**EVOLUTION OF MOLECULES IN SPACE: FROM INTERSTELLAR CLOUDS TO PROTOPLANETARY SYSTEMS.** A. Kouchi[1] and S. Tachibana[2]. [1]Inst. Low Temp. Sci., Hokkaido Univ., [2]Dept. Natural History Sci., Hokkaido Univ. E-mail: kouchi@lowtem.hokudai.ac.jp.

Star and planet formation have been extensively studied from a physics point of view, but the chemical aspects of their formation and evolution, including the Solar System, have not yet been thoroughly understood in spite of many meteoritical and observational evidence.

In order to understand the chemical evolution of stellar and planetary system, meteoritical and observational approaches should be systematically combined with laboratory and theoretical approaches, and a research project on "Evolution of molecules in space" has begun with a support by Grant-in-Aid for Scientific Research on Innovative Areas from Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan (FY2013–2017) [PI: A. Kouchi].

The project focuses on the formation and evolution of ice and organic matter in molecular clouds and during stellar and planetary formation because 1) hydrogen, oxygen, carbon, and nitrogen are the most abundant elements in space, 2) organic molecules are observable in various systems as a tracer of chemical evolution, and 3) ice and organic matter record the formation and evolution history of proto-stellar cores and outer protoplanetary disks in their isotopic and structural properties.

The project consists of five research-oriented sub-teams with different research approaches; **A01:** Laboratory experiments on molecular cloud processes [PI: A. Kouchi], **A02:** Laboratory experiments on protoplanetary disk processes [PI: H. Nagahara], **A03:** Modeling of surface chemical reactions and chemical evolution of molecular clouds and protoplanetary disks [PI: T. Fukazawa], **A04:** Astronomical observation of young stellar objects [PI: S. Yamamoto], and **A05:** Analysis of extraterrestrial and laboratory-simulated organic matter [PI: H. Yurimoto]. There are also two administration-oriented sub-teams (**X00:** Integration and management [PI: A. Kouchi] and **Y00:** International coordination [PI: A. Kouchi]) and 15 publicity-offered research projects (FY2014-2015).

With intense research activity within a sub-team and collaboration between sub-teams, A01, A02, and A05 have found that photon-irradiated $H_2O$-$CH_3OH$-$NH_3$ ice bubbles at 60–150 K, possibly implying the presence of super-cooled liquid [1]. A01, A04, and A05 with a publicity-offered project found the formation of chiral glycine ($NH_2CHDCOOH$) by quantum tunneling hydrogen–deuterium substitution reactions [2]. This chiral molecule formed in molecular cloud conditions could be a potential source of homochirarity in molecules in space. A03 and A04 found a drastic change of chemistry of infalling gas forming a disk around a protostar IRAS 04368+2557 with ALMA [3]. Unsaturated cyclic-$C_3H_2$ resides in the infalling rotating envelope, whereas SO is enhanced in the transition zone at the radius of the centrifugal barrier. This chemical change may be caused by local heating processes due to the discontinuous infalling motion at the centrifugal barrier [3, 4].

We will present the whole project and details of research activities at the meeting.

**References:** [1] Piani L. et al. *this symposium*. [2] Oba Y. et al. (2015) *Chem. Phys. Lett.* **634,** 53. [3] Sakai N. et al. (2014) *Nature* **507,** 78. [4] Aota T. et al. (2015) *Astrophys. J* **799,** 141.