EBERHARD KARLS
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**Faculty of Science**
**Department of Physics**
**Institute of Applied Physics**

IAP seminar
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# Nanoparticle Supercrystallography: What Can We Learn from Structural Biology?

Colloidal superlattices are solids composed of nanocrystals self-assembled into close-packed structures, and are widely studied for the collective properties that emerge from many-particle interactions. Owing to their three-dimensional periodicity, they are often described as "*crystals of particles*". But how far does this analogy really extend?
Among crystalline materials, protein crystals offer some of the most interesting parallels. Proteins are comparable in size to nanocrystals (2-10 nm), and both retain a shell of small molecules upon crystallization – water for proteins and ligands for nanoparticles. Yet the two systems have traditionally been approached from very different perspectives. Colloidal superlattices are primarily studied as the end point of efforts to construct functional materials from nanoscale building blocks. Protein crystals, by contrast, are not the end point of scientific inquiry, but tools that enable structure determination via single-crystal X-ray diffraction (XRD).
In this talk, we will discuss how these similarities extend beyond a simple analogy, and how the boundary between superlattices and macromolecular crystals may be more subtle than it first appears. By combining X-ray diffraction and molecular dynamics, we recently identified several striking parallels between $CsPbBr_3$ perovskite quantum dot superlattices and protein crystals, including similar disorder patterns, conformational changes upon crystallization, and self-organization behaviors of co-crystallized molecules. Following the lead of structural biology, we will finally discuss how single-crystal XRD can be extended to nanocrystal superlattices, what opportunities this new approach could offer, and what challenges must be addressed to turn supercrystallography from an exotic concept into an established technique.