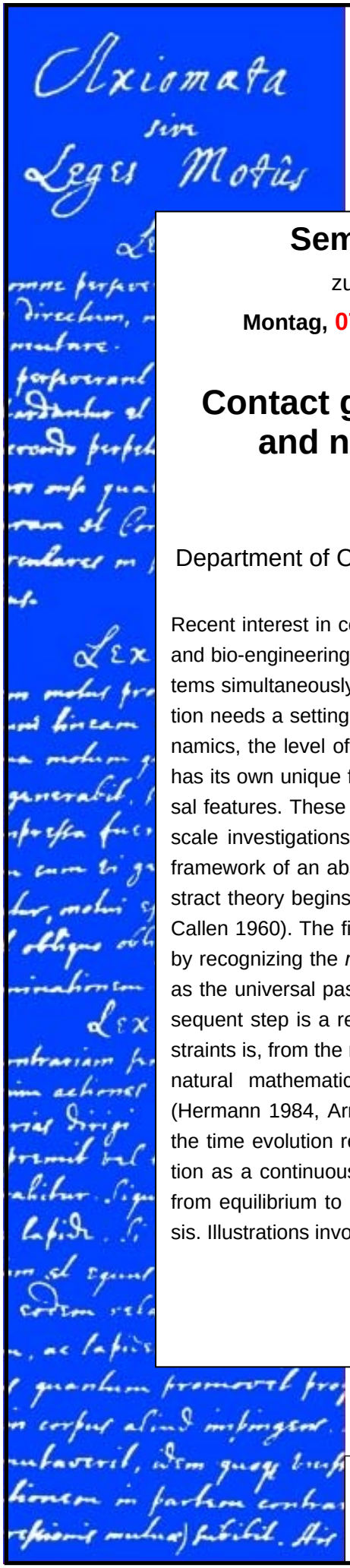

Friedrich-Alexander-Universität
Erlangen-Nürnberg

Seminar über Fragen der Mechanik

zu folgendem Vortrag wird herzlich eingeladen

Montag, 07.06.2010, 14:15 Uhr, Egerlandstr. 5, Raum 0.044

Contact geometry in multi-scale equilibrium and nonequilibrium thermodynamics

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Recent interest in combining nano, micro, and macro scales (called nano-engineering and bio-engineering) provides a renewed motivation for investigating macroscopic systems simultaneously on several different levels (scales) of description. Such investigation needs a setting that unifies levels like for instance the level of classical thermodynamics, the level of hydrodynamics, and the level of particle theory. While each level has its own unique flavor, an investigation of relations among the levels shows universal features. These features are then suggested to constitute the framework for multiscale investigations. We argue that the framework obtained in this way is in fact a framework of an abstractly formulated thermodynamics. The path leading to such abstract theory begins with the Gibbs formulation of classical thermodynamics (see e.g. Callen 1960). The first step towards more microscopic (mesoscopic) analysis is made by recognizing the *maximum entropy principle* as an essence of thermodynamics and as the universal passage to more macroscopic levels (Jaynes, 1967, 1978). The subsequent step is a realization that minimization of a convex function subjected to constraints is, from the mathematical point of view, a *Legendre transformation* and that the natural mathematical setting for Legendre transformations is *contact geometry* (Hermann 1984, Arnold 1989). Finally, in this geometrical environment, we introduce the time evolution representing the approach to a more macroscopic level of description as a continuous sequence of Legendre transformation. This is then the passage from equilibrium to nonequilibrium thermodynamics in the setting of multiscale analysis. Illustrations involve non-Fickian diffusion in polymers and rheology of blood.

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