Visiting Professors

Visiting Professor
KAMIYA, Yukiko *(from Kobe Pharmaceutical University)*

Expand the Artificial Nucleic Acid World Based on the Studies of Molecular Science

Nucleic acids (DNA and RNA) are essential biopolymers that carry genetic information in all living organisms. On the other hand, various artificial nucleic acids (XNAs) such as ribose-modified or non-ribose type nucleic have been developed. One of our motivation of XNA study is development of nucleic acid drugs. Another big motivation is addressing the fundamental question why nature selected ribose as backbone of genetic materials. Our group has focused on amino acid-type artificial nucleic acids and we are studying on characterization of their molecular recognition properties, design of unique structures, and development of molecular tools and drugs that target RNA as applications. In recent study we found that both SNA and L-αTNA of homopurine sequence could form unexpectedly stable triplex with XNA:RNA heteroduplex in a parallel manner, even though A*A pair had only single hydrogen bonding. This is the first report on the XNA:RNA*XNA triplex with *parallel* homopurine TFO involving single A*A *reversed* Hoogsteen pair.

Visiting Professor
SATO, Sota *(from The University of Tokyo)*

Integrated Molecular Structure Analysis Through Industry-Academia Collaboration

Elucidating molecular structures is crucial in various fields of molecular science, regardless of academia or industry. In addition to NMR and mass spectrometry, X-ray/electron diffraction is a powerful analytical technique that can directly determine atomic positions, enabling clear determination of three-dimensional structures. We are actively pursuing the “crystalline sponge method” as one of core technologies, which eliminates the need for the crystallization process and completes sample preparation by simply soaking the target molecules into crystalline sponge, allowing structural analysis even with minute sample amounts. Furthermore, we are extensively deriving technological advancements to reduce sample amount and building collaborative relationships with numerous companies to promote research aimed at creating new industries. Recently, we have been dedicated to fostering future talent who will support the scientific community in Japan and the world. We organized mock lectures and research experiences for high school students in collaboration with corporate researchers, aiming to nurture the next generation of scientists.

Visiting Professor
TOYABE, Shoichi *(from Tohoku University)*

Optimal Control of Biological Molecular Motors—What Is the Most Efficient Way to Control in Thermally Fluctuating Systems?

ATP synthase plays a central role in cellular energetics by synthesizing most of the ATP molecules required by cells. ATP synthase consists of two coupled motors, F_1 and F_o. F_1 has the ATP-synthesizing activity and catalyzes ATP synthesis using the mechanical driving force provided by F_o. We do not know in detail how F_o rotates F_1. But, we expect that F_o and F_1 has acquired an efficient control way in thermally fluctuating environment. And, we should be able to know what is the most efficient way to rotate F_1 based on physical theory. As the first step along this purpose, we compared the external rotation of F_1 by constant torque and angle clamp. We found that rotation by angle clamp is significantly more efficient and requires much less work. Our experiments with theory and simulation revealed that the angle clamp works as a damper and reduce nonequilibrium fluctuations that produce futile dissipation.