120th MSS-Seminar
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Clustering and dynamical arrest in colloidal dispersions

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Particle aggregation or clustering is an obligatory step for the initiation of the phase separation or the large-scale formation of materials that exhibit a heterogeneous structure, such as gels and porous media. Nevertheless, even though the macroscopic structure of such materials depends on the shape and size of the resulting clusters or aggregates, the cluster formation at equilibrium and its corresponding morphology are not fully understood. The local morphological information is also important for the identification of the physical mechanisms for arrested states of matter, especially gels and glasses, which remains a hotly debated research topic in condensed matter physics. Due to the complex nature and different microscopic details of each particular system, a general, consistent and unified definition is of paramount importance from both scientific and technological viewpoints.
Combining molecular simulations, experimental characterizations and theoretical calculations: 1) we conclusively demonstrate that the cluster morphology in short-ranged attractive colloidal systems (SRACS) at equilibrium conditions can be uniquely determined by the reduced second virial coefficient; our findings link the reversible colloidal aggregation with the extended law of corresponding states, 2) we show that gelation in adhesive hard-sphere dispersions is the result of the rigidity percolation with coordination number equal to 2.4; these results connect the concept of critical gel formation in SRACS to the universal concept of the rigidity percolation and, finally, 3) we provide a unified description and a general overview of the different aspects of the glass transition in largely asymmetric binary mixtures of hard-spheres; we highlight the fundamental relevance in considering explicitly the dynamics of both large and small particles to properly account for the glassy scenario.