Journey into the fascinating world of aperiodic crystals.

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The notion of crystal has been for long time associated with periodicity and believed to be the only possible form of long-range order in matter. The understanding of physical and chemical properties of solids has been also largely based on the notion of periodicity in a crystal. There is however a large class of materials, named aperiodic crystals, which are long range ordered, yet without lattice translation at least in one dimension. Aperiodic crystals fall in three classes [1]: incommensurately modulated phases, incommensurate composites and quasicrystals and are found almost ‘everywhere’: in minerals, single element under pression, organic compounds, intermetallic, oxydes, ferrolectrics… and even proteins. The lack of periodicity in aperiodic crystals, yet with long range order, opened a completely new and fascinating field of research where the understanding of the atomic structure and associated physical and chemical properties had to be reconsidered with new perspectives.

In this talk, using nice images from experimental results, I will illustrate how the theory developed over the years together with recent advances in diffraction experiments has allowed a precise understanding of the atomic structure and crystal chemistry of such complex phases. The question of the growth and stability of aperiodic crystals is still a challenging one, and will be discussed in the perspective of a property unique to all aperiodic crystals and named phason modes.

[1] T. Janssen, G. Chapuis, and M. de Boissieu, *Aperiodic Crystals. From modulated phases to quasicrystals (second edition)* (Oxford University Press, Oxford, 2018), Vol. 20, IUCr Monographs on Crystallography, 532 pages.