

# Jani Lukkarinen

**ONE OF THE VÄISÄLÄ PRIZES** awarded by the Academy in 2018 went to Professor Jani Lukkarinen.

Lukkarinen gained a doctorate in theoretical physics from the University of Helsinki in 2001, after which he spent half a year as a post-doctoral researcher at Rutgers University in the USA, concentrating mainly on mathematical physics. He then joined the team headed by Professor Herbert Spohn in the Department of Mathematics at the Technical University of Munich, Germany, for the period 2002–2007, before returning to Finland in 2008 to take up an Academy Research Fellow post awarded by the Academy of Finland. He was appointed University lecturer in mathematics at the University of Helsinki in 2009 and Professor of mathematical physics in 2018.

Jani Lukkarinen's research has involved the development and application of advanced mathematical methods for addressing issues arising in physics. Problem areas of this kind include kinetic the-

ory, non-linear lattice models and energy transport properties of various wave equations. Advanced methods are required, for example, to control terms in the related time-dependent perturbation expansions and in the precise estimation of oscillatory integrals occurring in such terms. Lukkarinen and Spohn were also able to demonstrate a divergence of thermal conductivity predicted from kinetic theory in the Fermi-Pasta-Ulam chain with increasing chain length. "The aim of mathematical physics is to obtain precise results for physical phenomena without compromising on mathematical accuracy. Although some simplification of the models and fixing of the assumptions is required, this can often be useful, as it helps us to find the essential details of the phenomenon concerned."

"We do things with a pencil and paper that you can't do either with a computer or by simulation. This is because a computer cannot handle arbitrarily large quantities, whereas infinity is not an issue for

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a mathematician. In fact, it can be made use of for the purposes of simplification and finding what is essential.”

”Computers are useful, of course, for testing ideas. When calculating integrals, for instance, it is possible to test whether they behave in the expected manner.”

”This is laborious and time-consuming work, in which everyday intuition is not always of very much help. At best, mathematics can take us to places where everyday intuition alone is likely to lead us astray,” Lukkarinen explains.

Jani Lukkarinen has also studied the statistical physics of non-equilibrium states and of quantum systems, and the mathematical models used in economics. He has produced more than 30 peer-reviewed scientific publications.

”We have very good conditions in Finland for doing research of this kind. In fact there are not many people in the world who have specialized in this field, so that maintaining contacts is not a problem. In any case, distance is meaningless

with our modern communications systems. The majority of my collaborators are people I worked with in the USA or Germany.”

”The motivation for this research arises mainly from the fact that there are microscopic models whose interactions are known precisely but for which it is not possible using computers to predict their macroscopic properties reliably. It is difficult to perceive causes and effects in these systems and often the relation between the two is indirect. In such a situation mathematical simplification and ”a search for what is essential” can often be useful. The eventual aim is to achieve macroscopic models of the phenomena studied that are more accurate and easier to use. This can typically be done best through collaboration with other research groups, including ones involved in experiments.”

Jani Lukkarinen’s team has received support from the Academy of Finland and he has acted as a scientific coordinator for its Centre of Excellence in Analy-

sis and Dynamics Research. He has served as the director of the Master's Programme in Theoretical and Computational Methods and as deputy head of the Department of Mathematics at the University of Helsinki.

And in spite of everything Jani is a keen user of computers, at least for gaming purposes: "Everyone should have a vice of some kind for moments of relaxation, and you could say perhaps that computer games are mine."

*Väisälä Prize is awarded annually to 1–3 already distinguished scientists in the active parts of their careers.*

*Photo: Susan Heikkinen*