Helical structures can be found in numerous systems such as C60 fullerenes packed into nanoscale tubes or colloidal particles trapped in self assembled channels. Hard spheres confined into cylindrical channels also form helical packing and provide the simplest model to study these helical arrangements. Depending on the diameter of the channels, spherical particles creates a variety of structures such as single, double and triple, chiral helices. Despite their abundance, little is known about how these helical structures actually form.

In our recent publication in the Physical Review letter, we used a combination of analytical theory and computer simulation to study the structures that spherical particle can produce in narrow cylindrical channels. Our findings show that the densest packing for this system is a perfect, symmetrical single helix. The presence of topological defects that change the local chirality of the helix lower the packing density and alter the local packing structure. The helical sections between defects become asymmetrical and are better described as a double helix with angular twists between first and second nearest neighbors that are determined by the defect separation distance. Increasing the fraction of defects unwinds the two helical strands so that the least dense structure is a non-helical packing of two zig-zag chains. We also show that the packing effects of the helical section induce a long range entropically driven, attraction between the defects.