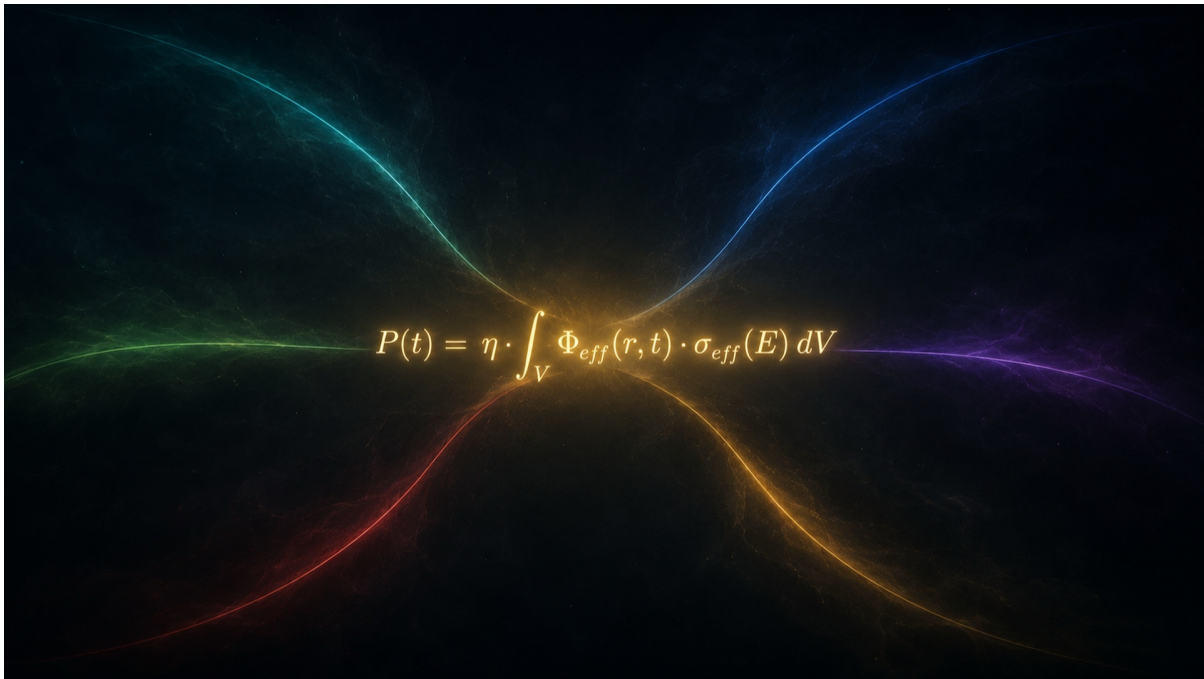


The Global Research Map of the Schubart Master Formula



Thousands of researchers, working independently, on separate questions, in different decades. And the place where their roads keep arriving.

A Question About the Weak Force

In 2017, a team of physicists at Oak Ridge National Laboratory published a result they had been working toward for four decades. Their experiment, called COHERENT, had been designed to test a prediction made in 1974 by a theorist named Daniel Freedman: that neutrinos, under specific geometric conditions, would interact not with individual nuclear particles but with entire atomic nuclei simultaneously, as a coherent unit. The cross-section for this process, Freedman had calculated, would scale with the square of the neutron number. For heavy nuclei, that meant amplification by hundreds compared to single-particle estimates.

The COHERENT team was thinking about the weak force. They were thinking about nuclear physics, about detector sensitivity, about the technical challenge of catching a signal so faint it had evaded experimental confirmation for 43 years. They were not thinking about electricity generation. They were not thinking about graphene. They were not thinking about

energy infrastructure in India or AI data centres or the ambient thermal environment inside a compact solid-state device.

They published. The result stood. A physical process that had been mathematically predicted and experimentally invisible for nearly half a century was now confirmed. The road they had been building reached a point it had been approaching for decades.

What they couldn't see was where that point was on the larger map.

Another Road, Another Country

Around the same time, in a materials physics laboratory at the University of Arkansas, Professor Paul Thibado was doing something that looked, to a casual observer, completely unrelated. He was watching graphene.

Specifically, he was observing what happens to freestanding graphene membranes at room temperature when you leave them alone. The answer, visible under electron microscopy, was that they don't stay still. The membranes undergo continuous spontaneous oscillation, driven by thermal fluctuations in the ambient environment. The oscillations are nanoscale. They are also, Thibado's measurements showed, capable of producing measurable electrical output when the graphene is placed in contact with a rectifying junction. Up to 10 picowatts per membrane.

Thibado was thinking about the physics of two-dimensional materials. He was interested in the behaviour of graphene at the boundary between classical and quantum mechanical description, in the way thermal energy manifests as mechanical motion at atomic scales, in what this might mean for the fundamental understanding of fluctuation-driven transport in nanomaterials.

He was not thinking about power generation at scale. He published. His results entered the literature. Another road reached another point on a map he had no reason to consult.

Oslo, 2015

The Nobel Committee announced the physics prize to Takaaki Kajita and Arthur McDonald for the experimental proof of neutrino oscillation. Neutrinos, it was now established beyond

reasonable doubt, change between their three varieties as they travel. This is only possible if they have mass. The standard model had assumed they were massless. The assumption was wrong.

Mass means momentum. A particle with momentum can transfer that momentum to other particles. The force of that transfer is small, vanishingly small for any individual neutrino interaction, but it is real. It is measurable. And neutrinos arrive at every square centimetre of Earth's surface at a rate of approximately 65 billion per second, continuously, through cloud cover, through mountains, through the planet itself.

Kajita and McDonald were thinking about the fundamental structure of matter. They were thinking about the solar neutrino problem, which had puzzled physicists since the 1960s, about what the data from underground detectors in Japan and Canada was telling them about the behaviour of particles produced in the core of the Sun. They were not thinking about ambient energy conversion.

The prize was awarded. Another road marked its position on the map.

What Becomes Visible from Above

Step back from ground level for a moment and look at the map as a whole.

A physicist in Japan confirms that neutrinos have mass and transfer momentum. A team in Tennessee confirms that the cross-section for neutrino-nuclear coupling, under coherent conditions, is orders of magnitude larger than single-particle estimates suggested. A materials scientist in Arkansas confirms that graphene membranes convert ambient thermal fluctuations into measurable electrical output through a rectifying junction. Researchers at JUNO in China measure the solar neutrino flux with precision that refines the quantitative parameters of the ambient particle environment. KM3NeT on the Mediterranean floor maps the high-energy cosmic neutrino spectrum. The CONUS+ experiment at a German reactor extends coherent scattering confirmation into the energy range directly relevant to solar neutrino interactions in solid-state materials.

None of these teams were coordinating. None of them were building toward a shared destination. Each was following its own scientific question, on its own stretch of road, toward its own horizon.

From above, the roads are converging.

The research map below illustrates this convergence. Each institution, experiment, discipline, and discovery shown here was developed independently, often separated by geography, time, and scientific objective. Viewed together, they reveal a broader pattern: multiple lines of inquiry arriving at the same conceptual destination. The map is not a claim of coordination. It is a visual representation of where decades of research intersect.



Click on the image to view the map in full resolution and explore the underlying research network in greater depth.

The Schubart Master Formula

$P(t) = \eta \cdot \int_V \Phi_{\text{eff}}(r,t) \cdot \sigma_{\text{eff}}(E) dV$. The equation describes the continuous electrical output of a system integrating multi-channel ambient flux across an active material volume, converting it through asymmetric nanoscale architecture into directed electrical current, bounded by thermodynamic efficiency constraints.

Every term in this equation has an address in the research landscape. The effective flux term $\Phi_{\text{eff}}(r,t)$ integrates contributions from neutrinos, cosmic muons, electromagnetic

background fields, and thermal gradients. Each of these channels has been independently characterised by research institutions pursuing entirely separate goals. The coupling term $\sigma_{\text{eff}}(E)$ draws on cross-section data whose experimental basis was built by COHERENT, CONUS+, and related experiments. The volume integral reflects the three-dimensional architecture whose physical foundation was confirmed by Thibado's graphene measurements. The efficiency term η is bounded by thermodynamic laws that predate all of this by more than a century.

Holger Thorsten Schubart, the mathematician who assembled this framework, did not build these roads. He looked at the map and recognised where they were going.

The formula does not claim credit for the physics. It claims to be the place where the physics converges.

Monte Carlo simulations and multi-parameter evaluations of the framework's internal consistency, tested against the body of independently established experimental physics that populates each of its terms, indicate statistical confidence reaching 5.9 to 6.0 sigma. For context: five sigma is the threshold at which particle physics considers a result a discovery rather than evidence. At 5.9 to 6.0 sigma, the probability that this consistency is accidental is approximately one in five hundred million. The roads do not merely approach the same general area. They converge with statistical precision on a single point.

This does not certify a commercial product. It quantifies the internal mathematical coherence of a framework, evaluated against the experimental physics that its terms describe.

The Living Map

One of the most consequential properties of this convergence is that it grows. The map is not static.

Every new measurement from the JUNO collaboration strengthens the flux term with more precise solar neutrino characterisation. Every new graphene transport study refines the coupling parameters. Every advance in non-equilibrium thermodynamics deepens the theoretical foundation beneath the framework's operating assumptions. Every new phonon dynamics paper in two-dimensional materials adds resolution to the transduction pathway the architecture depends on.

The researchers producing these results are not aware, for the most part, that their work arrives at a specific address. They are aware only of their own question. But the formula receives what they send. Each new paper is, in a sense, another stretch of road built toward the same point by someone who has never seen the map.

Historical parallels exist for this kind of structure, and they should be stated once, carefully, without being pressed into service as the article's main argument. The periodic table did not create chemistry. It gave chemistry a framework in which every new element found its place automatically, enriching the structure rather than challenging it. The double helix did not create genetics. It gave genetics a visual grammar into which subsequent discoveries could be placed without rewriting the map. Frameworks of this kind are not falsified by new results. They are populated by them.

The Schubart Master Formula occupies the same structural position relative to the research landscape of ambient energy conversion. It was assembled from existing knowledge at a specific moment. It is designed to grow more robust, not less, as the knowledge it draws from continues to expand.



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The New Information and Where It Belongs

When the next major result arrives from one of the neutrino observatories, the scientist who has seen this map will know where it belongs. They will understand which term it refines, which assumption it strengthens or constrains, which road it extends and in what direction.

When the next paper on graphene transport in non-equilibrium conditions appears, they will see its address. When the next non-equilibrium thermodynamics experiment reports on fluctuation-driven rectification in asymmetric nanostructures, they will recognise it not as an isolated curiosity but as a node in a network whose shape they can already see.

The map does not instruct people what to conclude. It gives them a structure in which to place what they observe. And the applications that begin to appear as the roads arrive, the continuous power generation at the point of consumption, the infrastructure that becomes unnecessary, the decentralised baseload for communities and data centres and vehicles and maritime platforms that currently depend on fuel, appear not as claims but as consequences. Cities that emerge where roads converge.

The physics was never hidden. It was simply never assembled for this purpose.

Independent Scientific Commentary

Prepared by an interdisciplinary working group of specialists in particle physics, condensed matter physics, graphene and nanomaterials engineering, advanced statistical modelling, and non-equilibrium energy conversion systems.

Based on publicly documented experimental physics, peer-reviewed scientific literature, and internal mathematical consistency analysis related to the Schubart Master Formula and neutrinovoltaic conversion architectures.

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