Talk Information for the Reading Seminar on Deng-Hani-Ma

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My part will focus on the art of describing the Newton dynamics of the interacting particles, from the basic setup of the N-particle *hard sphere systems* to the *cumulant expansion formula*. Following the advice of the authors, we will introduce these subjects totally through the view of *molecules*, in accordance with their upcoming version. Participants with an impression of the first two talks would find this formulation easy to understand.

The main goal of this celebrated paper is to establish some kind of *propagation of chaos* result, and the first step is to figure out the cumulant ansatz. Therefore, the goals of my talks will be the following.

- Introduce the problem, the basic setup, as well as the main result. The hard-sphere dynamics and the grand-canonical ensemble will be described. In this setting, propagation of chaos will take the form of the main result.
- Establish the main cumulant formula. Use it to reduce the proof into 3 main estimates. Extract the form of $\mathcal{I}_{\mathbb{M}}(Q_{\mathbb{M}})$ from the rough bounds.

Hence, these efforts are needed.

- Go through the sketch of the proof. Understand the notion of molecules. Introduce the time layering and the truncated dynamics.
- Prove the cumulant expansion formula. This is done by combining the initial cumulant expansion with the Penrose argument.
- In fact, after subtracting some error terms, a single layer cumulant formula can be deduced from the recurrence formula for $\tilde{f}_s$. This procedure will be discussed in detail.

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