

Optical Space and and Ground-based Techniques for Atmospheric and Ecological Research.

A COMBINED SYSTEM FOR ATTITUDE CONTROL OF THE ROTATING GEOPHYSICAL ROCKETS

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A system for attitude control of the rotating geophysical rockets comprising an infrared horizon sensor, a solar sensor and a magnetometer is described. The sensors measure angles between a rocket rotation axis and zenith direction, solar direction, and magnetic field vector. The system allows to determine the rocket spatial orientation at night as well as in the daytime. The redundant information obtained using three vectors measurements allows to increase reliability and accuracy of attitude control in the daytime. Launches of MR-12 rockets with this system have shown that attitude control accuracy isn't worse than one degree. Independent attitude control method based on measurements of time when the rocket-borne photometer observes bright planets confirmed this accuracy.

DIAGNOSTIC OF THE EXTENDED SCATTERING MEDIUM FROM SPATIAL DISTRIBUTION OF THE RAY SOUNDING POLARIZATION

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Depolarization of polarized modulating optical radiation scattered by diffuser have been considered. This diffuser consists of the random distributed secondary point-sources, submitting to Poisson statistic. In Frenel-diffraction approximation, the correlation matrix of scattered radiation when the diffuser illuminated by Gaussian beam was formed by doubly refractive lens with optical axis arranged in the lenses plane. It was shown, that the resulting optical field was essentially depolarized. The degree of polarization this optical field was depended on the scattering angle and scattering centres density. Furthermore the depolarization was not depended on diffuser displacements along the optical axis of system. We summarized, that the possibility of distance measurements of scattering centres density in random inhomogeneous medium and extended diffusing flows is existing.

DETECTION OF DUST PARTICLE LAYERS AT 60-90 KM ALTITUDE BY ROCKET-BORNE SPECTROPOLARIMETER

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Rocket-borne measurements of mesospheric scattered radiation polarisation rate performed in 1978 and 1986 detected scattering dust particle layers at 78 and 85 km altitude. These data were compared with measurements performed in the presence of noctilucent clouds. Registered rate of polarisation differs greatly from noctilucent cloud radiation rate of polarisation.

USE OF HELMHOLTZ RESONATOR FOR ENHANCEMENT OF PHOTOACOUSTIC SIGNALS

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Experimental photoacoustic signal amplitude data were obtained as a function of chopping frequency for a nonresonant photoacoustic cell, filled by methane, with a Helmholtz resonator attached to it. Data analysis made on base of a lumped parameter approach, showed satisfactory fitting between measured and calculated values of resonant frequencies and coefficients of acoustic enhancement depending on Helmholtz resonator length and diameter of the cylindrical tube connecting the cell and the resonator. Such instrument can be used for measurements of trace gas concentrations.

HIGH-SPEED MONITORING SPECTROMETER - ALTERNATING LIGHT INTERFERENCE X-EMERGENCY SYSTEM

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Grating interferometer functional possibilities and a lot of twenty years results are included. Field compensated Archipov single-grate optical system with grating-mirror modulation became small, multichannel and fast spectrometer. Registration both with high (interference) and low (diffraction) resolution gave us the possibility of multichannel spectra analysis. Noise suppressing digital and analog techniques was used. New proposals and names of supporters are listed.

SPACEBORNE IR FOURIER-SPECTROMETER FOR ATMOSPHERIC INVESTIGATIONS

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Fourier-spectrometer has been developed to study the surface and atmosphere of Mars from the orbit of the Mars satellite. Spectrometer comprises two Michelson interferometers, operating with the same electromechanical driver for simultaneous measurements in spectral regions 1.2 to 5 μ and 7 to 50 μ , two detectors on PbSe and LiTa, test channels of monochromatic ($\lambda = 0.6328 \text{ m}$) and "white" lights, a servo alignment system, a thermostabilizing system and a heat-removing wire to cool (190°K) the PbSe detector. The spectral resolution on two-sided interferogram is 1 cm^{-1} . The registration time for each interferogram is 4.3 seconds. Possibilities of using Fourier-spectrometer for the monitoring of Earth atmosphere and other applications are considered.

VUV LIGHT SOURCES FOR FLUORESCENT HYGROMETER

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The specific requirements to a VUV lamp for the open type fluorescent hygrometer are discussed. Two suitable types, a krypton and a hydrogen lamps were developed by SOI and were investigated and improved for this purpose.

Both of them are resonance, low pressure lamps with discharge excited by direct current between two electrodes within a glass capillary. They give well collimated beam of about $3 \cdot 10^{-14}$ photons per sec at 123.6 nm (a krypton one) or 121.6 nm (a hydrogen one). They can work with modulation at a 1 KHz frequency. With discharge current maintained constant their intensity is stable within 5% at 20 to -50 degrees temperature range.

A krypton lamp is preferable when a pure spectrum is required. A hydrogen lamp has a special radiatively coloured MgF_2 window which prevent radiation with wavelength of OH fluorescence (310 nm).

The comparison with a radiofrequently excited type hydrogen lamp developed in Stockholm University was carried out.

THE EXPERIENCE OF USING A KRYPTON AND HYDROGEN LAMPS FOR FLUORESCENT HYGROMETER

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The open type fluorescent hygrometer developed in CAO firstly used a krypton lamp to produce excited OH radicals. Although its wavelength (123.6 nm) slightly differ from a hydrogen line (121.6 nm), the distribution of rotational levels may differ noticeably. As the fluorescent flux was measured in a narrow band it led to a mistake in calculated humidity. The most of published data concern to using of a hydrogen lamp.

The appearance of a suitable hydrogen lamp made it possible to compare these two lamps mounted in two identical instruments in the same balloon flight. The data are presented. The efficiency of a hydrogen lamp was found to be 60% more than of a krypton one. The quenching coefficient with the use of hydrogen lamp was found $2.3 \cdot 10^{-11} \text{ cm}^3 \text{ s}^{-1}$, which is 20% less than for a hydrogen lamp.

PHOTOMETRIC SYSTEM FOR ACTIVE EXPERIMENTS IN SPACE PLASMA

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Two-channel photometric system for investigation of artificially stimulated emission in the visible part of the spectrum is described. The system is mounted on board of the satellite "Interkosmos-25" - project APEX and measures the intensities of optical emissions 630.0 nm, 557.7 nm, 391.4 nm caused by injection of an electron beam in the upper Earth's atmosphere. First results are presented.

DETERMINATION OF AEROSOL STRUCTURE ON GROUND-BASED RADIATION MEASUREMENTS

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The paper deals with the determination of the aerosol structure in the earth's atmosphere on the basis of the measurements at ground either of the spectral flux density of the direct solar radiation or of the spectral sky radiance. The aerosol distribution function is calculated by means of the method of the reverse tasks from the optical thickness of the atmosphere or from the scattering function. The distribution function of the particles is assumed in the form of the sum of the modified gamma function : $f_A(r) = \sum_n A_n \cdot r^{a_n} \cdot (\exp - b_n \cdot r)$.

RADIOMETRIC AND PHOTOMETRIC SECONDARY STANDARDS

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VNIIOFI has developed and has now in use a number of secondary standards and reference devices to transfer units in the fields of radiometry, spectroradiometry, photometry, spectrophotometry (materials spectrophotometry).

For irradiance measurements: absolute radiometer, non-selective radiation receivers with cavity and plane receiving elements, spectrozonal (band) irradiance meters. For light quantities measurements: photometers and illuminometers; photometric lamps of luminous intensity and luminous flux; colour temperature meter of radiation sources with spectral distribution close to the Planck source. For spectroradiometric measurements (spectral radiance and spectral irradiance): blackbody models with the following temperatures: $T=800-2800$ K; light-measuring lamps with spiral and strip filaments. For spectrophotometric measurements: sets of standard measures for directional transmittance and diffusion reflection, color master sets.

The measurement systems ensuring optical radiation parameters measurement under natural and laboratory conditions could be built up with the above-mentioned standards.

METROLOGICAL ASSURANCE OF OPTICAL METHODS
FOR ATMOSPHERIC STUDIES WITHIN THE OPTICAL
WAVELENGTH RANGE

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When measuring energy characteristics of optical radiation in the atmosphere the spectral range from 0.2 to 25.0 μm is the most significant one. In this case the dynamic range of measuring radiation fluxes is determined, on the one hand, by such weak sources as stars and , on the other hand, by such a high-intensity one as the Sun. A lot of problems in radiometry connected with the measurement of spectral and integral characteristics of optical radiation within the different spectral and dynamic ranges have led to establishing a number of primary and special standards for radiometric, spectroradiometric and photometric purposes. During the time period from 1975 up to nowadays there has been developed in VNIIOFI the whole complex of information-measurement systems allowing for performing metrological certification (calibration) of different instruments designed for investigation of atmospheric radiation, for study of the processes of optical radiation getting through different media; devices and systems for the Earth exploration as well as the devices, determining conditions of vital activity of a human being, animals and plant life. The VNIIOFI complex of primary and special standards having created on the basis of black body models and absolute radiometers has made it possible to determine spectral and integral characteristics of the optical radiation sources and receivers, reflecting and transmitting media parameters; and to reproduce and transfer light units. The metrological certification of each particular device for natural studies includes element-by-element researches and the selection of the optimal methods and primary measuring means.