



Doctoral school SPIM - science course 2015-2016

Acronym : FASO	Frequency and amplitude stability in oscillators from RF/microwaves to optics
Audience	PhD Students in Engineering and Physics, i.e., SPIM and Carnot-Pasteur in Bourgogne – Franche-Comté. Guests are welcome, from any other university, young scientists, private company employees, etc.
Requirements	General background in experimental sciences or engineering, at PhD-start level. A reasonable understanding of physics and electricity.
Instructor(s)	Prof. Enrico Rubiola, CNRS Femto-ST Institute. Web page http://rubiola.org
Contents	Time, and equivalently Frequency, is the most precisely measured physical quantity. Accuracy span from 10 ⁻⁵ (cheap watch) to parts in 10 ⁻¹⁶ (fundamental metrology). It is therefore inevitable that virtually all domains of engineering and physics rely on time-and-frequency metrology and thus need reference oscillators. We focus on the basic material, described underneath. The clock signal and its fluctuations. Fourier statistics. The measurement of power spectra. Allan variance and other wavelet variances. AM and PM noise in devices. The Leeson effect (phase-to-frequency noise conversion in oscillators and lasers). The Pound Drever Hall frequency control (locking an oscillator or a laser to a reference cavity). Experimental methods. Time-to-digital and frequency-to-digital converters. AM and PM noise in digital systems. This course derives from a series of tutorials given at int'l conferences and research labs, gathered, organized, and made more accessible.
Burden	15 hour lectures in two-and half consecutive days.
Learning material	An extended version of the slideshow (650 pages) is available on the lecture web page. The draft of a reference book is in progress (currently >400 pages). E. Rubiola, "Phase noise and frequency stability in oscillators," Cambridge 2012, ISBN 978-0-521-15328-7. Chinese translation, ISBN 978-7-03-041231-7.
Exam	A la carte. Either rather informal oral exam; or a simple assignment; or discussions on a specific problem brought by the attendee. Double standard, for students getting in serious T&F metrology & physics, and for students interested in T&F to broaden their general knowledge.
Certificate	A certificate of attendance will be emailed to all participants. For a paper certificate or for any use other than as PhD-training internal document, please contact both the instructor and this PhD school.
Schedule	This course is given every year at the end of Winter. Next session for 2015-2016 is scheduled as follows : 📅 Monday, April 11, to Wednesday, April 13, 2016. April 11–12: 9:00–17:30 (6 hours of instructions and pauses) . April 13: 9:00–12:30. (3 hours of instructions and pauses)
Location	ENSMM, 26 Rue Epataphe, 25000 Besançon – Access map on http://www.ens2m.fr . The room will be indicated later.
No of attendees	No limit, at least within the size of the available rooms. However, late registrations (<3 weeks) cannot be guaranteed for logistic reasons.
Registration	Email to formations.doctorales@univ-fcomte.fr Please use your "official" (University or Company), not free webmail services like google or yahoo. Provide first and last name, PhD school, university, lab and team, advisor contact, and year. Guests, please provide the appropriate information (name, age, main job, Company, etc.). Please register as early as you can, and no later than 3 weeks before the course starts. Last minute registrations cannot be guaranteed. You will receive email confirmation, and an email recall approx. one week before the course starts. WARNING: The courses are expensive, by registering, you agree to participate. If you are exceptionally ultimately unable to participate, be sure to inform as soon as possible.
Notes	It is understood that PhD lectures are only possible thanks to the good will of everybody. So, by registering you commit to attend all lectures; and, should you be absent for any reason, to inform the PhD in a due course. For regulatory reasons, all participants are expected to sign the attendance list at each lecture, and to fill the online inquiry at the end.
Web site	Learning material, schedule, rooms, and all information are on http://rubiola.org. Follow home -> syllabus -> PhD lectures