Lare 3D/2D code T. Arber *et. al.* (2001)

$$\boxed{\frac{D\rho}{Dt} = -\rho\nabla\cdot\boldsymbol{u},}$$

$$\boxed{\frac{D\boldsymbol{u}}{Dt} = \frac{1}{\rho}\left[(\nabla\times\boldsymbol{B})\times\boldsymbol{B} - \nabla P - \nabla\cdot\boldsymbol{\sigma}\right],}$$

$$\boxed{\frac{D\boldsymbol{B}}{Dt} = (\boldsymbol{B}\cdot\nabla)\boldsymbol{u} - \boldsymbol{B}(\nabla\cdot\boldsymbol{u}) - \nabla\times(\eta\nabla\times\boldsymbol{B}),}$$

$$\boxed{\frac{D\epsilon}{Dt} = \frac{1}{\rho}\left[-P\nabla\cdot\boldsymbol{u} + \eta\boldsymbol{J}^2 + \boldsymbol{S}:\boldsymbol{\sigma}\right],}$$

$$\boxed{P = \rho\epsilon(\gamma - 1)}$$

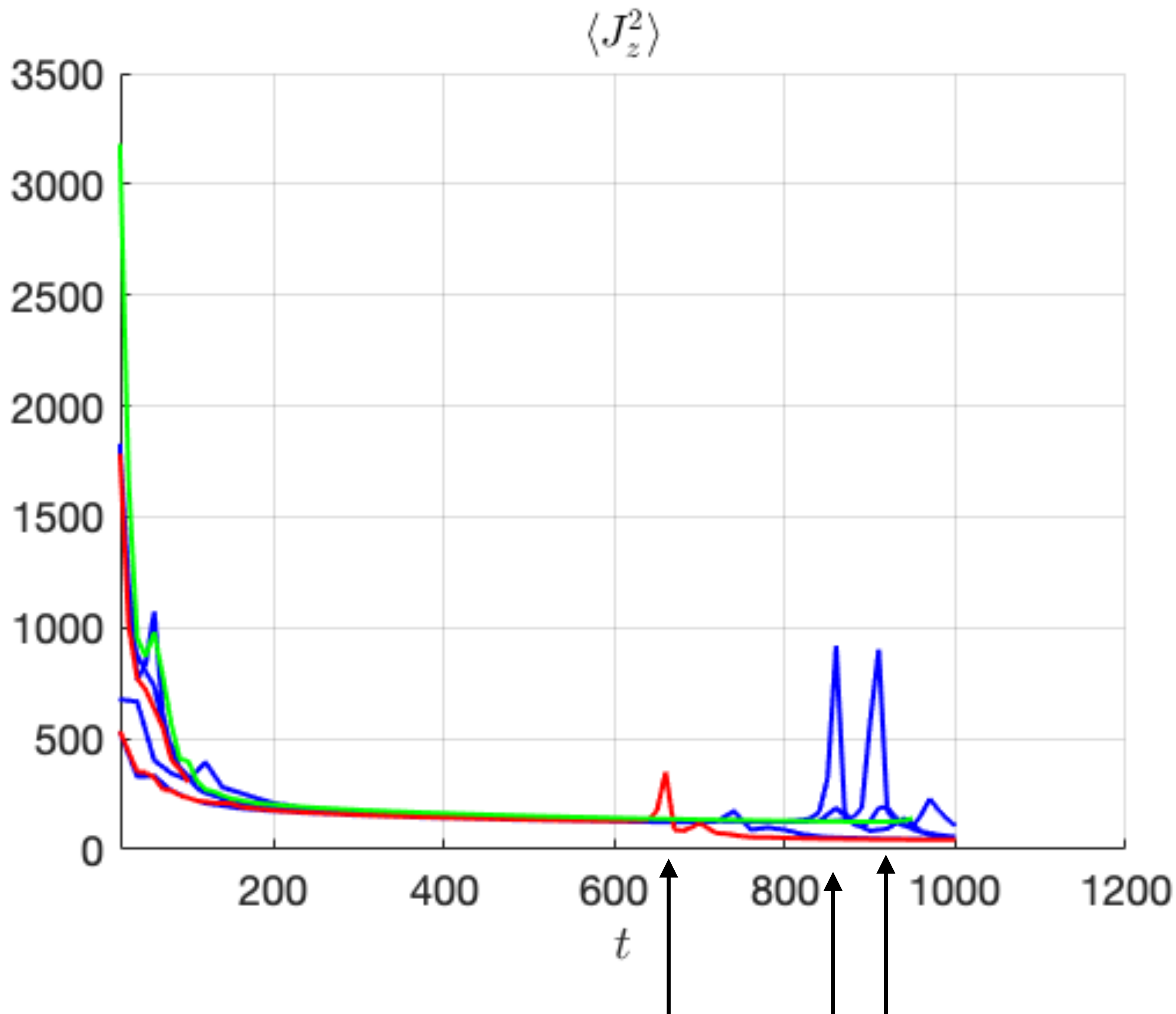
where **S** is the strain rate tensor, **σ** is the stress tensor, $\gamma = 5/3$.

bulk viscosity = 0.1, shock viscosity = 0.5, η=10^-4 ~10^-5

Initial conditions: velocity field = zero, prescribed (complex) magnetic field

Case A (Lare2d simulation) with different resolutions

η=10^-4



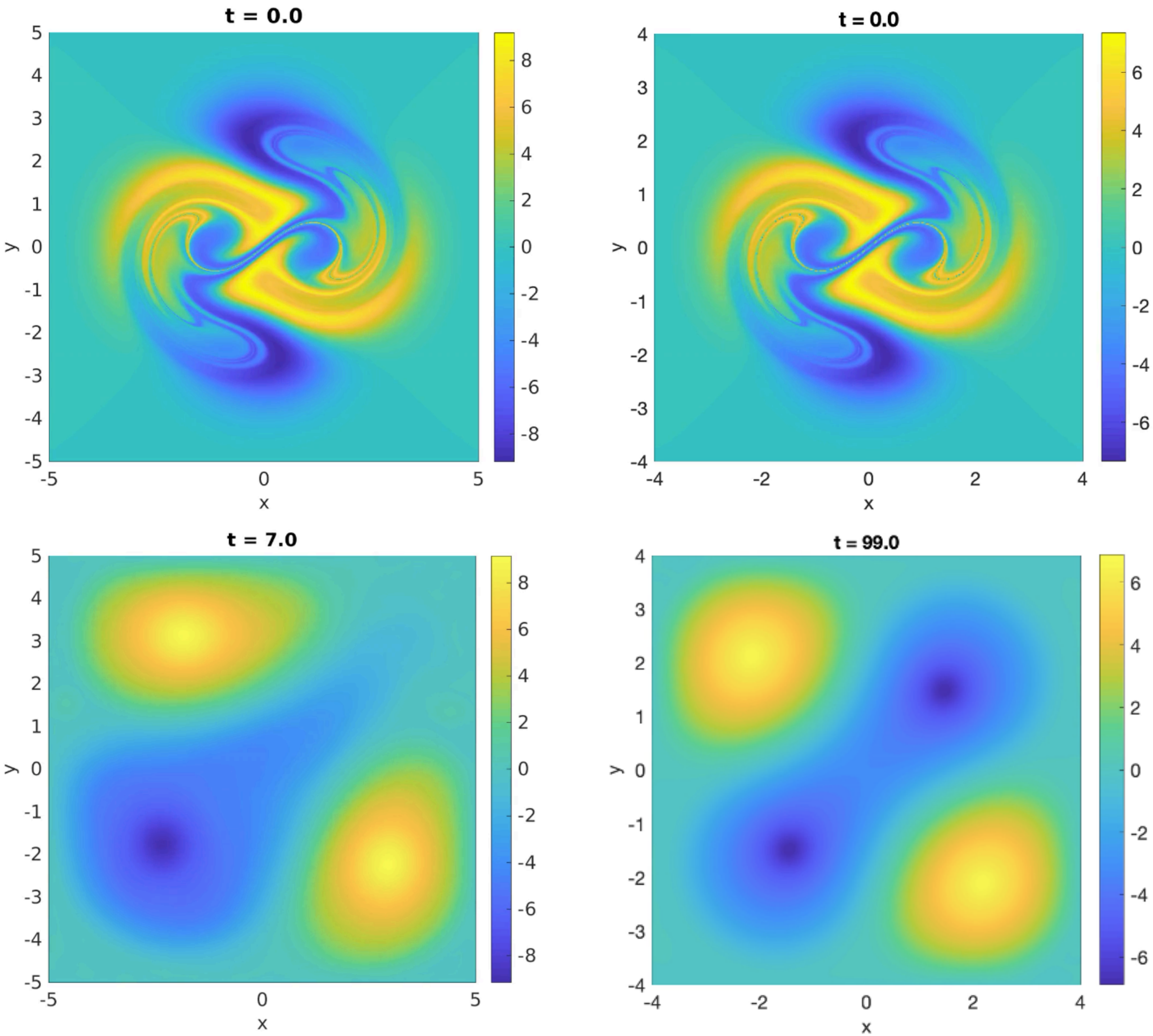
blue=matlab generated f_0, N=256, 512, 1024, 1280
red=python generated f_0, N=256, 1024
green=python generated f_0, N=2000

Note: some peaks are not prominent probably due to sparsely timed output, still they occur at a different time

Problem no. 1:
Secondary reconnection happens at different times?!

Tried to restart with an analytical initial condition with a shorter time evolution, still not good

Flux function Φ



High(er) resolution Vs Low resolution

B=curl (Φ(x,y) e_z)

η=10^-5

Problem no. 2: Change of magnetic field topology?!

Question no.1

Can we compare Lare and pencil code, and show pencil gives more accurate results?

Note: Entropy vs. Energy equation, different treatment of viscosity

Question no.2

Perhaps the comparison itself is not that important. The important thing we want to show is the numerical simulation can accurately reflect the topology of the magnetic field. How can we get an accurate result from the pencil code?