Berliner Colloquium für wissenschaftliche Visualisierung

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From bicontinuous minimal surface in nature to tricontinuous surfaces in chemistry?

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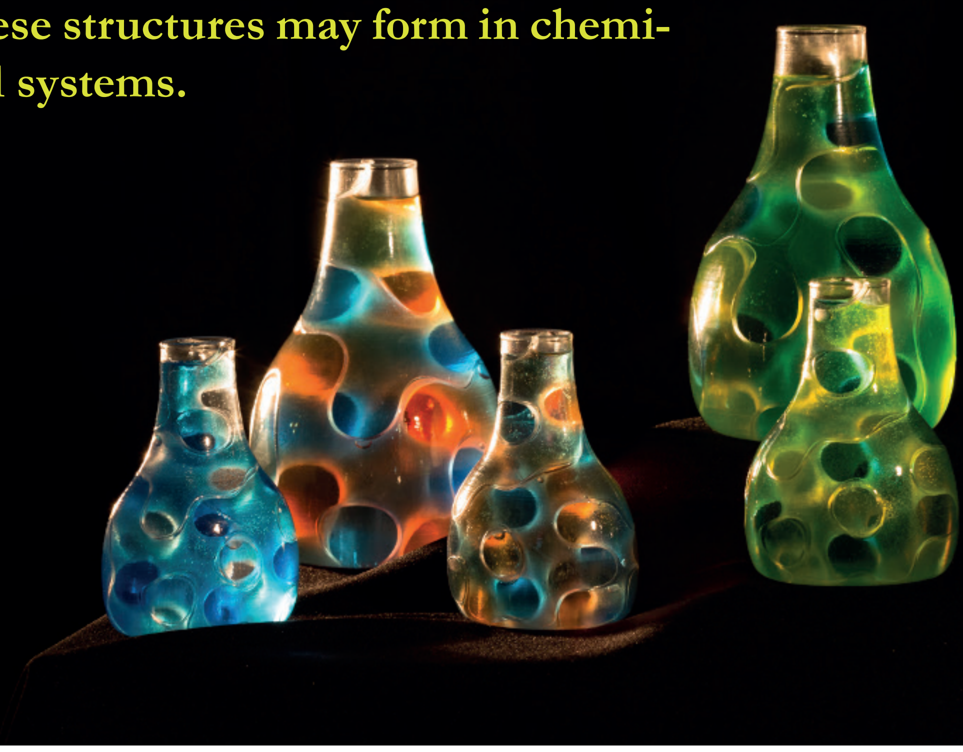
Triply-periodic minimal surfaces are symmetric saddle surfaces that divide space into two components, each resembling a three-dimensional labyrinth, and are hence called bicontinuous. While many triply-periodic minimal surfaces are known, one particular surface is particularly often found in natural nanostructures or synthetic membrane systems. This surface is Allan Schoen's Gyroid surface. The geometric reason for this prevalence is its homogeneity in terms of curvature and domain sizes, that is, the fact that variations of the Gauss curvature throughout this surface are smaller for the Gyroid than for most other triply-periodic minimal surfaces. We will discuss this argument in this seminar, demonstrating that - in a loose and maybe controversial sense, the Gyroid is nature's best (albeit not perfect) attempt at embedding the hyperbolic plane in Euclidean three-space. We then briefly consider a generalisation of the bicontinuous gyroid to tricontinuous structures. These consist of three entangled labyrinth-like domains with a branched (non-manifold) surface that obeys Plateau's foam laws forming the interface between the domains. We discuss that homogeneity arguments similar to the curvature variations provide a rationale for why these structures may form in chemical systems.



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