**Field:**
*Chemistry / Biochemistry*

**Session Topic:**
*Ultracold Molecules*

**Introductory Speaker:**
*Shin INOUYE, The University of Tokyo*

Chemistry is the science of matter. The biggest motivation behind the scene is our desire to control the property of matter in unprecedented precision. From physical chemistry to organic or biochemistry, a variety of new technologies are developed every year.

Ultracold molecule is a sample of molecules that recently became available, and it has a potential to revolutionize our understanding on chemical reactions. The temperature is so low and its internal state is in a single quantum state. The molecule's motion is completely under control. Under this condition, our notion on processes like atoms combine to molecules, or molecules react and become other molecules, are seriously challenged. Previously, energy and entropy is the deciding factor for understanding chemical reactions. Now, full quantum mechanical picture is necessary for understanding each step. For example, bosonic or fermionic molecules go through different type of reactions. Even many-body effect can govern the property of the gas. Completely adiabatic process can be used to convert atoms into molecules, or bring molecules back to atoms.

Ultracold atoms and molecules can be manipulated with electromagnetic fields, and that opens up the possibility for new applications. Exotic binding state that can only present at ultracold temperature can show up as a result of two or three body collision. The spectroscopy of ultracold molecules may reveal the time variation of fundamental physical constants like proton to electron mass ratio.

The session is divided into three parts. The overview of the field of ultracold atoms and molecules will be given by the Chair. Next, Dr. Comparat from CNRS will present how to make ultracold molecules by shining short laser pulses. Dr. Mukaiyama will present the experiments using ultracold fermions that show superconductivity.