David Richard — Curriculum Vitae

I am an independent Marie Sklodowska-Curie postdoc fellow working at the “Laboratoire Interdisciplinaire de Physique” in Grenoble (France). My research focuses on the statistical mechanics of systems out of equilibrium, including phase transitions, plasticity and failure in amorphous materials. My research is heavily based on developing and using advanced numerical methods.

•PERSONAL INFORMATION

Name: David Richard
Date of birth: 11/01/1991
Nationality: French
Marital Status: Married
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•ACADEMIC POSITIONS

— 01/10/2021 - present — **Marie Skłodowska-Curie postdoctoral Fellow**, with Prof. Jean-Louis Barrat (University of Grenobles Alpes, France)
— 01/02/2019 - 01/09/2021 — **Simons Foundation postdoctoral Fellow** funded by the Simons Collaboration on “Cracking the Glass Problem”, with Prof. Edan Lerner (University of Amsterdam, Netherlands) and Prof. Mary Lisa Manning (University of Syracuse, USA)

•EDUCATION

— 01/11/2014 - 14/11/2018 — **Ph.D. in Physics** Johannes Gutenberg University Mainz
with Prof. Thomas Speck. Title: “Phase Transitions in Colloidal Systems"
— 01/09/2012 - 01/09/2014 — **Master in Physics** University of Orléans, France
Master thesis at the Johannes Gutenberg University Mainz with Dr. Peter Virnau
— 01/09/2009 - 01/09/2012 — **Bachelor in Physics**
University of Orléans, France

•TEACHING EXPERIENCE

01/11/2014 - 14/11/2018 — **Teaching assistant** (approx. 350 hours)
Johannes Gutenberg University Mainz, Germany
- Advanced lab course: Molecular Simulations (Master level)

I supervised groups of student for small numerical projects that includes writing Molecular Dynamic and Monte Carlo codes

- Advanced statistical mechanics (Master level)

I prepared exercises and presented solutions about phase transition phenomena and stochastic processes

•STUDENTS SUPERVISED

— 01/04/2020 - 01/09/2021 — Julia Giannini, Ph.D. student, University of Syracuse, USA
— 01/03/2019 - 31/02/2020 — Robert Pater, Master student, University of Amsterdam, NL
— 01/04/2019 - 07/07/2019 — Steijn Delnoij, Bachelor student, University of Amsterdam, NL

• PEER-REVIEWED AND SUBMITTED MANUSCRIPTS

I have published 20 articles + 2 articles submitted (2 PRLs, 1 Scientific Report, 1 PRM), with a total of 16 as a first author, mainly in the Physical Review and Journal of Chemical Physics. A complete list of my publications is provided in an additional document.

Selected publications:

- **D. Richard**, G. Kapteijns, J. A. Giannini, M. L. Manning, and E. Lerner, Simple and Broadly Applicable Definition of Shear Transformation Zones, **Physical Review Letter** 126 (2021)

We have developed a new algorithm to detect soft excitations in structural glasses solely based on the Hessian of the system. These soft modes do not suffer from hybridization with phonons and allow to cleanly detect eminent plastic instabilities in a variety of structural glasses.

- **D. Richard**, M. Ozawa, S. Patinet, E. Stanifer, B. Shang, S. A. Ridout, B. Xu, G. Zhang, P. K. Morse, J-L. Barrat, L. Berthier, M. L. Falk, P. Guan, A. J. Liu, K Martens, S. Sastry, D. Vandembroucq, E. Lerner, and M. L. Manning, Predicting plasticity in disordered solids from structural indicators, **Physical Review Material** 4 (2020)

In this international collaboration, we provide an extensive comparison of the predictive power of many structural indicators used to detect plastic flows in amorphous solids. Our benchmark includes the detection of localized shear transformations and strain localization.

- **D. Richard** and T. Speck, Crystallization of hard spheres revisited. II. Thermodynamic modeling, nucleation work, and the surface of tension, **Journal of Chemical Physics** 148 (2018). **D. Richard** and T. Speck, Crystallization of hard spheres revisited. I. Extracting kinetics and free energy landscape from forward flux sampling, **Journal of Chemical Physics** 148 (2018)

In this paper series, we have developed a new methodology to study nucleation phenomena that combines rare event samplings and thermodynamic integrations based on the nucleation theorem. Our method allows us to compute free energy barriers as well as the surface of tension of small droplets.

I am also working as a referee for Physical Review, the Journal of Chemical Physics and SciPost.

• PARTICIPATION IN FUNDED PROJECTS

— Two years Marie Skłodowska-Curie postoctoral fellowship (approx. 200k euros)
ToughMG - Modeling the fracture toughness of metallic glasses through a multi-scale approach
— One year postdoctoral fellowship extension funded by the Simons Collaboration on “Cracking the Glass Problem” Proposal title: Revealing the statistical physics of STZs in driven computer glasses
— Genci project (500 000 CPU hours) Proposal title: “Modelling the fracture morphology of bulk metallic glasses across the ductile-to-brittle transition”

• RESEARCH VISITS

01/06/2016 - 31/09/2016 — Prof. C. P. Royall, University of Bristol, UK
Project title: “Experimental observation of the critical behavior of colloidal-polymer mixtures via confocal microscopy”

•CONFERENCES, WORKSHOPS AND SEMINARS

Invited Talks

2020 — Simulation Multiéchelle & Calcul Haute Performance— "Sampling methods to study rare events in Molecular Dynamics", PHYSTAT 2020, Orléans, France
2021 — APS march meeting — "Predicting failure in disordered solids from structural metrics", Denver, USA
2021 — News from Disordered Elastic Systems — "Comparison of computational methodologies for predicting plastic activity in amorphous materials", Spetses, Greece
2022 — Disorder's Role in Glass Formation and Deformation—"Tutorial on detecting soft spots in glasses", Leiden, Netherlands
2022— MMM10 — "Using non-linear modes to predict and understand plastic flow in disordered solids", Baltimore, USA
2022— Workshop: Machine Learning Glassy Dynamics — "Non-linear micromechanics of simple structural glasses", Paris, France
2023— CECAM: Mesoscale modelling of driven disordered materials: from glasses to active matter — "A mapping between the micromechanics of glasses and elasto-plastic models", Lausanne, Swiss

Talks & seminars

2016 — DPG spring meeting — "Crystallization of sheared nearly hard-spheres", Berlin, Germany
2017 — DPG spring meeting — "From criticality to gelation in sticky spheres", Dresden, Germany
2017 — Prof. A. Z. Panagiotopoulos — "Crystallization of hard spheres in the quiescent regime and under shear flow", Princeton, USA
2017 — 91st ACS Colloid & Surface Science Symposium — "From criticality to gelation in sticky spheres", New York, USA
2018 — DPG spring meeting — "Nucleation work in the crystallization of hard spheres", Berlin, Germany
2018 — Theoretical Physics Amsterdam (ITFA) — "Nucleation work in the crystallization of hard spheres", Amsterdam, Netherlands
2018 — NECD18 — "Understanding the crystallization kinetics and nucleation work for sheared liquids", Potsdam, Germany
2019 — ICMN CNRS — "From probing the crystallization kinetics of liquids to predicting failure in amorphous materials ", Orléans, France
2020 — Royaumont Simons annual meeting — "Anisotropic structural indicators", web conference
2020 — TimeMan Seminar — "Comparison of computational methodologies for predicting plastic activity in amorphous materials ", Lille, France
2021 — Soft Matter University of Amsterdam — "Comparison of computational methodologies for predicting plastic activity in amorphous materials",Amsterdam, Netherlands
2021 — PMMH CNRS — "Using soft excitations to predict and understand plastic flow in disordered solids", Paris, France
2022 — Workshop Defects in disordered systems, discussant "Two-level systems in structural glasses", Pennsylvania, USA
2022 — Winter School on Driven Amorphous Materials, "Bridging necking and shear-banding mediated tensile failure in glasses", Rehovot, Israel

Organization

2022— mini workshop GDR "Interaction, Désordre, Elasticité", Grenoble, France

• REFERENCES

- Prof. T. Speck, Johannes Gutenberg University Mainz, thomas.speck@uni-mainz.de
- Prof. E. Lerner, University of Amsterdam, e.lerner@uva.nl
- Prof. M. L. Manning, University of Syracuse, mmanning@syr.edu
- Prof. E. Bouchbinder, Weizmann Institute of Science, eran.bouchbinder@weizmann.ac.il
- Prof. C.P. Royall, University of Bristol, paddy.royall@bristol.ac.uk