Electronic Supplementary Material (ESI) for Soft Matter.

Supplementary Information: A Passive Star Polymer in a Dense Active Bath: Insights from Computer Simulations

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TABLE I. Model Parameters

Parameter	**Value**
σ_{ABP}	1
σ_{beads}	1
N_{ABP}	7338 ($\phi = 0.4$),
	9172 ($\phi = 0.5$),
	11007 ($\phi = 0.6$)
$\frac{m}{\gamma}$	10^{-3}
m	1
k_BT	1
Δt	5×10^{-5}
Pe	0, 20, 40, 60, 80,
	100, 120, 130,150

TABLE II. Fitting parameter for residence time distribution

Function $P(t_{res})$	**Parameters**
$\frac{a}{t_{res^*}} \exp -\frac{t_{res}}{t_{res^*}}$	$a = 0.0029,$
	$t_{res^*} = 0.75\tau$
$\frac{c}{t_{res1}} \exp -\frac{t_{res}}{t_{res1}} + \frac{d}{t_{res2}} \exp \frac{-t_{res}}{t_{res2}}$	$c = 0.00008,$
	$d = 0.00001,$
	$t_{res_1} = 152.5\tau,$
	$t_{res_2} = 4.5\tau$

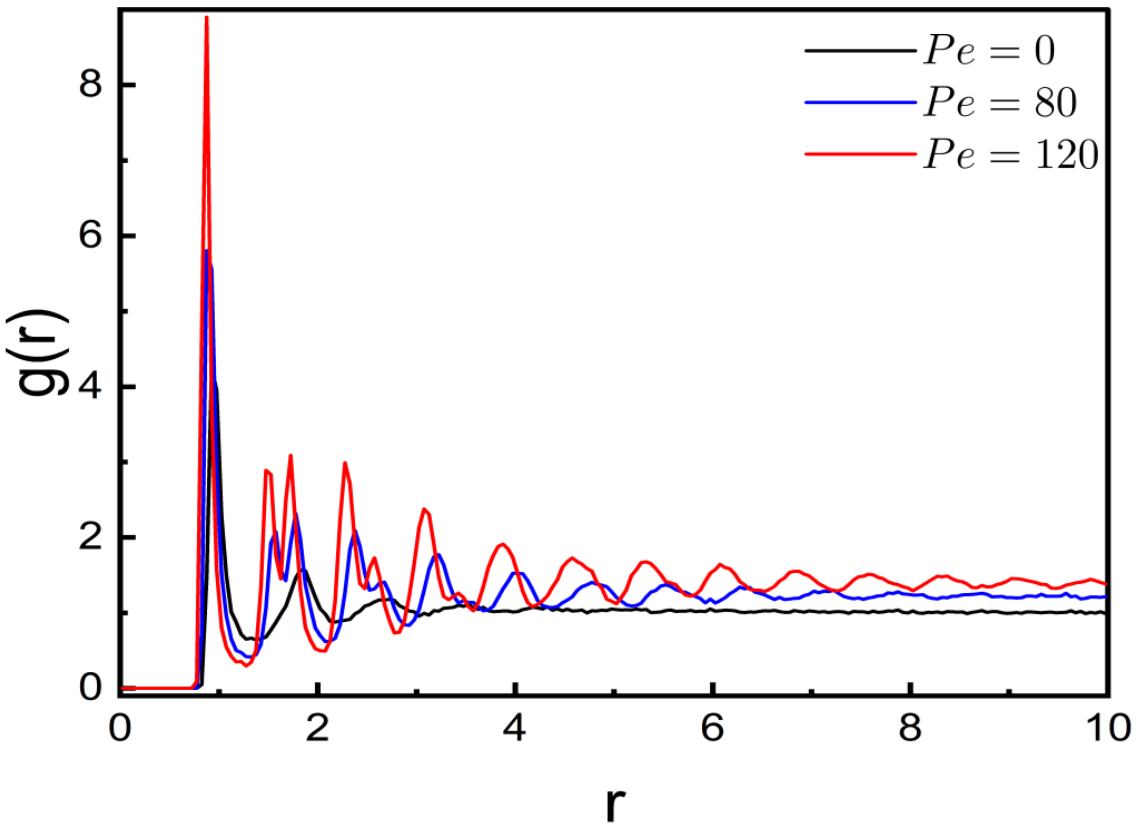

Fig. S1. Radial distribution function for ABPs in the bath of bare ABPs at $\phi = 0.6$.

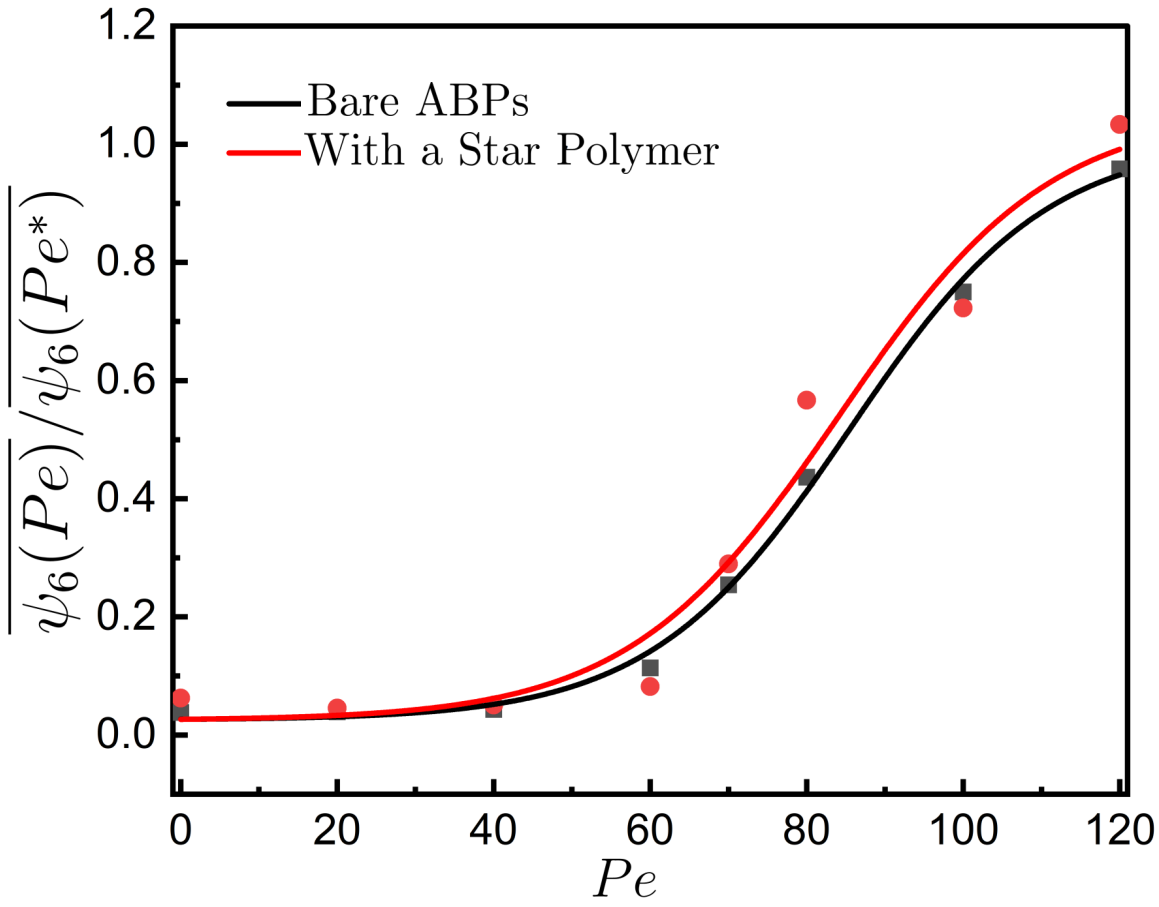

Fig. S2. Plots for relative averaged-global hexatic order $\overline{\psi_6(Pe)}/\overline{\psi_6(Pe^*)}$ at packing fraction $\phi = 0.6$ with activity. Symbols (black for bare ABPs and red for bath along with a star polymer) and solid lines are for their corresponding sigmoidal fit.

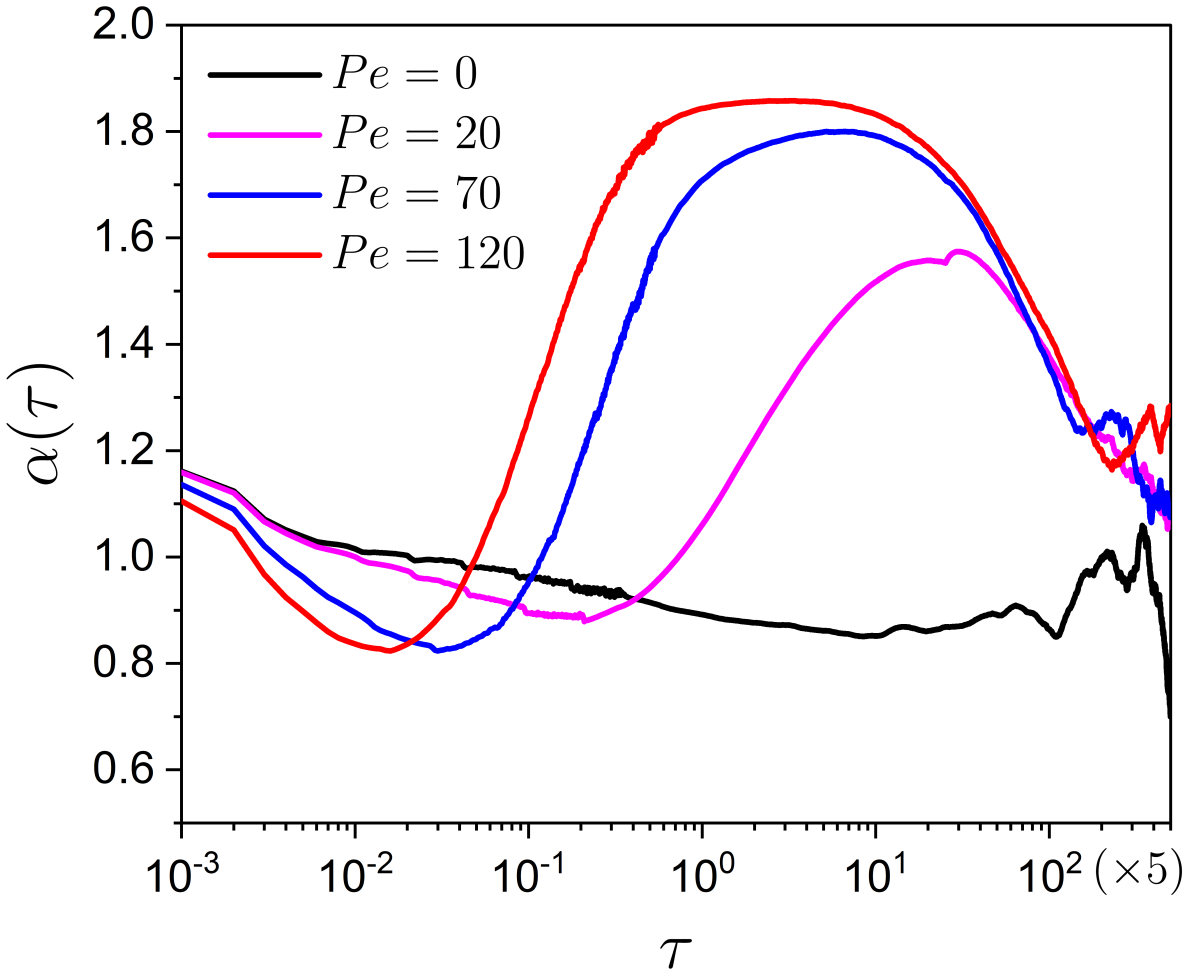

Fig. S3. Log-linear plot of time exponent $\alpha(\tau)$ *vs* τ for different Pe.

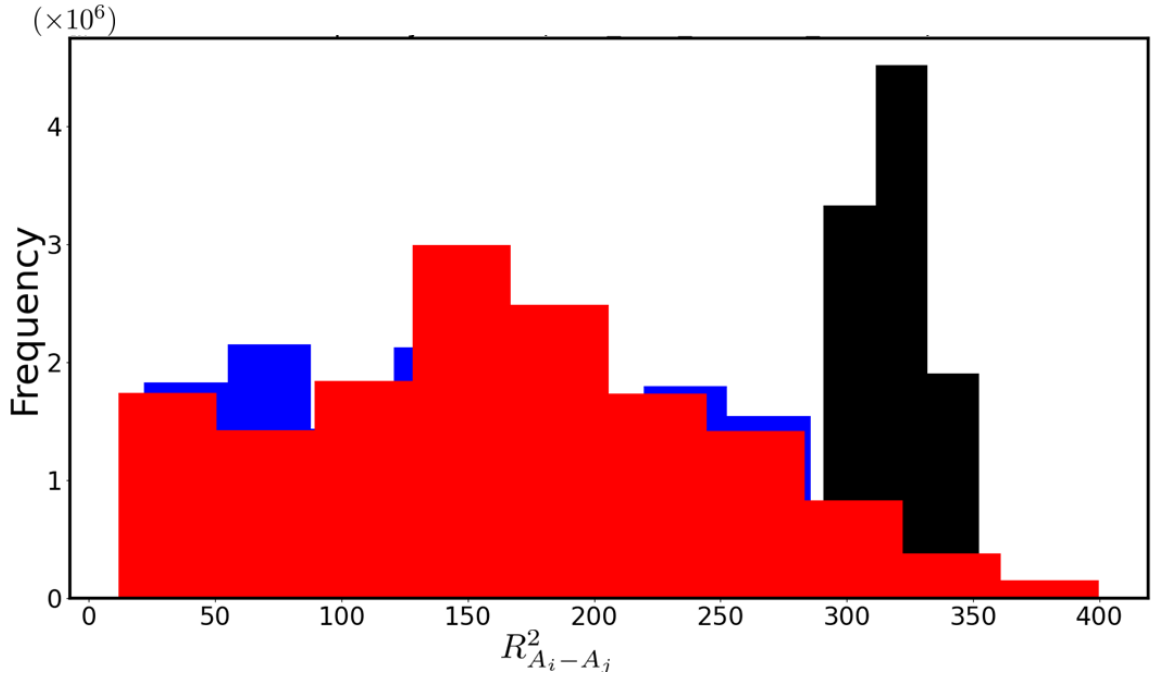

Fig. S4. Distribution of the arm-to-arm distances for different activities Black is for $Pe = 0$, blue is for $Pe = 70$, and red is for $Pe = 130$.

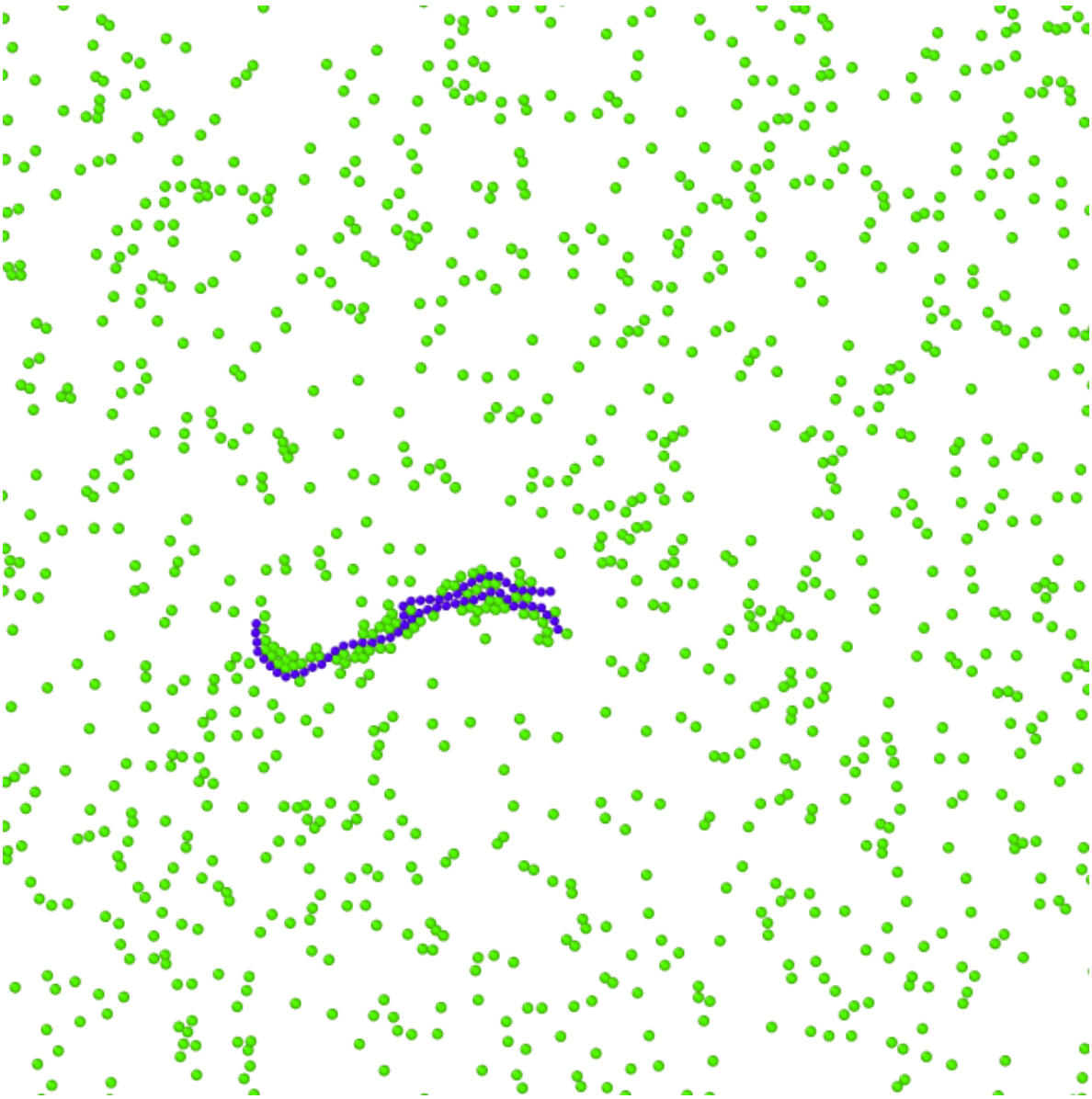

Fig. S5. Snapshot of the system at $\phi = 0.06,$ and $Pe = 100.$

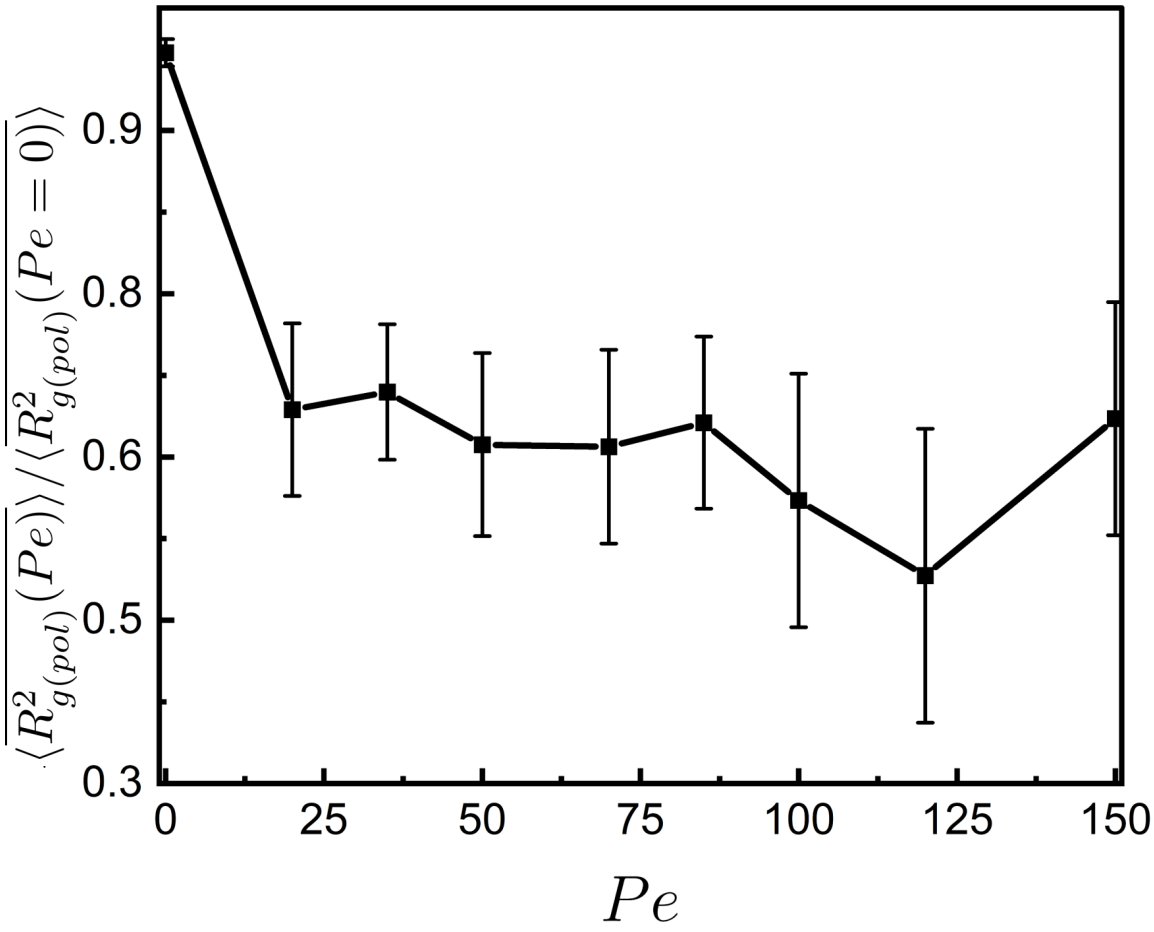

Fig. S6. Plot for averaged radius of gyration of star polymer with activity.

Movie description

Movie_1

Molecular dynamics simulation of the ABPs (green in color) at packing fractions $\phi = 0.4$ and $Pe = 100$. It is clear from the movie that there is no phase separation in this condition.

Movie_2

Molecular dynamics simulation of the ABPs (green in color) along with star polymer having three arms (blue in color) for $Pe = 100$ and packing fraction $\phi = 0.4$. Here, we observe that, with the inclusion of polymers, the largest cluster grows in the vicinity of the polymer. This inclusion also assists in nucleation which is not possible in the case of bare ABPs.

Movie_3

Molecular dynamics simulation of the Bare ABPs (green in color) at packing fraction $\phi = 0.6$ and $Pe = 100$ interacts with each other with repulsive potential. It is clear from the movie that the ABPs separates in the dilute and dense phase.

Movie_4

Molecular dynamics simulation of the ABPs (green in color) along with star polymer having three arms (blue in color) for $Pe = 100$ and packing fraction $\phi = 0.6$. Here, we observe that with the inclusion of the polymer, the largest cluster grows in the vicinity of the polymer by engulfing other clusters. Clustering in the nearby region results in the trapped dynamics of the polymer. Also, there is bending of the arms..

Movie_5

Molecular dynamics simulation of the ABPs (green in color) along with star polymer having three arms (blue in color) for $Pe = 130$ and packing fraction $\phi = 0.6$. We observe that, as a consequence of phase separation, high activity, and the imposition of topological constraints, a distinct pairing phenomenon occurs within the star polymer. Two of its arms exhibit a close association, while the third arm experiences a significant degree of separation.