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Interaction of the Streaming Instability and the Large-scale Gas Dynamics

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The streaming instability is a promising mechanism to overcome the barriers in direct dust growth and lead to the formation of planetesimals. Most previous studies of the streaming instability, however, were focused on a local region of a protoplanetary disk with a limited simulation domain such that only one filamentary concentration of solids has been observed. The characteristic separation between filaments is therefore not known. To address this, we conduct the largest-scale simulations of the streaming instability to date such that the effect of vertical gas stratification become prominent. We observe more frequent merging and splitting of filaments in simulation boxes of high vertical extent. We find multiple filamentary concentrations of solids, which measures the characteristic separation of planetesimal forming events driven by the streaming instability and thus the initial feeding zone of planetesimals.
Given the findings that the streaming instability interacts with the gas over at least one gas scale height, it remains unclear if it is also significantly affected by the dynamics of a magnetized protoplanetary disk. We will discuss our work in progress on capturing even further dynamical range for this kind of numerical simulations.

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