Stuttgarter Physikalisches Kolloquium

Fachbereich Physik, Universität Stuttgart
Max-Planck-Institut für Festkörperforschung
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Festkolloquium zum 100. Geburtstag Prof. Dr. Dr. h.c. Ekkehart Kröner

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Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart-Vaihingen

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Anticracks, Compaction Bands and Snowquakes: Ekkehart Kröner's nonlocal continuum mechanics applied to unusual deformation phenomena in snow

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Abstract

The scientific work of Ekkehart Kröner work is distinguished by many seminal contributions at the intersection between physics, mathematics and mechanics. One of the less well-known of these is his work on non-local formulations of continuum mechanics, which in a remarkable manner anticipates cutting-edge computational approaches to materials mechanics such as peridynamics.

After a short introduction into Kröner's nonlocal continuum mechanics, we illustrate its application in modelling deformation and failure processes in solid mechanics of snow. We envisage snow as a cohesive-granular material consisting of weakly sintered ice granules, where non-locality of mechanical properties is a natural consequence of the discrete granular microstructure. We first discuss unusual brittle failure modes ('anticracks') which are enabled by the high porosity of natural snow and play a key role in slab avalanche release. We then demonstrate that snow undergoing compressive deformation may exhibit complex temporal and spatio-temporal oscillation phenomena. These oscillatory deformation modes result from the interplay between load-driven failure of inter-granular bonds and diffusion-driven bond reconstruction ('rapid sintering') and are thus a consequence of the fact that snow under winter ambient conditions must be envisaged as an extreme case of a high-temperature material.