NBIA Workshop: A Copenhagen afternoon on geometry and topology in soft materials

Report of Contributions

https://indico.nbi.ku.dk/e/2050

Contribution ID: **1** Type: **not specified**

Gerd Schröder-Türk (Murdoch University): The Gyroid - Nature's best attempt at embedding the Hyperbolic Plane in Euclidean space

Monday 19 February 2024 13:00 (30 minutes)

By Hilbert's famous theorem, all infinite symmetric saddle surface with zero mean curvature (ie minimal surfaces) must have variations of the Gauss curvature. For bicontinuous minimal surfaces which divide space into two domains and define network-like domains, the Euler-Poincare number and hence the average Gauss curvature is negative. However, these surfaces also always have flat points with Gauss curvature zero. In Euclidean space, the perfect solution of a minimal surface with no variations in Gauss curvature does not exist. But is the Gyroid the minimal surface with the smallest degree of the unavoidable variations of Gauss curvature?

Contribution ID: **2** Type: **not specified**

Amin Doostmohammadi (University of Copenhagen): Topological defects in biological matter

Monday 19 February 2024 13:30 (30 minutes)

I will discuss various examples of how the emergence of orientational order and its breakdown are generic themes in fundamental processes in cell biology and how they provide a universal mechanism for choreographing the directional passage of mechanical and biochemical information in time and across different scales.

Contribution ID: **3** Type: **not specified**

Adil Mughal (Aberystwyth University): Peierls-Nabarro potential for a confined chain of hard spheres under compression

Monday 19 February 2024 16:00 (30 minutes)

Examples of bifurcation diagrams are presented for a chain of hard spheres under compression, which are confined by a transverse potential. The diagrams are modified in the presence of an axial force and show interesting topological rearrangements due to the reconnection of loci of different equilibrium solutions. The corresponding Peierls-Nabarro potential is defined and calculated for various values of compression. This relatively tractable and transparent system can illustrate in detail the general features of such a potential and its relation to experiment.

Contribution ID: **4** Type: **not specified**

Myfanwy Evans (University of Potsdam): Geometry-based simulation of self assembly

Monday 19 February 2024 14:30 (30 minutes)

The morphometric approach to solvation free energy is a geometry-based theory that incorporates a weighted combination of geometric measures over the solvent accessible surface for solute configurations in a solvent. In this talk, I will demonstrate that employing this geometric technique in simulating the self assembly of sphere clusters and small loops results in an assortment of interesting geometric configurations. This gives insight into the role of shape in the physical process of self assembly, potentially relevant to proteins, viruses and other complex systems.

Contribution ID: **5** Type: **not specified**

Matthias Himmelmann (University of Potsdam): An Empirical Treatment of Disordered Minimal Surfaces

Monday 19 February 2024 16:30 (30 minutes)

Triply periodic minimal surfaces – especially the Primitive, Diamond and Gyroid – appear throughout nature. While traditionally, the focus has been on highly symmetric phases, recently attention has shifted towards disordered structures. For example, these surfaces manifest as intermediate phases, sponge phases, and materials such as amorphous silicon. In this work, we employ two distinct approaches – one geometric and one of topological nature – to computationally generate disordered minimal surfaces. By empirically comparing the resulting structures and examining key invariants such as curvature fluctuation and isotropy, we aim to enhance our understanding of these surfaces' quality in relation to ordered phases.

Contribution ID: **6** Type: **not specified**

Jacob Kirkensgaard (University of Copenhagen): Exploring pattern formation on negatively curved surfaces via the hyperbolic plane

Monday 19 February 2024 15:00 (30 minutes)

We investigate the self-assembly behaviour of block copolymers constrained to thin hyperbolic films. Specifically, we study the pattern formation on the three-periodic cubic minimal surfaces P, D and G found ubiquitously in soft matter material science. We use a new method for visualisation and analysis of the patterns by mapping to two-dimensional hyperbolic space analogous to stereographic projections in cartography thus effectively creating a more accessible "hyperbolic map"of the pattern. This allows us to pinpoint in detail the role of intrinsic geometry and to probe the role of negative curvature on the resulting assemblies as contrasted with flat and positively curved films. We present results from AB diblock copolymers and ABC mikto-arm star terpolymers of varying composition. In the case of compositionally balanced diblocks, the resulting patterns are related to "free"tilings of the hyperbolic plane while unbalanced molecules form a plethora of disc packings. Star polymers form three-colored cellular patterns related to curved graphene-like schwarzites constrained to only form even polygons.

Contribution ID: **7** Type: **not specified**

Martin Cramer Pedersen (University of Copenhagen): Welcome

Monday 19 February 2024 12:50 (10 minutes)

Contribution ID: **8** Type: **not specified**

Martin Cramer Pedersen (University of Copenhagen): TBA