

# Oscillators – and – Scientific Instruments – Tentative Program, Spring 2022

	Date	No	Contents (based on 2021, will be updated)	Learning material & documentation project: Enrico's lecture notes and the following references
Part 1: General Instruments (Phase noise and frequency stability & Scientific Instruments)	Wed, Mar 2	1	Introduction to the course. Noise: quantum, thermal, shot	E. O. Göbel. U. Siegner, <i>The New International System of Units (SI)</i> , Wiley-VCH 2019
	Fri, Mar 4	2	Flicker. Instrument (structure). Rothe Dahlke. Guarding & shielding. Noise: temperature, factor, figure.	Various documents, to be listed later. A book project: E. Rubiola, <i>Phase Noise</i> .
	Mon, Mar 7	3	Photodiode. Noise Equivalent Power (NEP). Analog meets digital (no architectures). Fourier analysis	A. Yariv, <i>Optical Electronic in modern communications</i> , Oxford. Saleh-Teich <i>Photonics</i> , Wiley. C. E. Calosso, E. Rubiola, Phase Noise and Jitter in Digital Electronics, arXiv:1701.00094.
	Wed, Mar 9	4	Cross spectrum: theory and applications	E. Rubiola, F. Vernotte, The cross-spectrum experimental method, arXiv:1003.0113 Does not cover the applications
	Fri, Mar 11	5	Spectrum analyzer. Time-to-digital and frequency-to-digital converters	A book project about TDC, FDC and related statistics. J. Kalisz, Review of methods for time interval measurements with picosecond resolution, <i>Metrologia</i> 41(1) p.17-32, 2004
Part 2: Oscillators (Phase noise and frequency stability)	Wed, Mar 16	6	Phase noise, basic concepts. Allan variances, start	E. Rubiola, F. Vernotte, arXiv:2201.07109. A book project: E. Rubiola, <i>Phase Noise</i> U. L. Rohde, E. Rubiola, J. C. Whitaker, <i>Microwave and wireless synthesizers</i> , Wiley 2021 (Ch.2)
	Fri, Mar 18	7	Allan variance (cont.). Experimental methods, problem with the Rohde oscillator	E. Rubiola, F. Vernotte, arXiv:2201.07109. U. L. Rohde, E. Rubiola, J. C. Whitaker, <i>Microwave and wireless synthesizers</i> , Wiley 2021 (Ch.2)
	Mon, Mar 21	8	Interferometer. Amplifiers. Noise in digital systems	A book project: E. Rubiola, <i>Phase Noise</i> . A few articles by E. Rubiola. C. E. Calosso, E. Rubiola, Phase Noise and Jitter in Digital Electronics, arXiv:1701.00094.
	Wed, Mar 23	9	The Leeson effect (the origin of noise in oscillators and lasers)	E. Rubiola, <i>Phase noise and frequency stability in oscillators</i> , Cambridge 2010
	Mon, Mar 28	10	The Pound Drever Hall frequency control	A book project: E. Rubiola, <i>The Pound Drever Hall Frequency Control</i> Eric D. Black ED, An introduction to Pound–Drever–Hall..., <i>Am J Phys</i> 69(1) January 2001
Part 3: The New SI (Scientific Instruments)	Wed, Mar 30	11	Uncertainty. Int'l coordination of metrology	International Vocabulary of Metrology VIM and several BIPM documents about the coordination of Metrology. Everything is free on the BIPM web site.
	Fri, Apr 1	12	The SI unit of time	BIPM, The International System of Units 9 <sup>th</sup> ed, 2019. F. Riehle, <i>Frequency Standards</i> , Wiley-VCH 2004
	Mon, Apr 4	13	The SI units of length, and mass. Introduction to electrical units	BIPM, The International System of Units 9 <sup>th</sup> ed, 2019. E. O. Göbel. U. Siegner, <i>The New International System of Units (SI)</i> , Wiley-VCH 2019
	Wed, Apr 6	14	Quantum electrical standards. Practical electrical references.	BIPM, The International System of Units 9 <sup>th</sup> ed, 2019. E. O. Göbel. U. Siegner, <i>The New International System of Units (SI)</i> , Wiley-VCH 2019
	Fri, Apr 8	15	Temperature, fundamental and practical stuff. (Skip mole). Candela (quite short). Goodbye.	BIPM, The International System of Units 9 <sup>th</sup> ed, 2019. E. O. Göbel. U. Siegner, <i>The New International System of Units (SI)</i> , Wiley-VCH 2019



# Scientific Instruments — and — Phase Noise and Frequency Stability in Oscillators

Lectures for PhD Students and Young Scientists

Spring 2022

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Part 1: General

Part 2: Phase noise and oscillators

Part 3: The International System of Units SI

# Origin and Purposes

## The contents originates from

- My tutorials at int'l conferences and my lectures as a guest scientist in other labs
- Long term interests in the foundation of metrology
- Lab experience which does not fit elsewhere

Formally, a series of lectures for PhD students

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They are instructed to accept everybody

# Learning Material

<b>Contents</b>
<b>News</b>
<b>Enrico's Noise Chart</b>
<b>Publications</b>
• books
• open literature
• journal articles
• conference articles
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• seminar slides $\geq 1H$
<b>EFTS</b>
<b>Lectures</b>
• PhD lectures
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• U. Henri Poincaré
• Politecnico di Torino
<b>Oscillator noise</b> support material for my book (Cambridge, 2008)
<b>Affiliations</b>
<b>Links</b>

## Lectures

- PhD Lectures



## Enrico Rubiola home page

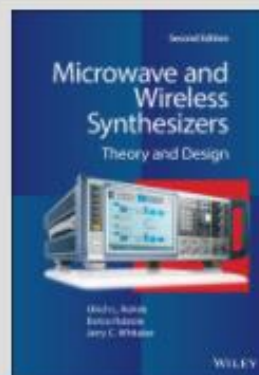
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replace "at" = "@" and "dot" = "."

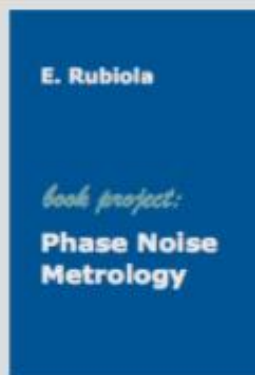
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## PUBLICATIONS

### Books



U. L. Rohde, E. Rubiola,  
J. C. Whitaker  
*Microwave and wireless  
synthesizers*  
John Wiley & Sons, Nov. 2020  
ISBN  
978-1-119-66600-4 Hardcover



E. Rubiola  
*Phase noise metrology*  
Book project