



PHYSICS COLLOQUIUM:

AI as a Co-Investigator in Physics Labs

Dr. David Rakestraw

Senior Scientist

Lawrence Livermore National Laboratory



About The Speaker:

David Rakestraw is a senior scientist at Lawrence Livermore National Laboratory (LLNL) in Livermore, California. For more than a decade, he led multidisciplinary research and development teams to counter chemical, biological, radiological, nuclear, and explosive threats. Over the past 5 years, he has focused on STEM education where he is developing inquiry-based activities that take advantage of the sensors in smartphones. Prior to LLNL, he spent 12 years at the Sandia National Laboratories location in Livermore, California, where he engaged in a wide range of research and development activities which began with the development of laser-based diagnostics for studying combustion processes. For 6 years between his time at the two national laboratories, Rakestraw co-founded a company that specialized in applying microfluidics for chemical analysis. Rakestraw has a BS in Chemistry from Ohio Northern University and a PhD in Chemical Physics from Stanford University.

Abstract:

What happens when every student can conduct research-level investigations as part of their introductory physics course? How can learning be transformed when students make thousands of measurements using high precision sensors with their own smartphones and partner with AI to analyze and evaluate their observations? How does engagement change when students get immediate feedback on their experimental designs, receive real-time answers to their questions, apply sophisticated computational analysis, and rapidly generate visualizations to uncover patterns in their data? What happens when every student can conduct research-level investigations as part of their introductory physics course? How can learning be transformed when students make thousands of measurements using high precision sensors with their own smartphones and partner with AI to analyze and evaluate their observations? How does engagement change when students get immediate feedback on their experimental designs, receive real-time answers to their questions, apply sophisticated computational analysis, and rapidly generate visualizations to uncover patterns in their data? The extraordinary and rapidly advancing capabilities of artificial intelligence are transforming science and engineering, reshaping how we conduct experiments, analyze data, and interpret results. This presentation explores how generative AI can be integrated into physics labs to enhance student engagement and learning. This seminar will provide concrete examples where students partner with an extremely capable AI co-investigator: conducting spectroscopic analysis of the dynamic changes in blood volume in their fingers by integrating millions of pixels from video; measuring the angular velocity of the Earth by using natural language to direct the creation of analysis codes to combine 100's of images and analyzing arc lengths of the light trails created by stars; and utilizing Fourier transforms of sound waves to illuminate the foundations of modern digital communications. Across these cases, the bottleneck shifts away from spreadsheet syntax and programming overhead toward higher-value scientific work: framing investigable questions, choosing appropriate methods, checking assumptions, validating outputs, and explaining results with physical reasoning. Attendees will leave with a set of adaptable investigation "patterns," example prompts and analysis workflows, and a clear view of how AI can enable labs that were impractical—if not impossible—just a year ago.

Date:

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Time:

10:30 AM – 11:50 AM

Location:

GRAN 135



For more information contact: Beth Nowadnick

enowadnick@ucmerced.edu