Speaker: **Frieder Lindel, Universität Freiburg**

Title: **Probing quantum states of light in space and time and their use for optimal control**

Date: **Wednesday, June 19, 16:00 pm**

Place: **Seminar room 915**

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Abstract:

Quantum field theory predicts that the fluctuating electromagnetic quantum-vacuum field possesses correlations and entanglement between distinct space-time regions—even those separated by spacelike intervals. As a consequence, two initially uncorrelated local field probes in vacuum can become entangled, despite being located in causally disconnected space-time regions and therefore unable to exchange information. In my talk, we will discuss how electro-optic sampling experiments can be used to probe correlations, entanglement, and Bell nonlocality within different states of the electromagnetic field in the terahertz frequency range—including the quantum vacuum state—between space- and time-like separated regions.

In addition to probing quantized light fields, we will also discuss their potential for controlling other quantum systems. While control conventionally relies on classical fields, in my talk the advantages provided by the quantum nature of control degrees of freedom will be analysed. To this end, I will present an optimal control theory that determines the initial state of a quantized field that optimally drives a target system into a predefined final state. This approach extends control theory to fully quantized and strongly coupled target and control systems.