From laboratory to space plasma experiments

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Laboratory is very often a useful place in order to prepare for the space experiment and to get complimentary information in order to understand the phenomena occurring in space.

Here we describe two laboratory experiments associated with space plasma: D region simulation and energetics on the E region plasma.

Chemistry of Ionospheric D region is still unclear because the media is a complicated mixture of neutral, positive and negative ions and electrons and it is very difficult to study by in-situ probe, such as mass-spectrometer in the D region. We tried to develop a mass-spectrometer especially to measure negative ions in the future. As a first step, positive and negative ions ,as well as electrons are produced by EUV radiation to the mixture gas of N2 and water vapor at the pressure of 1-4 Pascal. With these experiments we could obtain the basic information needed to develop further space plasma facility. As side products we detected cluster ions of both negative and positive. This facility can be used to the simulation of ice satellite , that is exposed to energetic particles.

The second experiment is on the study of electron temperature measurements. Since the initiation of sounding rocket in 1945,the problem on Te at the height of 100 km is not solved. Contrary to the theory, Te observed shows the value which is much higher than neutral temperature. After intensive laboratory experiments, we found the Te higher than neutral temperature is not due to instrument. Te, that was measured should reflect real geophysical situation. Interaction between vibrationally excited molecular nitrogen could be possible candidate. Laboratory experiment as well as sounding rocket experiment seems to support this scenario.

EUV radiation to the mixture plasma of molecular nitrogen and molecular oxygen produces hump in the energy distribution around the energy of 0.3- 0.4 eV, which might appear as a result of interaction between vibrationaly excited nitrogens and electrons. The vibrationally excited molecular nitrogen can be produced by O1(D),which is produced as a result of dessociation of O2 by EUV radiation.

These experiments can be done by using large and small space plasma chamber. Interested person should visit ISAS home page.