PHYSICS AND ASTRONOMY COLLOQUIUM

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Fractal vision: using retinal implants to restore vision to the blind

Technological advances over the past few decades have transformed the concept of bionic eyes from the wild speculations of science fiction into the practicalities of science fact. For one thing, the number of sensors that capture light in digital cameras is fast approaching the 127 megapixels of the human eye. Furthermore, surgeons can now insert electronic chips into the retina. With over one million people diagnosed with retinal diseases each year, the grand hope is to restore vision by replacing damaged rods and cones with artificial photoreceptors. Clinical trials are already under way using retinal implants based on camera chip technology. However, there are crucial differences between how the human visual system and the camera "see". These differences arise because, while the camera uses the Euclidean shapes favoured by engineers, the eye exploits the fractal geometry that is ubiquitous throughout nature. In this talk, I will discuss the advantages predicted for fractal-based implants. These include an increase in visual acuity by over an order of magnitude, potentially allowing people to read text and facial expressions – essential capabilities for performing every day tasks. Furthermore, unlike current designs, fractal implants will trigger the physiological mechanism used by the human visual system to prevent our stress-levels from soaring. This latter effect holds crucial implications for society: the U.S. spends over $300 billion annually on stress-induced illnesses, and stress is increasingly blamed for precipitating debilitating disorders such as schizophrenia and cancer.

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