UNIVERSITÀ DEGLI STUDI DI MILANO

TO MAGNIFICO RETTORE OF UNIVERSITA' DEGLI STUDI DI MILANO **ID CODE 4932**

I the undersigned asks to participate in the public selection, for qualifications and examinations, for the awarding of a type B fellowship at **Dipartimento di Fisica "Aldo Pontremoli"**
Scientist- in - charge: **Prof. Alessio Zaccone**

Carmine Anzivino
CURRICULUM VITAE

PERSONAL INFORMATION

Surname	Anzivino
Name	Carmine
Date of birth	11-12-1990

PRESENT OCCUPATION

Appointment	Structure
PhD-Candidate	Universiteit Utrecht (The Netherlands)

EDUCATION AND TRAINING

Degree	Course of studies	University	year of achievement of the degree
PhD	Physics	Universiteit Utrecht (The Netherlands)	Expected graduation date: 14th June 2021
Master's Degree *(Laurea Magistrale LM-17)*	Physics	Università degli studi di Trieste (Italy)	2016 (Final grade: 110/110 *cum laude*)
Bachelor's Degree *(Laurea Triennale L-30)*	Physics	Università degli studi di Bari (Italy)	2013 (Final grade: 105/110)

FOREIGN LANGUAGES

Languages	level of knowledge
Italian	Mother Tongue
English	Fluent

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TRAINING OR RESEARCH ACTIVITY

PhD in Physics in the "Soft Condensed Matter and Biophysics Group" at Utrecht University (The Netherlands)

SUPERVISORS: Prof. dr. ir. Marjolein Dijkstra, Prof. dr. René van Roij

PHD THESIS (SUBMITTED): *"On the effect of capillarity and polarity in colloidal suspensions of nanoparticles"*

During my PhD I have theoretically studied a series of phenomena occurring in systems of so-called *colloidal* particles, i.e. particles with dimensions ranging from a few nanometers up to several microns. In particular I have focused on colloids trapped at a fluid-fluid interface, and on liquid crystalline colloidal systems.

Chains of colloids at fluid-fluid interfaces

Nonspherical colloidal particles adsorbed at a fluid-fluid interface induce interfacial deformations that determine their orientations and generate mutual capillary interactions which drive the particles to assemble into 2D ordered structures. This self-assembly process may be regulated by controlling the size, the shape, and the surface chemistry of the adsorbed particles, such that a route can be established to build quasi-2D ordered structures at interfaces, with applications ranging from the stabilization of foams and Pickering emulsions to the development of new materials. Because of the large variety of colloidal particles nowadays available, with tunable shapes and surface functionalizations, the self-assembly of colloids trapped at a fluid-fluid interface has recently gained a great deal of attention in the soft-matter community, and the behavior at interfaces of nm- and μm-sized particles with several anisotropic shapes, e.g. rods, cylinders, cubes, dumbbells and discs, as well as particles with chemical heterogeneities on the surface, i.e. patchy and Janus particles, has been widely studied in the past years.

Inspired by recent experimental observations [1,2], during my PhD I have focused on chainlike aggregates formed by colloidal Janus dumbbells and colloidal cubes trapped at a fluid-fluid interface. To investigate these systems I have empolyed a simulated annealing numerical method that takes into account the interfacial deformations. The main results of my research can be found in Refs. [1] and [3], respectively, and in my PhD thesis (upon request).

[1] C. Anzivino, F. Chang, G. Soligno, R. van Roij, W.K. Kegel and M. Dijkstra, Soft Matter **15**, 2638 (2019).

[2] Q. Song, M. Steuber, S.I. Druzhinin and H. Schönherr, Angewandte Chemie International Edition **52**, 5246 (2019).

[3] C. Anzivino, G. Soligno, R. van Roij and M. Dijkstra, Soft Matter **17**, 965 (2021).

Liquid crystalline phase of "banana-like" particles

Liquid crystals are phases of matter sharing properties of both liquids and crystals, e.g. they can flow as liquids while they scatter light as crystals, typically found in suspensions of non-spherical particles. In a seminal paper published in 1949, Onsager predicted that the simplest of the liquid crystalline phase, known as *nematic* phase, can stabilize in a fluid of hard rods at sufficiently high rods concentration [1]. In the nematic phase, while centers of mass of the particles are homogeneously distributed in space, the long axes of the particles align on average along a preferred direction, such that the system exhibits orientational order in the absence of translational order. Since Onsager's paper, the importance of particle shape in determining the phase behavior of liquid crystals has been generally recognized, even if the mechanism connecting the macroscopic structure to the microscopic details of the constituent particles is still an open problem in many cases.

A great deal of attention has been recently attracted by systems of polar particles, having a "banana-like" or bent-core shape that favor spontaneous bend deformations in the nematic director field. By

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noting that a pure bend deformation cannot uniformly fill the 3D space, Meyer [2] and Dozov [3] suggested that the local bend deformations have to be accompanied by either a twist or splay deformation. In the former case they theoretically postulated the stabilization of a spatially modulated *twist-bend* nematic phase, in the latter the stabilization of a spatially modulated *splay-bend* nematic phase was predicted. While the twist-bend phase displays a heliconical variation with bend and twist deformation in the molecular orientation, the splay-bend phase is characterized by alternating domains of splay and bend.

While most of the research on bent-core liquid crystals has focused on *thermotropic* bent-core mesogens that become liquid crystalline upon lowering the temperature, very recently various routes have been developed to synthesize *lyotropic* colloidal model systems of bent particles, e.g. colloidal silica rods with a sharp kink or smoothly curved SU-8 rods [4]. By contrast with thermotropic systems, the liquid crystalline behavior of these colloidal systems is driven by concentration. For lyotropic systems, several predictions have been formulated by means of simulations [5].

During my PhD I have developed a phenomenological Landau-de Gennes theory for lyotropic colloidal suspensions of bent rods, able to decribe recent simulation results. More details can be found in Ref. [6] and in my PhD thesis (upon request).

[1] L. Onsager, Ann. N.Y. Acad. Sci. **51**, 627-659 (1949).

[2] R.B. Meyer, "Structural problems in liquid crystal physics", in *Molecular Fluids,* Les Houches Summer School in Theoretical Physics, edited by R. Balian and G. Weil (Gordon and Breach, New York, 1976), pp. 271-343.

[3] I. Dozov, Europhys. Lett. **56**, 247-253 (2001).

[4] C. Fernández-Rico et al., Science **369**, 950 (2020).

[5] M. Chiappini, T. Drwenski, R. van Roij and M. Dijkstra, Phys. Rev. Lett. **123**, 068001 (2019).

[6] C. Anzivino, R. van Roij and M. Dijkstra, The Journal of Chemical Physics **152**, 224502 (2020).

Master's Degree in Physics at Università degli studi di Trieste (Italy)

SUPERVISOR: Prof. dr. Giorgio Pastore

THESIS: *"Integral equations and spontaneously broken replica symmetry in the liquid-glass transition"*

During my Master's thesis project I have investigated the liquid-glass transition occurring in a Lennard-Jones fluid. To this aim I have used the Parisi-Mézard replica technique together with the integral equations theory for the liquid state. More details can be found in my Master's thesis (upon request).

Bachelor's Degree in Physics at Università degli studi di Bari (Italy)

SUPERVISORS: Prof. dr. Giuseppe Gonnella, dr. Antonio Lamura

THESIS: *"Application of Lattice Boltzmann Methods to the analysis of convective phenomena in the Rayleigh-Bénard problem"*

My Bachelor's thesis project has focused on the Rayleigh-Bénard convection, i.e. a type of convection occurring in a planar horizontal layer of fluid heated from below. To this aim I have employed the Lattice Boltzmann methods. Details can be found in my Bachelor's thesis (upon request).

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CONGRESSES AND SEMINARS

Date	Title	Place
January 21-22 2020	Physics@FOM	Veldhoven (The Netherlands)
November 17 2019	The 27th Dutch Soft Matter Meeting	Utrecht (The Netherlands)
March 25-29 2019	Spring School on the Mathematical Design of Materials	Isaac Newton Institute for Mathematical Science, Cambridge (The United Kingdom)
January 21-22 2019	Physics@FOM (Poster presented)	Veldhoven (The Netherlands)
April 16-18 2018	Debye Spring School "Nanomaterials for Daily Life"	Driebergen (The Netherlands)
January 23-24 2018	Physics@FOM (Poster presented)	Veldhoven (The Netherlands)
July 17-21 2017	The 10th Liquid Matter Conference	Ljubljana (Slovenia)
January 23-27 2017	The 28th Han sur Lesse WinterSchool	Han sur Lesse (Belgium)
January 17-18 2017	Physics@FOM (Oral talk)	Veldhoven (The Netherlands)
October 17 2016	The 21st Dutch Soft Matter Meeting	Wageningen (The Netherlands)

PUBLICATIONS

Articles in reviews
C. Anzivino, G. Soligno, R. van Roij and M. Dijkstra, "*Chains of cubic colloids at fluid-fluid interfaces*", Soft Matter **17**, 965 (2021)
C. Anzivino, R. van Roij and M. Dijkstra, "*A Landau-de Gennes theory for twist-bend and splay-bend nematic phases of colloidal suspensions of bent rods*", The Journal of Chemical Physics **152**, 224502 (2020)
C. Anzivino, F. Chang, G. Soligno, R. van Roij, W. K. Kegel and M. Dijkstra, "*Equilibrium configurations and capillary interactions of Janus dumbbells and spherocylinders at fluid-fluid interfaces*" Soft Matter **15**, 2538 (2019)

OTHER INFORMATION

From September 2019 to November 2019: Teaching Assistant of the 2018-2019 "Advanced Statistical Physics" course (NS-370B Bachelor in Physics) Universiteit Utrecht, The Netherlands Lecturer: dr. Laura Filion
From September 2018 to November 2018:

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Teaching Assistant of the 2017-2018 "Advanced Statistical Physics" course (NS-370B Bachelor in Physics) Universiteit Utrecht, The Netherlands Lecturer: dr. Laura Filion
From February 2017 to April 2018: Teaching Assistant of the 2016-2017 "Structure of Matter" course (NS-266B Bachelor in Physics) Universiteit Utrecht, The Netherlands Lecturers: dr. André Mischke, dr. Ingmar Swart
From October 2015 to December 2015: Tutorship organized by the Dipartimento di Fisica Università degli studi di Trieste, Italy Exercises in Newtonian mechanics, calculus and linear algebra for mathematics and physics undergraduate students

Declarations given in the present curriculum must be considered released according to art. 46 and 47 of DPR n. 445/2000.

The present curriculum does not contain confidential and legal information according to art. 4, paragraph 1, points d) and e) of D.Lgs. 30.06.2003 n. 196.

Place and date: Bovino (FG), March 22nd 2021

SIGNATURE

Carmine Anzivino