Supertoroidal Electrodynamics

Nikitas Papasimakis
University of Southampton, Southampton, UK
e-mail: n.papasimakis@soton.ac.uk

This talk will introduce toroidal electrodynamics, a recently established area in electromagnetism research, involving excitations of toroidal topology in free-space (in the form of toroidal pulses) and in matter (in the form of toroidal charge-current configurations). Latest developments in the field will be presented, including the introduction of a general family of pulses, termed supertoroidal pulses, that exhibit a number of intriguing features, such as topological structures similar to skyrmions in condensed matter and exotic propagation properties, e.g. non-diffracting propagation over arbitrary distances and energy transfer reminiscent of “vortex streets” in fluid dynamics. Moreover, the light-matter interactions of such toroidal pulses with doughnut-shape particles can lead to the excitation of supertoroidal modes, fractal iterations of toroidal excitations, enabling new types of non-radiating sources and apparent Lorentz reciprocity violations.