

# Chapter 7

## Summary and conclusion

*Abbreviations/Acronyms:* **ABPs** ( active Brownian particles), **ABP** ( active Brownian particle), **AMB**(active model B), **AMBN**(active model B with noise), **AMBN**(Hexagonal close packed).

### 7.1 Summary

In this chapter we briefly summarized our works done so far. Chapter 1 is about the detailed introduction of active matter systems and methodologies to study them. In chapter 2, we have taken a binary mixture of active and passive particles and studied the system using overdamped Langevin equation, where we have found that for large size and activity of the active particles, passive particles form periodic hexagonal close pack (HCP) spanning clusters in the system and mass of largest cluster shows a much slower growth kinetics in contrast to conserved growth kinetics in ABP system. In chapter 3, we have discussed the phase separation in collection of ABPs in presence of random quenched obstacle. Motivation behind choosing such system was creating a non homogeneous environment for active particles. System is studied by simulating overdamped Langevin equation, where we observe that obstacle enhances phase separation in ABPs and boundary of phase separation

in the plane of packing fraction and pecelet number shift towards lower than the value obtained for the clean system of ABPs. Chapter 4 and 5 are about the the study of the ordering kinetics of the collection of ABPs, modeled using coarse-grained conserved active model B (AMB) in presence of multiplicative noise for critical and off-critical mixture. In Chapter 4, we study the system for critical mixture and find that the noise become relevant in case of AMB. We see the structure of domains changes from isolated droplet type for AMB without noise to bi-continuous type for active model B with noise (AMBN). The growth law shows a crossover from early time  $1/3$  value to intermediate time  $1/4$  value and it again traverses from  $1/4$  to  $1/3$  asymptotically. Correspondingly the two different scaling functions are found for intermediate time and late time with growth law  $1/4$  and  $1/3$  respectively. Chapter 5 is study for the off-critical mixture of collection of ABPs. First we have done the study, when the system is slightly away from the critical composition and find that the system develops a competition between the activity and asymmetry due to the off-criticality present in the system and growth exponent is always  $1/3$  for any strength of noise. When there is no such competition, the exponent approaches to value  $1/4$  for intermediate strength of noise for some intermediate time and asymptotically it goes to  $1/3$ . For deep off -critical mixture we find no such competition and exponent always remains  $1/3$ . Chapter 6 is the study of relevance of hydrodynamic field on the ordering kinetics of orientational field of the system. We model the system as a collection of orientable objects supplied with active stresses and momentum damping coming from the viscosity of bulk fluid medium. We study the system for contractile and extensile stresses and find that extensile fluid enhances the domain growth whereas the contractile fluid supresses it. Study of the growth exponent shows that the asymptotic growth becomes pure algebraic for large magnitudes of activity.

## 7.2 Future aspects

In the presence of disorder, we have observed the enhanced phase separation in the system. We can analyse the critical nucleation size for the formation of clusters. In active polar fluid, where we have studied the growth kinetics, exploring the effect of convective non-linearity due to the activity of the orientation field on the ordering kinetics would also be interesting to observe. For the off-critical composition, we can see the crossover of the growth exponent from  $1/4$  to  $1/3$  as we have observed in the case of critical composition.

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