Book of abstracts

The workshop is the 5th annual meeting of the CNRS Groupement de recherche ***Interaction, Désordre, Elasticité*** (**GDR IDE**), started in 2022. It will cover five topics of the GDR, with invited and contributed talks:

- **Granular matter**
- **Soft materials**
- **Dense active systems**
- **Memory in disordered systems**
- **Quantum disordered systems**

ORGANISATION

Elisabeth Agoritsas – Personal webpage

Vivien Lecomte – LIPhy, Université Grenoble-Alpes and CNRS (France)

Alberto Rosso – LPTMS, Université Paris-Saclay and CNRS (France)

Damien Vandembroucq – PMMH, ESPCI Paris and CNRS (France)

Claudine Le Vaou (Administrative manager) – LPTMS, Université Paris-Saclay and CNRS (France)

cnrs GDR Groupement de recherche — Université Grenoble Alpes — LIPhy Laboratoire interdisciplinaire de Physique — LPTMS

WEBSITE

http://gdr-ide-2026.sciencesconf.org/

Newsletter for the GDR IDE

SCHEDULE

	Monday 04/05	Tuesday 05/05	Wednesday 06/05
9 :00	Opening		
9 :10	Keta Yann-Edwin	Edera Paolo	Amon Axelle
9 :45	Bertin Eric	Crauste-Thibierge Caroline	Rodriguez Solenn
10 :05	Parage Baptiste	Santucci Stéphane	Viallet Maud
10 :25	Roni Chatterjee	Tanguy Anne	Corbel Pierre-Yves
10 :45	Coffee break	Coffee break	Coffee break
11 :15	Lemarié Gabriel	Deboeuf Stéphanie	Maitra Ananyo
11 :50	Bouverot-Dupuis Oscar	Michel Laura	Henry Hervé
12 :10	Morpurgo Giacomo	Faulconnier Antoine	Vanel Loïc
12 :30	Lallemant Valentin	Crassous Jérôme	Emig Thorsten
12 :50			
13 :00	Lunch break	Lunch break	Lunch break
14 :30	Ramos Laurence		Giamarchi Thierry
15 :05	Pelosse Alice		Angeli Ettore
15 :25	Parmar Anshul		Wiese Kay
15 :45	Coffee break		Coffee break
16 :15	Russo Giovanni		
16 :35	Thiraux Ptashanna		
16 :55	Bhadra Satyanu		
17 :05	Zetterberg Love		
17 :15			
19 :30	Aperitif - dinner	Conference dinner	Dinner

CONFIRMED SPEAKERS

INVITED TALKS

Axelle Amon (Institut de Physique, CNRS/Université de Rennes) - *Creep response of granular materials*

Stéphanie Deboeuf (Institut d'Alembert, CNRS,/Sorbonne Université) - *Sheet compression: from Euler Elastica to disordered states*

Paolo Edera (C3M, CNRS/ESPCI Paris) - *Mechanical Tuning of Residual Stress, Memory, and Aging in Soft Glassy Materials*

Yann-Edwin Keta (PMMH, CNRS/ESPCI Paris/Sorbonne Université/Université Paris Cité) - *Correlated cell movements drive epithelial finger formation*

Gabriel Le Marié (INPHYNI, Université Côte d'Azur, CNRS, Nice) - *2D Anderson Localization belongs to KPZ Universality Class*

Ananyo Maitra (Laboratoire de Physique Theorique et Modelisation LPTM, Université Cergy-Pontoise) - *Active ordering in disordered environments*

Laurence Ramos (Laboratoire Charles Coulomb L2C, CNRS/ Université Montpellier) - *Colloidal rheology in a drop*

CONTRIBUTED TALKS

Ettore Angeli — *Pinning Dominated Dynamics and Internal Texture Effects in Field- and Spin-Orbit Torque-Driven Domain Walls*

Eric Bertin — *Giant density fluctuations in locally hyperuniform states*

Satyanu Bhadra — *Deflatables*

Oscar Bouverot-Dupuis — *One-dimensional dissipative Mott transition*

Pierre-Yves Corbel — *Kinematics of an elastic fiber dragged in a granular medium*

Jérôme Crassous — *Knots*

Caroline Crauste-Thibierge — *Memory effects at small and large strain in polymer films*

Thorsten Emig — *How far does shear propagate? Boundary-driven granular flow in channels with complex basal forcing*

Antoine Faulconnier — *Laddering in knitted fabrics*

Thierry Giamarchi — *Disorder and interactions in one-dimensional quantum system*

Hervé Henry — *Phase field study of fracture in heterogeneous materials*

Valentin Lallemant — *An explicit formula of the Oslo stationary state*

Laura Michel — *Mechanics of a model knitted fabric*

Giacomo Morpurgo — *Localization Transition for Interacting Quantum Particles in Colored-Noise Disorder*

Baptiste Parage — *Interplay between activity and attraction in active polymers*

Anshul Parmar — *Tuning dynamics and mechanics of disordered systems via structural constraints*

Alice Pelosse — *How drop volume and particle size shape evaporating armored droplets*

Solenn Rodriguez — *Mechanical Behaviour of Confined Ferromagnetic Granular Materials*

Chatterjee Roni — *Memory behavior of a randomly driven model glass*

Giovanni Russo — *Activation and avalanche length scales in the finite-temperature creep of an elastic interface*

Stéphane Santucci — *Multiscale stress dynamics in sheared liquid foams revealed by tomo-rheoscopy*

Anne Tanguy — *Disorder and Non-Linear interactions*

Ptashanna Thiraux — *Exploring and simulating earthquake interactions*

Loic Vanel — *Rupture of heterogeneous materials: Creep and stress relaxation dynamics?* or *Time-dependent sideways cracks in filled elastomers?*

Maud Viallet — *Discharge of magnetic particles in a 2D silo*

Kay Wiese — *How can zeta = 1.25 for an elastic string at depinning be realized in an experiment?*

Love Zetterberg — *Creep vs relaxation in brittle disordered solids*

PREVIOUS MEETINGS

This meeting also follows up on the line of previous workshops and meetings organised on the subject, in particular:

- Driven Disordered Systems (Grenoble, 2014)
- Dynamical Phase Transitions in Driven Systems (Grenoble 2016)
- Yielding of Amorphous Solids (Paris, 2017)
- Crackling Noise in Materials (Stockholm, 2018)
- Yielding versus depinning in disordered systems (Paris, 2018)
- Avalanche Dynamics and Precursors of Catastrophic Events (Les Houches, 2019)
- Yielding phenomena in disordered systems (Bariloche, 2019)
- News from Disordered Elastic Systems (Spetses, 2021) (non-official kick-off of this GDR)
- Avalanche 2022 - Avalanche dynamics and precursors of catastrophic events (Hungary, 2022)

and specifically, since the beginning of the GDR IDE:

- 1ères Journées du GDR IDE "Interaction Désordre Élasticité" (Grenoble, 2022)
- 2èmes Journées du GDR IDE "Interaction Désordre Élasticité" (Les Houches, 2023)
- 3èmes Journées du GDR IDE "Interaction Désordre Élasticité" (Grenoble, 2024)
- 4èmes Journées du GDR IDE "Interaction Désordre Élasticité" (Sète, 2025)

The main motivation of the GDR IDE is to enhance the collective dynamics on disordered systems, in the same spirit as the previous GDR "Systèmes élastique désordonnés" (GDR 2284) that was funded from 2001 to 2005 (NB. Much of the talks material is still available on their associated webpages.)

- Première rencontre du GDR 2284: Systèmes élastiques - Du désordre à la plasticité (St-Flour, 2001)
- Deuxième rencontre du GDR 2284: Systèmes élastiques - Du désordre à la plasticité (Carcassonne, 2002)
- Troisième rencontre du GDR 2284: Systèmes élastiques - Du désordre à la plasticité (Asnelles-sur-mer, 2003)
- Ecole thématiques du GDR 2284: Systèmes élastiques - Verres - Plasticité et fracture (Autrans, 2004)
- Quatrième rencontre du GDR 2284: Systèmes élastiques - Du désordre à la plasticité (Vogué, 2005)

ORAL CONTRIBUTIONS (in chronological order)

Monday May 4

Yann-Edwin Keta — *Correlated cell movements drive epithelial finger formation*

Sheets of epithelial cells form protective barriers in multicellular organisms. When damaged, finger-like protrusions form at the advancing edge, closing the damaged area. Due to the resemblance to fluid spreading, existing models typically invoke instability mechanisms to explain the onset of fingers. Combining in vitro experiments on freely expanding MDCK cell monolayers with simulations of the self-propelled Voronoi model and an active viscoelastic theory, we show that instead fingers form spontaneously due to emergent, correlated cell motion within the cell layer and simply represent long-lived active fluctuations of the boundary. Simulations and theory both quantitatively match spatiotemporally correlated cell motion measured in the interior of the monolayer. To capture finger formation, we model the actomyosin cable at the advancing edge as a contractile semi-flexible polymer driven by correlated active noise representing the interior. The model not only exhibits spontaneous finger formation but also quantitatively predicts tangent-tangent and roughness correlation functions of the edge in space and time, as well as fluctuation spectra. Our results, therefore, indicate that correlated cell movements lead to robust finger formation, without the need for any feedback mechanism, suggesting that leader cells, cell-cell signalling, and division modulate an intrinsic process instead of causing it.

Eric Bertin — *Giant density fluctuations in locally hyperuniform states*

Systems driven far from equilibrium may exhibit anomalous density fluctuations: active matter with orientational order display giant density fluctuations at large scale, while systems of interacting particles close to an absorbing phase transition may exhibit hyperuniformity, suppressing large-scale density fluctuations. We show that these seemingly incompatible phenomena can coexist in nematically ordered active systems, provided activity is conditioned to particle contacts. We characterize this unusual state of matter and unravel the underlying mechanisms simultaneously leading to spatially enhanced (on large length scales) and suppressed (on intermediate length scales) density fluctuations. Our work highlights the potential for a rich phenomenology in active matter systems in which particles' activity is triggered by their local environment, and calls for a more systematic exploration of absorbing phase transitions in orientationally-ordered particle systems.

Baptiste Parage — *Interplay between activity and attraction in active polymers*

Among the exciting classes of active matter, self-propelled polymer-like objects are particularly notable for their relevance across biological systems, from cytoplasmic biopolymer networks to worm collectives at the macroscopic scale. While activity is known to strongly affect the conformation and dynamics of self-repelling chains, generally leading to chain shrinkage, its impact on the attraction-driven coil-to-globule transition remains largely unexplored. We address this question by performing single-chain Brownian dynamics simulations of three-dimensional flexible, tangentially driven active polymers with intrachain attraction. We find that activity smears out the collapse transition, promoting necklace-like conformations before the polymer forms a highly reconfigurable compact globule. Interestingly, the effect of activity varies with attraction strength, leading to activity-induced shrinkage below the theta point and swelling above it. By rescaling the attraction strength into an effective activity-dependent parameter, we obtain a universal master curve for the radius of gyration.

Chatterjee Roni — *Memory behavior of a randomly driven model glass*

We investigate by atomistic simulations the memory behavior a model glass subjected to random driving protocols. The training consists of a random walk of forward and/or backward shearing sequences bounded by a maximal shear strain of absolute value γT . We show that such a stochastic training protocol is able to record the training amplitude. Different read-out protocols are also tested and are shown to be able to retrieve the training amplitude. We then emphasize the ten- sorial character of the memory encoded in the glass sample and then characterize the anisotropic mechanical behavior of the trained samples.

Gabriel Le Marié — *2D Anderson Localization belongs to KPZ Universality Class*

In this talk, I will present our recent findings on two-dimensional Anderson localization, demonstrating its connection to the Kardar-Parisi-Zhang (KPZ) universality class. The KPZ equation [1] describes the growth of rough interfaces. It is well-known for its universal scaling exponents and distributions, which have been found to apply to a variety of classical and quantum systems. Following early studies [2], our numerical analysis reveals key properties of the KPZ universality class in the fluctuations of the density logarithm of 2D Anderson localized wave packets [3,5], as well as in eigenstates [4] and the conductance logarithm [6,7]. This analogy provides Anderson localization with a wealth of predictions in a regime difficult to access analytically.

[1] Kardar, M., Parisi, G., & Zhang, Y. C., *Phys. Rev. Lett.* 56, 889 (1986).

[2] Somoza, A. M., Ortuno, M. & Prior, J., *Phys. Rev. Lett.* 99, 116602 (2007).
[3] Mu, S., Gong, J. & Lemarié, G., *Phys. Rev. Lett.* 132, 046301 (2024).
[4] Izem, N., Gergeot, B., Gong, J., Lemarié, G. & Mu, S., arXiv:2512.12085 (2025).
[5] Mu, S. , Izem, N., Georgeot, B., Gong, J., Moessner, R. and Lemarié, G., in preparation (2026).
[6] Lemarié, G., *Phys. Rev. Lett.* 122, 030401 (2019).
[7] Swain, N., Adam, & Lemarié, G., *Phys. Rev. Research* 8, 013038 (2026).

Oscar Bouverot-Dupuis — *One-dimensional dissipative Mott transition*

We establish the full phase diagram of a 1D bosonic system coupled to local baths acting as dissipation. We identify three phases: a Luttinger liquid (LL), a Mott insulator (MI) and, in between, a dissipative phase (DP). Using state-of-the-art Monte Carlo simulations, we confirm that the LL/DP transition lies in the BKT universality class, and, for the first time, characterize the universality class of the MI/DP transition. The critical exponents are shown to be $z=4$ and $\nu=1/4$.

Giacomo Morpurgo — *Localization Transition for Interacting Quantum Particles in Colored-Noise Disorder*

We investigate the localization transition of interacting particles in a one-dimensional correlated disorder system. The disorder which we investigate allows for vanishing backwards scattering processes. We derive by two renormalization group procedures its phase diagram and predict that the localization transition point is shifted from finite attractive interaction to the non-interacting point. We finally show numerically that the scaling of the localization length with the disorder strength deviates from the usual scaling of a localized phase.

Valentin Lallemant — *An explicit formula of the Oslo stationary state*

TBA.

Laurence Ramos — *Colloidal rheology in a drop*

The realm of solid-like colloid-based materials is vast, with a wide variety of structures. Rationalizing the link between the structures and the mechanical properties of this class of materials is a formidable task. However, measuring the rheological features of solid-like colloid-based materials is not easy, especially because of the interaction of the colloidal material with solid surfaces that may impact the sample rheological response submitted to a shear deformation. In order to suppress possible artefacts due to interactions with surfaces, we have developed a strategy based on the use of millimetric drops. We use a multiscale approach combining macroscopic mechanical measurements and imaging with microscopic dynamical and structural measurements to probe colloidals gel confined in a drop. In this framework, I will present several experimental results from the decoupling between structure and elasticity in colloidal gels under isotropic compression o the brittle-to-ductile transition of beads of colloidal gels.

Alice Pelosse — *How drop volume and particle size shape evaporating armored droplets*

When a drop evaporates, its shape is dictated by capillarity. However, for liquid marbles, i.e., drops coated with hydrophobic particles trapped at the interface, the situation is fundamentally different. The particulate shell must then adapt to a shrinking volume while balancing the solid-like mechanical properties of the interface. In this talk, I will demonstrate how elasticity features emerge in such discrete armor by systematically varying both the drop volume and the particle size in experiments. I will also show how the initially disordered particle arrangement evolves under compression into crystalline structures with defects, defects that ultimately govern the drop's deformation. This interplay between volume reduction, particle size, and structural organization reveals the singular mechanics of armored drops.

Anshul Parmar — *Tuning dynamics and mechanics of disordered systems via structural constraints*

Structural engineering of disordered systems and tuning their properties remain central challenges in materials science. We present a model of gel-like particles connected by reversible bonds, where bond strength and concentration directly determine the material's physical properties. Simulations show that varying these parameters produces dramatic changes in structural relaxation, thermal stability, and mechanical response. Bond strength and concentration also enable long-lived yet reconfigurable states, linking microscopic bonding dynamics to macroscopic performance. This framework provides a versatile route to design disordered materials with tailored properties.

Giovanni Russo — *Activation and avalanche length scales in the finite-temperature creep of an elastic interface*

We investigate the finite-temperature creep dynamics of a driven elastic interface below the depinning threshold. Using an effective kinetic Monte Carlo dynamics built from activated rearrangements followed by deterministic relaxation, we show that creep is governed by two distinct length scales. The first, $\ell_{\rm opt}(f)$, is the thermal activation nucleus controlling the energy barriers and the Arrhenius timescale. The second, $\ell_{\rm av}(f, T)$, is the spatial extent of the depinning-like avalanche triggered after activation. Structure-factor measurements and four-point dynamical correlations show that, at fixed drive, this avalanche scale grows as $\ell_{\rm av}(f, T) \sim T^{-\nu_{\rm dep}}$ Thus, finite-temperature creep separates into two mechanisms: activation controls time, while depinning-like avalanches control space.

Ptashanna Thiraux — *Exploring and simulating earthquake interactions*

Earthquakes and faults are often considered a paradigm of "crackling noise," i.e., slowly driven complex systems that respond through intermittent events [1], characterized by scale-free statistics such as a power-law distribution of seismic moments (the Gutenberg-Richter law), and space/time correlations expressed, for example, by a slowly decaying rate of aftershocks (Omori's law) associated with scale-free (sub)diffusion. Understanding the physical origin of these scaling laws is of primary importance for natural hazard forecasting. Slider-block models, incorporating only simple static friction and elastic interactions, have long been proposed to simulate fault mechanics and earthquakes [2]. The seminal 1D models were later extended to 2D using cellular automata with a simplified, short-range version of elastic stress redistribution [3]. While these models can simulate intermittent events with power-law-distributed slip sizes, they lack a timescale and thus cannot simulate aftershocks or the associated space and time clustering. More recently, deterministic rheologies (e.g., viscoelastic [4] or rate-and-state [5]) have been introduced to capture these complex space/time properties. We introduce timescales at a more fundamental level by incorporating thermal activation [6] of individual block slip. This approach allows exploration of the coupled effects of thermal activation and elastic stress redistribution on earthquake self-organization, as well as the influence of temperature on earthquake triggering. Additionally, the impact of the elastic redistribution kernel—short-range versus more realistic long-range—is investigated. The introduction of healing processes enables modeling of both velocity-strengthening and velocity-weakening regimes in the rate-and-state framework, without adding deterministic rheologies. Another improvement is computing real slip in a dislocation-like model to simulate earthquakes, and further study the link between stress field correlations, the Gutenberg-Richter exponent, and cutoff is in progress.

Refs. : [1] J. P. Sethna, K. A. Dahmen, and C. R. Myers, *Nature* **410**, 242 (2001). [2] R. Burridge and L. Knopoff, *Bulletin of the Seismological Society of America* **57**, 341 (1967). [3] Z. Olami, H. J. S. Feder, and K. Christensen, *Phys. Rev. Lett.* **68**, 1244 (1992). [4] E. Jagla and A. Kolton, *Journal of Geophysical Research: Solid Earth* **115** (2010). [5] T. W. de Geus and M. Wyart, *Phys. Rev. E* **106**, 065001 (2022). [6] J. Weiss *et al.* (2025) *In prep.

Satyanu Bhadra — *Deflatables*

We present a new method of shape transformation via application of vacuum over 3d printed TPU structures enclosed in a fabric. This method allows us to print 3d structures with double curvatures which are flat until activated. This allows for easier storage and transport, rapid deployment, and dissassembly when finished. We will go over the various steps of the process, starting from a target 3d shape to the final assembly and deployment.

Love Zetterberg — *Creep vs relaxation in brittle disordered solids*

When studying materials that are subjected to loading over long periods of time, two phenomena, creep and stress relaxation, emerge as a sort of mirror image of one another. Creep is defined as the slow deformation of a material under constant load, while relaxation is defined as a material held at constant strain and displaying a slow decrease of the internal stress. In the case of brittle heterogenous materials, which are of great importance for example in civil engineering and rock mechanics, these two phenomena can be linked to thermally activated microfracturing. Strain evolution during creep strain is typically modelled in three stages, starting with a primary slowing down of the strain rate, a possible secondary creep associated to a constant strain-rate preceding an acceleration to macroscopic failure. Primary creep is most commonly modelled as a power law decrease of the strain rate with time. Similarly, relaxation is often observed as a logarithmic decrease of the stress with time, corresponding to a stress-rate decaying as 1/t. In both cases these descriptions remain phenomenological and do not explain the underlying process . Modelling the material as a collection of subvolumes, each capable of deforming and damaging once a local “yield” stress is reached athermally, or by thermal activation, one can create more physically grounded models for creep and relaxation of disordered brittle materials. A 1st order approach, analytically tractable, is to describe primary creep from a statistical exhaustion model, assuming thermal activation of individual subvolume damage, but ignoring elastic stress redistribution . However, this idealized approach neglects spatially and temporally localized effects which have been shown to increase the strain rate and decrease the time to failure through internal stress redistribution. In order to better understand the relationship between primary creep and relaxation in brittle materials, and aiming to clarify the relationship between these two macroscopic phenomena and the significance of internal stress redistributions for the underlying microscopic damaging, we analyze creep as well as relaxation tests performed on concrete samples, and in particular acoustic emissions furnishing a precise chronology of damage events. This is compared to what is expected from a simple exhaustion model in order to reveal the combined role of quenched disorder, thermal activation and elastic stress redistributions on these processes.

Tuesday May 5

Paolo Edera — *Mechanical Tuning of Residual Stress, Memory, and Aging in Soft Glassy Materials*

Glassy materials rapidly quenched from a liquid to a solid state upon flow cessation or cooling solidify in an out-of-equilibrium configuration, trapping residual stresses and retaining the memory of the processing conditions for very long times, which compromises their physical characterization and can adversely affect processing operations. Erasing the mechanical history encoded in disordered materials constitutes a great challenge. Here, we address this problem using experiments and particle dynamic simulations for the case of colloidal glasses made of soft particles densely packed at high volume fractions. We propose a conceptual framework that connects residual stresses, directional memory, and aging of colloidal glasses to the distribution of local shear stresses in the shearing plane. The mean value of the distribution corresponds to the macroscopic stress, the skewness carries information about directional memory, and the standard deviation is related to mechanical aging. Periodically training soft particle glasses near the yield point with a sequence of stress-controlled oscillations provides a fine-tuning of the particle stress distribution. Asymmetric shear stress distributions resulting from previous flow are transformed into symmetric distributions, thereby successfully erasing residual stresses and directional memory. The same methodology is successfully applied to colloidal and polymer gels with thixotropic properties, suggesting that it is general and may be extended to other classes of disordered materials.

Caroline Crauste-Thibierge — *Memory effects at small and large strain in polymer films*

Memory is a well-known property of disordered systems. Usually, their answer to a perturbation depends not only on the perturbation itself but also of the thermal or mechanical history of the material. Submitted to mecanical strain (or shear), they can keep in their structure the signature of the direction or of amplitude of the strain. Under certain conditions, it becomes possible to read this memory of the mechanical history. Using a tensile machine, we apply strain to polymer films and measure their mechanical response. We also perform in-situ dielectric measurements during the strain. I will present our last results on different kinds of memory effects including Baüchinger effects in two limit regims of the polymer response. We studied the low strain response, in the reversible plastic regim and the high strain response in the stran-hardening regim in polycarbonate sheets.

Stéphane Santucci — *Multiscale stress dynamics in sheared liquid foams revealed by tomo-rheoscopy*

Rheology aims at quantifying the response of materials to mechanical forcing. However, standard rheometers provide only global macroscopic quantities, such as viscoelastic moduli. They fail to capture the heterogeneous flow of soft amorphous materials at the mesoscopic scale, arising from the rearrangements of the microstructural elements, that must be accounted for to build predictive models. To address this experimental challenge, we have combined shear rheometry and time-resolved X-ray micro-tomography on 3D liquid foams used as model soft jammed materials, yielding a unique access to the stresses and contact network topology at the bubble scale. We reveal a universal scaling behavior of the local stress build-up and relaxation associated with topological modifications. Moreover, these plastic events redistribute stress non-locally, as if the foam were an elastic medium subjected to a quadrupolar deformation. Our findings clarify how the macroscopic elastoplastic behavior of amorphous materials emerges from the spatiotemporal stress variations induced by microstructural rearrangements.

Anne Tanguy — *Disorder and Non-Linear interactions*

In this talk, I would like to compare different signatures of non-linear interactions in disordered materials like amorphous solids: spatial dependence of group velocity and non-linear waves, localization of low frequency waves, plasticity. We will discuss possible effects on thermal transfer, when disorder is at the atomic scale.

Stéphanie Deboeuf — *Sheet compression: from Euler Elastica to disordered states*

Thin structures, common in nature (plant leaves in buds, DNA in viral capsids) and engineering (flexible electronics, packaging), exhibit complex mechanical behaviors under confinement, including metastability and multi-scale properties. Their low bending stiffness, due to the scale separation between their dimensions, promotes large rotations and displacements, introducing geometric nonlinearities despite the material's linear elasticity. This presentation will explore the compression of thin structures, inducing non-penetration constraints and contact forces, both with containers and at self-contacts, possibly with friction. Different geometries are considered, through experimental, theoretical and numerical approaches. The free segments, delimited by contacts, are the elementary units of compacted structures: their mechanical equilibrium is solved for moderate compaction, while their statistical properties are investigated for highly compacted and disordered configurations.

Laura Michel — *Mechanics of a model knitted fabric*

Knitted fabrics consist of yarns intertwined into an intricate periodic network of loops. The mechanical response of such a network is inherently nonlinear, dissipative, and history-dependent, due to the slenderness of the fibers and the frictional contacts between threads. As a result, predicting the mechanical response of a fabric remains an ongoing challenge, even numerically. In this work, we describe the elasticity of periodic frictional knitted fabrics using both a 2D elastica model and a 3D numerical model. In particular, we show that, in the absence of solid friction between threads, the mechanics of the fabrics can be fully rationalized through the study of their elastic energy. When solid friction between threads is taken into account, one can still determine the possible equilibrium shapes for a given set of applied forces or, conversely, the possible applied forces for a given shape. Finally, we show that a simple model allows to predict the spontaneous curvature of such fabrics.

Antoine Faulconnier — *Laddering in knitted fabrics*

A knitted fabric is composed of a series of loops, called stitches, which are intertwined from a single thread. This network of loops is stabilized by its topology. Knits are all at once highly flexible, stretchable, lightweight, and strong. These remarkable mechanical properties emerge from their architecture, controlled by the deformation of the loops on one hand and solid friction at the thread crossings on the other. In this sense, the knitted fabric can be classified in the category of metamaterials. In such system, a local break of the thread within the fabric generates a topological defect within the stitches network that is able to propagate along the stitches columns at high velocity. This phenomenon, known as laddering, is the primary cause of failure in tights. However, in practice, while sometimes the defect are able to propagate across the whole fabric, it sometimes also can stop, slow down, restart, or even not propagate at all. Therefore, in this work, we aim at understanding what governs this complex behaviour. For this, in the framework of the ANR FiScal, we have conducted series of experiment relying on a biaxial tensile test machine to adress this question. To begin with, we will describe the laddering phenomenon. Then we will question the influence of some key parameters, such as the tension and knit geometry, offering insights into the mechanisms behind ladder propagation in knitted fabrics.

Jérôme Crassous — *Knots*

I will present some recent results on the effect of friction on the mechanical stability of knots. By combining numerical modeling and theoretical analysis, we will show that knots (within the limits of flexible rope) can be viewed as a mechanical feedback mechanism for tension between different points on the rope.

Wednesday May 6

Axelle Amon — *Creep response of granular materials*

I will present recent results on the spontaneous deformation of a granular material submitted to a constant stress below its yield stress. We observe non-monotoneous creep deformation of the sample: overall, we observe a logarithmic slowdown of the shear strain, interrupted by bursts of activity, which ultimately leads, in some samples, to spontaneous failure. Those results are surprising as the granular material we use (dry glass beads of typical diameter 100 microns submitted to a low confining pressure) is supposed to be athermal and without any clear damage processes. Using an interferometric method of measurement allowing us to measure the spatial distribution of the strain in the sample during the test, we show that the bursts we observe correspond to avalanches of correlated events.

Solenn Rodriguez — *Mechanical Behaviour of Confined Ferromagnetic Granular Materials*

The pressure at the bottom of a container filled with granular material saturates [1], as the silo walls can support part of the grains' weight due to frictional interactions — a phenomenon known as the

“Janssen Effect.” We investigate this effect using ferromagnetic particles: when exposed to a magnetic field, these particles acquire a magnetic moment, leading to anisotropic magnetic interactions. We develop different experimental setups and Discrete Element Method (DEM) simulations [2], in both 3D and 2D. We demonstrated recently that applying a magnetic field aligned with the granular column results in an even greater reduction of the pressure at the bottom of the container [3] compared to the classical Janssen Effect. Strikingly, beyond a critical magnetic field or a critical mass of grains, the apparent weight of the column can be completely canceled, rendering the column undetectable on the scale! We focus on the approach of the “invisibility” threshold, examining the impact of the magnetic field intensity and the initial mass of grains. We also studied the influence of the proportion of ferromagnetic grains within the column: the pressure at the bottom of the column decreases only when the fraction of magnetic grains exceeds a threshold corresponding to the percolation of magnetic clusters [4].

[1] Janssen, H. A. Investigations of pressure of grain in silo. Vereins Eutscher Ingenieure Zeitschrift 1045-1049 (1895). [2] J. Sautel, C.E. Lecomte, N. Taberlet, Particle size segregation in two-dimensional circular granular aggregates. Physical Review E, 103(2), 022901 (2021). [3] L. Thorens, K.J. Måløy, M. Bourgoin, S. Santucci, Magnetic Janssen effect, Nature Comm., 12, 2486 (2021). [4] L. Thorens, S. Rodriguez, N. Taberlet, M. Bourgoin, K.J. Måløy, S. Santucci, Hybrid Magnetic Janssen Effect Arising from Percolating Ferromagnetic Grain Networks, submitted 2026.

Maud Viallet — *Discharge of magnetic particles in a 2D silo*

We study the impact of magnetic interactions induced by an external magnetic field on the discharge of a 2D hourglass filled with a mono-layer of ferromagnetic grains. We demonstrate control of the granular flow via an effective tunable friction with the cell walls that increases with the amplitude of the applied magnetic field, and modifies the velocity profiles at the aperture, up to the emergence of a jamming transition.

Pierre-Yves Corbel — *Kinematics of an elastic fiber dragged in a granular medium*

How an elastic rod deforms within a dense granular medium is a complex fluid–structure interaction problem. Quantifying the forces required to insert or extract a rod from the granular medium, as well as understanding how the rod deforms and displaces the surrounding grains, are both fundamental and technological questions. These issues arise in applied fields such as the mechanical reinforcement of materials with fibers or fiber separation–extraction processes in the recycling of fibrous materials. They are also relevant in several areas of biology, from the swimming of sandfish to the uprooting of plant roots from soil. To identify the purely mechanical behavior of this fluid–structure interaction, we designed an experiment in which a fiber of variable shape is dragged through a two-dimensional granular medium confined within a horizontal cell under an imposed pressure. The relevant scale for our study is that of the grain, to understand the coupling between the fiber elasticity and the discrete nature of the granular medium. We present initial results on the conformational changes of an elastic fiber with an initially sinusoidal shape, as a function of the fiber's geometric and mechanical parameters, and for several imposed confinement pressures in the granular medium. In particular, we investigated the rectification of the fiber (change in amplitude) as a function of its length, thickness, initial wavelength, and initial amplitude of the sinusoidal shape. Based on the results obtained for rectification, we propose a renormalization law derived from the deflection of a beam under distributed loading.

Ananyo Maitra — *Active ordering in disordered environments*

It is by now well known that motility allows active polar fluids to remain ordered in lower dimensions than their passive counterparts. It is less known that the stabilising effect of motility is even more pronounced in disordered environments. Indeed, I will show that a particular kind of active polar fluids can retain orientational order in two dimensions even in the presence of random-field disorder. This is because motility has an "annealising" effect on time-independent disorder. In the second part of the talk, I will shift my attention to active phases that break translational symmetry--specifically, polar smectics and solids--and demonstrate that, even here, motility anomalously stabilises order. Indeed, the equal-time statistics of displacement fluctuations of motile smectics in d dimensions with quenched disorder are equivalent to time-displaced correlations of the height field in the d-1-dimensional KPZ equation. For one class of motile solids, I will show that the equal-time displacement correlations in the presence of quenched disorder are only as large as the equal-time displacement correlations of passive solids in the absence of quenched disorder, again attesting to the annealising effect of motion.

Hervé Henry — *Phase field study of fracture in heterogeneous materials*

I will discuss if it is possible to describe crack propagation in heterogeneous materials using effective laws for propagation that average material properties over a representative volume. The discussion will be based on numerical simulations using phase field models.

Loic Vanel — *Rupture of heterogeneous materials: Creep and stress relaxation dynamics?* or *Time-dependent sideways cracks in filled elastomers?*

TBA.

Thorsten Emig — *How far does shear propagate? Boundary-driven granular flow in channels with complex basal forcing*

We investigate slow, dense granular flows in a channel driven by prescribed basal motion, motivated by split-bottom and boundary-driven shear experiments. Using a regularized viscoplastic formulation inspired by the $\mu(I)$ rheology, we compute steady velocity fields in a U-shaped channel with rough sidewalls and various basal forcing profiles, including uniform, split, and sinusoidal motion. A robust geometric control of shear penetration emerges: the surface velocity drops sharply once the filling height exceeds a lateral length scale set by the width or wavelength of the basal forcing. When expressed in terms of an effective aspect ratio, the transition occurs for values of order unity and is largely independent of driving speed in the quasi-static regime. This approach provides a simple framework to study boundary-driven granular flows without explicitly tracking yield surfaces, and naturally extends to the full $\mu(I)$ rheology and to models including normal-stress effects relevant for non-spherical grains.

Thierry Giamarchi — *Disorder and interactions in one-dimensional quantum system*

TBA.

Ettore Angeli — *Pinning Dominated Dynamics and Internal Texture Effects in Field- and Spin-Orbit Torque-Driven Domain Walls*

TBA.

Wiese Kay — *How can zeta = 1.25 for an elastic string at depinning be realized in an experiment?*

TBA.