
THE WEIZMANN INSTITUTE OF SCIENCE
FACULTY OF MATHEMATICS AND COMPUTER SCIENCE

Faculty Seminar

Room 1 ,Ziskind Building
on Thursday, Feb 02, 2023 at 12:45

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Computational Imaging for Scientific Discovery: From Cloud Physics to Black Holes Dynamics

Abstract:

Imaging plays a key role in advancing science, from revealing the internal structure of clouds to providing the first visual evidence of a black hole. While both examples come from different imaging systems, they illustrate what can be achieved with modern computational approaches. Computational imaging combines concepts from physics, machine learning, and signal processing to reveal hidden structures at the smallest and largest of scales. In this talk, I will highlight how peeling away layers of the underlying physics leads to a spectrum of algorithms targeting new scientific discoveries. I will focus on the Event Horizon Telescope (EHT), a unique computational camera with the goal of imaging the glowing fluid surrounding supermassive black holes. In May of 2022, the EHT collaboration revealed the first images of the black hole at the center of our galaxy: Sagittarius A* (Sgr A*). These images were computationally reconstructed from measurements taken by synchronized telescopes around the globe. While images certainly offer interesting insights, looking toward the future, we are developing new computational algorithms that aim to go beyond a 2D image. For example, could we use EHT observations to recover the dynamic evolution or even the 3D structure? We tackle these challenges by integrating emerging AI concepts with physics models. Our hope is that in the not-too-distant future, these new and exciting prospects will enable scientific discovery and even provide a glimpse into the very nature of space-time itself in our galaxy's most extreme environment.

Bio:

Aviad Levis is a postdoctoral scholar in the Department of Computing and Mathematics at Caltech, working with Prof. Katherine Bouman. Currently, as part of the Event Horizon Telescope collaboration, his work focuses on developing novel computational methods for imaging black hole dynamics. Prior to that, he received his Ph.D. (2020) from the Technion and his B.Sc. (2013) from Ben-Gurion University. Notably, his Ph.D. research into 3D remote sensing of clouds is a key enabler in a novel interdisciplinary space mission (CloudCT) funded by the ERC and led by Yoav Schechner, Ilan Koren, and Klaus Schilling. Aviad is a recipient of the Zuckerman and the Viterbi postdoctoral fellowships.