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Self-assembly of Amyloid Fibrils in One, Two and Three Dimensions

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Amyloid fibrils are protein aggregates, which occur in-vivo in the case of neurodegenerative diseases and in-vitro in the design of advanced functional materials of relevance in nanotechnology and nanosciences. At length scales above the well-established atomistic fingerprint of amyloid fibrils, these colloidal aggregates exhibit mesoscopic properties comparable to those of natural polyelectrolytes, yet with persistence lengths several orders of magnitude beyond the Debye length. This intrinsic rigidity, together with their chiral, polar and charged nature, provides these systems with some unique physical behavior in one, two and three dimensions. In this talk I will discuss our current understanding on the mesoscopic properties of amyloid fibrils at the single molecule level, the implication of their semiflexible nature on their liquid crystalline properties, and I will illustrate how this information proves useful in understanding their collective behavior in bulk and when adsorbed at liquid interfaces. By the careful exploitation of the physical properties of amyloid fibrils, the design of advanced materials with unprecedented physical properties becomes possible, and I will give a few examples on how these systems can ideally suit the design of biosensors and biomaterials.