

# Contents

Chapter 1. Introduction	1
Homological rotation sets	1
Homotopical rotation sets	3
Review of the results	4
Some open questions	6
Acknowledgments	7
Chapter 2. Quasi convexity of fundamental domains	9
Chapter 3. Rotation sets: definition and star shape	13
Chapter 4. Realisation of rotation vectors for closed geodesics	19
Chapter 5. Creation of new rotation vectors: elementary results	25
Chapter 6. Almost annular homeomorphisms	31
Chapter 7. Examples	35
7.1. A uniquely ergodic diffeomorphism with uncountable rotational directions	35
7.2. A diffeomorphism with trivial rotation set but unbounded displacements in all directions	36
7.3. An example of homeomorphism with non closed rotation set	37
Chapter 8. Intersections of closed geodesics: consequences on the homological rotation set	39
8.1. Background on covering maps	39
8.2. Preliminaries on homological rotation sets	44
8.3. Homological consequences when two geodesics intersect	45
Chapter 9. Closed geodesics with self-intersection	51
9.1. Some results of forcing theory for transverse trajectories	51
9.2. Markovian intersections	53
9.3. Geometric vs. $\mathcal{F}$ -transverse intersections	57
9.4. Setting	64
9.5. Creation of new periodic points	64
9.6. Horseshoe	66
Chapter 10. Two transverse closed geodesics	71
10.1. Two cases	72
10.2. Essential intersection points	74
10.3. Case 1	77

10.3.1. Leaves and trajectories	77
10.3.2. Transverse intersections	87
10.3.3. Admissible trajectories	89
10.4. Case 2	92
10.4.1. Choice of the points $\tilde{x}_1$ and $\tilde{x}_2$	92
10.4.2. Transverse intersections	98
10.4.3. Admissible trajectories	100
Bibliography	109