

- 01. Introduction to the PIC simulation
- 02. Random number generation and its application
- 03. Particle weighting and normalization
- 04. Particle pusher
- 05. Poisson's equation
- 06. One-dimensional electrostatic PIC code
- 07. Numerical tips and tricks in PIC simulations
- 08. Visualization
- 09. Electromagnetic field solver
- 10. Relativistic particle pusher
- 11. One-dimensional electromagnetic PIC codes

Particle-in-Cell (PIC) kinetic simulations

12. Advanced boundary conditions

Chun-Sung Jao (饒駿頌)

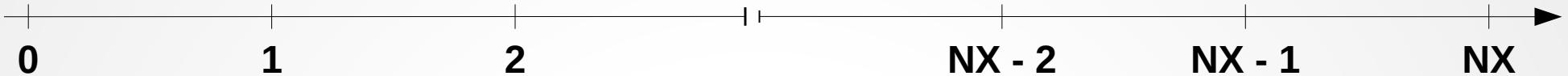
Assistant Research Scholar,
Institute of Space Science and Engineering,
National Central University, Taiwan

University of São Paulo, 2019.11.25-12.06

www.slido.com code: #B194

Boundary conditions for field

$$\frac{dA}{dx} = B$$



$$\frac{A_2 - A_0}{2 \Delta x} = B_1$$

$$\frac{A_1 - A_{NX-1}}{2 \Delta x} = B_0$$

$$\frac{A_{NX} - A_{NX-2}}{2 \Delta x} = B_{NX-1}$$

$$\frac{A_1 - A_{NX-1}}{2 \Delta x} = B_{NX}$$

$$B_0 = B_0$$

Fixed boundary

$$B_{NX} = B_{NX}$$

$$B_0 = B_1$$

Open boundary

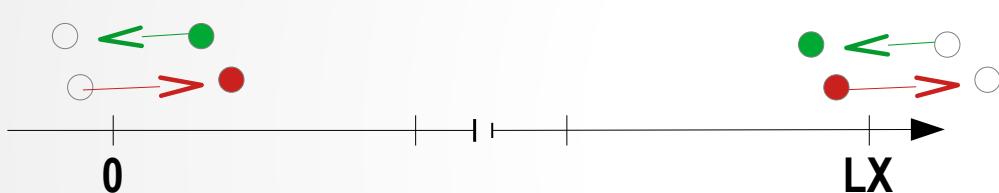
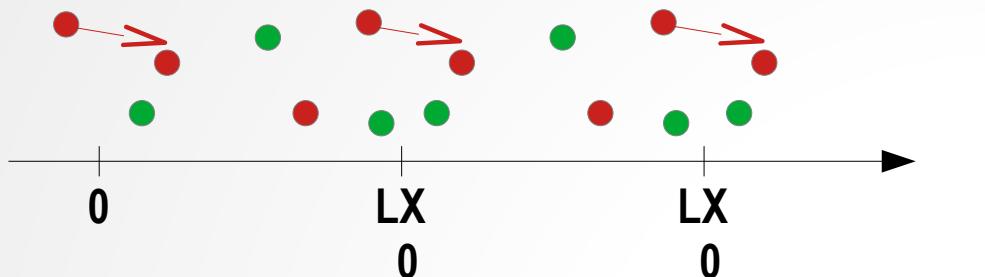
$$B_{NX} = B_{NX-1}$$

$$\frac{B_1 - B_0}{\Delta x} = \frac{B_2 - B_1}{\Delta x}$$

$$\frac{B_{NX} - B_{NX-1}}{\Delta x} = \frac{B_{NX-1} - B_{NX-2}}{\Delta x}$$

Boundary conditions for particles

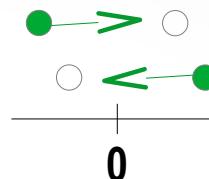
Periodic boundary



$$\vec{v}' = \vec{v}$$

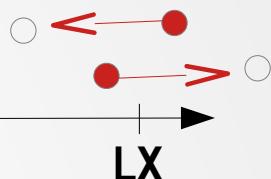
$$\vec{x}' = \vec{x} \pm LX$$

Reflecting boundary



$$\vec{v}' = -\vec{v}$$

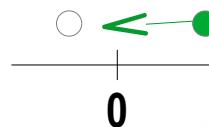
$$\vec{x}' = -\vec{x}$$



$$\vec{v}' = -\vec{v}$$

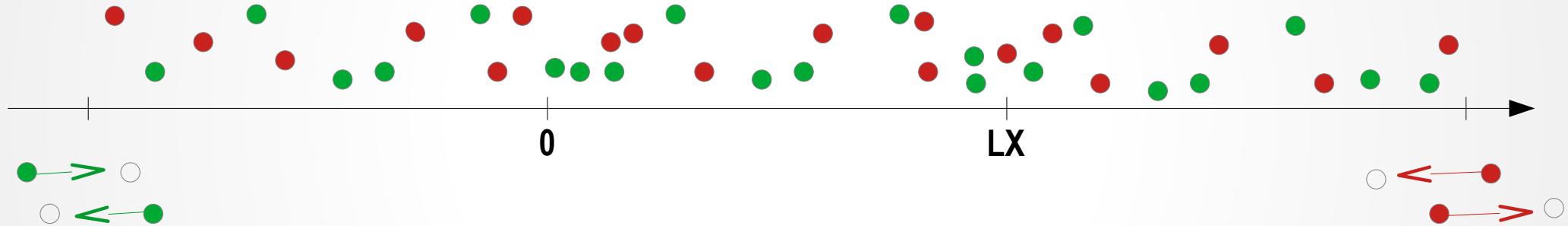
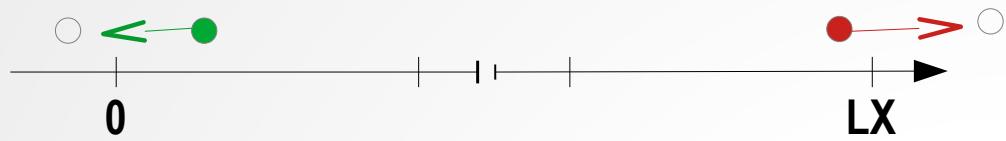
$$LX - \vec{x}' = \vec{x} - LX$$

Open boundary



Boundary conditions for particles

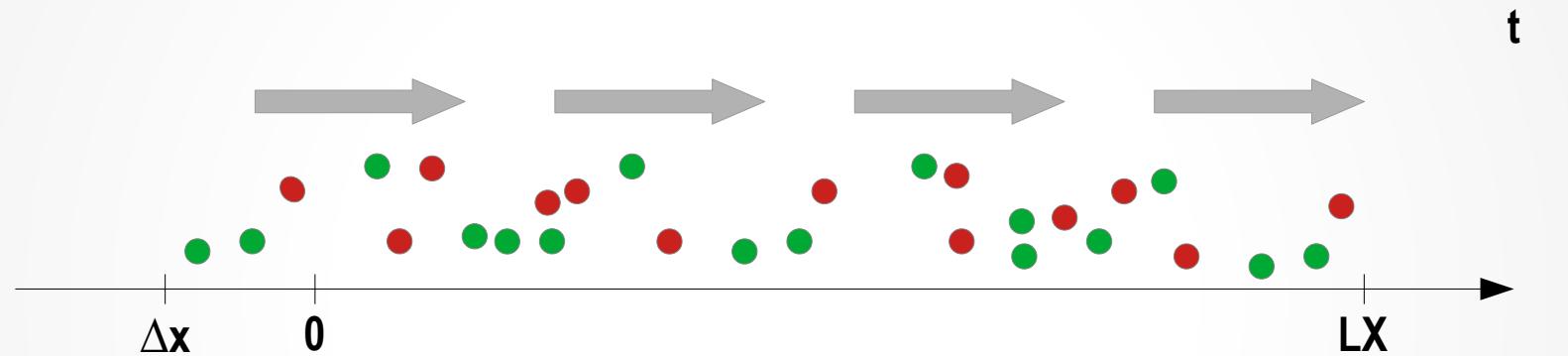
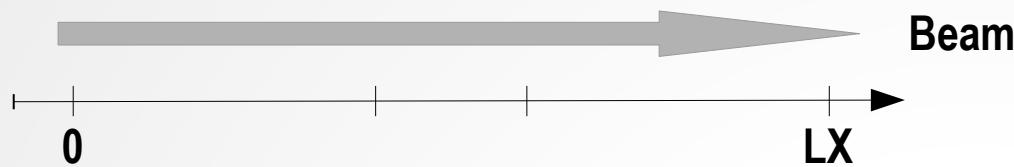
Open boundary



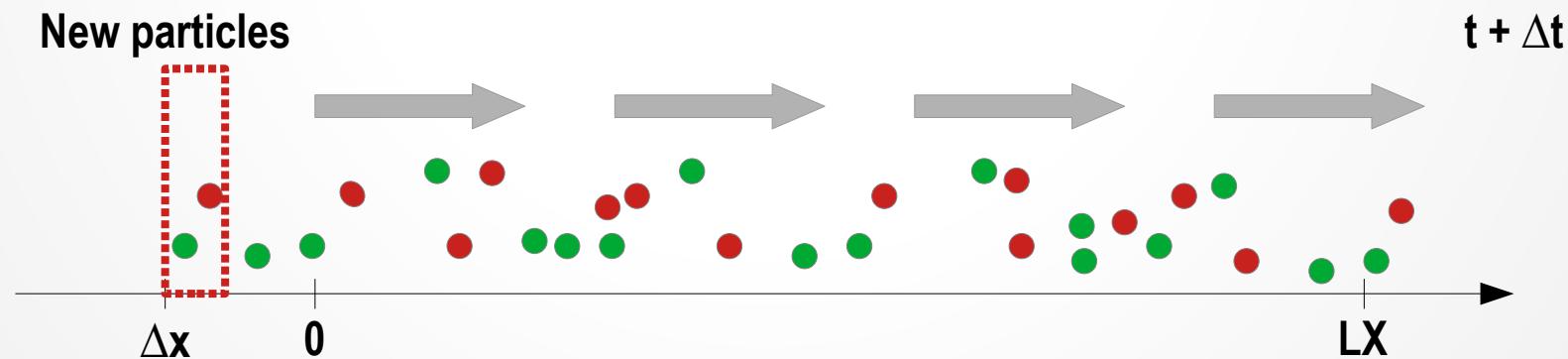
Simulation domain

Boundary conditions for particles

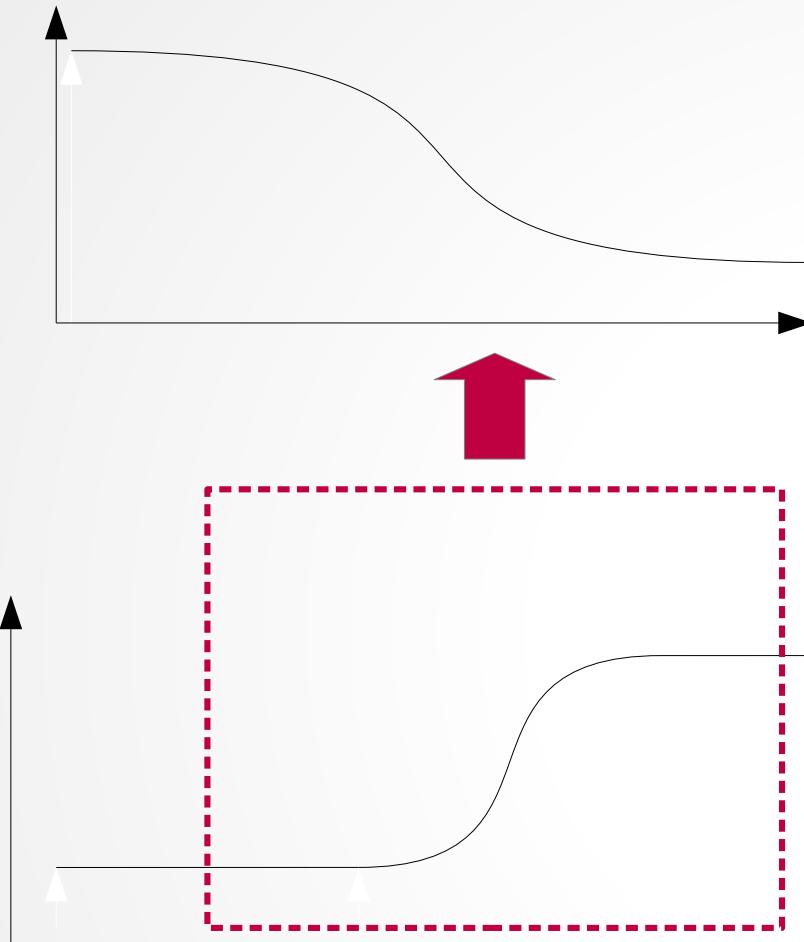
Open boundary



New particles



Periodic boundary



Reflecting boundary??
Open boundary??

Periodic boundary