Research Record (Non-equilibrium Physics)

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1. After discussion with professor, we decided to search for negative drag on AOUP particles in quartic polynomial external potential, unlike linear potential which we have been doing so far.

2. We make this decision after referring to an article which shows that the AOUP reaches equilibrium if their smooth interaction potential has zero third derivatives.[1]

3. The revised external potential with n^{th}-order polynomial is as follows

$$\begin{cases} V(x) = \frac{f\Lambda}{2}\left[1 - \left|\frac{2x}{\Lambda}\right|^n\right] & |x| < \Lambda/2 \\ V(x) = 0 & \text{else} \end{cases} \tag{1.1.1.1}$$

4. Running simulation under following parameters:

# ptcl	# ens	bound	Γ	T	τ	D_a	δt	init	sample	gap	order
1000	1000	5.0	1.0	1.0	1.0	1.0	0.001	10,000	100	1,000	4

slope f	lambda λ	velocity v
$0.1 \sim 0.5$	$0.1 \sim 0.5$	$0.001 \sim 10.0$

5. Markov process is independent of history and depends only on the current status

6. The dimensionless parameter is as follows

characteristic time	propulsion force	persistence length	typical velocity
τ	$\Gamma\sqrt{\frac{D_a}{\tau}}$	$\sqrt{D_a \cdot \tau}$	$\sqrt{\frac{D_a}{\tau}}$

References

[1] L. L. Bonilla. Active ornstein-uhlenbeck particles. *Phys. Rev. E*, 100:022601, Aug 2019.