



Thema für Beleg oder sHK-Tätigkeit

Optical measurement on a rigid sphere falling in rare-earth solution with/ without magnetic field (ShK 15 hours/ week; 3 months; Beginning 2022)

Rare-earth salt dissolved in water exhibits a macroscopic phenomenon of showing a positive affinity along positive magnetic field gradient. The force is ratorized by its intrinsic magnetic susceptibility. For the highly magnetic susceptible rare-earth salt like Dy(III), this phenomenon can be dramatic when the salinity is increased. For a 2 M Dy(III) aqueous solution, the magnetic susceptibility can be as high as 10^{-3} . This dramatic paramagnetic property can be used to levitate object which is much heavier than the liquid itself even in a stray field provided by small permanent magnetic assembly. Such effect is what we refer to as super-diamagnetic levitation.

In this work, the free falling spherical rigid glass particle settled at a reference position and the dynamics of its free fall process in a paramagnetic solution is to be investigated by means of laser based optical method. The drag coefficient is to be calculated under condition when there is a magnetic field or without (Stokes/ Schiller-Naumann) magnetic field. Advanced candidate is given chance for using our high-end particle image velocimetry setup for resolving the velocity field in the liquid.

Major working package:

1. Design/ 3D print a module that can release rigid SiO₂ particle with diameter ranging from 0.1-1 mm in solution in a controlled manner
2. Using a laser based shadowgraphy and high speed camera to capture the transient behavior of falling particle with and without magnetic field from a permanent magnetic assembly.

3. Data analysis/ particle tracking on the time resolved velocity profile
4. Dimensionless analysis on the drag coefficient
5. PIV measurement (3 full day of work)

Requirement:

1. Interest on applied optical experiment
2. Some CAD ability
3. Capable of communication and some basic data analysis skill

Extra Info:

1. The student with strong applied optics or CFD skill could do a follow-up work with us, e.g. Belag or Diplomarbeit
2. Excellent candidate will be prior considered for our future PhD programs

Ansprechpartner:

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