

CONTENTS

1. Introduction	1
1.1. Previous works	1
1.2. Results	6
1.3. Organization of the memoir	17
1.4. Remarks, notes and references	20
1.5. Acknowledgments	22
2. Notation and preliminary material	25
2.1. Notation for punctured elliptic curves	25
2.2. Notation and formulae for theta functions	25
2.3. Modular curves	26
2.4. Teichmüller material	27
2.5. Complex hyperbolic geometry	27
2.6. Flat bundles, local systems and representations of the fundamental group	28
2.7. Geometric (and in particular flat) structures (especially on surfaces)	31
3. Twisted (co)homology and integrals of hypergeometric type	39
3.1. The case of Riemann surfaces: generalities	39
3.2. On punctured elliptic curves	43
3.3. Description of the first twisted (co)homology groups	50
3.4. The twisted intersection product	55
3.5. The particular case $n = 2$	57
4. An explicit expression for Veech's map and some consequences	63
4.1. Some general considerations about Veech's foliation	63
4.2. An explicit description of Veech's foliation when $g = 1$	69
4.3. Veech's foliation for flat tori with two cone singularities	88
4.4. An analytic expression for the Veech map when $g = 1$	96
5. Flat tori with two cone points	107
5.1. Some notation	107
5.2. Auxiliary leaves	110
5.3. Mano's differential system for algebraic leaves	112
5.4. Some explicit examples	118

6. Some explicit computations and a proof of Veech's volume conjecture when $g = 1$ and $n = 2$	121
6.1. Examples of explicit degenerations towards flat spheres	121
6.2. When N is small: relations with classical special functions	123
6.3. Holonomy of the algebraic leaves	127
6.4. Volumes	138
6.5. Some concluding comments	142
Appendix A. 1-dimensional complex hyperbolic conifolds	149
Appendix B. The Gauß-Manin connection associated to Veech's map	157
Index	175
Bibliography	177