We build branched DNA species that can be joined using Watson-Crick base pairing to produce N-connected objects and lattices. We have used ligation to construct DNA topological targets, such as knots, polyhedral catenanes, Borromean rings and a Solomon's knot. Nanorobotics is a key area of application. We have made robust 2-state and 3-state sequence-dependent devices and bipedal walkers. We have constructed a molecular assembly line using a DNA origami layer and three 2-state devices, so that there are eight different states represented by their arrangements. We have demonstrated that all eight products can be built from this system. We have self-assembled a 3D crystalline array and reported its crystal structure to 4 Å resolution. We can use crystals with two molecules in the crystallographic repeat to control the color of the crystals. Rational design of intermolecular contacts has enabled us to improve crystal resolution to better than 3 Å. We are now doing strand displacement in 3D to change the color of crystals. Thus, structural DNA nanotechnology has fulfilled its initial goal of controlling the internal structure of macroscopic constructs in three dimensions. A new era in nanoscale control awaits.

Speaker:
Professor Nadrian Seeman
Margaret and Herman Sokol Chair in Chemistry
Department of Chemistry, New York University
Kavli Prize in Nanoscience

Nadrian C. Seeman was born in Chicago in 1945. He received his B.S. in biochemistry from the University of Chicago in 1966, Ph.D. from the University of Pittsburgh in 1970 and postdoctoral training at Columbia and MIT. He got a faculty position at SUNY/Albany and moved to New York University in 1988. He was the first to demonstrate the correctness of Watson-Crick base pairing at atomic resolution and was the founding president of the International Society for Nanoscale Science, Computation and Engineering. He has published over 290 papers, and has won the Sidhu Award, the Feynman Prize, the Emerging Technologies Award, the Rozenberg Tulip Award in DNA Computing, the World Technology Network Award in Biotechnology, the NYACS Nichols Medal, the SCC Frontiers of Science Award, the ISNSCE Nanoscience Prize, the Kavli Prize in Nanoscience, the Einstein Professorship of the Chinese Academy of Sciences, a Distinguished Alumnus Award from the University of Pittsburgh, and the Jagadish Chandra Bose Triennial Gold Medal; he is a Thomson-Reuters Citation Laureate and was elected a Fellow of the American Crystallographic Association.