

# Contents

<b>List of figures</b>	<b>vii</b>
<b>List of tables</b>	<b>ix</b>
<b>1 Introduction</b>	<b>1</b>
1.1 NMR basics	1
1.2 CMOS electronics in NMR tools: trends	5
1.3 Sensitivity of mass-limited NMR probes	9
<b>2 A broadband single-chip transceiver for multi-nuclear NMR probes</b>	<b>21</b>
2.1 Abstract	21
2.2 Introduction	21
2.3 Electronics design	23
2.3.1 Transmitter	23
2.3.2 Receiver	25
2.3.3 Deadtime	25
2.3.4 Variable frequency probes	26
2.3.5 External coil: intrinsic gain and pulse time	27
2.3.6 Integrated coil	28
2.4 Experimental Setup	28
2.5 Results	30
2.5.1 Noise and Gain	30
2.5.2 Multinuclear NMR spectroscopy	31
2.5.3 Discussion	35
<b>3 CMOS-based broadband NMR probes for high field magnetometry</b>	<b>37</b>
3.1 Abstract	37
3.2 Introduction	37
3.3 Experimental Setup	39
3.3.1 Description of the integrated circuit	39
3.3.2 Description of the main unit	40
3.3.3 Data processing	42
3.3.4 Standard Probe Heads	42
3.4 Results	43

## Contents

---

3.4.1	Resolution in DC field measurements . . . . .	43
3.4.2	Compact multichannel field monitoring probes . . . . .	45
3.4.3	Absolute accuracy . . . . .	48
3.4.4	Conclusions . . . . .	48
<b>4</b>	<b>NMR spectroscopy of single sub-nL ova with ultra-compact single-chip probes</b>	<b>51</b>
4.1	Abstract . . . . .	51
4.2	Introduction . . . . .	52
4.3	Results . . . . .	53
4.3.1	Linewidth in <i>Rc</i> ova . . . . .	53
4.3.2	Experiments on <i>Rc</i> ova with an alternative setup . . . . .	54
4.3.3	<i>Rc</i> ova spectroscopy . . . . .	56
4.3.4	<i>Hp</i> ova spectroscopy . . . . .	58
4.3.5	Sensitivity (with maps) of the single-chip probe . . . . .	59
4.3.6	Chemical shifts in <i>Rc</i> and <i>Hp</i> ova. . . . .	60
4.4	Discussion . . . . .	61
4.5	Methods . . . . .	63
4.5.1	Single ovum probe mounting. . . . .	63
4.5.2	Tardigrade <i>Richtersius coronifer</i> ( <i>Rc</i> ). . . . .	63
4.5.3	Nematode <i>Heligmosomoides polygyrus bakeri</i> ( <i>Hp</i> ). . . . .	64
4.5.4	NMR experimental details. . . . .	64
<b>5</b>	<b>Appendix: supplementary, designs</b>	<b>65</b>
<b>6</b>	<b>Conclusions and Outlook</b>	<b>83</b>
	<b>Bibliography</b>	<b>89</b>