

HKIAS Distinguished Lecture Series

# Energy and entropy content of time dependent metamaterials

**Professor Sir John Pendry**

Imperial College London, HKIAS Senior Fellow  
Kyoto Prize (2024)



**Date:** 13 November 2025 (Thursday)

**Time:** 11:15am-12:15pm

**Venue:** Interdisciplinary Multi-function Room (AE-040), LG/F,  
Academic Exchange Building, City University of Hong Kong

**Abstract** Time dependent metamaterials, sometimes known as space-time crystals, can obey PT symmetry with a Hamiltonian whose eigenvalues are real. In contrast to static systems eigenstates do not have definite energy and eigenvalues are not associated with energy, rather some other quantity depending on the system. Nevertheless eigenstates have an expectation value for their energy and also for the number of photons. I shall explore whether it is possible to define a 'ground state' for these systems, what is the minimum energy expectation of this state and whether it is possible to find an eigenstate of a PT symmetric system with zero photon content. PT systems can be regarded as Carnot engines as they are reversible; they therefore conserve entropy. Given time, the consequences of entropy conservation will be explored.

**Biography** John Pendry is known for his work on metamaterials, electromagnetic materials that owe their properties more to their internal micro-structure, than to their chemical composition. He has worked at Imperial College London since 1981 where he served as Dean, Head of Physics, and Principal Faculty of Physical Sciences. He is a Fellow of the Royal Society, Foreign Associate of the US Academy of Sciences, and a Foreign Member of the Norwegian Academy of Sciences. Amongst his several awards are the UNESCO Niels Bohr Gold Medal, the Kavli prize for nanotechnology, the Dan David Prize for nanotechnology, and the Kyoto Prize laureate in Advanced Technology.

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