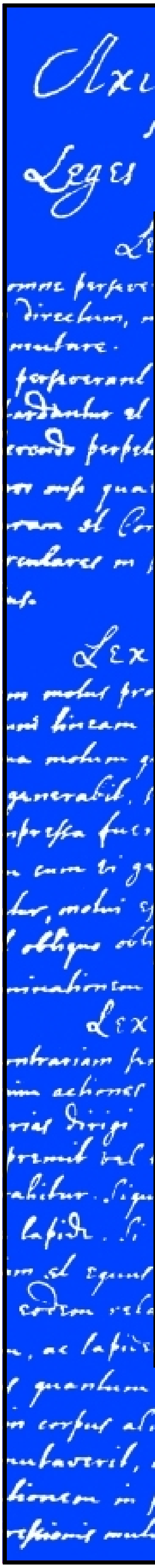

Seminar über Fragen der Mechanik

zu folgendem Vortrag wird herzlich eingeladen

Donnerstag, 03.08.2017, 10:30 Uhr, Egerlandstr. 5, Raum 0.044

Mathematical modelling of quasicrystals: generalized dynamics

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Quasicrystals were discovered by Shechtman in 1982 [1]. Quasicrystals belong to aperiodic crystals and possess a lone-range orientational order but no translational symmetry. Due to the discovery of quasicrystals, the International Union of Crystallography changed the official definition of a crystal in 1992. Shechtman was awarded the 2011 Nobel Prize in Chemistry for his great discovery bringing quasicrystals to the front of the scientific panel. Due to their structure, quasicrystals possess some particular properties (mechanical, electronic, thermodynamical, chemical) which could be characterized as desirable properties like low friction coefficient, high wear resistance and low adhesion. These properties make quasicrystals having advantages compared to other conventional materials used today (see, e.g., [2]). Nowadays, quasicrystals represent an interesting class of novel materials.

The basis of the continuum theory of solid quasicrystals is set up by two elementary excitations; the phonons and phasons. The description of the dynamic behavior of quasicrystals is challenging the scientific community from their discovery up to now, since none of the existing models is in complete accordance with the experimental data. The most frequently used models in the current literature are the so-called elastodynamic and the elasto-hydrodynamic models. According to the first model, both, phonons and phasons, describe wave propagations. The second model provides that the phonons are represented by waves while the phasons by a type of diffusion.

Agiasofitou and Lazar [3] proposed the elastodynamic model of wave-telegraph type for the description of dynamics of quasicrystals. According to this model, phonons are represented by undamped waves, and phasons by waves damped in time and propagating with finite velocity. Therefore, the equations of motion for the phonon fields are partial differential equations of wave type and for the phason fields are of telegraph type. The main advantage of this model is its ability to describe the damping of the phason waves with respect to the time, and to overcome the paradox of the infinite velocity propagation which is implied by the diffusion equation. Proceeding to the modelling of damped phason waves, the concept of phason frictional forces is used. In this context, anisotropic effects of the damped waves can also be captured. To gain more insight into the significance of this model, qualitative (mathematical and physical) differences and similarities with existing models (elastodynamics of wave type and elasto-hydrodynamics of quasicrystals) are presented and discussed [4].

Based on the elastodynamic model of wave-telegraph type [3], Chiang et al. [5] have recently used the “local radial basis function collocation method” to study bending problems in quasicrystalline plates. The numerical results demonstrate the ability of the model to capture the influence of the phason friction coefficient to the dynamic behaviour (phonon and phason displacements, bending moment) of the quasicrystalline plate.

References

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