



Polymers under Multiple Constraints

# Polymer- & Soft-Matter-Seminar

Monday,  
22<sup>nd</sup> October  
2018

at: 5.15pm

VDP4 1.27,  
Von-Danckelmann-Platz 4,  
06120 Halle

## Prof. Siegfried Stapf

(Technische Universität Ilmenau, Dept. Technical Physics II,  
Ilmenau, Germany)

### **“Relaxation and diffusion in polymer melts and solutions: new experimental approaches to probe molecular dynamics in homopolymers and copolymers”**

The time-dependence of the rms displacements of chain segments in polymer melts has been a cornerstone of experimental tests of various chain motion models. Rouse and Reptation dynamics (below and above the entanglement limits for chain lengths, respectively) are described by characteristic power-laws. Neutron spin echo and gradient NMR studies have tested and confirmed these power-laws, but have also found discrepancies in some cases. The wide time gap between these two techniques is partially covered by NMR relaxometry. Again, relaxometry finds power-law relationships between NMR relaxation times and Larmor frequency, but both the dependence on frequency and molecular weight were shown to deviate substantially from tube-reptation predictions. In recent years, intra- and intermolecular spin interactions were found to possess quite different frequency dependences which makes them distinguishable. In principle, the mean-squared displacement can be obtained with the help of partial deuteration of the polymer.

More complex structures, such as branched polymers or block-copolymers, have only rarely been the subject of relaxometry studies because of difficulties to separate individual species: in particular field-cycling relaxometers do not possess the spectral resolution to allow such identification. Recently, we have demonstrated that two- or three-component systems can be studied with much improved reliability if their separation in the T<sub>2</sub>-domain can be achieved by TE-ARDROPS. A different approach, both improving the signal-to-noise ratio and introducing specificity of chemical interaction, requires the use of DNP in solution; the additional relaxivity brought about by the dissolved radicals is eliminated by measurements of at least two radical concentrations (FIVE-AND-DIME), recovering the true relaxation dispersion of the polymer protons. Experiments on block-copolymers revealed the distinct dynamics of both blocks, dominated by bulk-like Rouse mode behaviour but modified in dependence of concentration and macrophase ordering.



UNIVERSITÄT  
LEIPZIG



MARTIN-LUTHER-UNIVERSITÄT  
HALLE-WITTENBERG

