

Contents

1	Introduction	1
2	Pulse propagation in normal dispersive fibers	5
2.1	Wave-equations and solitons	5
2.2	Optical wave breaking	11
2.3	Similaritons and parabolic pulses	14
3	Mode-locking of lasers	18
3.1	Passive mode-locking techniques for fiber oscillators	18
3.2	Operation regimes of fiber oscillators and their limitations	25
3.3	Master equations	28
4	Normal dispersive fiber oscillator at $1\mu\text{m}$	31
4.1	Experimental setup	31
4.2	Numerical model	35
4.3	Output characteristics	40
4.4	Impact of dispersion	49
4.4.1	Group-delay dispersion	49
4.4.2	Net third-order dispersion	54
5	Detailed studies on the operation regime	62
5.1	Dynamics inside the resonator	62
5.2	Importance of spectral filtering	71
5.3	Comparison with analytical predictions	74
5.4	Decoupling amplification from pulse shaping	78

6 Hybrid mode-locking of wave breaking-free fiber oscillators	84
6.1 Experimental setup	84
6.2 Self-starting capability	86
6.3 Tuning of the output characteristic	92
6.4 Dispersion control with a hollow-core photonic bandgap fiber	95
6.4.1 Generation of bunched noise-like pulses	97
6.4.2 Generation of wave breaking-free pulses	100
7 Transfer to other wavelengths: normal dispersion fiber oscillator at 1.5 μm	104
7.1 Introduction	104
7.2 Experimental setup	107
7.3 Output characteristics	111
7.4 Impact of intrapulse Raman-scattering	113
7.5 Discussion of the operation regime	119
7.6 Limitation of the pulse energy	121
8 Conclusion	129
9 Outlook	133
List of acronyms	137
List of figures	143
Bibliography	145
Curriculum vitae	163
List of publications	165
Acknowledgment	169