The Global COE Program

"The Next Generation of Physics, Spun from Universality and Emergence"

Bilateral International Exchange Program (BIEP, invite) report

Send report to: Your responsible Professor in Kyoto University

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(Year/Month/Day) 2008/12/19

Invited Student

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Research Project

Title	DNA compaction
Duration	1 month

Please summarize your activities and results during your stay in Kyoto University .
You can add a sheet, if you need more space. You can also write any comments and requests to the GCOE program. We will appreciate them.

At the beginning of my stay I have presented my results on joint conference "International Meeting: Young Frontiers on Polymer Physics". After that I had fruitful discussion with many members of laboratory of Prof.Yoshikawa.

I took participation at some international discussion.

It was proposed in Kyoto University that DNA compaction happen in cells without any special thing. It is because that the high concentration of proteins makes DNA molecules to be collapsed. As the condition of solution changes, a DNA molecule changes its shape. In good solvent a DNA molecule is elongated, this state is called coil state. On the other hand, in poor solvent, a DNA molecule is compacted, this is called globule state. Such transition is thought to be related to DNA transcription, because in coil state, transcriptase can work, but in globule state, it can't.

We proposed a theoretic model of the case, when DNA macromolecule compact in BSA solution. We consider DNA macromolecule as a long stiff polyelectrolyte chain with a persistent flexibility mechanism. BSA macromolecules are characterized by high charge.

We took attention to two limiting situations. The first situation is the regime, when protein molecules cannot penetrate into the DNA due to strong electrical interaction. In the second limiting situation salt concentration is enough to screen electrostatic interaction, and protein can easily penetrate into the DNA volume.

In first limiting case 3 regimes were found on the point of scaling dependences and scaling estimates were evaluated. At law BSA concentration is polyelectrolyte regime. DNA is swollen due to the electrostatic repulsion and their sizes do not depend on BSA concentration. The second one is the case, when the volume fraction of DNA is determined by the pressure of counterions and BSA. The last regime is due to excluded volume and pressure of BSA. In each case the dependence of volume fraction of DNA on the concentration of BSA was found. The conditions for changing regime were also found.

The results corresponds to experimental dates obtained by Seiko Hirota. We have started to write joint paper.