Mode-coupling theory of the glass transition

Thomas Franosch

Institut für Theoretische Physik,
Leopold-Franzens-Universität Innsbruck

DATE / TIME: Monday, April 20th 2015, 04:00 p.m.
LOCATION: Lise-Meitner-Hörsaal, Boltzmanngasse 5, 1st floor, 1090 Vienna

Thomas Franosch | thomas.franosch@uibk.ac.at

Transport in liquids often slows down by orders of magnitude upon cooling or compression by a few percent. Correspondingly, dynamic correlations display non-trivial behavior at time scales much larger than the microscopic scale, hence a structural arrest emerges at mesoscopic time scales. Many of the phenomena associated with this glassy dynamics have been rationalized within the mode-coupling theory (MCT) of the glass transition developed by Götze and collaborators within the last 30 years.

In this presentation I give an introduction to what a theory of the glass transition should explain and how a non-trivial feed-back mechanism is encoded in the MCT yielding a scenario for slow dynamics which differs drastically from the critical slowing down in continuous phase transitions. Second, I will report on recent generalizations of the MCT from bulk to liquids confined between two planar walls. The presence of the walls renders the liquid intrinsically anisotropic which has to be taken into account both at the level of the static structure as well as for the dynamic correlation functions. The theory then predicts a striking multi-reentrant phenomenon of the glass transition line for a hard-sphere fluid as function of the packing fraction and the wall separation. We compare the theoretical predictions to extensive computer simulations and find semi-quantitative agreement.