Contents

Introduction **1**

1. Methods and Concepts **5**
1.1. Mode-Locked Lasers 5
1.2. The Carrier-Envelope Phase 8
1.3. Measuring the Carrier-Envelope Phase Evolution 12
1.4. Stabilization of the Carrier-Envelope Phase 16
1.5. Supercontinuum Generation for f–$2f$ Interferometry 19
1.6. Origin of the Detected Carrier-Envelope Phase Jitter 21

2. Improvements of the Carrier-Envelope Phase Stabilization of Amplifier Systems **25**
2.1. Quasi-common-path f–$2f$ Interferometer 26
2.1.1. Prism-based Quasi-Common-Path f–$2f$ Interferometer 28
2.1.2. Dichroic Quasi-Common-Path f–$2f$ Interferometer 31
2.1.3. Further Improvements 34
2.2. Fast f–$2f$ Interferometer for Amplifier Stabilization 35
2.3. Concluding Remarks 44

3. Direct Frequency Comb Synthesis with Arbitrary Offset **47**
3.1. Concept for Direct Frequency Comb Synthesis 48
3.2. Experimental Verification 50
3.3. Further Improvements 58
3.4. Concluding Remarks and Outlook 63

4. Sub-Shot-Noise Carrier-Envelope Frequency Jitter in Kerr-Lens Mode-Locked Lasers **65**
4.1. Observation of Sub-Shot-Noise Carrier-Envelope Frequency Jitter . . 66

Dieses Werk ist copyrightgeschützt und darf in keiner Form vervielfältigt werden noch an Dritte weitergegeben werden.
Es gilt nur für den persönlichen Gebrauch.

4.2. Origin of Sub-Shot-Noise Carrier-Envelope Frequency Jitter in Feedback Configuration 78
4.2.1. Feedback Based Generation of Sub-Shot-Noise Characteristics 78
4.2.2. Interpretation in Terms of Soliton Induced Photon-Number Squeezing 80
4.2.3. Interpretation in Terms of Quantum Non-Demolition Measurements 81
4.3. Concluding Remarks 89

5. Conclusions **93**

A. Phase Noise Characterization **95**
A.1. Frequency Analysis of the Carrier-Envelope Phase Noise 95
A.2. Phase Noise Measurements with a Radio-Frequency Spectrum Analyzer 97

Bibliography **99**

Danksagung **115**

Dieses Werk ist copyrightgeschützt und darf in keiner Form vervielfältigt werden noch an Dritte weitergegeben werden.
Es gilt nur für den persönlichen Gebrauch.