

Table of contents

List of figures	xix
1 Introduction	1
1.1 Statistical mechanics and its development	1
1.2 Active matter system	5
1.2.1 Types of active particles	7
1.3 Methodology	12
1.3.1 Agent or microscopic rule based simulation	12
1.3.2 Phenomenology : hydrodynamic equations of motion	16
1.3.3 Lorentz lattice gas	18
1.4 Objective and organisation of the thesis	20
1.5 Technical details	22
2 Dynamics of a collection of active particles on a two-dimensional periodic undulated surface	23
2.1 Introduction	23
2.2 Model	25
2.2.1 Results	28
2.3 Green-Kubo	32
2.4 Discussion	36

3	Dynamics of passive particle in active run and tumble medium	39
3.1	Introduction	39
3.2	Model	41
3.3	Results	43
3.3.1	Results for different size of passive particles	43
3.3.2	Results with varying activity of RTPs	45
3.4	Summary	48
4	Macro to micro phase separation in a collection of chiral active swimmers	51
4.1	Introduction	51
4.2	Model	53
4.3	Results	54
4.3.1	Cluster size distribution	58
4.3.2	Structural ordering	59
4.4	Phase Diagram	61
4.5	Discussion	62
5	Phase separation of passive colloidal particles in active suspensions of bacteria	65
5.1	Introduction	65
5.2	Model	66
5.3	Effective Potential between Passive Particles	68
5.4	Conclusion	70
6	Dynamics of a single particle moving on a Random Lorentz Lattice-gas	71
6.1	Introduction	71
6.2	Construction of the Random Lattice	73
6.3	Properties of random lattice	76
6.4	Model: Definitions	78

6.4.1	Observables and characterisation of the system	79
6.5	Pure Random Motion (RM)	80
6.6	Dynamics in the presence of leftmost (L_t) and rightmost (R_t) rotators (ER)	81
6.7	Dynamics in the presence of left and Right rotators (R)	85
6.8	Conclusion	86
7	Summary and conclusion	95
7.1	Summary	95
7.2	Future prospects	97
	References	99
	List of Publications	i