

**COMPACT HETERODYNE 220 GHz RECEIVER FOR PLANETARY  
SPECTROSCOPY**

**Olga Boric-Lubecke\*, Richard F. Denning, Michael A. Janssen  
and Margaret A. Frerking**

**Jet Propulsion Laboratory, California Institute of Technology,  
4800 Oak Grove Drive, Pasadena, CA 91109-8099**

*\*Currently with Photodynamics Research Center, The Institute of Physical  
and Chemical Research, Sendai, Japan*

**ABSTRACT**

Solar System spectroscopy yields information about the physics, chemistry and dynamics of **planetary** atmospheres. Many molecular species, such as CO, H<sub>2</sub>O have very strong **spectral** emission lines in the millimeter and **submillimeter** wave regions [1]. Unfortunately, due to the high opacity of the Earth's atmosphere in this wavelength region, only a very limited part of the spectrum can be observed from the Earth. **Submillimeter** and millimeter wave heterodyne spectrometers above the Earth's atmosphere and sufficiently *near the* various planets could supply a wealth of information on the nature of the planet's atmospheres. However, such instruments must be compact and light weight to be viable **candidates** for future small spacecraft missions. For example, latest NASA's mission to Mars, Mars Pathfinder, launched in December 1996, will employ a lander that will have a mass of 264 kg, output power of 35 W, and a diameter of about 5m including large (2.5 m) solar panels. A 10.5 kg rover (robot vehicle), about 0.5 m in diameter will be deployed from the lander. Obviously, a heterodyne spectrometer to be employed on such a rover, or even on a lander, must be very small and consume little power. Here we **will** present a 220 GHz receiver that could be used in such a mission, with a mass smaller than 1.5 kg, requiring less than 4.8 W, and with dimensions of 30x15x 10 cm (exclusive of telescope) [2]. This receiver uses commercially available components that are not necessarily **state-of-**

the-art, and implementation of **MMIC IF** amplifiers will further reduce total mass and power **in the future**. The mass and power saving are achieved through reducing system components to a minimum, **while** still providing adequate performance, for example, for Mars sounding applications.

While SIS receivers are much more sensitive, a **Schottky** receiver offers a distinct advantage for space applications, since refrigerators necessary for operation of superconducting junctions are bulky, expensive and difficult to **space qualify** [3]. A subharmonic mixer was chosen over a fundamental mixer, so that a frequency multiplier for the **local** oscillator (LO), and a **Fabry-Perot diplexer** for separation of the LO and the measured signal, are not required. A bias-voltage tuned GUNN oscillator is used for the LO, to provide the frequency scanning necessary for the observation of about 1 GHz wide spectral lines. Portions of the line are observed at the output of a 10 MHz wide filter sequentially, thus eliminating the need for filter banks or back-end spectrometers. The downconverted signal from the mixer is detected at the first intermediate frequency (IF) so that no further downconversion is necessary, which eliminates the need for additional 10 w frequency LO sources and amplifiers. A novel frequency control technique is also implemented here, which uses bias-tuning of the GUNN oscillator to produce the desired LO frequency over a wide range of temperature, thus eliminating the need for phase-locked loop and active thermal control systems.

[1] "Retrieval of Atmospheric Parameters in Planetary Atmospheres from Microwave Spectroscopy," D. O. Muhleman and R. T. Clancy, Ch. 9 in "Atmospheric Remote Sensing by Microwave Radiometry," edited by M. A. Janssen, John Wiley & Sons, Inc., 1993.

[2] "Miniature Low Power **Submillimeter-Wave Spectrometer** for Detection of Water in the Solar **Sytem**," O. Boric-Lubecke, R. F. Denning, M. A. Janssen, and M. A. Frerking, to be presented at the 1997 IEEE **MTT-S** International Microwave Symposium, Denver, Colorado, June 8-13, 1997.

[3] "A Superconducting **Submillimeter Wave Limb Emission Sounder (Smiles)** on the Japanese Experimental Module (**JEM**) of the Space Station for Observing Trace Gases in the **Middle Atrnsp** here," H. Masuko, S. Ochiai, Y. Irimajiri, J. Inatani, T. Noguchi, Y. Iida, N. Ikeda, and N. Tanioka, to be published in the Proceeding of the Eight International Symposium on Space Terahertz Technology, Boston, **Massachussets**, March 25-27, 1997.

**CONTRIBUTIONS**

Original, previously unpublished contributions are expected. Extended abstract should be informative and concentrate on results. Abstracts should be in English and must not exceed two typewritten A4 pages (figures and list of references included).

Authors are invited to classify their papers according to the topics listed above.

The author's name, affiliation, full address and telephone/fax/e-mail should be given on the separate page together with the topic number which seems the most appropriate to the work. Please use, number 15 for the topics which are not listed. Three copies of the extended abstract should be sent to the Conference Secretariat. Deadline for submission: 15 April 1997.

Authors will be informed of the decision of the Technical Programme Committee by 31 May 1997.

A complete manuscript will be required by 31 July 1997 for inclusion in the Proceedings. Detailed instructions for preparing a camera ready manuscript will be sent to all authors of accepted papers. Authors are responsible for obtaining publications approval from their employer.

Summaries will not be returned to the authors. All correspondence will be addressed to the first author.

**EXHIBITION**

Exhibition will be held from October 8 through 10, 1997. The space will be available for exhibits related to the Conference topics. For further details, please contact the Secretariat.

**WORKSHOPS**

Two workshops will be organised on Friday 10 October 1997.

1. MMDS (organiser: Bratislav Milovanović, University of Niš)
2. Cable Television (Organiser: France Presetnik, Radio-Television of Serbia, Belgrade, Yugoslavia)

Workshops will be held in Serbia.

**ROUND TABLES**

Two round tables will take place:

1. Modern production and broadcasting of TV and radio programme.
2. Situation and perspective of the domestic electronic industry.

Round tables will be held in Serbian on Friday 10 October 1997.

**CORRESPONDENCE**

Conference Chairman:

**Prof. Dr. Bratislav Milovanović**  
Faculty of Electronic Engineering  
Beogradska 14, 18000 Niš, Yugoslavia  
phone: +381 18355882  
fax: +381 1846180  
e-mail: bmilovanovic@efnis.elfak.ni.ac.yu

Technical Secretary:

**Olivera Pronić**  
Faculty of Electronic Engineering  
Beogradska 14, 18000 Niš, Yugoslavia  
phone: +381 1848725  
fax: +381 1846180  
e-mail: telsiks@europa.elfak.ni.ac.yu

**UPDATED INFORMATION**

Updated information can be obtained from the conference web page:

<http://www.elfak.ni.ac.yu/~telsiks/telsiks.html>

**IMPORTANT DATES**

Submission of abstracts: 15 April 1997

Notification of acceptance: 31 May 1997

Submission of papers: 31 July 1997

Program publishing: 31 August 1997

3rd INTERNATIONAL CONFERENCE ON  
TELECOMMUNICATIONS IN MODERN SATELLITE,  
CABLE AND BROADCASTING SERVICES

**TELSIKS'97**

Yugoslavia, Niš, 8-10 October 1997.

**FIRST ANNOUNCEMENT AND  
CALL FOR PAPERS**



Organized by  
Faculty of Electronic Engineering, Niš  
El Holding Co., Niš  
Radio-Television of Serbia, Belgrade

Under auspices of  
Ministry of Science and Technology of the  
Republic of Serbia, Belgrade

In the co-operation with:  
IEEE Yugoslavia section, Belgrade  
Yugoslav IEEE MTT chapter, Belgrade  
Yugoslav IEEE Communications chapter, Belgrade  
Society for Telecommunications, Belgrade  
Yugoslav Society for Microwave Theory and  
Technique, Belgrade

We are pleased to inform you that the 3rd international Conference on Telecommunications in Modern Satellite, Cable and Broadcasting Services **TELSIKS'97** will be held from October 8 through 10 1997, at the Faculty of Electronic Engineering, University of Niš, Yugoslavia.

Niš is an administrative, economic and the cultural center of the South-East Serbia, some 240 kilometers away from Belgrade. Niš stands on the site of the Roman settlement of Naissus, the birthplace of emperor Constantine the Great, in the valley of the river Nišava.

Niš is rich with ancient monuments which testify about the stormy history of this city. Niš is known as the greatest gate between East and West, because it is on the crossroad of the three important directions of the international highway, railway and air traffic.

Niš is the second university center in Serbia. The Faculty of Electronic Engineering, one of the organisers of the conference **TELSIKS'97** and one of the most perspective university institutions in the country, gives the great contribution to the development of the University of Niš.

## BACKGROUND

The series of the biannual conferences on telecommunications in modern satellite and cable services have been initiated by Professor Bratislav Milovanović in 1993. The Conference **TELSIKS** is intended to be a highly competent, scientific and professional meeting aimed at the efficient exchange of results in the area of telecommunications, through presentation of current scientific results, development trends, etc. The first two well organised conferences with a great number of participants from abroad and Yugoslavia, allowed organisers to make few steps in improving the conference quality. The 1997. conference will have an international character with an 'international Program Committee. All papers will be presented in English. Besides scientific and application oriented papers, a special category of student papers will be presented at the Conference too. Also, two workshops, exhibition and two round tables will take place.

## CONFERENCE TOPICS

1. Satellite communication
2. Cable communication systems
3. Radio communication
4. Satellite and terrestrial broadcast systems
5. Television technique
6. Applied electromagnetic
7. Antennas and propagation
8. **R** and microwave technique
9. Optical communication systems
10. Telecommunication and DSP integrated circuits
11. Modulations and Coding
12. Signal processing
13. Multimedia
14. Telecommunication networks
15. Other

## CATEGORIES OF PAPERS

Two categories of contributions are eligible for presentation at the Conference: scientific and application oriented papers.

A special category of student papers is also available. Authors must be students only, while professors should be mentioned as mentors.

## LANGUAGE

ENGLISH will be the official language of the Conference. No simultaneous translation will be provided.

## PAPER PRESENTATION

Papers will be presented in oral and poster sessions. Authors are asked to suggest the form of presentation, while the Organizing Committee will make the final decision.

## TECHNICAL PROGRAM COMMITTEE

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