Module: Elective Advanced Lectures: Experimental Physics

Module No.: physics70a

Course: Precision Metrology (E)

Course No.: physics744

Category	Type	Language	Teaching hours	CP	Semester
Elective	Lecture with exercises	English	2+1	4	WT/ST

Requirements for Participation:

Preparation:
Fundamentals of Quantum Mechanics, Atomic Physics

Form of Testing and Examination:
Requirements for the examination (written or oral): successful work within the exercises

Length of Course:
1 semester

Aims of the Course:
The aim of the course is to give the students a deeper insight to the field of precision metrology. Building on prior knowledge from the Bachelor courses it will cover topics from the field of sensing and metrology. The course will focus on work related to atomic physics and laser spectroscopy.

Contents of the Course:
Introduction to precision measurements: the system of SI units, systematic and statistical errors, precision and accuracy, error budgets, Allan deviation; the hydrogen atom and test of QED, including muonic hydrogen; atomic clocks: RF clocks, optical clocks (lattice clocks, ion clocks, nuclear clocks; matter wave interferometry; entanglement and squeezing; search for physics beyond the standard model in atomic physics: isotope shift spectroscopy, drifts in fundamental constants and dark matter, Lorentz violation, parity violation; ring laser gyroscopes for rotation sensing; technology: lasers, frequency combs, resonators. Possible topics outside of atomic physics include tests of special relativity and gravitational wave detection.

Recommended Literature:
Will be given in the lecture