# Taipei Symposium on Upper Atmosphere

## 17 April 2019

## RCEC Lecture Hall, Academia Sinica

## 中央研究院 環境變遷研究大樓

中央研究院
環境變遷研究中心
Research Center for Environmental Changes
Academia Sinica

## Table of Contents

# Program

| Time | Agenda |
|---|---|
| 08:30 - 09:00 | Registration |
| 09:00 - 09:50 | *Connecting lower and upper atmospheres – how tropospheric processes may affect the upper atmosphere*<br>**Academician Pao-Kuan Wang**<br>Research Center for Environmental Changes, Academia Sinica |
| 09:50 - 10:40 | *Chemical physics of D and E layers of the ionosphere*<br>**M.G. Golubkov, A.V. Dmitriev, Y.A. Dyakov, G.V. Golubkov, M.I. Manzhelii**<br>Semenov Institute of Chemical Physics of Russian Academy of Sciences |
| 10:40 - 11:00 | Coffee Break |
| 11:00 - 11:50 | *The use of anomalous optical properties of D and E layers of the ionosphere*<br>**G.V. Golubkov, A.V. Dmitriev, Y.A. Dyakov, M.G. Golubkov, M.I. Manzhelii**<br>Semenov Institute of Chemical Physics of Russian Academy of Sciences |
| 11:50 - 13:30 | Lunch Break |
| 13:30 - 14:20 | *In situ study of the upper atmosphere*<br>**Alexei Dmitriev**<br>National Central University |
| 14:20 - 15:10 | *Modeling of the high and low latitude ionosphere according the satellite data*<br>**A. T. Karpachev**<br>Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Russian Academy of Sciences |
| 15:10 - 15:30 | Coffee Break |
| 15:30 - 16:20 | *The Rydberg complex signatures in MLT (Mesosphere and Lower Thermosphere (the lower ionosphere) observed by GPS radio occultation sounding of FORMOSAT-3/COSMIC*<br>**Jann-Yenq Liu, Shih-Ping Chen, Charles C.H. Lin**<br>Department of Earth Science, National Cheng Kung University |
| 16:20 - 17:00 | Group Discussions |

# CHEMICAL PHYSICS OF D AND E LAYERS OF THE IONOSPHERE

M.G.Golubkov, A.V.Dmitriev, Y.A.Dyakov, G.V.Golubkov, M.I.Manzhelii

*Semenov Institute of Chemical Physics of Russian Academy of Sciences*
*Moscow, Russia*

**Abstract:** A detailed analysis of the influence of Rydberg states to the behavior of radio signals in D and E layers of the ionosphere is presented. The main chemical reactions that lead to formation of the nonequilibrium two-temperature plasma and highly excited Rydberg complexes are considered. A special attention is given to l-mixing reaction responsible for the formation of quantum resonance properties for radio wave propagation medium. It is shown that the transition frequencies between the excited states of orbitally degenerate Rydberg complex are resonant with respect to the carrier frequencies of GPS. That is why these states are the main cause of the GPS signal distortion. Finally, the mechanism of radio signal delay in D and E layers is discussed.

# THE USE OF ANOMALOUS OPTICAL PROPERTIES OF D AND E LAYERS OF THE IONOSPHERE

G.V.Golubkov, A.V.Dmitriev, Y.A.Dyakov, M.G.Golubkov, M.I.Manzhelii

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*Moscow, Russia*

**Abstract:** The problems concerned with the registration of far-infrared radiation in the D and E layers of the ionosphere that is necessary to determine the plasma parameters are discussed. Available experimental data makes it possible to assume the presence of Rydberg complexes, which leads to the additional background of UHF radiation in D layer of ionosphere. The main problems of remote sensing of the Earth's surface, which occur due to the resonant quantum properties of the medium of radio waves propagation in the upper atmosphere, are considered. A critical analysis of the generally accepted ideas about the optical transparency of D and E layers for the propagation of radio waves, which are currently used in the processing of data measurement have been performed. The "correct" use of the GPS technology as a measuring instrument is discussed. In conclusion, the calibration problems of the measuring equipment in the microwave range are considered.

# IN SITU STUDYING OF THE UPPER ATMOSPHERE

Dr. A. V. Dmitriev

*National Central University*
*Taoyuan, Taiwan*

**Abstract:** It is proposed to build a nanosatellite for in situ measurements of the bottomside ionosphere and upper atmosphere at heights from 300 to 80 km. We choose the platform of 3U cubesat, on which the following instruments will be installed: Novel Infra-Red Detector (NIRD), Langmuir sensor for measuring the concentration and temperature of electrons, magnetometer. The cubesat will be oriented along ram axis with the help of a parachute installed at the back. The spaceborne Langmuir sensor and magnetometer have been already built by the team from NCU. They have been successfully launched and were operated in the space onboard Tatiana-2 satellite. It is proposed to create a NIRD instrument in which to combine 100 plates of 2x2 mm to measure the spectrum in the IR range. The detector must be adapted to be installed on a 3U cubesat. The design of NIRD will be developed in close cooperation between Russian engineers (sensors) and Taiwanese engineers (electronics).

# MODELING OF THE HIGH AND LOW LATITUDE IONOSPHERE ACCORDING THE SATELLITE DATA

Prof. A.T. Karpachev

*Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation (IZMIRAN)*
*Moscow, Russia*

**Abstract:** The global empirical models of foF2 in winter high latitude and low latitude ionosphere were built. The data of the Interkosmos-19, CHAMP and COSMIC/FORMOSAT satellites were used. The winter high latitude model includes the ionospheric trough structure (position and shape) variations with local time and longitude. The low latitude empirical model includes the equatorial anomaly structure (intensity and crests position) variations for all seasons, local times and longitudes. The winter high latitude model can use for the all levels of the solar activity, the low latitude model is valid only for the high solar activity. Both models are valid for the quiet geomagnetic conditions (Kp=2). Both models are fundamentally more accurate than the IRI model.