

# Table of contents

<i>Introduction</i>	-----	17
References	-----	25
<i>Justification and objectives</i>	-----	33
<i>Chapter 1: Probing the operability regime of a minimal ribocomputing cell.</i>	-----	35
1.1.    Introduction	-----	37
1.2.    Results	-----	39
1.2.1.    Analog behavior of the system	-----	39
1.2.2.    Environmental robustness of the system	-----	42
1.2.3.    Genetic burden of the system	-----	44
1.2.4.    Evolutionary stability of the system	-----	46
1.3.    Discussion	-----	49
1.4.    Materials and Methods	-----	50
1.4.1.    Strain, plasmids, and reagents	-----	50
1.4.2.    Preparation of cultures for characterization	-----	51
1.4.3.    Fluorescence quantification	-----	51
1.4.4.    Empirical model to predict the response	-----	52

1.4.5.	Different environmental conditions	52
1.4.6.	Growth rate curves	53
1.4.7.	Experimental evolution	53
1.4.8.	Sequencing of the genetic circuit	53
1.4.9.	Statistical analysis	54
1.5.	References	55

*Chapter 2: Bacterial population control with macroscopic HKUST crystals.* **59**

2.1.	Introduction	61
2.2.	Results	63
2.3.	Discussion	75
2.4.	Materials and Methods	77
2.4.1.	Material preparation.	77
2.4.2.	Chloramphenicol loading into material.	78
2.4.3.	Measurement of copper release from material.	79
2.4.4.	Bacterial strain and precultures.	80
2.4.5.	Measurement of bacterial growth in liquid medium.	80
2.4.6.	Measurement of bacterial growth in solid medium.	81

2.4.7.	Statistical analysis	82
2.5.	References	83
<i>Chapter 3: Evolutionary canalization mediated by altered expression of the GroEL chaperone.</i>		87
3.1.	Introduction	89
3.2.	Results	92
3.2.1.	Experimental evolution under strong bottlenecks: clonal evolution	92
3.2.2.	Determining changes in biological fitness: growth rates	95
3.2.3.	Determining changes in GroEL expression: qPCR	98
3.2.4.	Experimental evolution under soft bottleneck (1%), population evolution	99
3.2.5.	Mutational dynamics of GroEL clients and non-clients	101
3.3.	Discussion	102
3.4.	Materials and methods	104
3.4.1.	Bacterial Lines	104
3.4.2.	Evolution Experiment	105
3.4.3.	Growth Rate and Fitness Measurements	106

3.4.4.	GroEL Measurement and Quantification by qPCR	107
3.4.5.	Deep Sequencing and DNaseq Data Analysis	107
3.4.6.	Phenotypic arrays	109
3.4.7.	Statistical analysis	109
3.5.	References	111
<b><i>General discussion</i></b>		<b>119</b>
References		125
<b><i>Conclusions</i></b>		<b>129</b>
<b><i>Acknowledgments</i></b>		<b>131</b>