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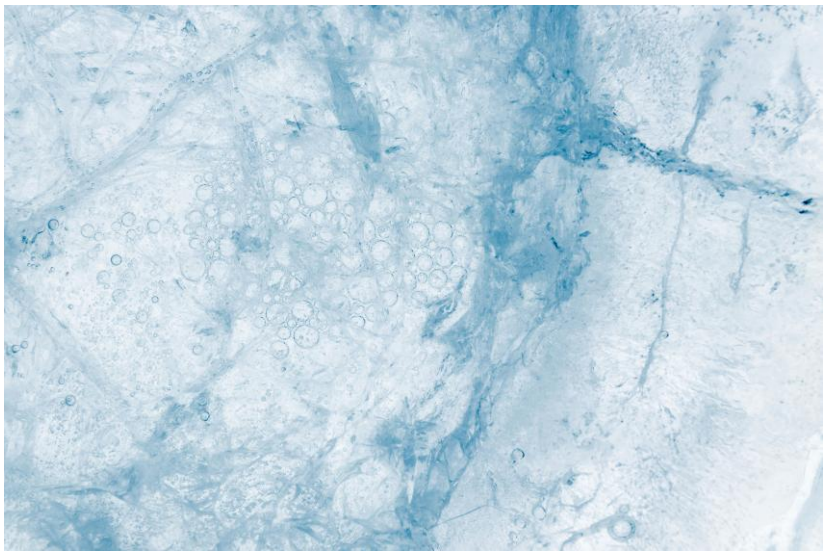
PRESS RELEASE

Two SISSA Papers Included in the “PRL Collection of the Year”

Both studies, conducted in collaboration with international research groups, investigated the Mpemba effect—a phenomenon in which warm water is said to freeze faster than cold water



Trieste, 07 February 2025

Two papers authored by researchers from SISSA’s physics area, in collaboration with international research groups, have been included in the prestigious “Physical Review Letters Collection of the Year”, which highlights the most significant works published by the journal in 2024.
As stated on the “PRL Collection of the Year”’s webpage:
“Each year Physical Review Letters publishes about 2000-2500 Letters across ~52 issues. We select about 400 of those papers to highlight as Editors' Suggestions. That is still a lot to read. So, we have decided to provide a more concentrated distillation of some of the most important and interesting papers in physics and related”.

The Mysterious “Mpemba Effect”

Both SISSA studies that received this important recognition investigated the so-called “Mpemba effect”, an intriguing scientific phenomenon and a subject of

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debate since ancient times—one that now extends into the most sophisticated areas of research.
"The Mpemba effect," explains Professor Pasquale Calabrese, who participated in both studies, "is a counterintuitive phenomenon in which, under certain conditions, warm water freezes faster than cold water. This paradox, debated since ancient Greece, continues to spark discussions in the scientific community today, with no definitive consensus on its validity or the precise conditions that enable it."
In recent years, interest in this phenomenon has expanded into the quantum realm, with theoretical and experimental studies suggesting the possibility of an analogous effect in the nonequilibrium dynamics of quantum systems.

The Two Selected Studies

But does the Mpemba effect truly exist? The two SISSA research groups recognized by the journal tackled this very question. Professor Calabrese explains: "In one of the papers selected by Physical Review Letters, titled "Observing the Quantum Mpemba Effect in Quantum Simulations", we present experimental evidence confirming the existence of the Mpemba effect in a quantum context, demonstrating that a system initially in a more excited state can relax to equilibrium faster than a less excited one. In the second study, titled "Microscopic Origin of the Quantum Mpemba Effect in Integrable Systems", we provide a theoretical explanation of this effect within a particular class of models known as integrable systems."

The results, Professor Calabrese notes, open "new perspectives in the study of thermalization in quantum systems and could have significant implications for statistical physics, quantum information, and the control of nonequilibrium quantum dynamics."

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"PRL collection for the year"

IMAGE:
Credits: image by Pawel Czerwinski on Unsplash

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