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**Mini-course by Burkard HILLEBRANDS:**  
***Magnon Macroscopic Quantum States***

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The research platform MMM „Mathematics-Magnetism-Materials“, jointly with the Fakultät für Mathematik, the Fakultät für Physik, together with the **Wolfgang Pauli Institut** kindly invite you to the 2 lectures mini-course of **Burkard Hillebrands** (RPTU Kaiserslautern):

**Lecture 1: *Fundamentals and Bose–Einstein Condensation***

**Time: Monday, 13. October 2025, 9:15–11:00**

**Place: Erwin Schrödinger Hörsaal, 5th floor Boltzmannngasse 5, 1090**

9h15: Welcome by Norbert J. Mauser (head MMM & director WPI c/o U.Wien)

Introduction by Andrii Chumak (MMM & WPI c/o Fak. Physik U.Wien)

9h20: Lecture 1 by Burkard Hillebrands

**Lecture 2: *Magnonic Supercurrents, Accumulation Phenomena, Applications in Data Processing***

**Time: Tuesday, 14. October 2025, 12:45–14:15**

**Place: Seminarraum 1, 1st floor Boltzmannngasse 5, 1090 Wien**

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**Abstract:**

Magnonics investigates spin waves—collective excitations of the spin system in magnetically ordered media—as prospective information carriers beyond conventional electronics.

The first lecture, “*Fundamentals and Bose–Einstein Condensation*”, will introduce the essential principles of spin-wave dynamics, dispersion, and nonlinear interactions. Experimental approaches such as parametric pumping and microfocused Brillouin light scattering will be discussed as powerful tools for populating and probing spin-wave spectra. Particular emphasis will be placed on the realization of magnon Bose–Einstein condensation (BEC) in magnetic insulators, most notably in yttrium iron garnet (YIG), where thermalization and overpopulation of magnons give rise to condensates observable at room temperature. This part will provide a conceptual and experimental framework for understanding condensate formation in solid-state bosonic systems.

The second lecture, “*Magnonic Supercurrents, Accumulation Phenomena, Applications in Data Processing*”, will expand the discussion toward macroscopic transport and collective states beyond conventional condensation. A central theme will be the phenomenon of **quasiparticle accumulation**, which generalizes the notion of condensation by enabling spontaneous, but not necessarily coherent, population of distinct spectral regions. In particular, the magnon–phonon interaction produces hybrid

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magnetoelastic modes and can lead to bottleneck accumulation of quasiphonons and quasimagnons with different propagation characteristics. Such accumulation phenomena extend the diversity of many-body states in driven magnetic systems, providing new perspectives on transport, localization, and hybridization. The lecture will conclude with an outlook on magnon supercurrents, Bogoliubov waves, and the prospective use of condensates and accumulation regimes in magnonic devices for data processing, information storage, and hybrid quantum technologies.

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## **Short Biography:**



**Burkard Hillebrands** is Prof. Emeritus of experimental physics at the Rheinland-Pfalz Univ. of Technology, Kaiserslautern. After studies at the Univ. Köln and a postdoctoral stay at the Optical Sciences Center in Tucson, Arizona, he became associate prof at the Univ. Karlsruhe in 1994. Since 1995 he is full prof at the Univ. Kaiserslautern. From 2006 to 2014 he was Vice President for Research, Technology and Innovation of Univ. Kaiserslautern. From 2016 to 2017 he served as Scientific Director of the Leibniz Institute for Solid State and Materials Research Dresden.

His research field is experimental magnetism, in particular magnonics. He is especially interested in nonlinear magnonic phenomena, magnonic crystals, magnon gases, magnon condensates and magnonic supercurrent phenomena in view of applications in novel information technologies such as magnon logics.

In 2019-2022 he served as President of the European Magnetism Association. In 2015-2017 he was Chair of the International Union of Pure and Applied Physics (IUPAP), Commission C9: Magnetism. He is member, Chair of the Class of Mathematics and Natural Sciences, and Vice President of the Academy of Sciences and Literature, Mainz. He is member of the National Academy of Science and Engineering (acatech) and member of the European Academy of Sciences (EurASc). He is IEEE Fellow, APS Fellow and Fellow of the Institute of Physics, London. In 2016 he received an ERC Advanced Grant of the European Commission. In 2023 he received the Achievement Award of the IEEE Magnetics Society. He served on the Administrative Committee of the IEEE Magnetics Society and was Honors&Awards Chair in 2013-2018. In 2018-2024 he was Chair and Member of the Scientific Advisory Board of the Helmholtz Center Dresden-Rossendorf (HZDR), and also Member of the HZDR Supervisory Board.

He has published more than 430 refereed articles, book contributions, and several patents.

Currently in Vienna he is a Pauli fellow at the WPI c/o “Magnonics group” of Andrii Chumak at the Fak. Physik of Univ. Wien.