The Poirier lab has two primary research programs that are interconnect.

The first primary research program is focused on how the organization of the human genome regulates gene expression. Our genomes are organized into physical polymers, i.e. chromatin fibers, where each chromosomal DNA molecule is repeatedly wrapped into nanometer sized spools, i.e. nucleosomes that contain about 50 nm of DNA each. This results in our 1-meter length of genomic DNA being organized into about 20 million nucleosome spools. The physical properties of nucleosomes and chromatin fibers are key regulators of all DNA processing including gene expression. However, the physical mechanisms by which nucleosomes and chromatin function to control gene expression is not understood. This research program relies on a cross-disciplinary approach that combines biochemical, biophysical and single molecule (**Fig. 1**) methodologies is to understand the physical basis of chromatin regulation of gene expression. This program is largely fund by the National Institutes of Health.

Figure 1: Newly installed LUMICKS C-Trap single molecule system that was funded by the NIH. It is located in Room 0136 in the Physics Research Building.

The second primary research direction is in the field of DNA nanotechnology. We are focused on developing and understanding DNA based nanodevices that are engineered via DNA origami. DNA origami is a rapidly emerging approach that is uniquely suited to create multi-functional devices out of DNA for biological and nanoscience applications. These DNA based devices have unparalleled control over nanoscale geometry, are highly biocompatible, can be controllably reconfigured, and can be functionalize with many components in a site-specific manner. We are currently working on three separately funded projects.

(1) Develop DNA based nano-calipers to detect mesoscopic structural changes within chromatin both *in vitro* and *in vivo*
(2) Develop devices that integrate DNA origami nanodevices with either gold or magnetic nanoparticles to create reconfigurable devices that can externally controlled optically and or magnetically.
(3) Develop new DNA origami nanomaterials with new sensing, communicating and pattern forming properties (**Fig. 2**)

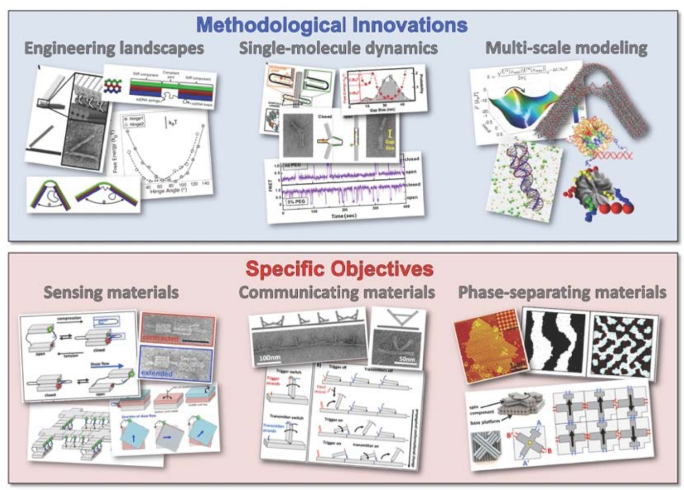

Figure 2: NSF DMREF project to develop new DNA based nanomaterials.

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