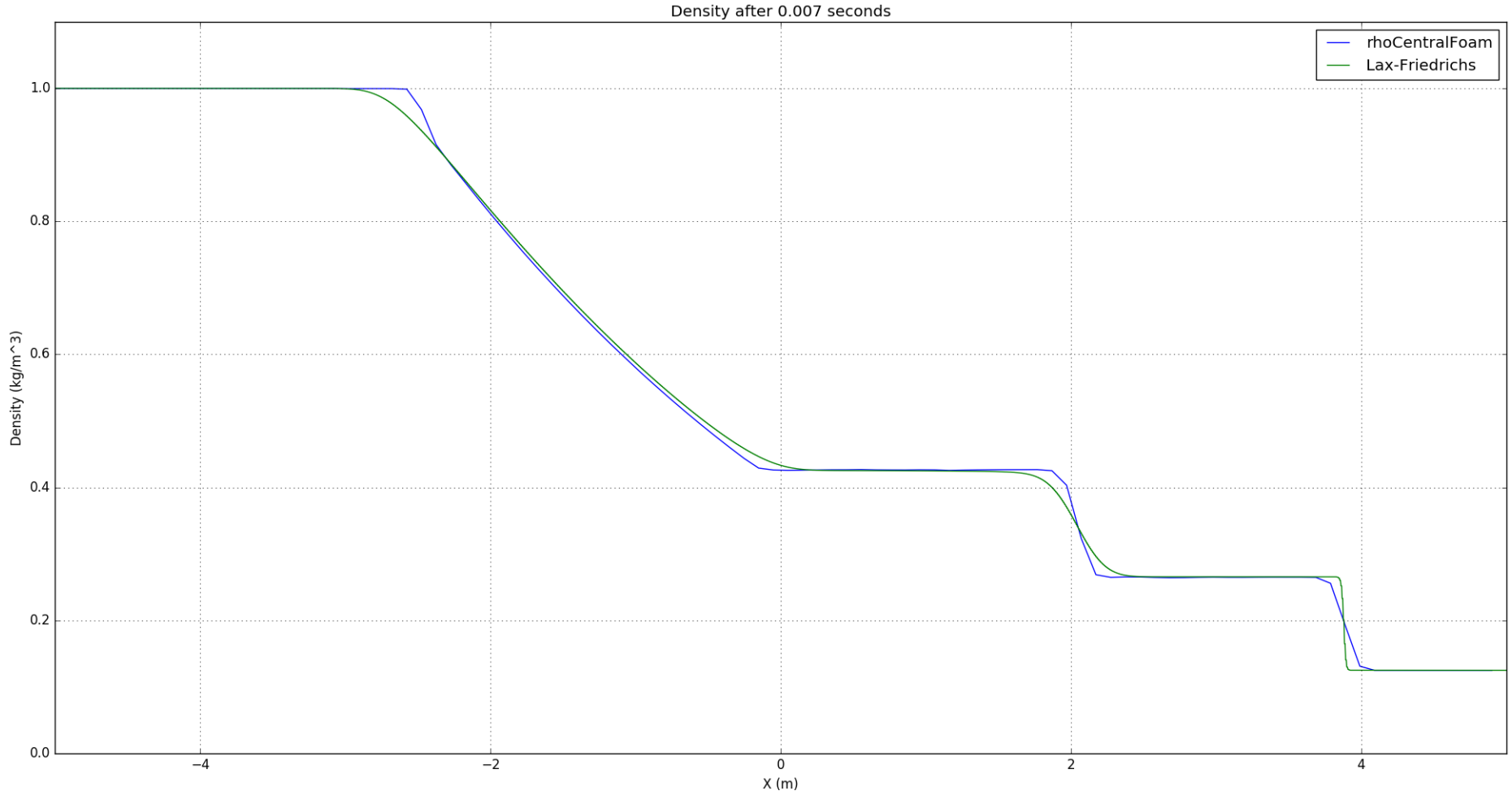




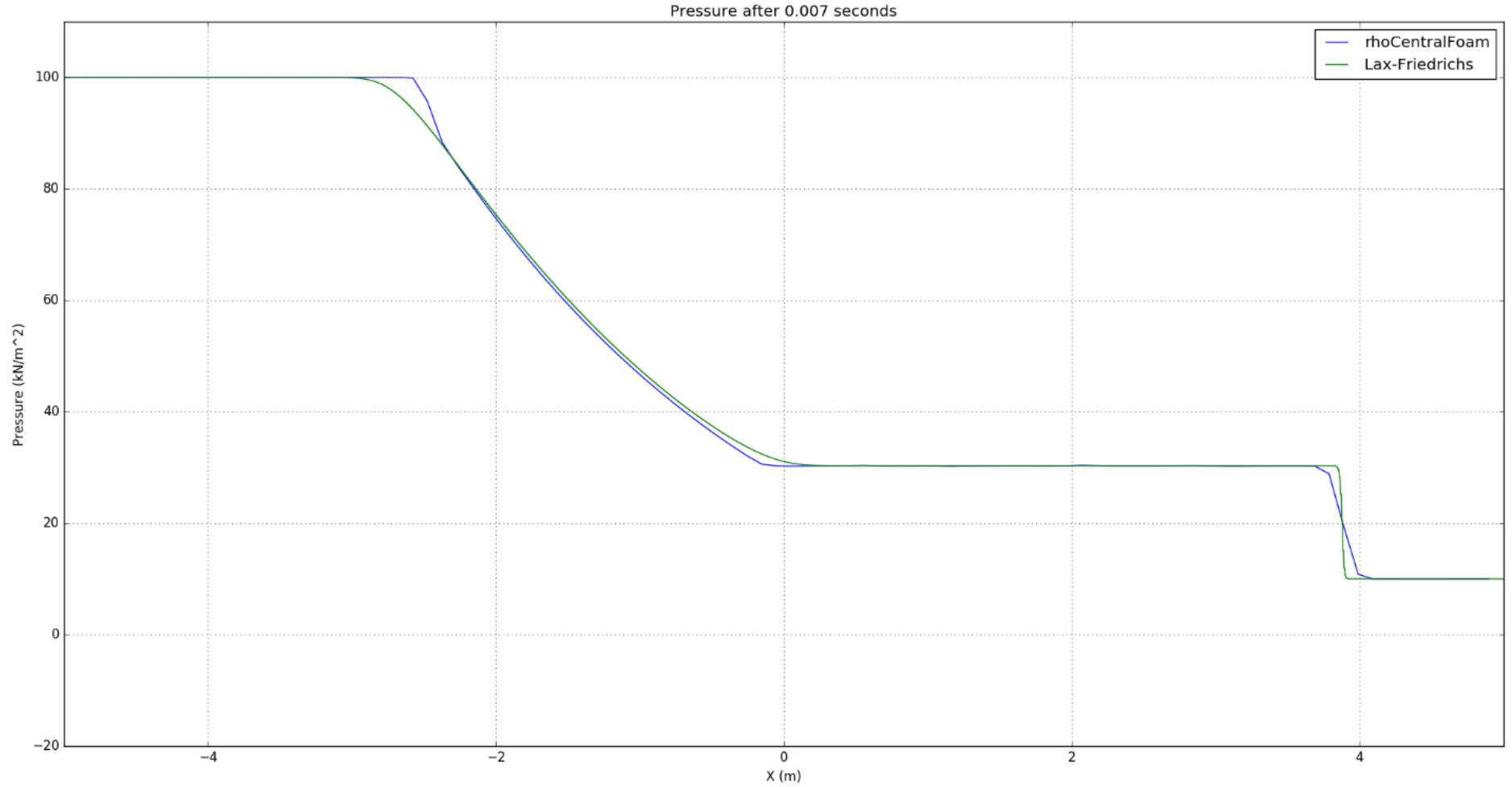
rhoCentralFoam

$$rhoCentralFoam \begin{cases} 0 \begin{cases} p \\ T \\ U \end{cases} \\ constant \begin{cases} polyMesh\{blockMeshDict \\ thermophysicalProperties \\ turbulenceProperties \end{cases} \\ system \begin{cases} controlDict \\ fvSchemes \\ fvSolution \\ sampleDict \\ setFieldsDict \end{cases} \end{cases}$$

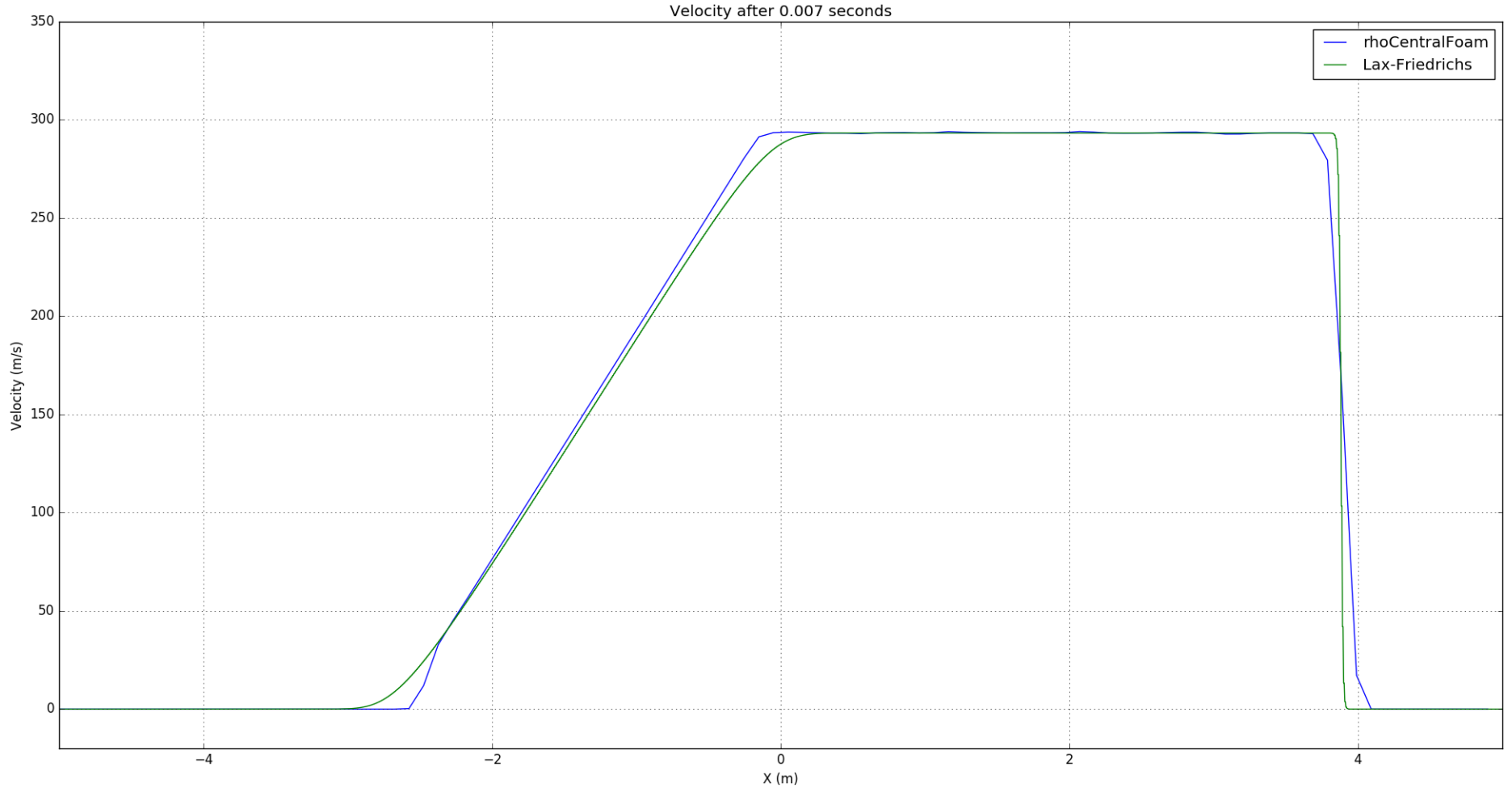
rhoCentralFoam vs Lax Friedrichs



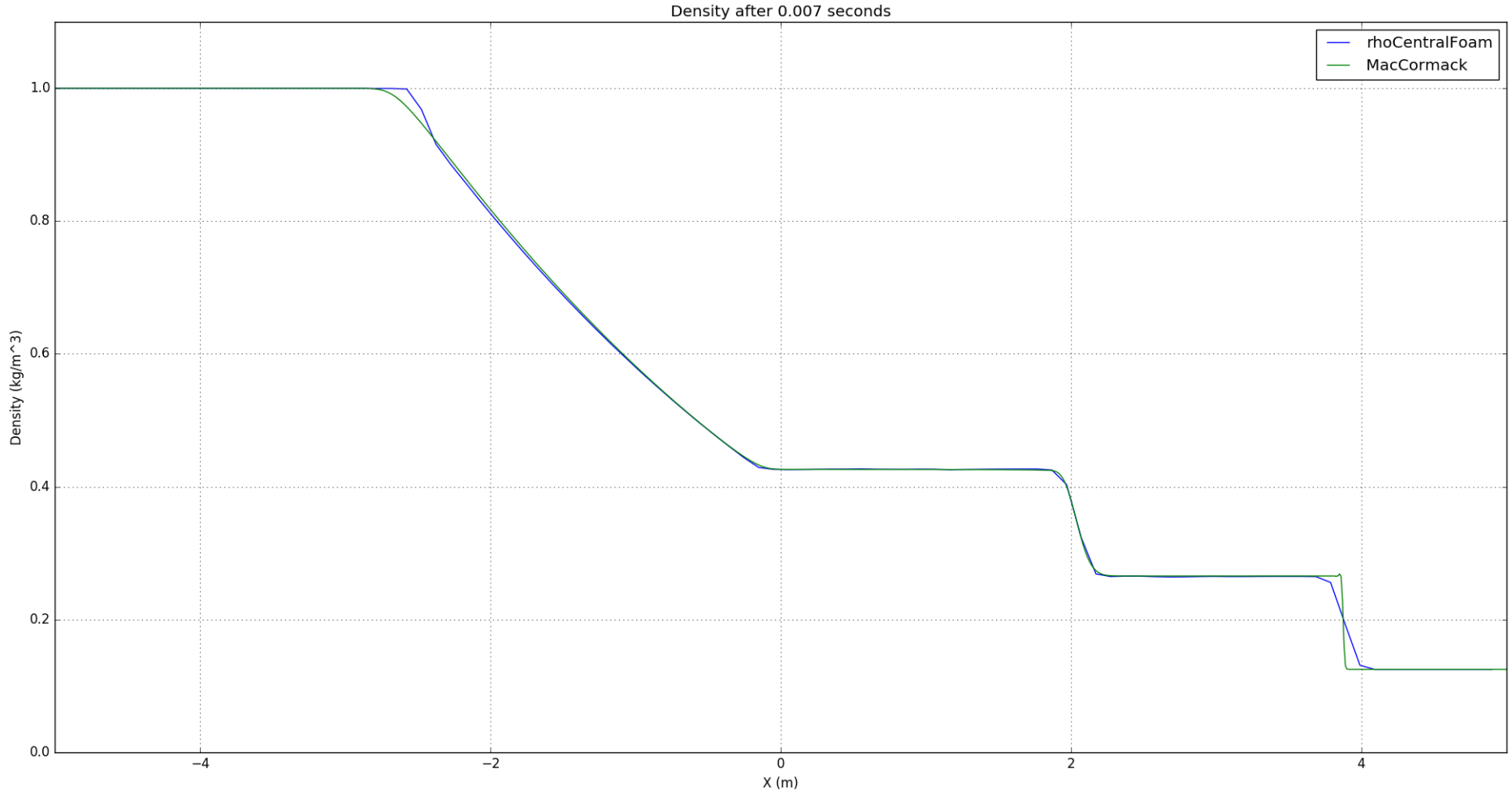
rhoCentralFoam vs Lax Friedrichs



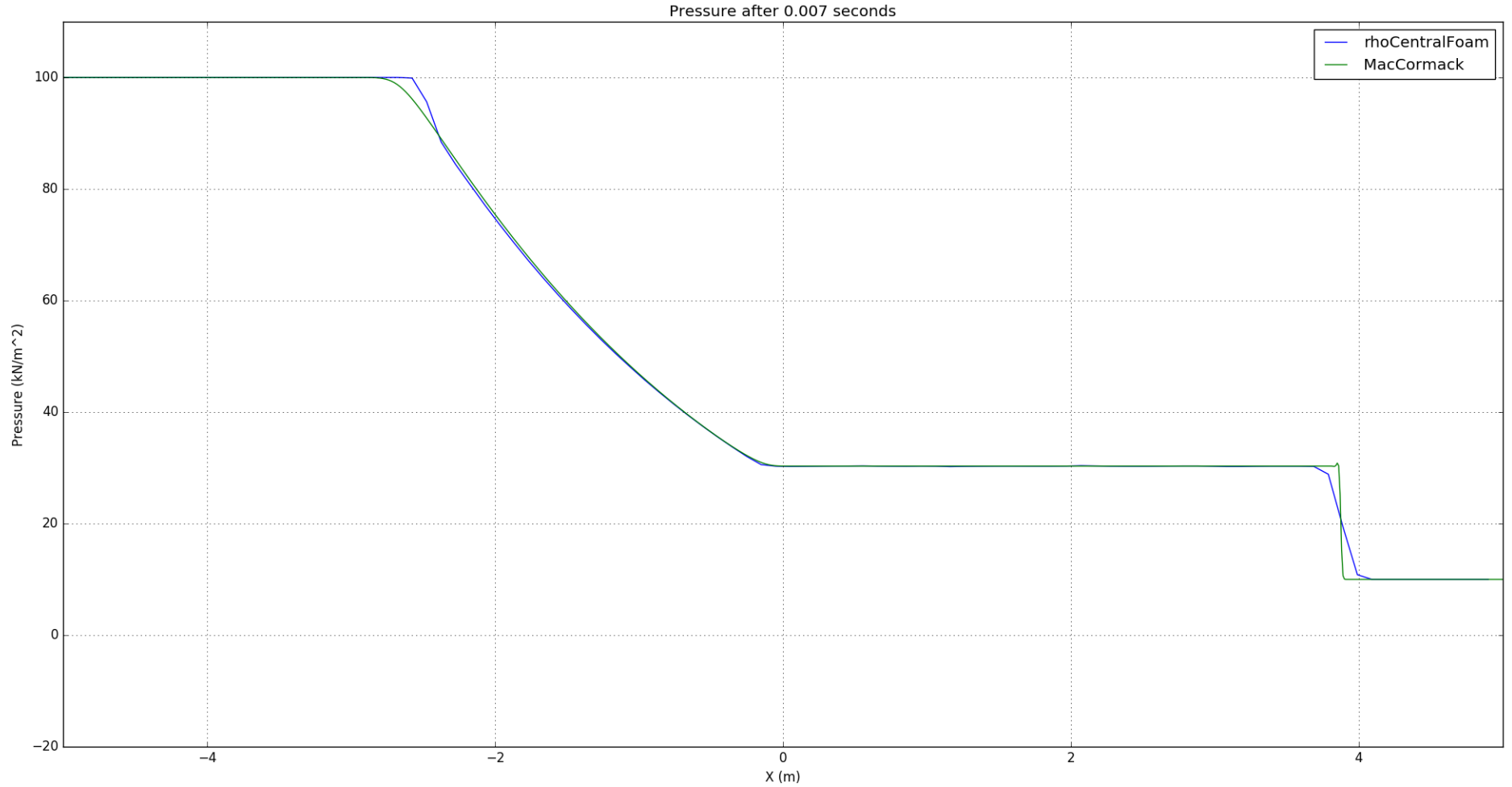
rhoCentralFoam vs Lax Friedrichs



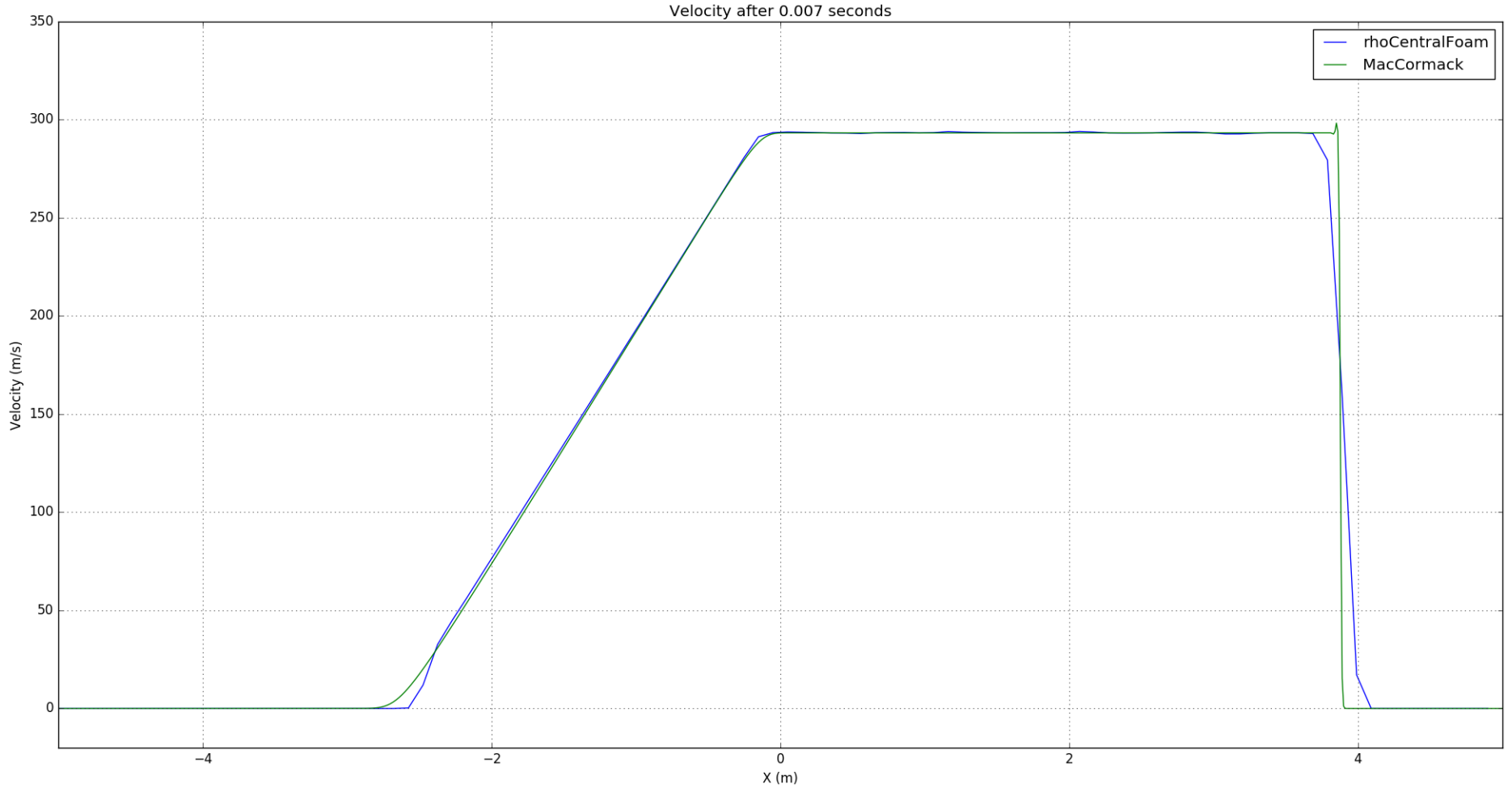
rhoCentralFoam vs MacCormack



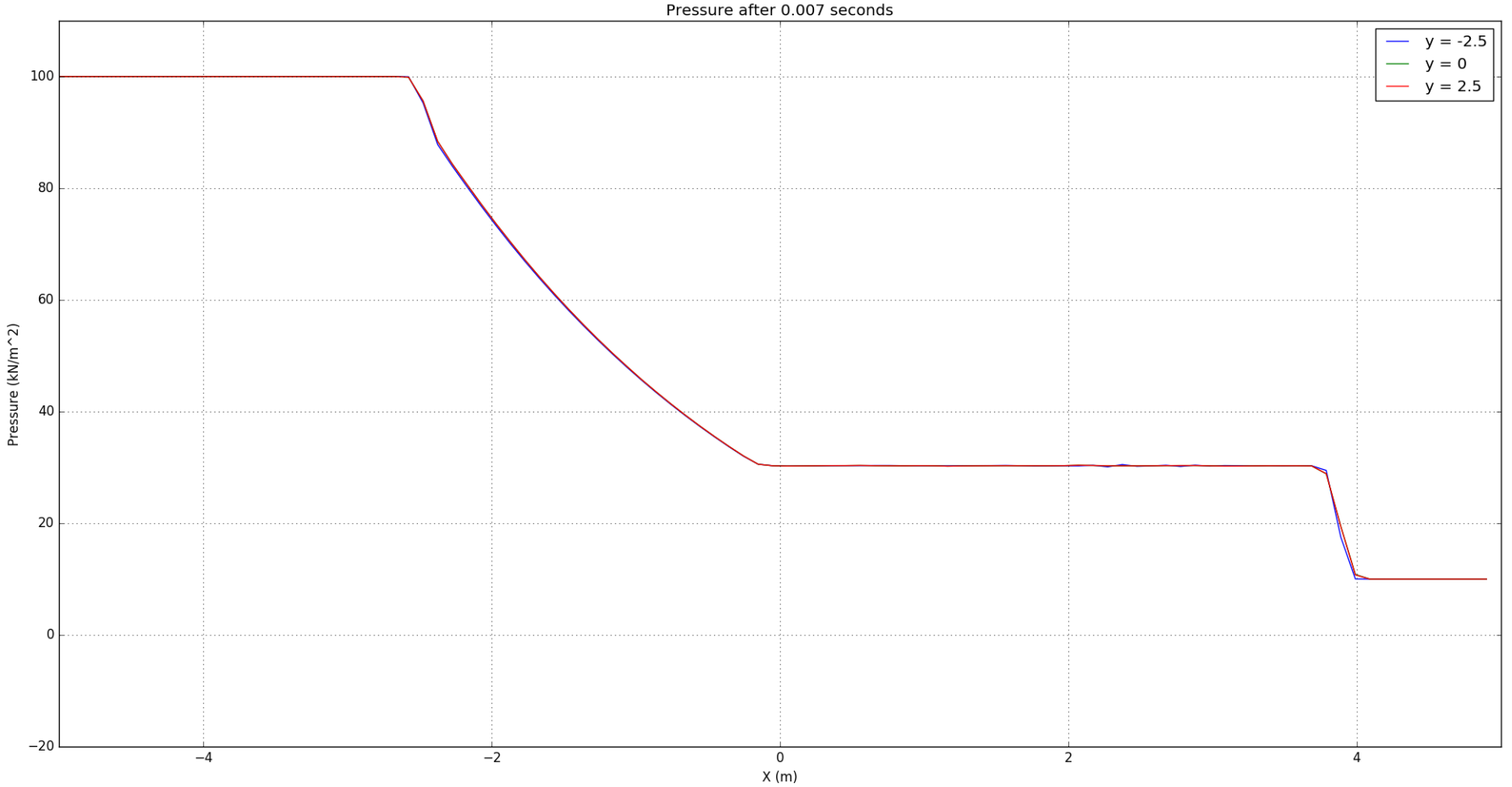
rhoCentralFoam vs MacCormack



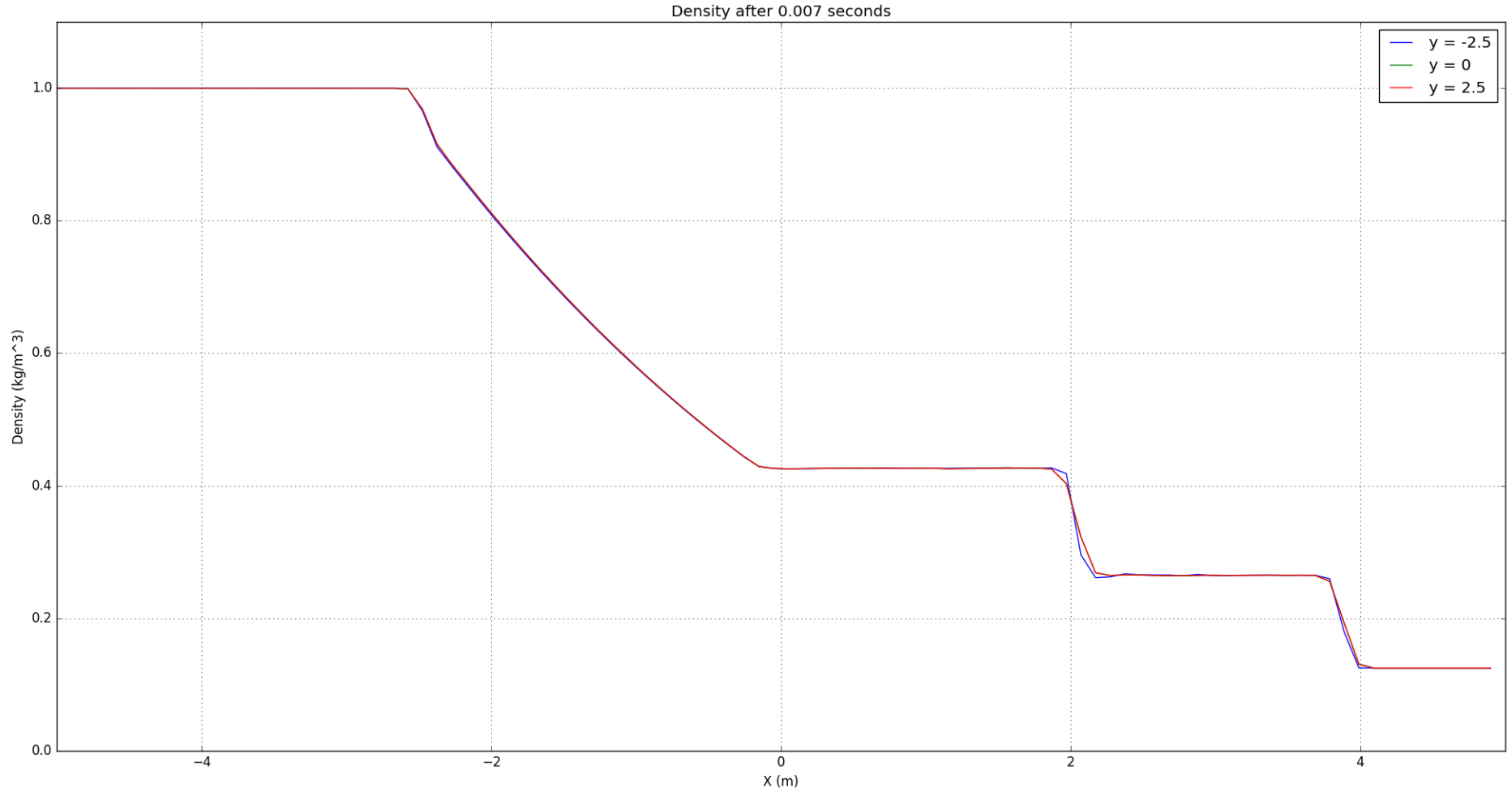
rhoCentralFoam vs MacCormack



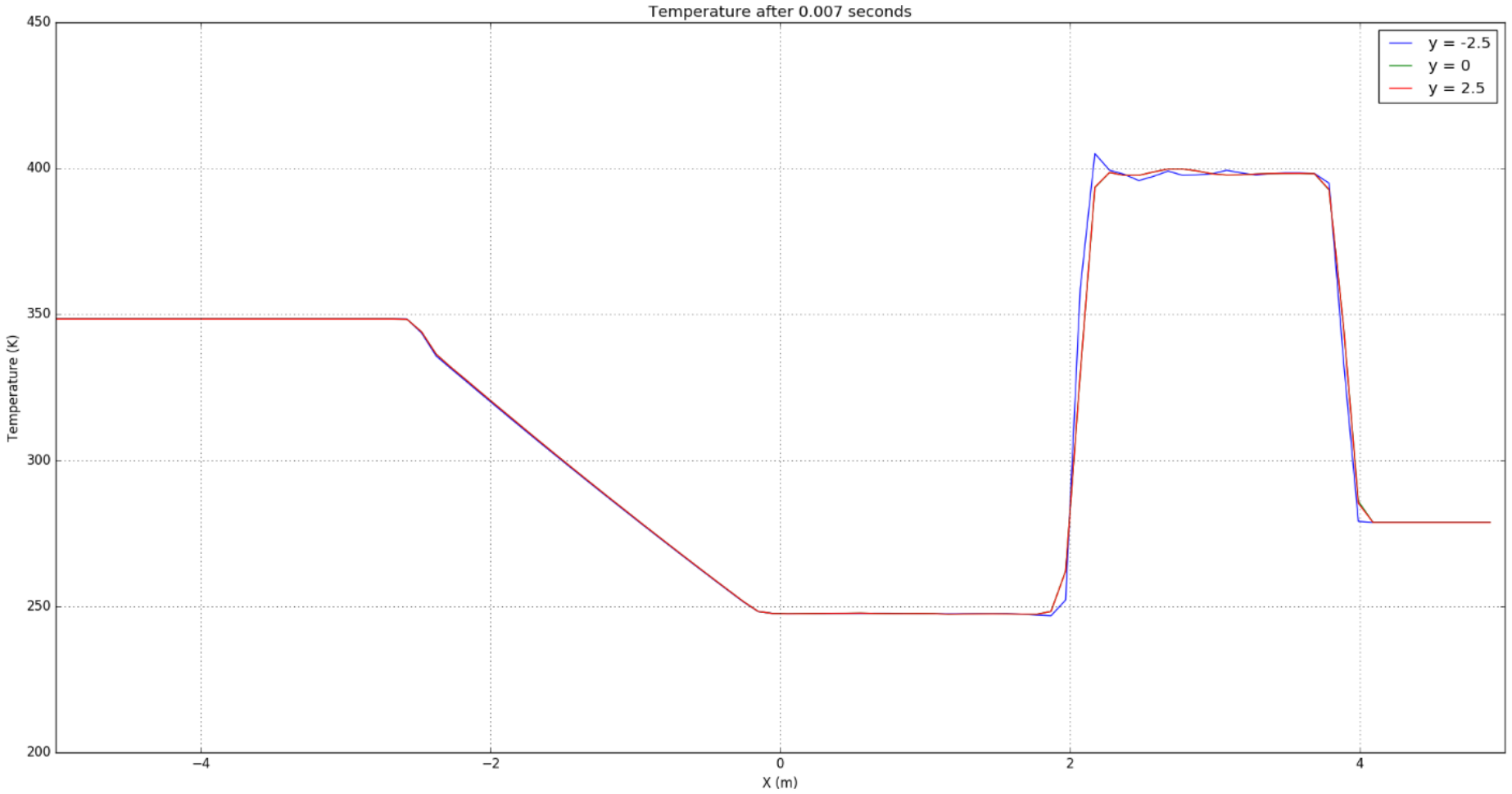
rhoCentralFoam



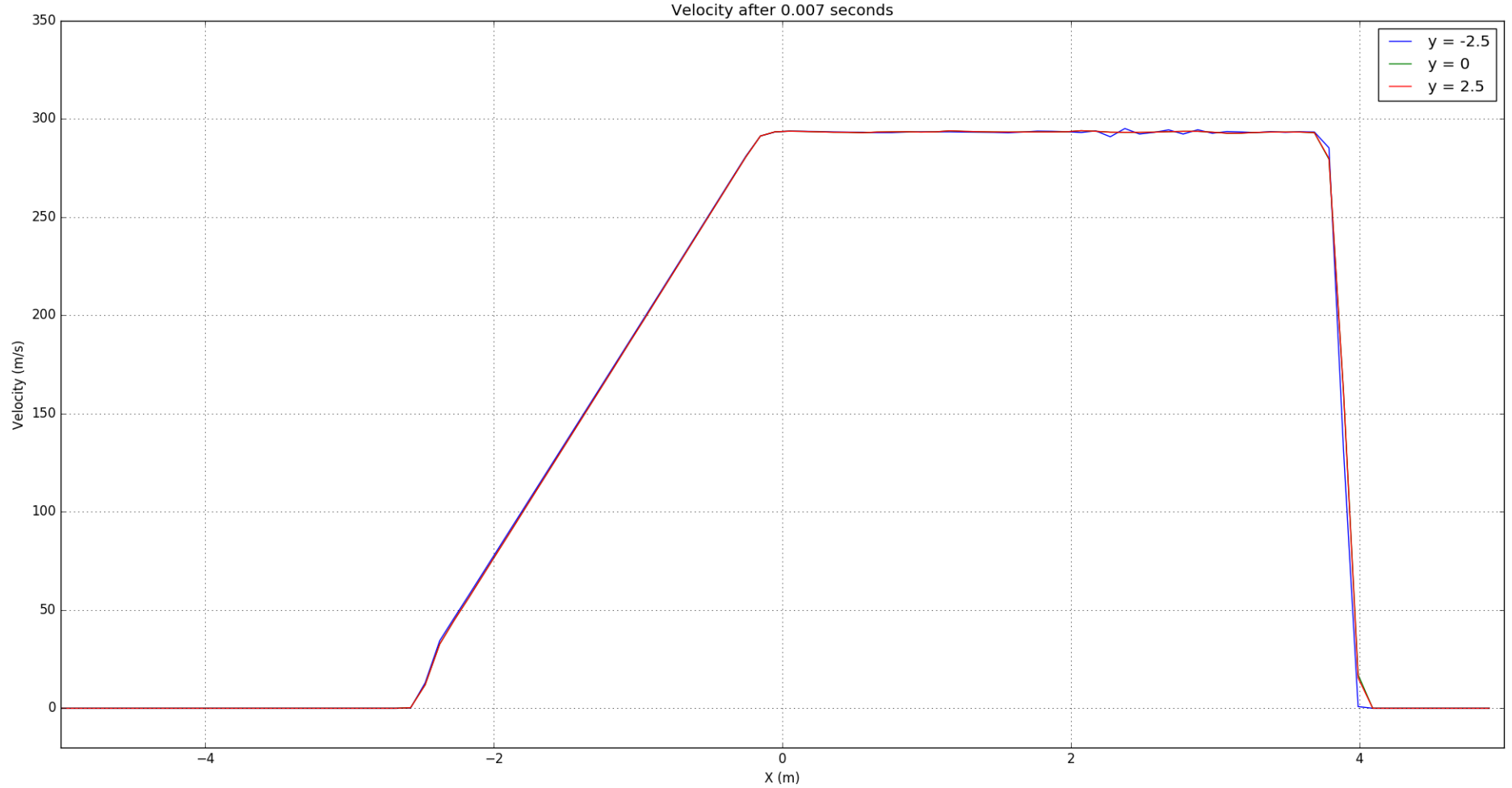
rhoCentralFoam



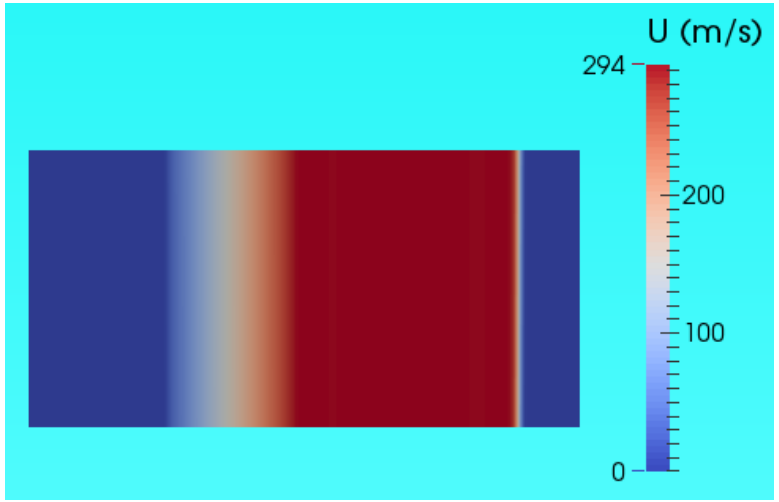
rhoCentralFoam

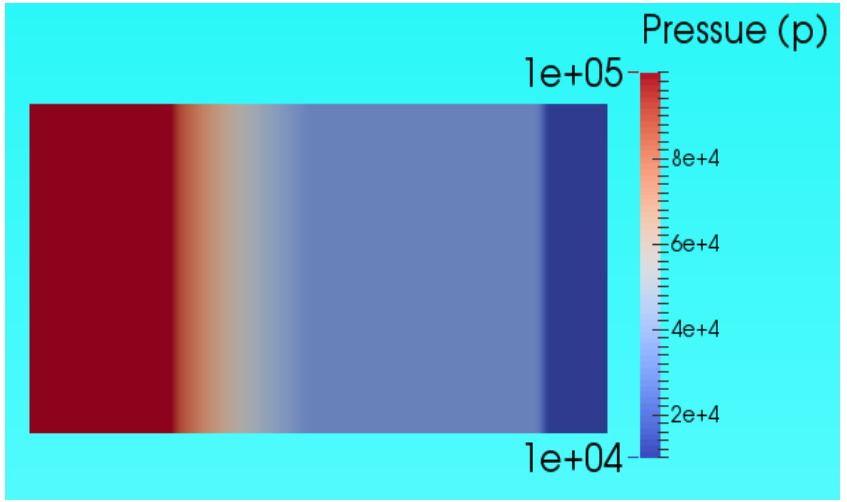


rhoCentralFoam

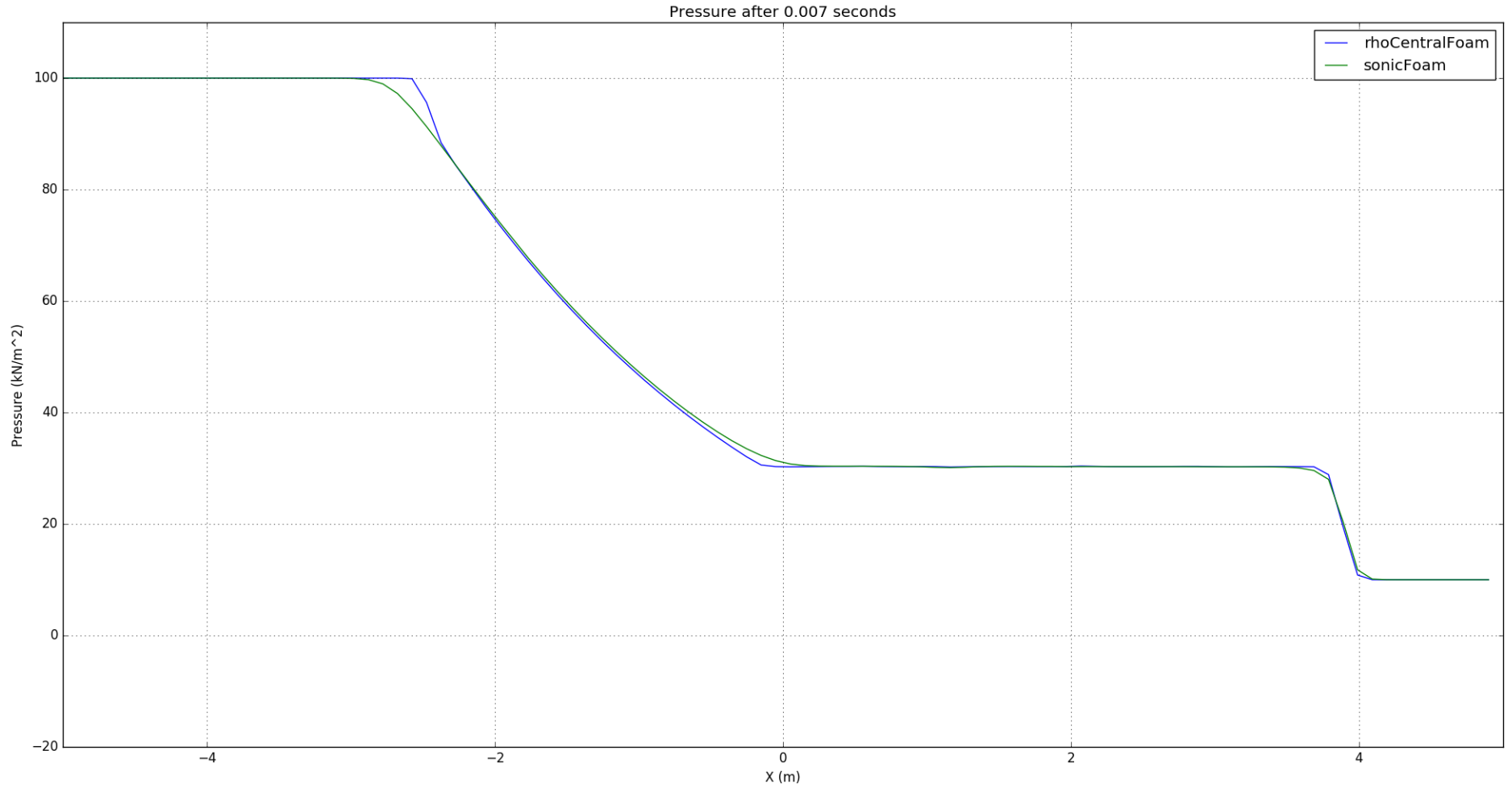


rhoCentralFoam

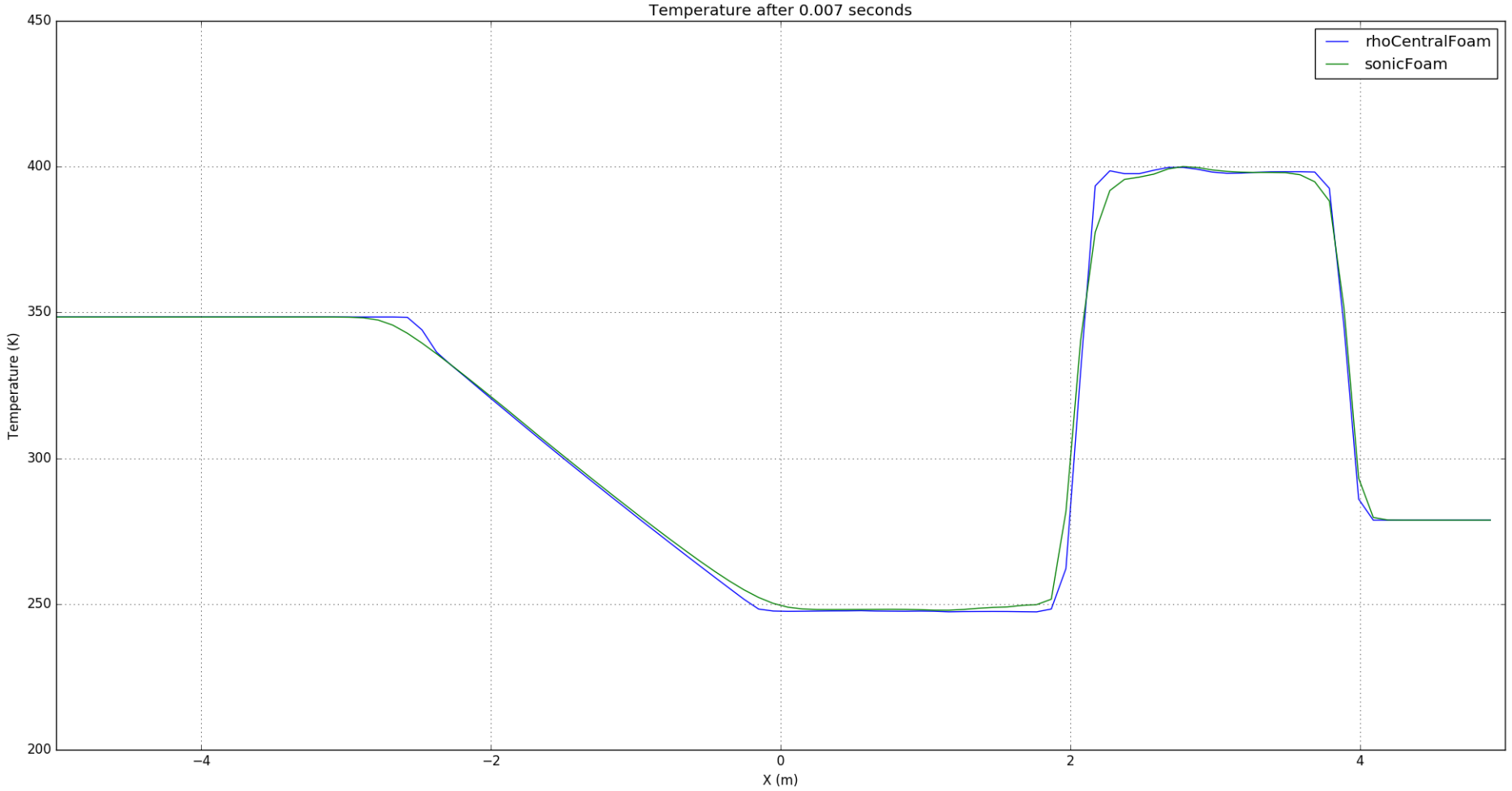




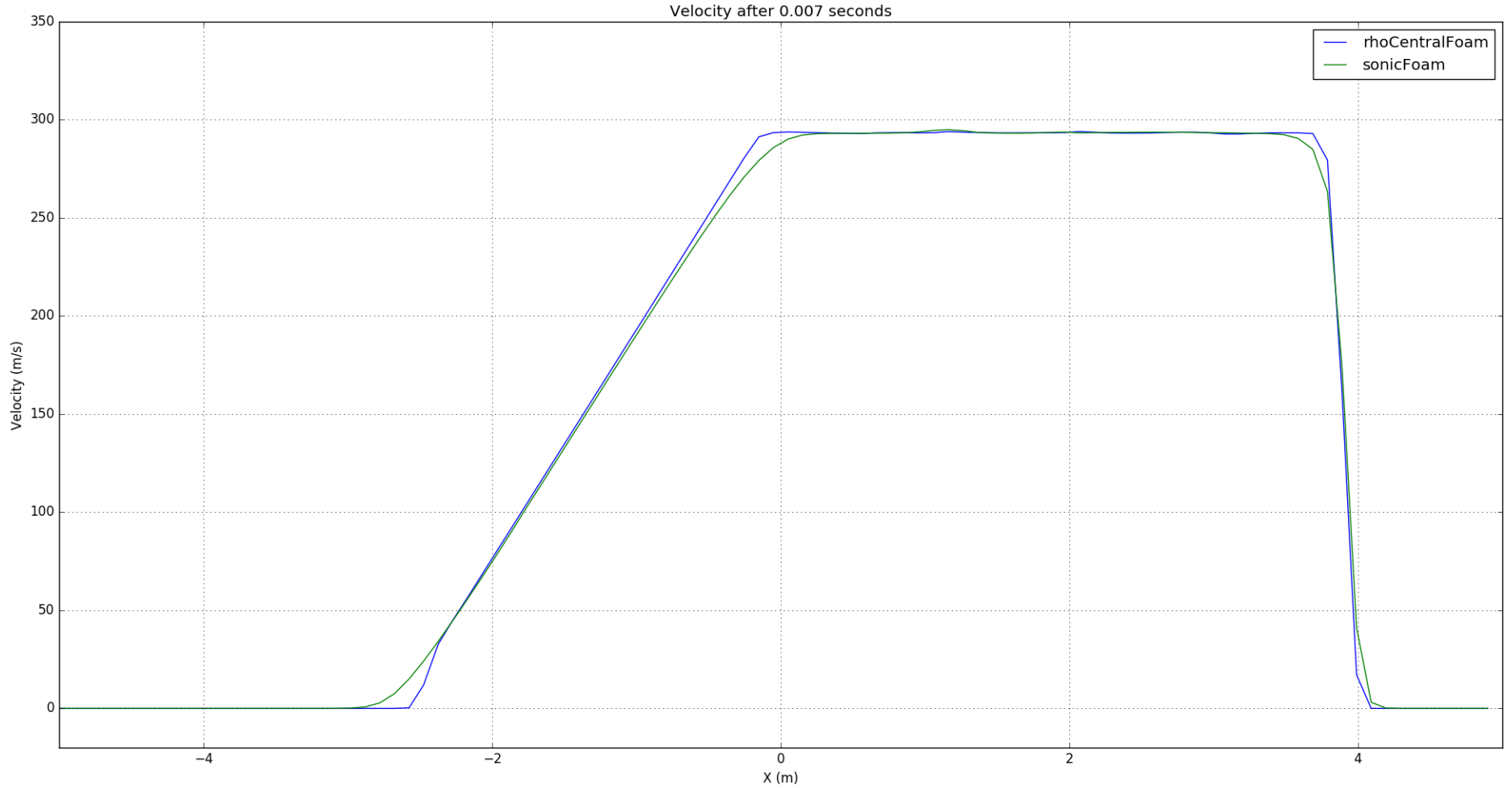
rhoCentralFoam vs *sonicFoam*



rhoCentralFoam vs *sonicFoam*



rhoCentralFoam vs *sonicFoam*



Conclusions

- rhoCentralFoam works well and in coherence with MacCormack solution
- Minor changes in physical properties by introducing viscosity
- rhoCentralFoam is more accurate than sonicFoam
- rhoCentralFoam is faster solver than sonicFoam


Thank You