Sub-cycle metrology of terahertz fields

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The metrology and transduction of quantum level sub-terahertz and terahertz waves is a prerequisite for future applications in quantum sciences, sensing, metrology or high speed control of light. With past technologies mainly limited to classical signals at radio frequencies, quantum-level terahertz waves are anticipated to boost current functionalities by carrying out one of two duties. On one hand side, they can be themselves the carriers of unique information e.g. for spectroscopy or communication. On the other hand side, they can control optical signals at ever faster speeds – in so-called transducers that establish a direct link between the terahertz and e.g. the optical domain. This talk will deal with two questions: First, what opportunities lie behind metrology and transduction of quantum level electric fields that oscillate at frequencies up to the terahertz, especially if the measurement happens on temporal and spatial scales that are shorter than one single cycle of their oscillation? And second, what are the limits for achieving such measurement precision (in time, space and amplitude) in practical nano-engineered devices deployed at large scales?