Contribution ID: **52** Type: **Invited**

Quasielastic neutron scattering experiments on confined glass-forming liquids

Thursday, 13 October 2022 11:30 (30 minutes)

The explanation of the dynamics of glass-forming materials is a still unsolved problem in solid state theory. My collaboration with Bernhard Frick started in 1990 when quasielastic neutron scattering (QENS) was beginning to be employed on such systems. At that time, experiments mostly aimed at scrutinizing Mode Coupling Theory (MCT) and were done on bulk systems because this theory does not explicitly include a length scale. After first successes, the limitations of MCT became clearer over the years and alternative concepts were sought. One of these is that of Cooperatively Rearranging Regions (CRR) of the size of some nanometers. An obvious way to test the importance of CRRs is to confine the sample to that size and look for changes in the dynamics. By the mid-90s materials became available with suited pore sizes, Controlled Porous Glasses (CPG). We immediately started the QENS experiments on simple liquids confined in CPGs, later extending them to polymers and liquid crystals in a cooperation with Andreas Schönhals who provided additional methods allowing an enormous increase in dynamical range. The experiments showed that the basic predictions of a CRR model are fulfilled but surface effects modify the dynamics significantly. To reduce these, experiments were done in 'soft confinement', i.e., microemulsions which confine the glass-forming liquid in droplets. These experiments gave a clearer support to CRR ideas but also turned out to be much more complicated in their interpretation because the 'matrix' material is not immobile.

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Session Classification: Talks dedicated to Bernhard Frick

Track Classification: Contributions