Atoms at ultralow temperatures are fascinating quantum objects, which can tunnel through barriers, repel or attract each other, and interfere like electromagnetic waves. This wavy behavior of ultracold atoms evidently illustrates the particle-wave duality as discussed in quantum physics. By loading repulsively interacting atoms into tiny optical cells (or optical lattices), we show that the wavy nature of the atoms can be completely suppressed. At the same time, the gaseous sample develops an interesting multi-layer structure with density plateaus, resembling a multi-tier wedding cake. Our observation of the cake structure in 2D ultracold gases [1] raises new prospects to investigate the dynamics and transport across the phase boundary [2] and to identify universal scaling laws in the (quantum) critical regime [3]. Surprising findings along these directions will be presented and discussed.

References: