
# KSETA Topical Courses, October 4 – 8, 2021

All courses will take place via zoom

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| **Introduction to quantum physics** (broader)<br>**non-physicists** | **Ulrich Husemann** | **4.10.2021**<br>**6.10.2021** | **13:30 - 16:45 h**<br>**9:00 - 12:15 h** |

Our world is a quantum world: quantum effects play a key role in modern technology. Yet physics at subatomic scales is quite different from our macroscopic world. This course aims at a first dive into the quantum world for KSETA fellows with little physics background.

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| **OLED-displays: From fundamental solid state physics to a multi-billion € industry** (broader)<br>**all** | **Ulrich Lemmer** | **5.10.2021** | **9:00 - 12:15 h** |

The display industry is one of the most dynamic branches of the high-tech sector. Organic light emitting diodes (OLEDs) are on their way to become the dominant display technology. The course will guide you through the history of this fascinating technology. I will give an overview, pinpoint the important technological breakthroughs, and will discuss the recent developments and current challenges.
This course counts together with "**Organic Semi-conductors"** from March 2021 as a full course.

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| **Introduction to Machine Learning and Deep Learning** (broader)<br>**all** | **Simon Kast (Bosch)** | **5.10.2021**<br>**7.10.2021** | **13:30 - 16:45 h**<br>**13:30 - 16:45 h** |

In this course, we will introduce the basics of Machine Learning. Concepts like how to train a model or how to avoid overtraining will not only be discussed theoretically, but will also be shown in hand-on coding sessions using Decision Trees as a simple example. As a second type of Machine Learning models, neural networks and Deep Learning are presented, again with hands-on coding examples.

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| **Baryogenesis** (deeper)<br>**theoretician** | **Mikhail Shaposhnikov (EPFL)** | **6.10.2021**<br>**7.10.2021** | **13:30 - 16:45 h**<br>**9:00 - 12:15 h** |

This course will start with a historical introduction and formulation of the problem of baryon asymmetry of the Universe. The following topics will be covered: Sakharov conditions, Equilibrium and non-equilibrium in expanding Universe, kinetic theory, Relevant literature, Anomalous fermion number non-conservation in electroweak theory, Sphalerons, Dilution of the baryon asymmetry by sphalerons, Baryon asymmetry in the Standard Model, Phase transitions in the early Universe, Basics of finite temperature quantum field theory, Electroweak phase transition and phase diagram, Electroweak baryogenesis on bubble walls during first order phase transition, Neutrino physics, Majorana neutrinos, and baryogenesis: Thermal leptogenesis, Low scale leptogenesis, Possibilities for experimental verification, Relation to Dark Matter.

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| **Scientific Journalism** (better)<br>**all** | **Rolf Krauter (Deutschlandradio)** | **8.10.2021** | **9:00 - 16:45 h** |

Communicating your scientific research to the general public (for instance in conversations with interested laypersons, public talks or media contributions) requires skills which are generally different from those which are honed through writing down your thesis work and presenting it to a scientific audience. This course is aimed at providing this specific skill-set, starting from considering a suitable language and wording. Through hands-on training you will find out how to identify key messages, get "to the point" and break down complex aspects to a more tangible frame. The course will consider both written texts and oral presentations/interview situations


# KSETA Topical Courses, October 11 – 15, 2021

All courses will take place via zoom

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| **Broad introduction into modern experimental particle physics** (broader) **exp. physicists** | **Frank Hartmann** | **11.10.21**<br>**13.10.21** | **9:00 - 12:15 h**<br>**9:00 - 12:15 h** |

The lecture series will give a broad overview on todays and future particle experiments at particle accelerators, e.g. LHC, HL-LHC, fix target, e+e- colliders, and the future ultimate FCC-hh. The emphasis will be on the technical design/implementation choices and how they can meet the multiple new challenges.

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| **Low-Temperature (Superconductive) Detectors** (broader) **all** | **Sebastian Kempf** | **11.10.21**<br>**14.10.21** | **13:30 - 16:45 h**<br>**9:00 - 12:15 h** |

Thermal detection of radiation started more than a century ago when Langley developed a resistive bolometer to study infrared radiation from the sun. Since then, many different types of thermal radiation detectors have been developed. Among them, low temperature detectors (LTDs), initially proposed by Simon in 1935, have emerged as an outstanding tool to study various type of radiation. They are nowadays strongly advancing the state of the art of instrumentation intended to measure the energy or power of any type of incident radiation. LTDs combine (superconductor-based) quantum technology with unique solid-state properties and outperform conventional detectors by orders of magnitude in performance. For this reason, they are heavily used in science, society and industry. With that in mind, this lecture series will introduce the operation principles, performance and readout technology of selected types of low-temperature detectors. It will also give an overview of the wide range of applications for which LTDs are nowadays used or developed and will highlight some of these applications such as the investigation of the neutrino mass, the study of the cosmic microwave background or radiation metrology in more detail.

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| **Neutrino mass phenomenology** (broader) **all** | **Werner Rodejohann (MPIK)** | **14.10.21**<br>**15.10.21** | **13:30 - 16:45 h**<br>**9:00 - 12:15 h** |

After explaining how masses of elementary particles are generated in the Standard Model, we argue why neutrino masses are most probably physics beyond the Standard Model. The difference of Dirac and Majorana neutrinos is discussed, and various mechanisms of neutrino mass generation are introduced, together with possibilities to distinguish them.
Then we turn to the three main methods to determine neutrino mass experimentally, using direct experiments such as KATRIN, cosmological observations, and neutrinoless double beta decay. The complementarity of the three approaches is stressed.