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Fluid estimation for a kinetic-diffusive Monte Carlo scheme and its analysis in homogeneous case

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0 What is Kinetic-Diffusion(KD)?

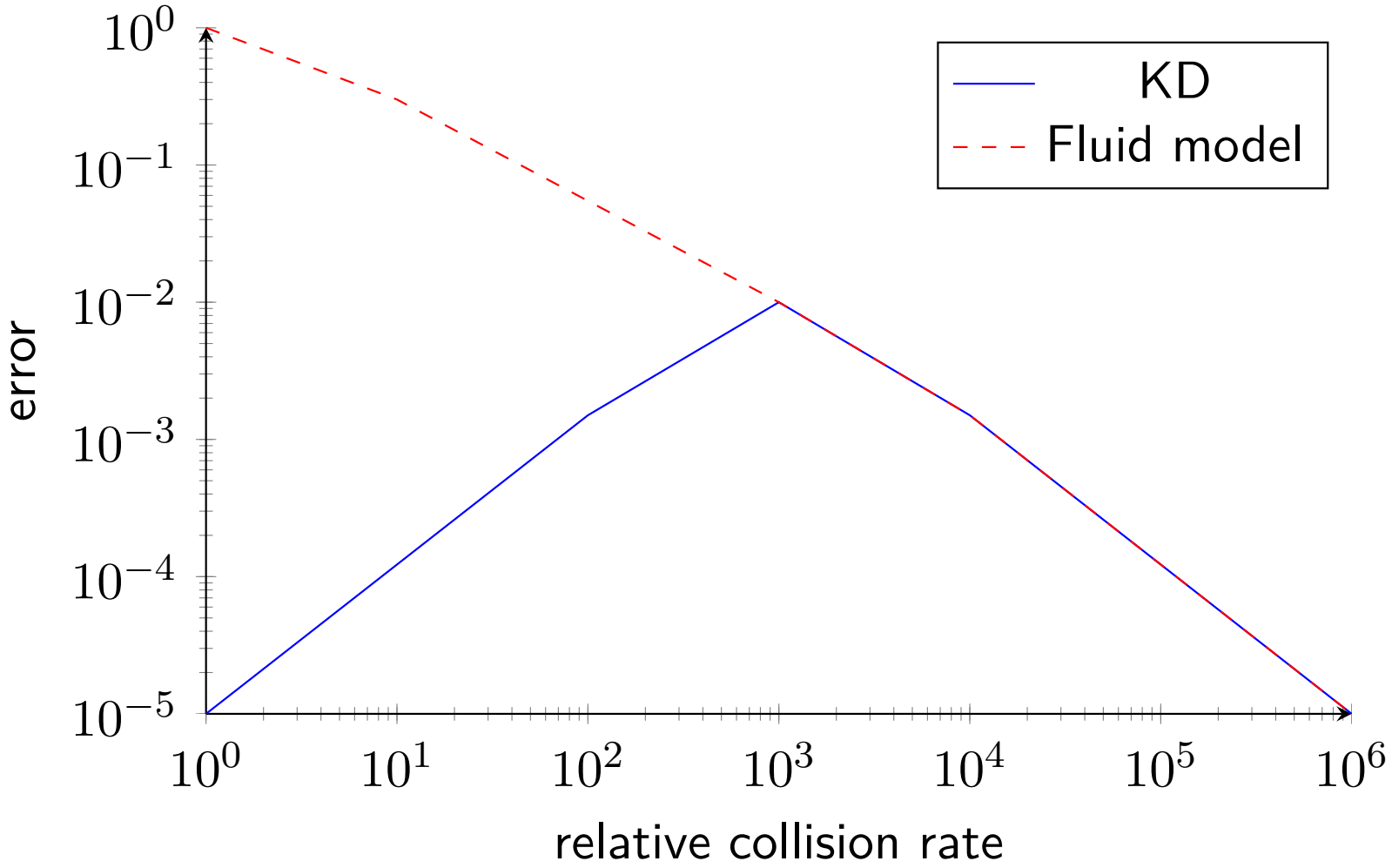
- Kinetic neutrals $\rightarrow$ accurate, very slow in high-collisional regime.
- Fluid neutrals $\rightarrow$ fast, inaccurate in low-collisional regime.
- KD: replace some of the kinetic steps by larger diffusive steps

0 KD: pseudocode

Simulation of one timestep Δt

1. Sample τ_c
2. If $\Delta t < \tau_c$
3. Do fully kinetic step:
4. $X^{n+1} = X^n + \Delta t V^n$
5. Else
6. Do kinetic-diffusion step:
7. $X^n + \tau_c V^n + \Delta W$ (ΔW is a diffusive step with time $\Delta t - \tau_c$)

0 Errors in KD



Note, the exact numbers here are meaningless

0 Estimation in KD

- Individual paths are lost $\rightarrow$ no track-length estimation.
- Solution, run fluid model for estimation as well
  - Accumulate diffusive step information and run fluid post-processing
  - Time step is averaged
  - Depends on linearity of fluid-model

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  - Accumulate diffusive step information and run fluid post-processing
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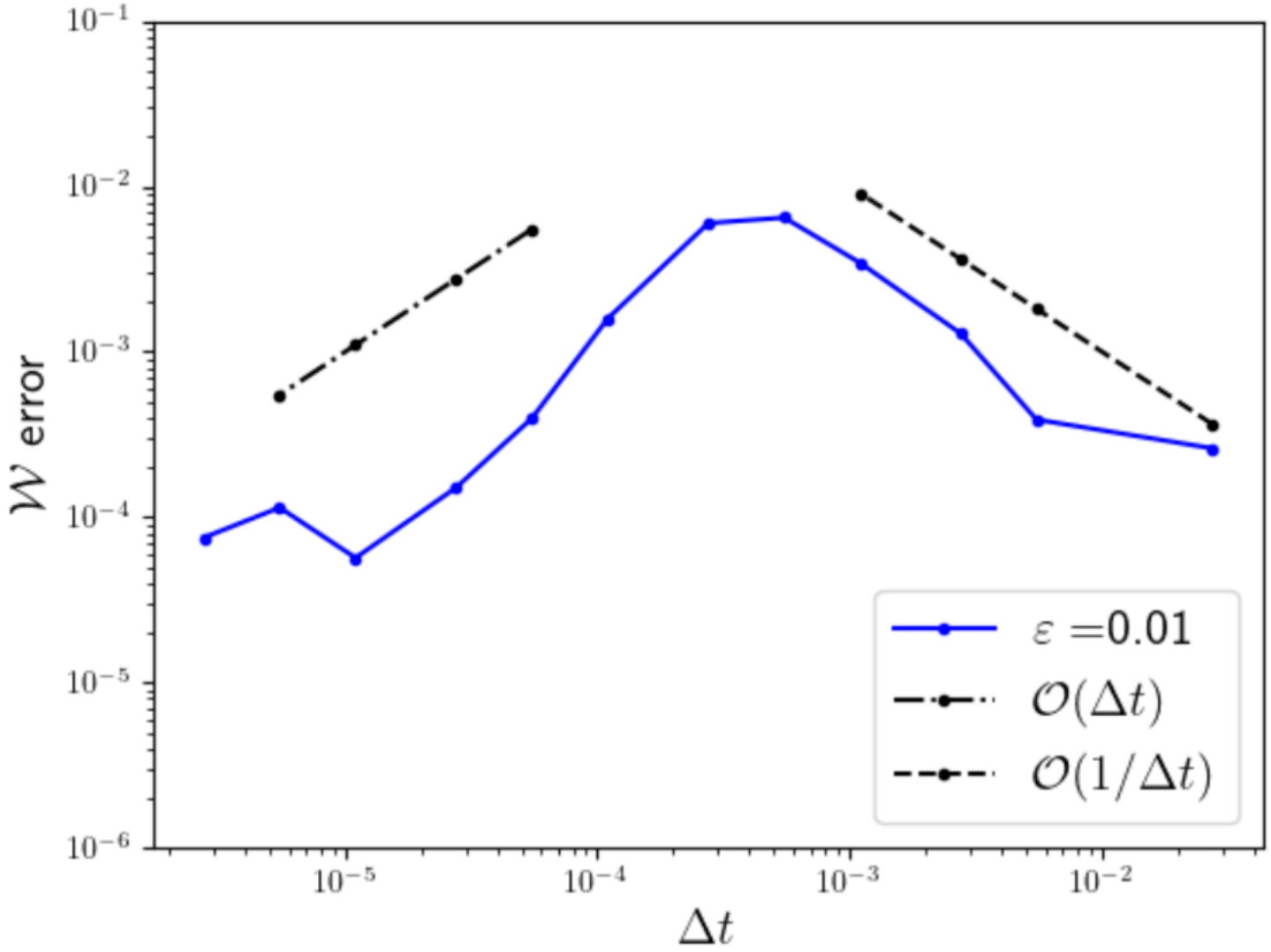
  - Depends on linearity of fluid-model
- Is this accurate?

0 Theoretical results

- I'll be honest, I don't fully understand the proof
- Conclusion: Error is dominated by individual particle errors due to KD. Fluid estimator is able to estimate well.

0 Experimental results



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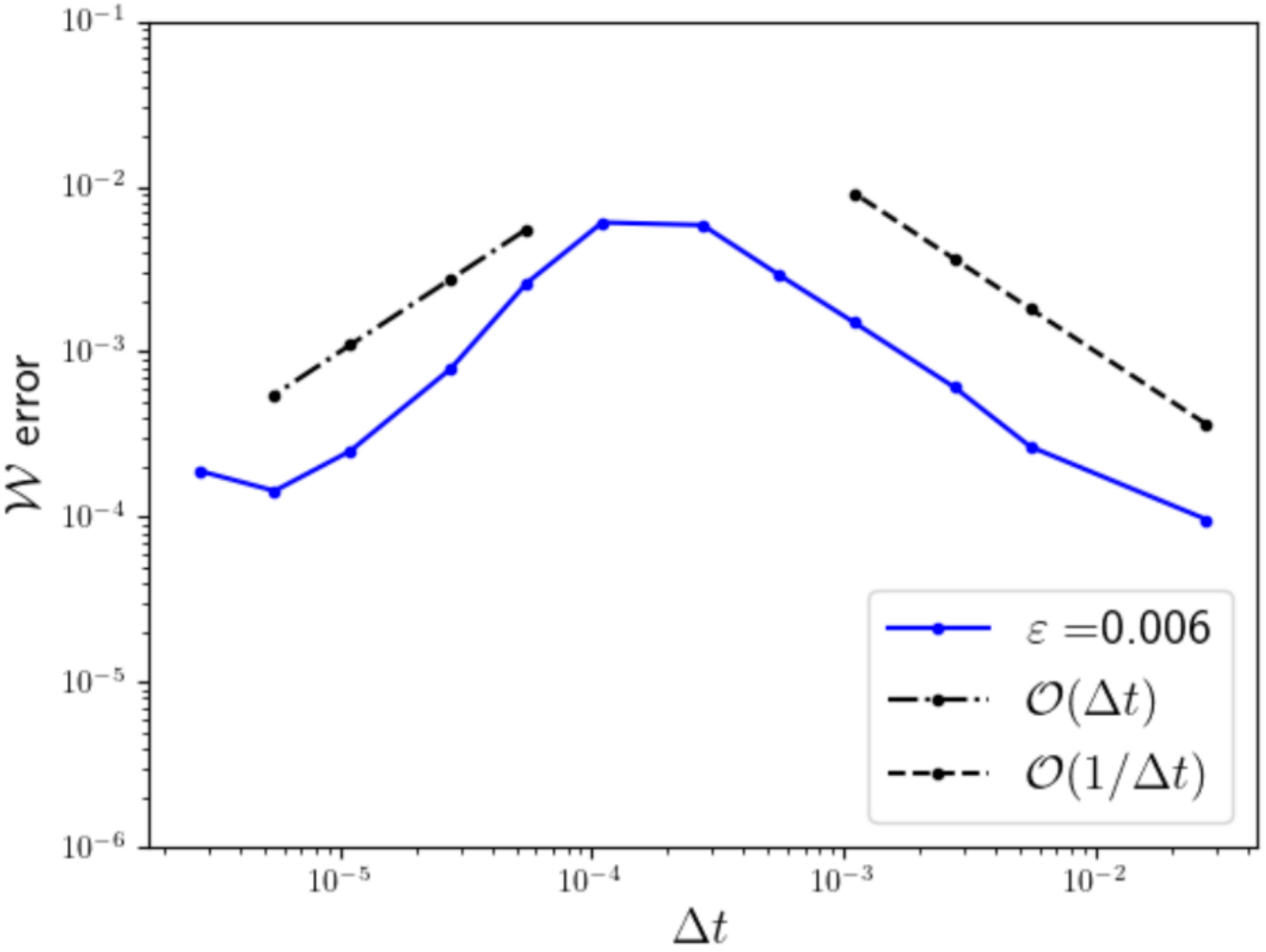

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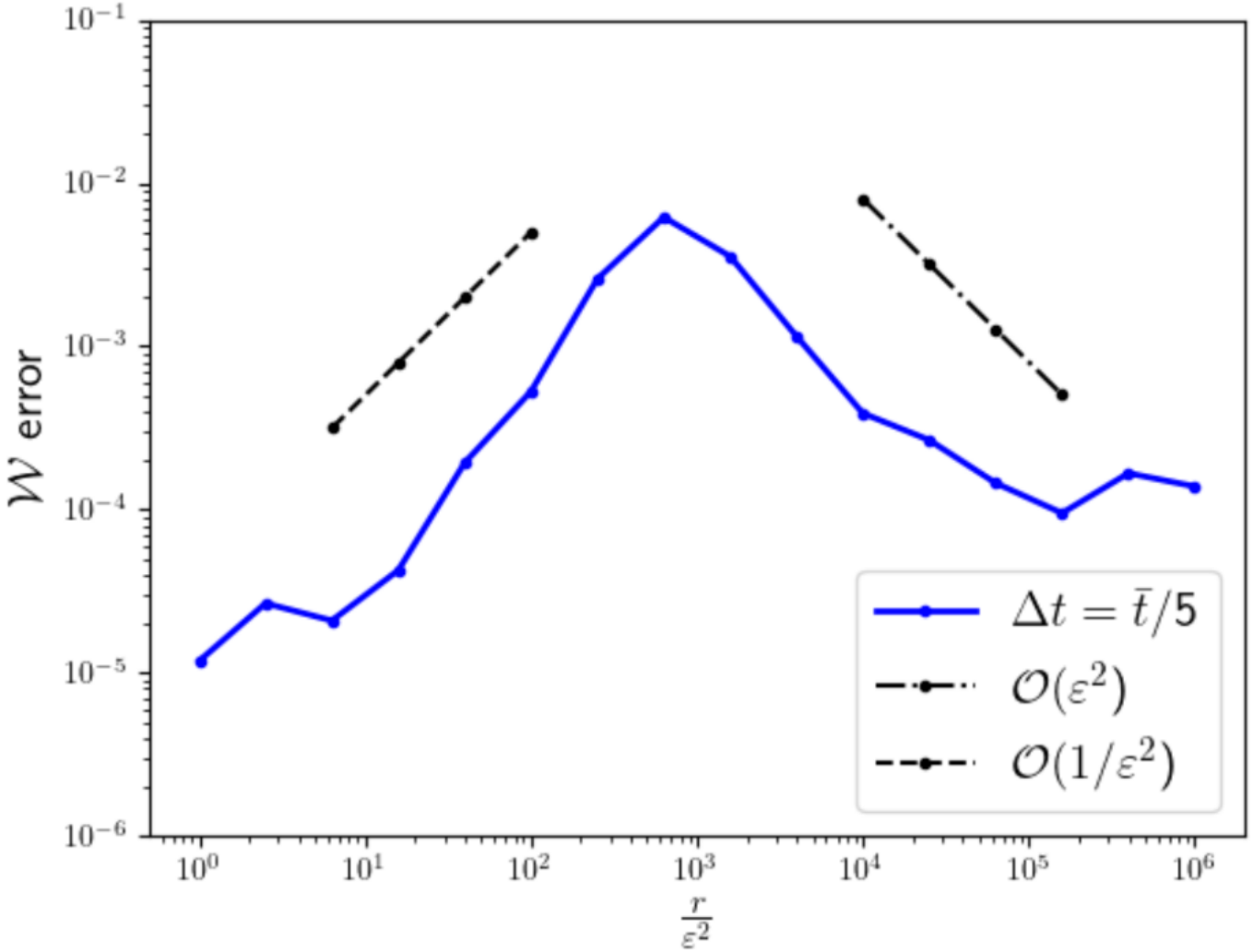

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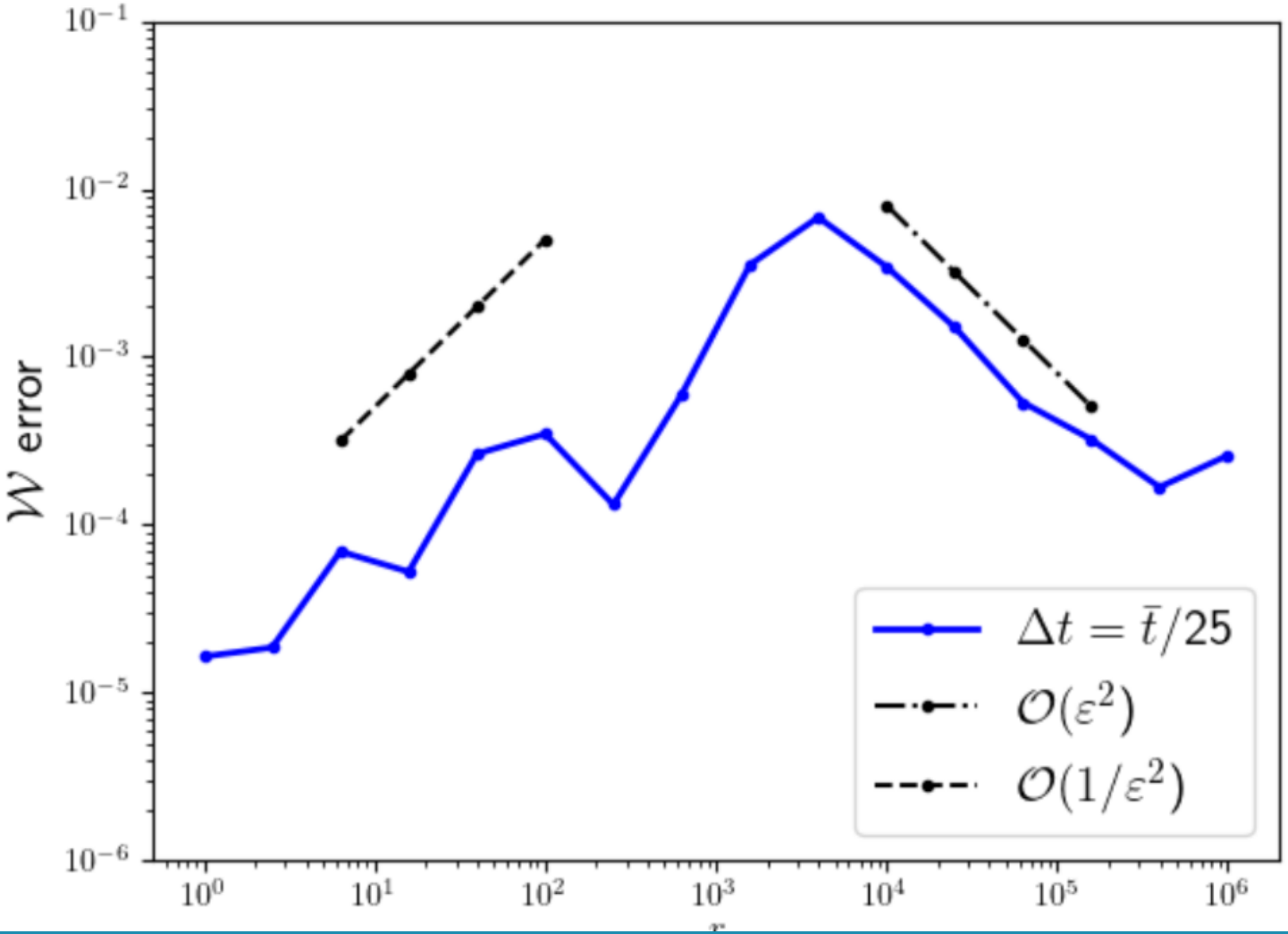

0 Future work

- Compare with track-length
- Use more accurate fluid model
- Extend to heterogeneous background