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Mass Aggregation in the Stochastic Model of Sticky Particles

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Consider a one-dimensional system of n identical particles, each one of mass n^{-1}. At time zero the particles are randomly distributed on a line and have random initial velocities. The particles are accelerated by gravitational forces of mutual attraction. When particles collide, they stick together forming a new particle, called "cluster", whose characteristics are defined by the laws of mass and momentum conservation. The motion of particles between collisions follows the standard laws of Newtonian mechanics.

As particles stick together at collisions, clusters become larger and larger until all particles aggregate into a single giant cluster. The most general question is to describe this aggregation process as $n \to \infty$, under various assumptions on random initial data of the particle system. In this talk we will discuss the behavior of two variables - the number of clusters in the system and the total kinetic energy, denoted by $K_n(t)$ and $E_n(t)$, resp. Our main result on $K_n(t)$ is the functional CLT for the model with zero initial velocities of particles ("cold gas"). This case drastically differs from the "warm gas" with nonzero random initial velocities. On the contrary, it turns that $E_n(t)$ has the same limiting behavior for the warm gas and the cold gas. We prove appropriate limit theorems.