Cell growth rate dictates the onset of glass to fluid-like transition and long time super-diffusion in an evolving cell colony

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Collective migration dominates many phenomena, from cell movement in living systems to abiotic self-propelling particles. By focusing on the early stages of tumor evolution, I hope to enunciate the principles involved in cell dynamics and highlight their implications in understanding similar behavior in seemingly unrelated soft glassy materials and possibly chemokine-induced migration of $CD8^+$ T cells. Using simulations and theory I will show that tumor cells at the periphery move with higher velocity perpendicular to the tumor boundary, while motion of interior cells is slower and isotropic. The mean square displacement, of cells exhibits glassy behavior at times comparable to the cell cycle time, while exhibiting super-diffusive behavior at longer times. A sketch of the theory for these characteristics motion will be given. In the process we establish the universality of super-diffusion in a class of seemingly unrelated non-equilibrium systems. Our findings for the collective migration, which also suggests that tumor evolution occurs in a polarized manner, are in quantitative agreement with *in vitro* experiments. Although set in the context of tumor invasion the findings should also hold in describing collective motion in growing cells and in active systems where creation and annihilation of particles play a role.

References:

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