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We are interested in the tail behavior of the pdf of mass density within the one and d-dimensional Burgers/adhesion model used, e.g., to model the formation of large-scale structures in the Universe after baryon-photon decoupling. We show that large densities are localized near "kurtoparabolic" singularities residing on space-time manifolds of codimension two ($d \leq 2$) or higher ($d \geq 3$). For smooth initial conditions, such singularities are obtained from the convex hull of the Lagrangian potential (the initial velocity potential minus a parabolic term). The singularities contribute *universal power-law tails* to the density pdf when the initial conditions are random. In one dimension the singularities are preshocks (nascent shocks), whereas in two and three dimensions they persist in time and correspond to boundaries of shocks; in all cases the corresponding density pdf has the exponent $-7/2$, originally proposed by E, Khanin, Mazel and Sinai (1997 Phys. Rev. Lett. 78, 1904) for the pdf of velocity gradients in one-dimensional forced Burgers turbulence. We also briefly consider models permitting particle crossings and thus multi-stream solutions, such as the Zel'dovich approximation and the (Jeans)–Vlasov–Poisson equation with single-stream initial data: they have singularities of codimension one, yielding power-law tails with exponent -3.