How to choose a unit system for Poiseuille-Flow in Espresso

1. Start with a unit of length. A resolution of 50 lattice points over the 50 µm channel would be appropriate, therefore

$$[x] = 1\,\mu m. \tag{1}$$

2. The lattice-Boltzmann algorithm only produces valid results within a certain parameter range. By choosing the parameters to be around 1, you should be on the safe side. In a system like this, we acually have enough freedom to scale the units, so that all parameters become 1 exactly. Doing this for the density yields the mass unit $[m]$

$$\rho = 1 \times 10^3\,\mathrm{kg\,m^{-1}} \overset{!}{=} 1\,[m]\,[x]^{-3}.$$
$$\Rightarrow [m] = 10^{-15}\,\mathrm{kg}. \tag{2}$$

3. You get the unit for time $[t]$ by fixing the viscosity

$$\eta = 1\,\mathrm{mPa\,s^{-1}} = 1 \times 10^{-3}\,\mathrm{kg\,s^{-1}\,m^{-1}} \overset{!}{=} 1\,[m]\,[s]^{-1}\,[t]^{-1}.$$
$$\Rightarrow [t] = 1\,\mu s. \tag{3}$$