

Einladung zum Physikalischen Kolloquium

23.01.2026 Jan Kieseler, Karlsruher Institut für Technologie
»From Reconstruction to Detector Design: AI as a Key Enabler«
Einführung: M. Klute

Our understanding of fundamental physics is built on the comparison between theoretical predictions and experimental measurements. In experimental particle physics, these measurements rely on large and highly complex detectors, which do not observe the underlying physical processes directly, but only those particles that are sufficiently stable to traverse the detector material, thereby producing detectable signals. Inferring the properties of these particles from the raw signals recorded by multiple detector subsystems is a central and highly non-trivial task. This process, known as reconstruction, ultimately limits the physics reach of an experiment.

Modern machine learning techniques provide a new approach to this problem by enabling the direct identification of complex patterns in high-dimensional detector data. Rather than relying exclusively on manually designed, step-by-step procedures, ML-based reconstruction methods can learn how to infer particle properties directly from detector signals, naturally combining information from different detector components. This shift is particularly powerful in increasingly granular detectors and complex event environments, and also offers new opportunities to address growing computational constraints.

Beyond reconstruction, these developments also open a new perspective on detector design itself. By enabling end-to-end optimisation strategies, tools from artificial intelligence allow detector designs to be adjusted and improved directly with respect to physics goals, with reconstruction performance forming an integral part of the optimisation loop rather than a downstream consideration.

This colloquium discusses machine-learning-based reconstruction methods and outlines how tools from modern artificial intelligence can be used to explore and optimise detector designs in an end-to-end fashion, as well as the challenges and opportunities that come with this shift.

Der Vortrag findet **am Freitag, den 23. Januar 2026 um 15:45 Uhr im Otto-Lehmann-Hörsaal**, Physik-Flachbau (Geb. 30.22), KIT-Campus Süd statt.