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Editorial

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Colloidal dispersions are solutions of mesoscopic particles in a solvent. Among the various soft matter systems, colloidal dispersions play a prominent role as they can be both prepared and characterized in a controlled way. The effective interaction between the colloidal particles can be tailored by changing, e.g., the salt concentration in the solvent. Moreover, colloidal dispersions can be regarded as the simplest prototype of soft matter: the length scale separation between the molecular solvent and the mesoscopic particles is unique and complete. Spherical particles without any additional structure on the mesoscopic length scale possess the simplest and highest possible symmetry. This directly implies that a simple theoretical modelling of a single particle without many fitting parameters is possible. Exciting questions concern collective many-body effects induced by cooperation and self-organization of many particles. A striking advantage of colloidal dispersions lies in the fact that these questions can be studied simultaneously by using three different complementary methods, namely experiment, computer simulation, and theory.

A profound theoretical understanding also provides an insight into the general basic principles and mechanisms of phase transformations such that colloids play an important role as model system for condensed matter in general. Colloids play a similarly dominant role in exploring changes of soft matter properties in external fields which can be used to control the colloidal samples.

Bulk phase transitions of colloidal soft matter are meanwhile well-understood but important questions in confining geometries and additional external fields have been explored. Such fields can be realized by a shear flow or by the presence of electric and magnetic as well as laser-optical fields and topographical fields such as confining geometry. The motivation to study an external control via external fields has two main reasons: i) First, by definition, soft matter reacts sensitively upon external perturbations and manipulations. The occurrence of stable colloidal bulk samples is the exception rather than the rule, i.e., one has to protect the sample carefully against shear and other perturbations. ii) The second reason is that strong external fields induce qualitatively novel effects.

Within the German–Dutch research network SFB TR6 "Colloidal Dispersions in External Fields" which was funded by the German science foundation and the Dutch FOM, there has been considerable scientific progress for colloids in external fields within the last 5 years. This will be reviewed in a bunch of 23 mini-review articles which cover various topics of colloids in shear, electric, magnetic, laser-optical fields and in confinement.

First of all a **general introduction** to colloids in external fields is given in [1] which also provides a guide and a detailed classification of the different minireviews. Moreover the different subsequent minireviews correspond to different projects of the SFB TR6 according to different types of external fields. In detail:

Project group A) Shear Flow

- **A1:** Mixtures of particles with Complex Architecture in Shear Flow [2]
- **A2:** "Tunable" Model Systems for Soft Colloids [3]

A4: Colloidal Soft Matter under Shear Flow [4]
A5: Computer Simulations of Structure, Dynamics and Phase Behaviour of Colloidal Fluids in Confined Geometry and under Shear [5]
A6: Time-Dependent Flow in Arrested States [6]
A7: Force–Driven Micro– and Macro–Rheology [7].

Project group B) Electric Fields

B1: Structure and Transport Properties of Charged Sphere Suspensions in Electric Fields [8]
B2: Electrokinetic Properties of Charged Colloids in External Fields [9]
B4: Computer Simulation of Electrokinetics in Colloidal Systems [10]
B7: Colloids in Crossed Electric and Magnetic Fields [11]
B8: Phase Transitions of Confined Nanorods in Electric Fields [12]
B9: Computer Simulations of Charged Colloids in Alternating Electric Fields [13].

Project group C) Laser–Optical and Magnetic Fields

C1: Dynamics of Autonomous Swimmers in Confinement [14]
C2: Two–dimensional Colloidal Systems in Anisotropic Magnetic Fields or in Light Fields [15]
C3: Phase Transitions of Two–Dimensional Paramagnetic Colloids in External Fields [16]
C4: Effect of Modulated Boundaries on Structure Formation Near the Liquid–Solid Transition in Equilibrium and Under Shear [17]
C7: Concentrated Colloidal Suspensions in Modulated Light Fields [18].

Project group D) Confining Geometries

D1: Confined Colloidal Crystals in and out of Equilibrium [19]
D3: Differently Shaped Hard Body Colloids in Confinement: From Walls to Porous Media [20]
D5: Mixture of Rod–like and Spherical Colloids under Confinement: Phase Transition Kinetics [21]
D6: Structure Formation in Columnar Mineral Liquid Crystals in Confinement [22]
N1: Colloids at Interfaces [23].

It is our intention to document both the progress of this rapidly growing field and the achievements of the SFB TR 6 in this research area.

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