High order methods in Numerical Relativity

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BAMPS meeting, July 28th, 2020

1. Project: Entropy viscosity method

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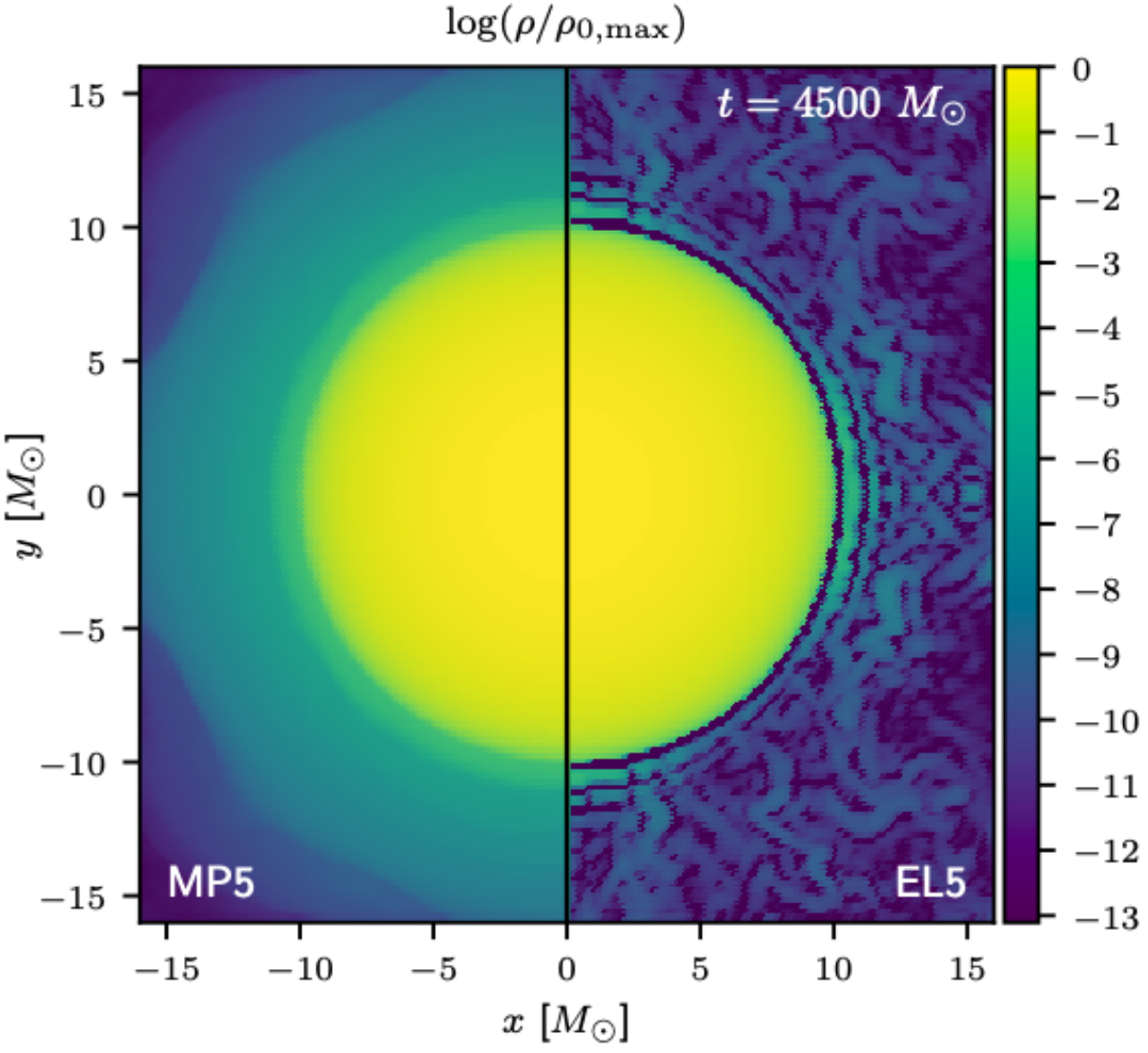

Figure 1: Taken from [1]

How does it work? [2], [3]

Conservation law

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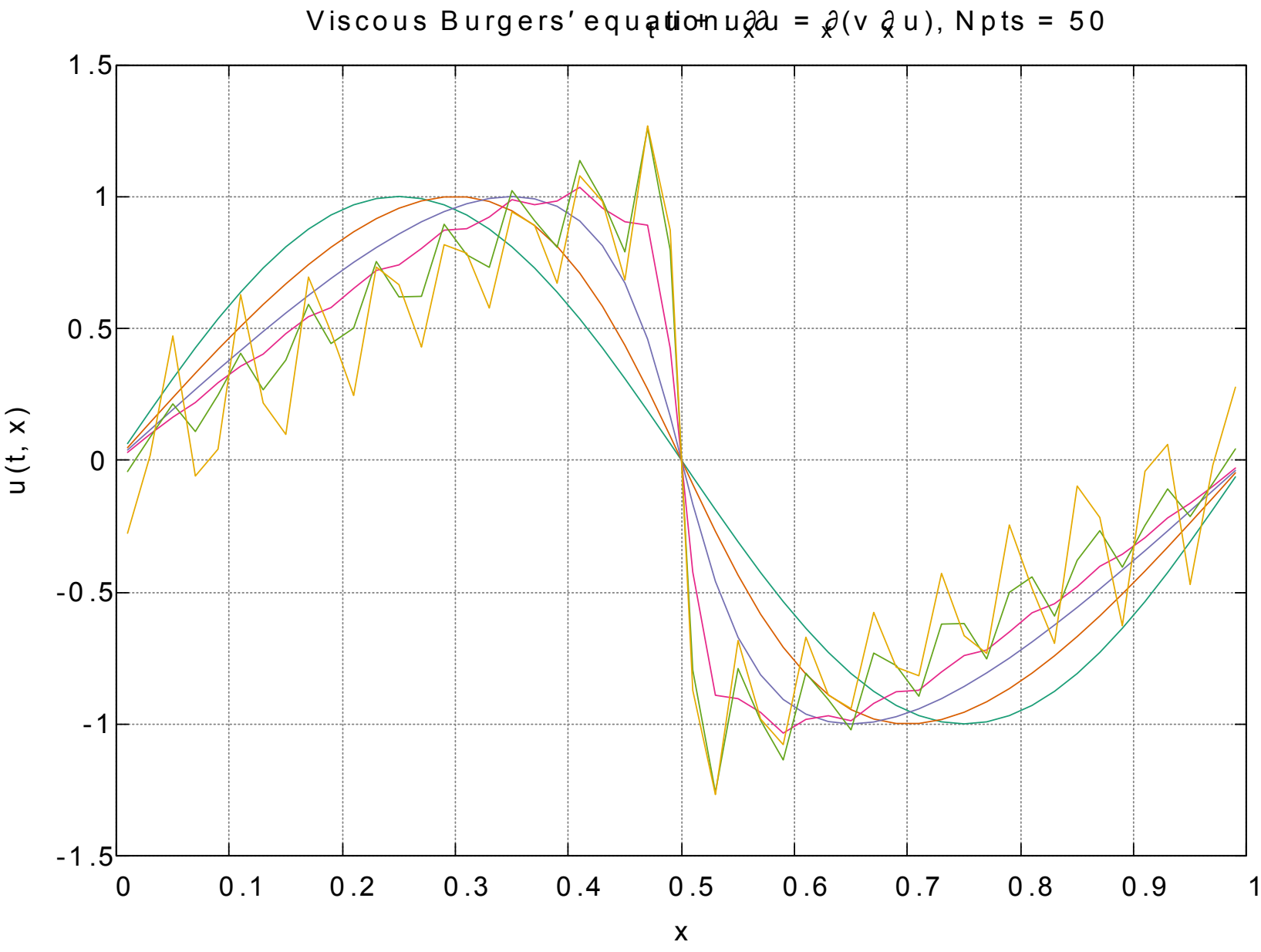
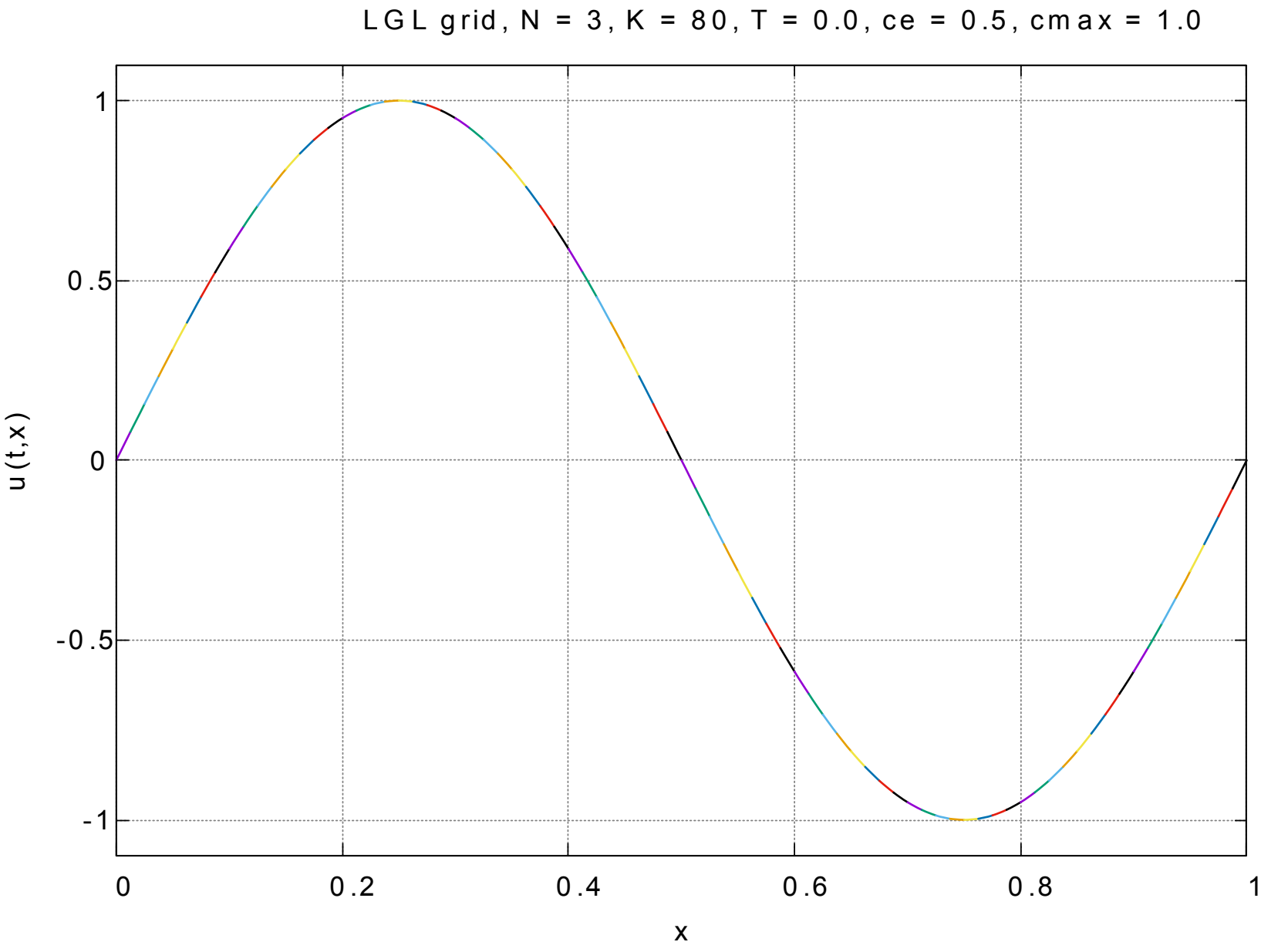
Tuning via

$$\nu = \nu(c_{max}, c_e), \qquad c_{max}, c_e \in \mathbb{R}$$

Burgers' equation (gone bad)



Burgers' equation $f(u) = u^2$



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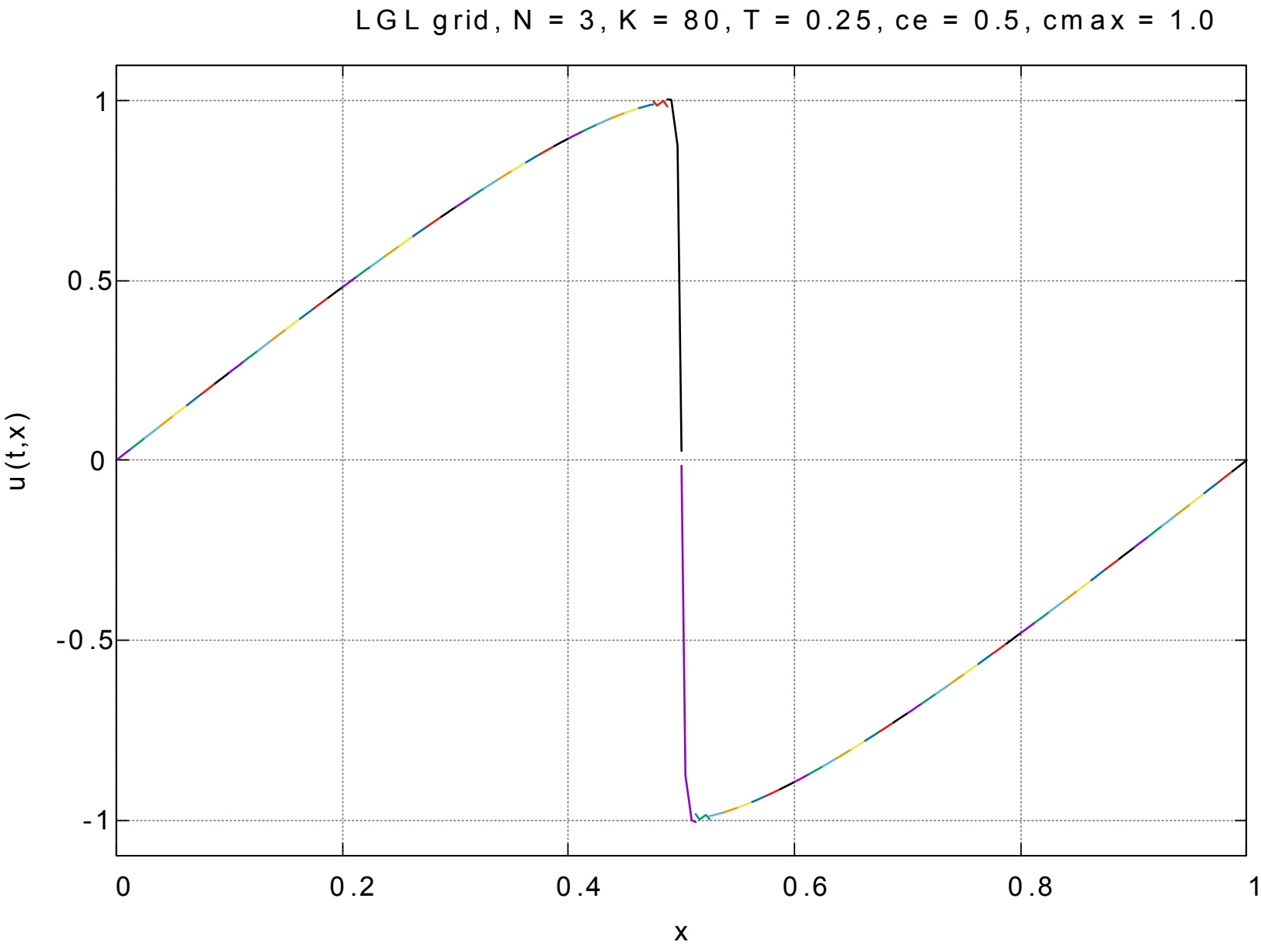
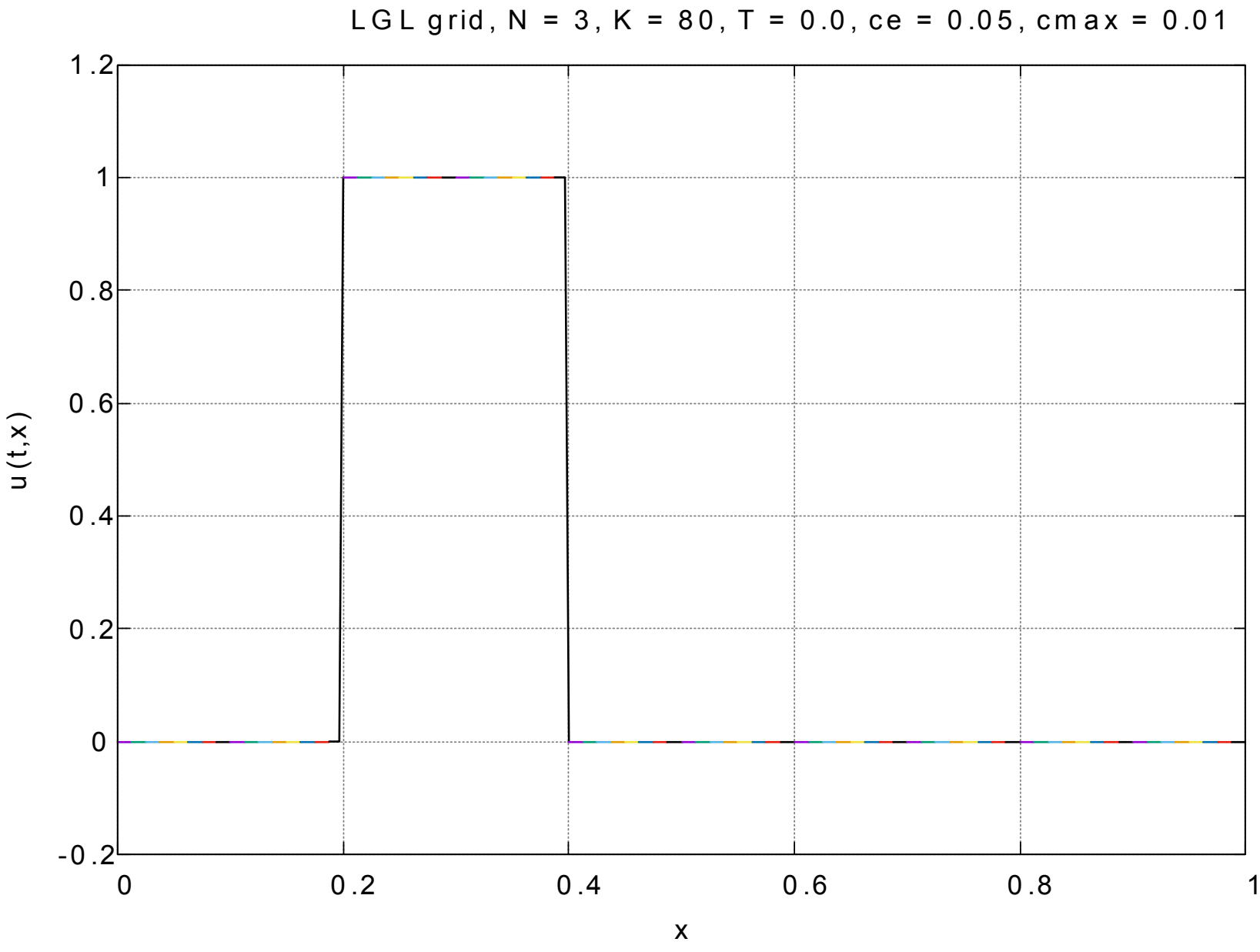


Advection equation $f(u) = u$



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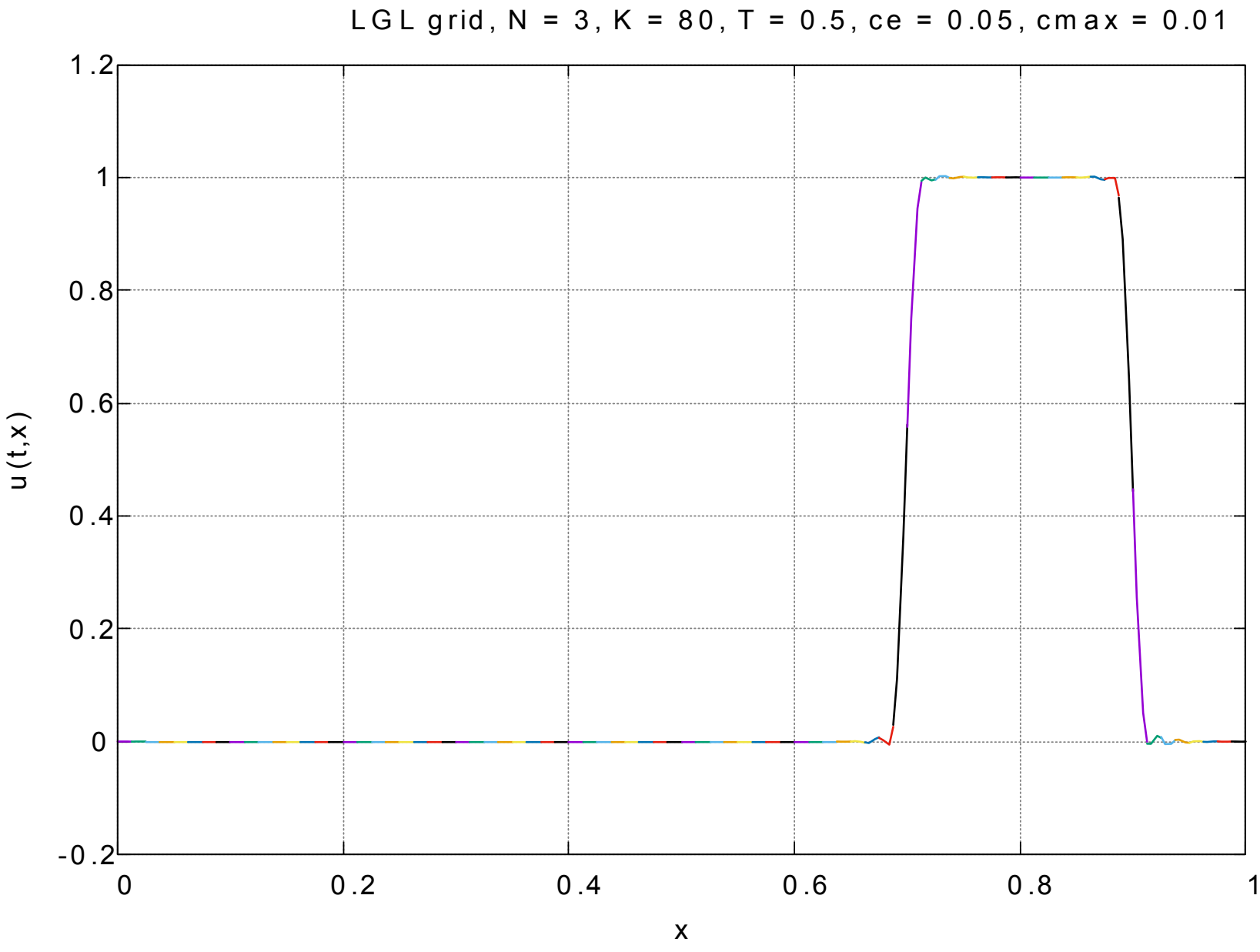
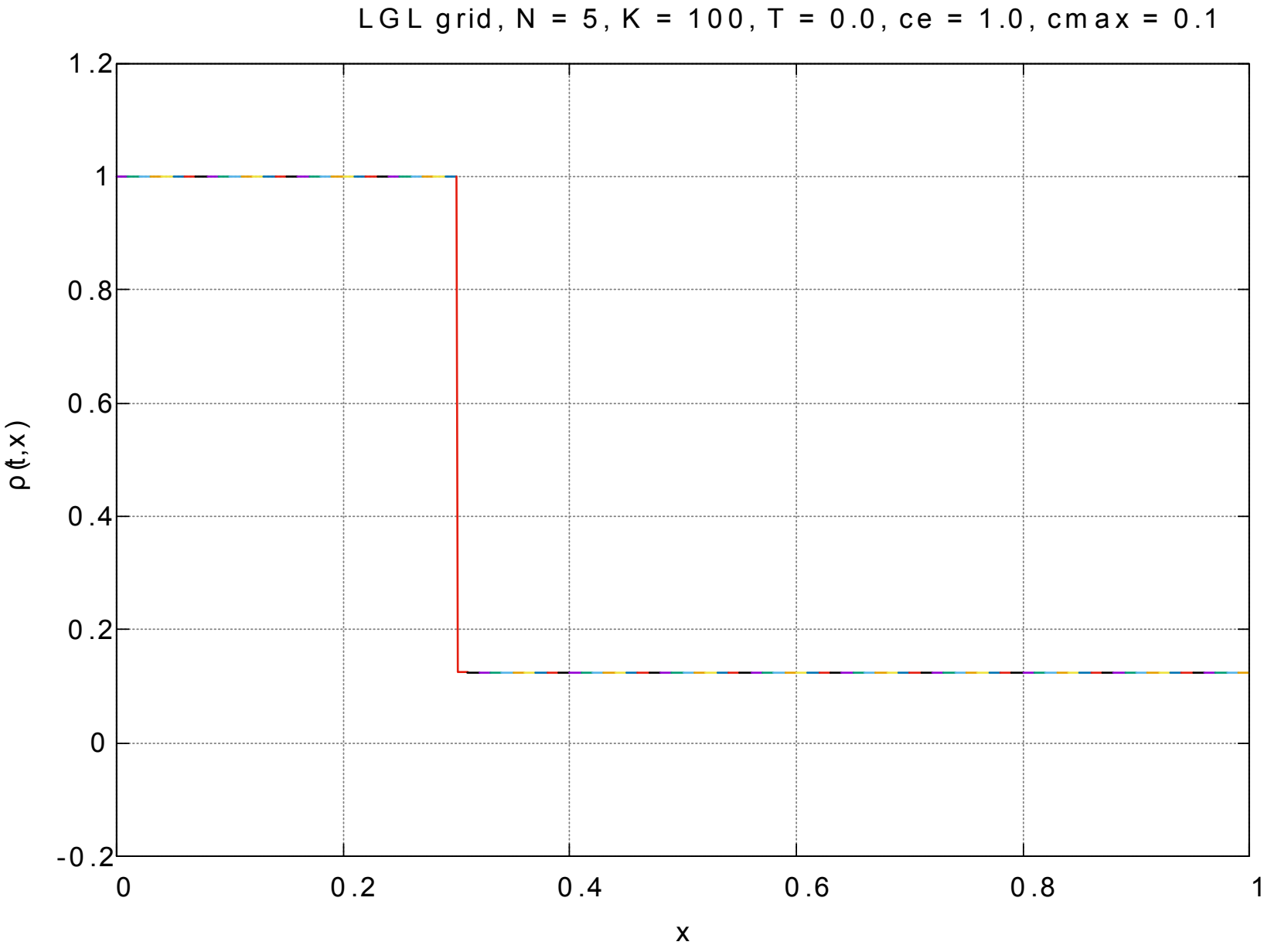


Euler equations



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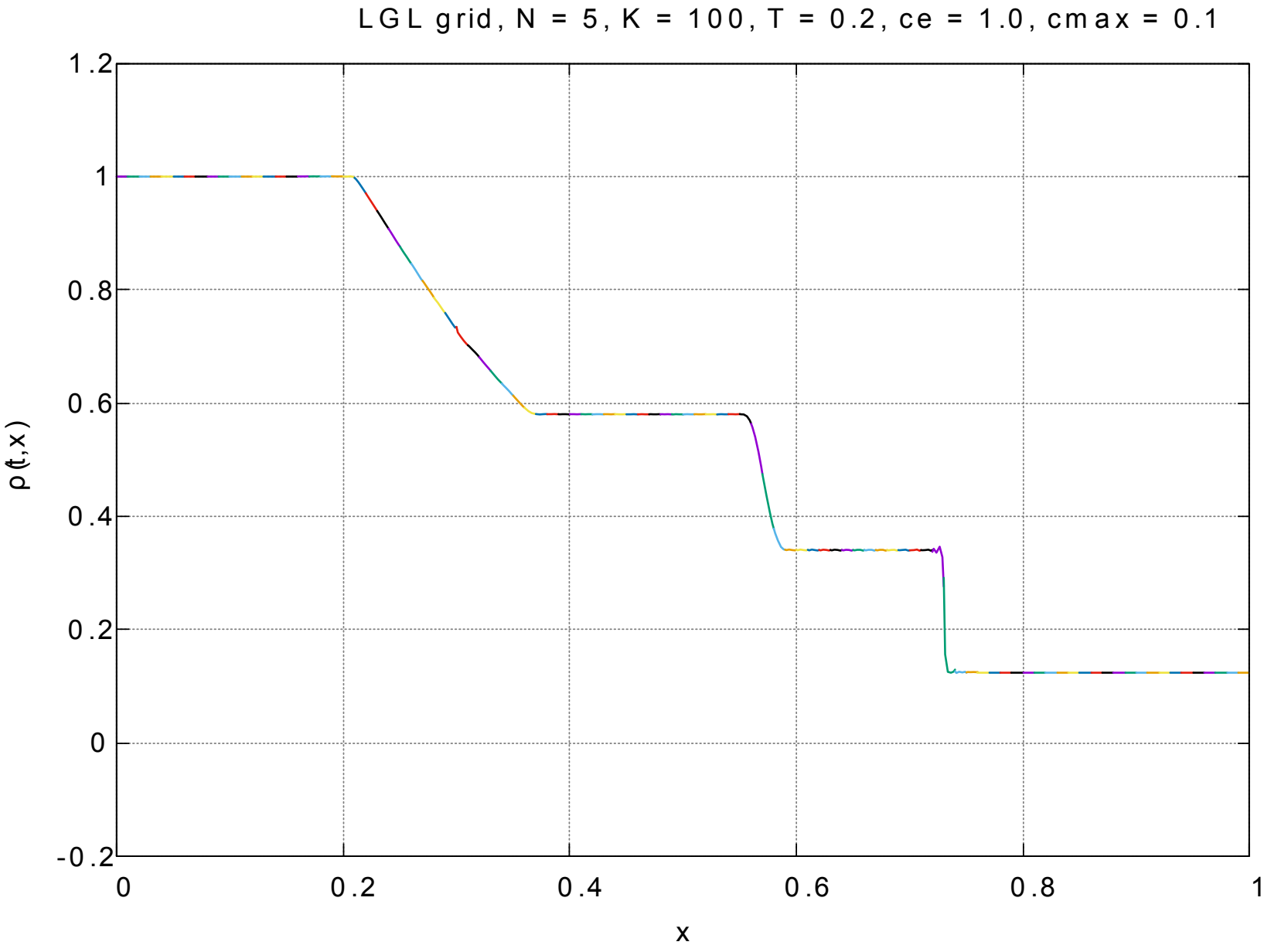

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Thank you!

Bibliography

[1] F. Guercilena, D. Radice, and L. Rezzolla, "Entropy-limited hydrodynamics: A novel approach to relativistic hydrodynamics," *Computational Astrophysics and Cosmology*, vol. 4, no. 1, p. 3, 2017.

[2] J.-L. Guermond and R. Pasquetti, *Entropy-based nonlinear viscosity for fourier approximations of conservation laws*, vol. 346. Elsevier, 2008, pp. 801–806.

[3] V. Zingan, J.-L. Guermond, J. Morel, and B. Popov, "Implementation of the entropy viscosity method with the discontinuous galerkin method," *Computer Methods in Applied Mechanics and Engineering*, vol. 253, pp. 479–490, 2013.