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Molecular biology is an interdisciplinary field that delves into the biological processes and behavior of macromolecules. It spans across sectors including genetics, physical chemistry, biochemistry and more, and utilizes model systems in order to observe the application of fundamental laws in complex biological systems. With numerous developments made throughout decades, in 1970, the discovery of “restriction enzymes” at Johns Hopkins University which could cut a site within the phage DNA, began a new era of molecular biology and genetics. The distinguishing feature of restriction enzymes of cutting DNA at very specific base sequences made possible molecular cloning, DNA mapping and various genome projects.The significance of these restriction enzymes is highlighted the separation of DNA fragments, which is usually done with the gel electrophoresis method.

Throughout many years of usage in the scientific community, gel electrophoresis has posed various problems such as smearing, poorly visible bands and poorly separated bands. The efficiency in separation has been found to be lower for long-stranded DNA. In order to troubleshoot issues in polymer solution gel matrices, researchers in Cornell demonstrated a new microchip-based DNA separation technique using entropic recoil force.

The main advantage of entropic recoil separation is that it allows for a direct measurement of the contour length of the molecule, while conventional methods infer the length. These indirect measurements suffer from a rapid decrease in the resolution as molecules get larger. On the other hand, this novel technique demonstrated that if the DNA molecules are undamaged by a pulsed electric field during a single-step separation with one voltage cycle, there would be no effect on the probability of passage in the following stages. Thus, in principle, DNA molecules could be separated over a wide range of sizes with high resolution. In order to optimize separation performance, various parameters could be explored since the technique shows relative ease and flexibility in the fabrication process. Possible improvements may involve shortening the transition time around the critical pulse duration when changing to another separation stage, and increasing the resolution. In addition, since this entropic recoil separation could be applied not only on DNA molecules but on other polymers, discovering the optimal material for each polymer type would be helpful in improving efficiency. If implemented properly, this separation strategy would provide a better alternative for long DNA and polymer separations.