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Shaping the quantum wavepacket of free electrons

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The past two decades showed a growing interest in shaping the spatial profile of optical beams by imprinting them with a phase singularity that gives them discrete values of orbital angular momentum. Recently this idea has led to shaping the quantum wavepacket of free electrons, imprinting them with orbital angular momentum and with other intriguing structures. The author show that by shaping wavepackets of relativistic free electrons, fundamental relativistic effects such as length contraction and time dilation can be engineered, leading to the exciting possibility of extending the lifetime of decaying particles. When interacting with matter, the author show how specially designed electron wavepackets create a new kind of Čerenkov radiation, significantly deviating from the conventional Čerenkov Effect. Some of these effects remain even in the classical limit, without requiring a special design of the wavepacket, proving that the well-established Čerenkov Effect contains new phenomena arising directly from the quantum nature of the charged particles. Finally, the author discusses novel phenomena that occur when electrons interact with photons in novel nanophotonic structures. These interactions can lead to novel physical phenomena such as new types of radiation, coherent x-ray sources, and improved detectors for high-energy physics experiments.

Biography

Ido Kaminer is a Graduate of the Technion Excellence Program, receiving his Bachelor in both Electrical Engineering and Physics. He was granted the Knesset (Israeli Parliament) Award for outstanding undergraduate student achievements in 2007. He has completed his PhD degree in the Physics Department. In his dissertation, he discovered new classes of accelerating beams in nonlinear optics and electromagnetism, for which he received the 2012 Israel Physical Society Prize and the 2014 APS Award for Outstanding Doctoral Dissertation in Laser Science. He is currently a Marie Curie fellow at MIT working in the group of Prof. Marin Soljačić.

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