Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Clustering of brain tumor cells: a first step for understanding tumor recurrence EVGENIY KHAIN, Department of Phyiscs, Oakland University, M.O. NOWICKI, E.A. CHIOCCA, S.E. LAWLER, Department of Neurological Surgery, The Ohio State University Medical Center, C.M. SCHNEIDER-MIZELL, L.M. SANDER, Department of Physics, University of Michigan — Glioblastoma tumors are highly invasive; therefore the overall prognosis of patients remains poor, despite major improvements in treatment techniques. Cancer cells detach from the inner tumor core and actively migrate away [1]; eventually these invasive cells might form clusters, which can develop to recurrent tumors. In vitro experiments in collagen gel [1] followed the clustering dynamics of different glioma cell lines. Based on the experimental data, we formulated a stochastic model for cell dynamics, which identified two mechanisms of clustering. First, there is a critical value of the strength of adhesion; above the threshold, large clusters grow from a homogeneous suspension of cells; below it, the system remains homogeneous, similarly to the ordinary phase separation. Second, when cells form a cluster, there is evidence that their proliferation rate increases. We confirmed the theoretical predictions in a separate cell migration experiment on a substrate and found that both mechanisms are crucial for cluster formation and growth [2]. In addition to their medical importance, these phenomena present exciting examples of pattern formation and collective cell behavior in intrinsically non-equilibrium systems [3].

[1] A. M. Stein et al, Biophys. J., 92, 356 (2007).
[2] E. Khain et al, EPL 88, 28006 (2009).
[3] E. Khain et al, Phys. Rev. E. 83, 031920 (2011).

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Date submitted: 08 Nov 2011 Electronic form version 1.4