**Figure SI1.** The distribution of the head beads in the two-component system as a function of four consecutive time steps. The exact same region of the vesicle is shown in all the snapshots.
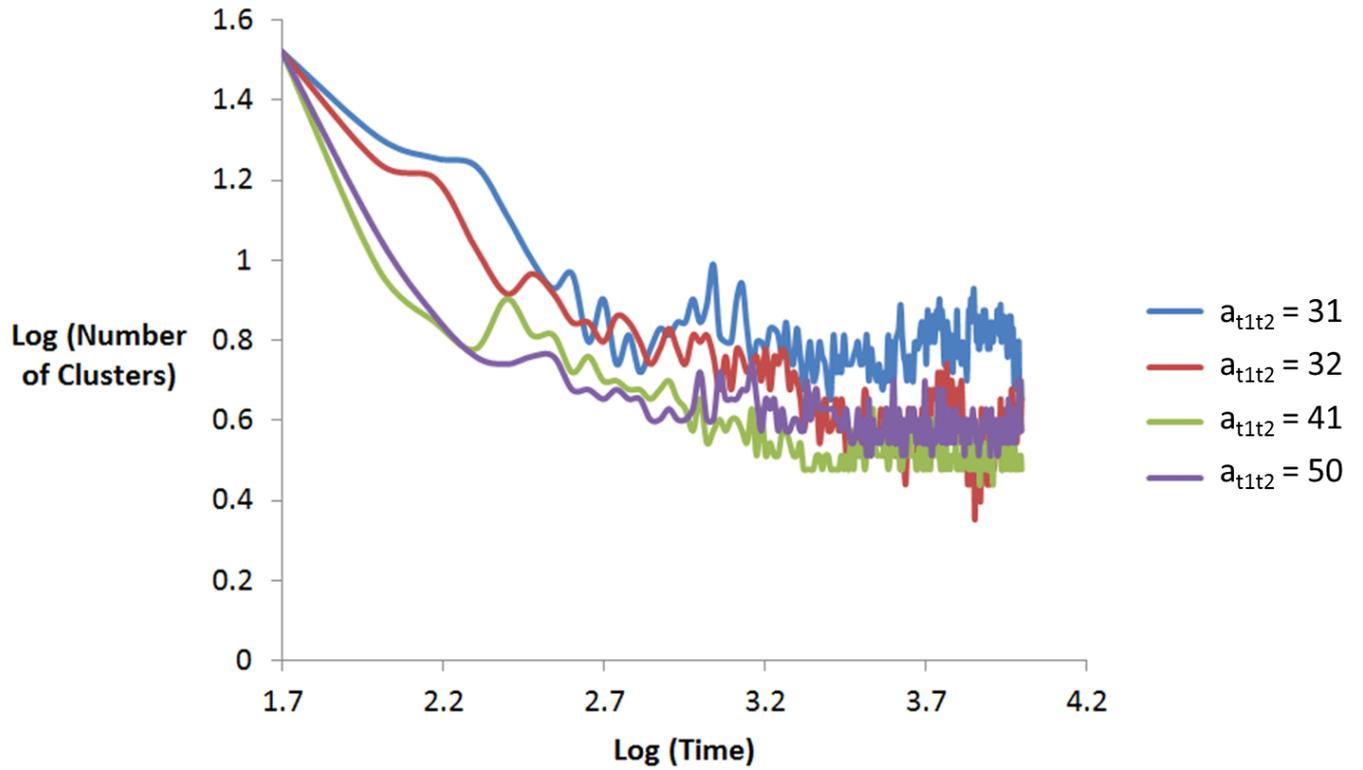
**Figure SI2.** A plot of time scale behavior for the number of clusters used to obtain the scaling exponent (α) for the tail-tail soft repulsive interaction parameters of $a_{t1-t2} = 31$, 32, 41, and 50. The simulations have been run for a total time of $10,000\tau$ from the mixed state and each data point has been averaged over four simulation runs using different random seeds.
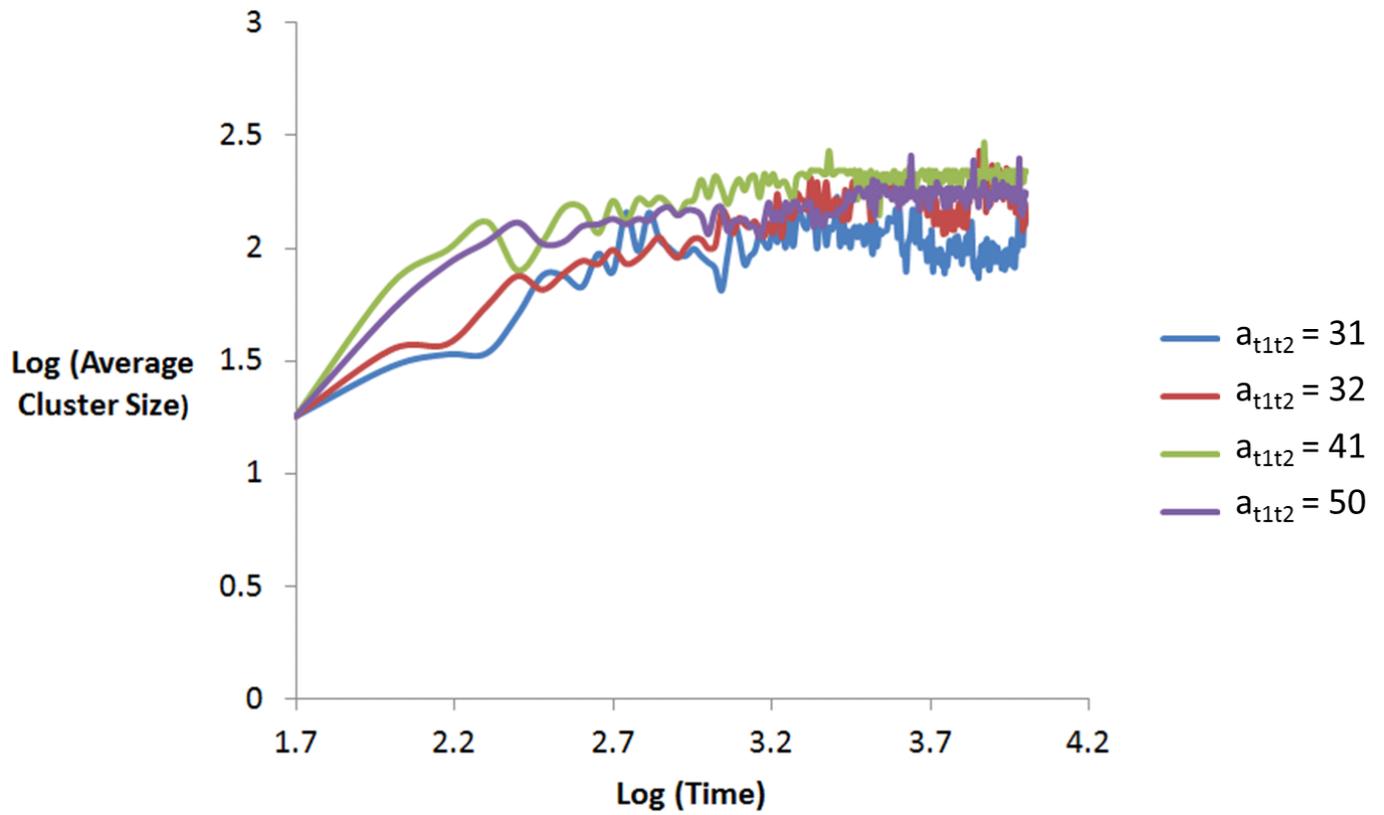
**Figure SI3.** A plot of time scale behavior for the average cluster size used to obtain the scaling exponent (β) for the tail-tail soft repulsive interaction parameters of $a_{t1-t2}$ = 31, 32, 41, and 50. The simulations have been run for a total time of $10{,}000\tau$ from the mixed state and each data point has been averaged over four simulation runs using different random seeds.