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Two extensions: bronze-mean quasicrystal and crystals on saddle-shaped surfaces

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I) Quasicrystals are believed to have nontraditional crystallographic symmetry such as icosahedral, decagonal, dodecagonal, and octagonal rotational symmetries. Indeed, quasiperiodicity is characterized by two or more spacings whose length ratio is an irrational number associated with the unconventional rotational symmetry: for instance, the golden-mean Penrose tiling with decagonal symmetry and the silver-mean Ammann-Beenker tiling with octagonal symmetry. Contrary to the belief that quasicrystals are originated from the unusual rotational symmetries, we present a "6-fold" self-similar quasiperiodic tiling related to the "bronze mean", which number is a natural extension in the literature. Using a two-lengthscale potential, which has turned out to be a minimal and efficient tool to produce quasicrystals, we have obtained a random-tiling of the bronze-mean quasicrystal [1,2].

II) On a flat surface the hexagonal arrangement is a ubiquitous regular arrangement of spherical particles. What is the regular arrangement of particles when the surface is curved? On a spherical surface, this question was firstly raised by J. J. Thomson, and later for biological icosahedral viruses Caspar and Klug proposed a construction principle of regular arrangements inspired by Buckminster Fuller's geodesic dome. In contrast, regular arrangements on a saddle-shaped surface have yet to be fully elucidated. In this presentation, we intend to extend crystals on triply periodic minimal surfaces using Monte Carlo simulations of hard spheres. Remarkably, there exist magic numbers producing regular structures, which are simply explained by means of hexagulation numbers H, in analogy with the Caspar and Klug's triangulation numbers T for icosahedral viruses. The key is that there is only a limited number of efficient crystal design possible even on the triply periodic minimal surfaces [3].

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