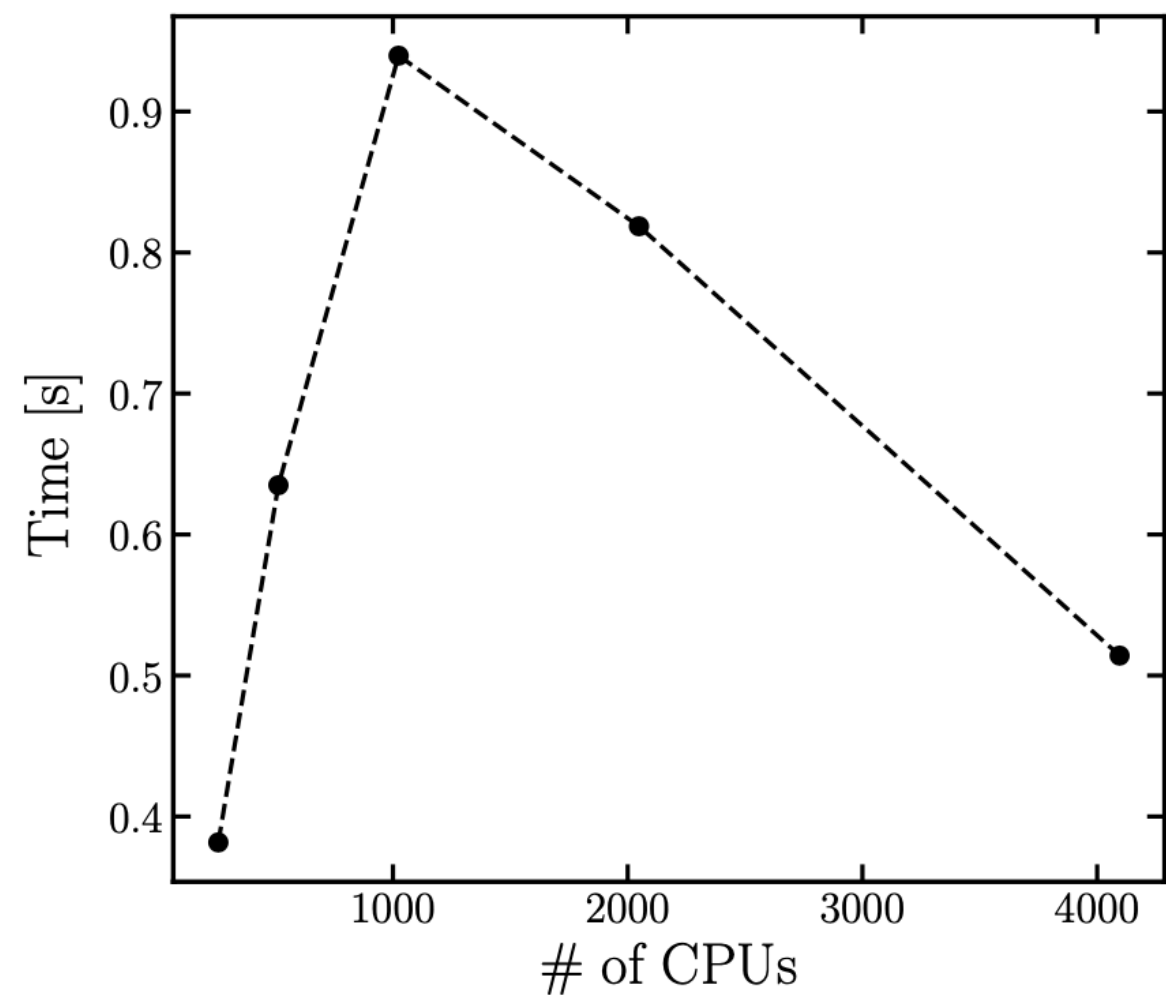
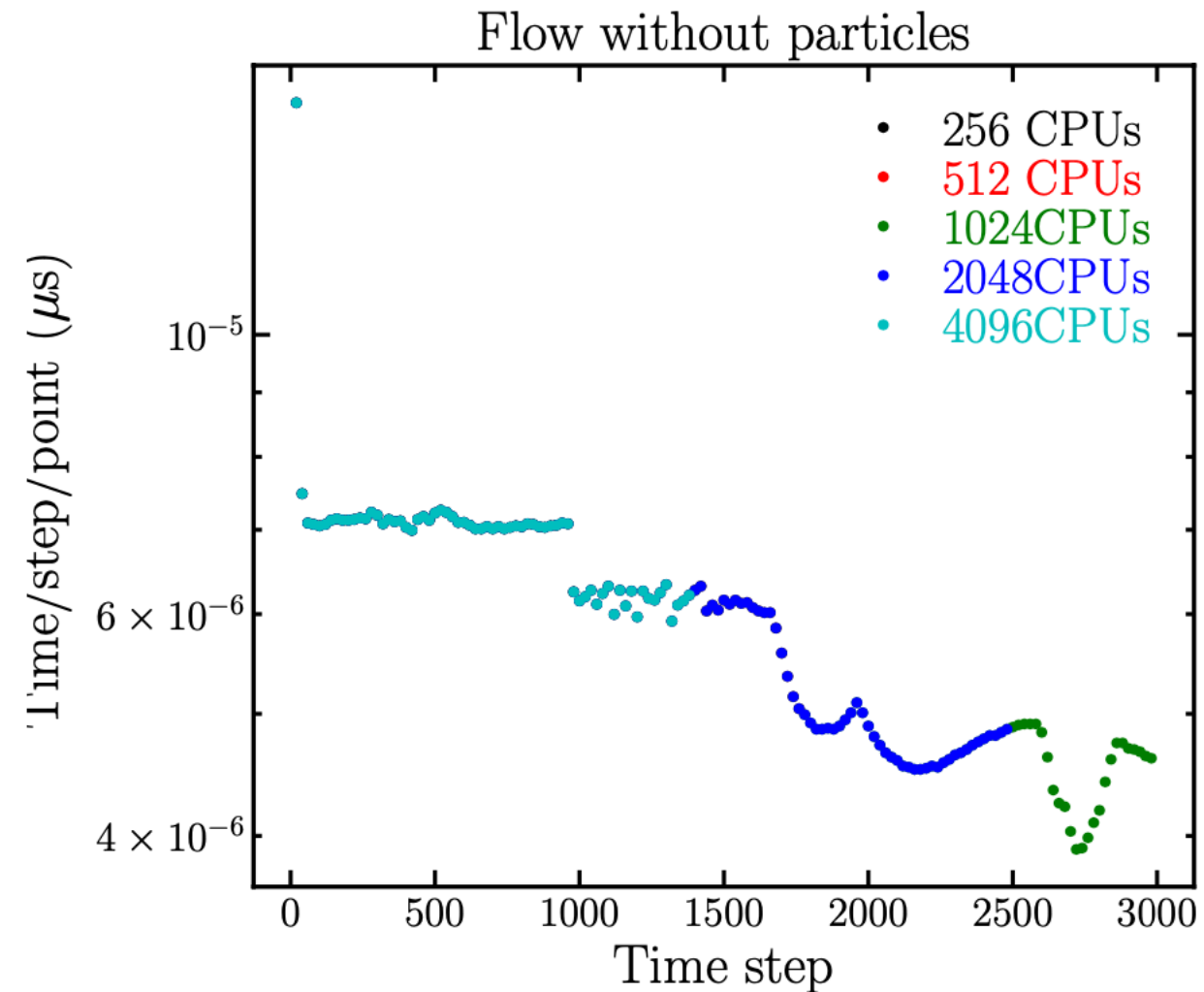


Particle modules in Pencil Code (PC)

- Scalability of particle modules in PC;
- "particles_dust.f90" and "particles_charged.f90": inertia, Coulomb force and Lorentz force cannot be handled at the same time;
- Dealing with large number of inertial particles

Scalability of particle modules in PC



Scaling for $N_{\text{grid}} = 1024^3$ and different number of CPUs, $M_{\text{rms}} = 5$, $Re=200$

"particles_dust.f90" and "particles_charged.f90"

$$\frac{\partial}{\partial t} \mathbf{A} = \mathbf{u} \times \mathbf{B} - \eta \mu_0 \mathbf{J},$$

$$\frac{D}{Dt} \mathbf{u} = -c_s^2 \nabla \ln \rho + \frac{1}{\rho} \mathbf{J} \times \mathbf{B} + \mathbf{f} + \rho^{-1} \mathbf{F}_{\text{visc}},$$

$$\frac{D}{Dt} \ln \rho = -\nabla \cdot \mathbf{u},$$

$$\frac{d\mathbf{v}_i}{dt} = \frac{1}{\tau_i} (\mathbf{u} - \mathbf{v}_i) + \frac{(\mathbf{u} - \mathbf{v}_i) \times \hat{\mathbf{B}}}{t_L}$$

Larmor time: $t_L = \frac{m_g c}{q_g \mathbf{B}}$

inertia, Coulomb force and Lorentz force **cannot** be handled at the same time

Dealing with large number of inertial particles

5.24.2 Large number of particles

- Increase ncpu and decrease mpar_loc. For npar=124999680, ncpu=1024 is needed.

```
integer, parameter :: ncpus=1024,nprocx=8,nprocy=8,nprocz=ncpus/(nprocx*nprocy)
integer, parameter :: nxgrid=1024,nygrid=nxgrid,nzgrid=nxgrid
integer(kind=ikind8), parameter :: npar=124999680
integer, parameter :: mpar_loc=5*npar/ncpus
integer, parameter :: npar_stalk=100000, npar_mig=npar/ncpus
```