Registration open until March 12

KSETA Topical Courses, March 17 – 28, 2025

Science Communication for Particle Physics (better) **all**	**Jens Kube (AWKJK)**	**17.03.2025** **18.03.2025**	**13:25 – 16:40** **09:00 – 12:15**	**Bldg. 30.23 – Room 6/1 (CS)** **Bldg. 30.23 – Room 6/1 (CS)**

Effective science communication is essential for conveying complex ideas to diverse audiences, from policymakers to the general public. This two-day workshop explores key principles of science communication, including audience engagement, storytelling, and the use of digital and visual media. Special focus will be given to real-world examples from particle physics, such as explaining fundamental particles, accelerator technology, and groundbreaking discoveries.

Key questions addressed in the workshop include:

* How can I tailor my message to different audiences?
* What storytelling techniques make complex physics concepts more engaging?
* How can visualizations and metaphors improve understanding of particle physics?
* What role does science communication play in career advancement and funding opportunities?
* What are the best platforms and formats for sharing my research beyond academic publications?

Beyond communication techniques, the workshop will also examine the role of science communication in career development, from fostering interdisciplinary collaborations to opening new professional opportunities.

Through interactive exercises, participants will refine their ability to present their research in a clear and compelling way, gaining practical tools to enhance both their scientific impact and career prospects.

Superconducting magnets for particle accelerators (broader) **all**	**Axel Bernhard (KIT)** **Bennet Krasch (KIT)**	**19.03.2025** **20.03.2025**	**09:00 – 12:15** **13:25 – 16:45**	**Bldg. 345 - Rom 121 (CN)** **Bldg. 30.23 – Room 3/1 (CS)**

High-energy charged particle beams play an indispensable role in fundamental research, from collision experiments for exploring the most fundamental building blocks of matter to the production of highly brilliant X-rays for condensed matter research to fusion. To technically control charged particle beams well-designed electromagnetic fields are required, and if high-energy charged particles are considered, superconducting magnets are the tool of choice for guiding and confining these beams. The same is true for the production of high-energy photons in dedicated synchrotron light sources.

What are the requirements such magnets must fulfill and what are they based on? How do we technically meet those requirements and how do we control that we actually do meet them? Which further ingredients are required to safely operate such magnets? In this course we will address some fundamental charged-particle beam optics concepts and the corresponding magnet design concepts especially for superconducting magnets. We will take a tour through technological aspects such as technical superconductors, coil production techniques, field quality requirements and assurance, quenching and magnet protection, cryogenics.

The course will encompass lectures (180 m), a laboratory practical course (120 m) and a tour to accelerators and magnet production and qualification facilities at KIT north campus (60 m).

Software Engineering for Physicists (better) **all**	**Pranav Sampathkumar (KIT)**	**21.03.2025** **26.03.2025**	**13:30 – 16:45** **13:30 – 16:45**	**Bldg. 30.23 – Room 6/1 (CS)** **Bldg. 30.23 – Room 6/1 (CS)**

Max. 20 people

Knowledge transfer of existing code bases and scripts is an essential part of scientific endeavours. As scientists create more and more open code bases to share and collaboratively develop, it becomes very important we learn software engineering fundamentals so that our development paradigm aligns with industry standards, which allows for more maintainable and transferable code. It helps a lot in reducing onboarding and offboarding time from projects and speeds up scientific development.

In this course, we will present strategies to use well-known tools in a "clean" manner, that are based on current industry standards which can allow for creation of code bases which live well beyond the work times of individual contributors. The topics we cover include:

- Basics of Software Engineering: Technical Debt, Code Rot/Entropy, Development vs Engineering, Code vs Software.
- Git: How to structure a repository, How to create good commits and have a useful history, How to organise a project on GitHub and other integration with other collaboration tools.
- Programming paradigms and styles: Test/Behaviour driven development, Signs to look out for in bad code (code "smells") and how to fix them, rules of thumb for neat code.
- Strategies in Software Development Life Cycle (SDLC) Eg: Waterfall model, Continuous Integration, Agile
- Tools to help have a better programming structure (Formatters, Linters etc.)
- Hands-on Session in some of these principles.

Most of this course will be taught with Python as examples so a working knowledge of Python is expected. Basics of Git are also recommended as the course deals only with meta-level strategies and not the basics.

Future Particle Collider(s): Which? Why? When? (broader) **For particle physicists**	**Christophe Grojean (DESY)**	**24.03.2025** **25.03.2025**	**09:00 – 12:15** **13:30 – 16:45**	**Bldg. 30.23 – Room 6/1 (CS)** **Bldg. 30.23 – Room 6/1 (CS)**

The 2020 European Strategy for Particle Physics recommended an electron-positron collider working as a Higgs and electroweak factory as successor to the Large Hadron Collider to decipher the fundamental laws of Nature at the smallest scales. These lectures will aim at providing a snapshot at the current state of affairs. The different projects will be reviewed and the feasibility study of the Future Circular Collider (FCC) at CERN will be presented in detail. Emphasis will be given on the FCC physics case. Be it for testing the standard model predictions with unprecedented precision or to search for new particles, FCC is designed with versatility and diversity at the heart of its multi-stage program that will fuel the field of high-energy physics for several decades to come.

Computer algebra and Symbolica (deeper) **For theoretical physicists**	**Ben Ruijl (Ruijl Research)**	**24.03.2025** **25.03.2025**	**13:30 – 16:45** **09:00 – 12:15**	**Bldg. 30.23 – Room 6/1 (CS)** **Bldg. 30.23 – Room 6/1 (CS)**

When doing computations with pen and paper, we often rely on heuristics. We all know (without applying an algorithm) that 2/4=1/2, we can guess the factorization of x^2+3x+2, and we learned the integral of 1/(x^2+1) by heart. But how would you instruct a computer to perform these operations reliably? In this two-part lecture, we will focus on describing mathematical domains (such as rings and fields) in computer code and we will sketch algorithms to perform common operations. We will also encounter the largest obstacle in computer algebra: intermediate expression swell.

The second part is an overview and tutorial of the symbolic-numeric computation framework Symbolica (https://symbolica.io), which can be used as a library in Python and Rust. We will discuss several design aspects, expression manipulation, pattern matching, computational graphs and fast expression evaluation.

Direct searches for dark matter (broader) **For experimental physicists**	**Belina von Krosigk (U. Heidelberg), Teresa Marrodan (MPIK)**	**24.03.2025** **25.03.2025**	**13:30 – 16:45** **09:00 – 12:15**	**Bldg. 30.23 – Room 3/1 (CS)** **Bldg. 30.23 – Room 3/1 (CS)**

Dark matter, accounting for a significant portion of the mass in the universe, remains elusive, yet its influence on the dynamics and structure formation in the universe is undeniable. This lecture aims to shed light on the field of experimental astroparticle physics with a specific focus on dark matter. We will explore cosmological and astrophysical evidences and viable particle physics models, and review experimental techniques employed to directly detect and study dark matter across a mass range of more than ten orders of magnitude. A requirement for this lecture is a completed course in particle physics at least at the introductory level.

Scientific Writing (better) **all**	**CJ Fitzsimons (Leaderschip Sculptor)**	**27.03.2025** **27.03.2025** **28.03.2025**	**09:00 – 13:00** **13:00 – 17:00** **09:00 – 17:00**	**Bldg. 30.23 – Room 6/1 (CS)** **Bldg. 30.23 – Room 3/1 (CS)** **Bldg. 30.23 – Room 6/1 (CS)**

Max. 12 people

Young scientists can benefit from the workshop because they receive information about what makes a clear, concise, and compelling manuscript. They also have the chance to receive individual feedback on their own manuscripts, so they can make changes in their texts in parallel to learning the theory. In addition, the workshop addresses typical challenges with scientific writing and offers guidance about overcoming those obstacles.