

Observation of a magnetic sub-storm event in the equatorial thermosphere-suggestion for interpretation

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Abstract : The equatorial peak atomic oxygen density in the lower thermosphere (around 100 km) is seen to be moderately enhanced following a magnetic sub-storm using data obtained from the ground based observations. The temperature of the mesopause obtained from OH(7 – 2) night airglow observation has shown a rise similar to the positive bay of the magnetic field intensity (horizontal component) during the said disturbance. There is no enhancement of OI(6300) intensity around 300 km compared to the OI(5577) rise. The implication of these observation is discussed in the light of the extra-ionospheric current, increasing the recombination rate.

Keywords : Thermosphere, magnetic sub-storm, airglow.

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Tropospheric VHF signal level variation : estimation of monthly and seasonal behavior of scintillation index

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Abstract : Fluctuations in the signal strength of 188 MHz TV signal (transmitted regularly from Satkhira TV station Bangladesh from 1630 hours to 2230 hours) have been recorded at Electronics and Communication Science Unit of Indian Statistical Institute to investigate the propagation characteristics of radiowaves over the eastern region of India. Recorded VHF signal levels are analyzed to estimate the percentage occurrence of scintillation index (SI) (which in turn, provide information regarding the change in refractive index of the propagating medium) for the different months and seasons over this region. In addition to this, we have also estimated the distribution of average value of VHF scintillation index with respect to period of observation for all the twelve months and four different seasons over the site of experiment. The obtained results show a significant discrepancy in monthly and seasonal behavior of scintillation index of VHF signal. Attempt has been made to explain these discrepancies on the basis of radioclimatological condition over the eastern coastal region of India.

Keywords : Electromagnetic wave propagation, refractive index, scintillation index.

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Impact of pre-monsoon thunderstorm on tropospheric VHF propagation

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Abstract : Thunderstorms which occur during the pre-monsoon season are the most common kind of storms over the eastern region of India. Onset and departure of these storms bring large scale changes in the thermodynamic state of the lower atmosphere. In this paper, we have studied the impact of these pre-monsoon thunderstorms on tropospheric propagation of 188 MHz TV signal over a 70 km path situated between Satkhira TV station in Bangladesh and Electronics and Communication Science Unit of Indian Statistical Institute, Kolkata (India). The propagation characteristics of 188 MHz TV signal observed on stormy days are compared with those which observed during the normal days of the same season. It is observed that these pre-monsoon thundersorm bring a noticable change in fading characteristics of the 188 MHz VHF signal. In addition to this, SODAR observations and radiosonde data are analysed to study the radioclimatology during these stormy days and obtained results are compared with that observed during the normal days of the same season.

Keywords : Electromagnetic wave propagation, thunderstorms, troposphere.

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The study of phenomenon of ozone layer depletion as a physical process[†]

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Abstract : Ozone (O_3) is the most important trace constituent of the stratosphere. Incidents such as the industrial emissions of CFCs, supersonic transports, and volcanic eruptions provide a most visible example of global unbalance in our natural ecology. Among other scientific and socio-economic fallouts from this, the aggravation of the phenomenon of ozone layer depletion (OLD) is particularly disturbing. Events like 1987 Montreal Protocol explain the magnitude of the threatening status of the OLD. For OLD analysis, to overcome doubts of the effectiveness of the mathematical formulation against the empirical relation, this work studies the formulation of the phenomenon of OLD as a physical process, with special reference to the stratospheric region of Pakistan. This paper establishes the results of preliminary calculations reported elsewhere, confirming quantitatively the phenomenon of OLD.

Keywords : O_3 layer depletion, stratosphere of Pakistan, assessing structure of O_3 variations.

PACS Nos. : 92.70.Cp, 82.33.Tb

Estimation of ionospheric parameters by propagation of electromagnetic waves at low latitude

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Abstract : In this paper, some results related with the propagation characteristics of electromagnetic waves in very high frequency (VHF), very low frequency (VLF) and extremely low frequency (ELF) ranges through the ionospheric plasma have been reported. Amplitude of scattered VHF signal is recorded and morphological features of ionospheric plasma irregularities are studied. Auto-correlation and power spectrum analysis are carried out to estimate scale length which varies between 200 m to 500 m and drift velocity of plasma irregularities which varies between 75 m/sec to 200 m/sec. VLF waves propagate in guided and ducted mode. The VLF whistler wave spectrum is analysed to estimate electron density of ionospheric plasma and the total electron content in a flux tube of unit cross section. Dispersion analysis of ELF proton whistlers is carried out to estimate ionospheric proton density and proton temperature. The results are found in good agreement with the other reported works.

Keywords : Ionospheric irregularities, proton whistler, scintillation.

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Study of ionosphere–magnetosphere coupling using whistler data

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Abstract : The whistler mode wave propagation through the magnetosphere is facilitated by the formation of ducts caused by latitudinal variation (enhancement) of electron density through the process of interchange of flux tube or perturbation produced by electric field. The enhanced electron density decays by the process of diffusion across and along the magnetic field. Charged particles have much greater mobility along the magnetic field lines as compared to that across the field line and hence diffuse along the field line from the magnetosphere to the ionosphere and as a result, coupling of magnetosphere to the ionosphere is established.

Whistler data is used to calculate the equatorial electron density and total electron content in a flux tube of unit cross section at the reference height. The time development of electron flux yields downward/upward movement of flux. The transported flux during geomagnetically disturbed and quiet condition is evaluated. The whistler data recorded at Indian stations Varanasi and Gulmarg are used in the present study. The refilling of ionosphere by the flux transported from the plasmasphere is discussed in the light of other available measurements.

Keywords : Whistler, ionosphere, magnetosphere.

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Theory for transport properties of molecular fluids of non-spherical molecules

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Abstract : The effective diameter hard sphere theory is employed to estimate the transport properties of molecular fluids of non-spherical molecules interacting *via* the hard Gaussian overlap and Gaussian overlap with constant energy (GOCE) potentials. The transport properties (TP's) of the molecular fluids are expressed in terms of a hard sphere (HS) fluid of properly chosen effective hard sphere diameter. The explicit expressions for the shear viscosity and thermal conductivity for the HS fluid are given. The theory is applied to estimate the TP's of fluids of the hard ellipsoid of revolution, N_2 and C_6H_6 . The agreement is found to be fairly good.

Keywords : Molecular fluid, transport properties, non-spherical molecules.

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Application of X-ray spectroscopic analysis to human blood samples

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Abstract : X-ray emission techniques like Particle Induced X-ray emission (PIXE) and Energy Dispersive X-ray Fluorescence (EDXRF) spectrometry are applied to analyse the elements in biomedical samples at the Institute of Physics, Bhubaneswar in collaboration with the Acharya Harihara Regional Cancer Centre, Cuttack. After the development of the systems, initially experiments were carried out with the certified reference materials (CRMs) like IAEA animal blood standards to verify their applicability to biomedical samples. Then human blood samples from different patients as well as healthy persons were analysed to compare the results applying both the techniques. In this paper, both the X-ray emission techniques are discussed in detail with their advantages and limitations. The results obtained by both the methods prove their efficiency for analysis of biomedical samples.

Keywords : X-ray fluorescence, PIXE analysis, trace elements

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Rayleigh-Taylor instability of Rivlin-Ericksen elastico-viscous fluid through porous medium

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Abstract : Rayleigh-Taylor instability of Rivlin-Ericksen elastico-viscous fluid through porous medium is considered. We have studied the stability aspects of the system. The effects of a uniform horizontal magnetic field and a uniform rotation on the problem are also considered separately. The uniform magnetic field is found to stabilize certain wave-number band whereas the system is unstable for all wave numbers in the absence of magnetic field.

Keywords : Rayleigh-Taylor instability, Porous medium, Rivlin-Ericksen fluid.

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Raman phonon spectroscopic study of solid state photoreaction in 7-bromo coumarin crystals

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Abstract : The photodimerization reaction in 7-bromo coumarin (7BC) in the crystalline state has been studied by Raman phonon spectroscopy. Monotonic red shift of the phonon bands and nonappearance of any new phonon bands on reaction progress suggest that the mechanism is homogeneous and the reactant and the product form solid solution. Broadening of the phonon band suggests that the reaction lattice becomes disordered with the increase of product concentration. Significant overlap between the electronic absorption and emission bands indicates that the exciton-phonon coupling is not very strong in the monomer lattice. Softening of a specific phonon mode with the progress of reaction observed in the Raman spectrum suggests that the reaction is phonon mediated through this mode softening. In the reaction, formation of cyclobutane ring through the >C=C< of the pyrone moiety is established by infrared and Raman spectroscopy.

Keywords : Crystalline state photoreaction, Raman phonon spectroscopy, 7-Bromo coumarin.

PACS Nos. : 33.20.Ea, 33.20.Fb, 33.20.Tp

Vibrational studies of trifluoromethyl benzene derivatives I : 2-amino, 5-chloro and 2-amino, 5-bromo benzotrifluorides

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Abstract : Polarized Raman spectra of 2-amino, 5-chloro and 2-amino, 5-bromo benzotrifluorides have been recorded in the liquid phase on a Yobin Yvon Raman HG 2S spectrometer and a 1403 Spex monochromator in the region $100\text{--}4000\text{ cm}^{-1}$. Infrared spectra have been recorded on a Perkin-Elmer-783 and an FTIR-200 spectrometers in the region $200\text{--}4000\text{ cm}^{-1}$. Vibrational assignments for the observed Raman and infrared bands have been made assuming C_s point group symmetry. It could be possible to assign 43 normal modes for the two molecules on the basis of the observed bands directly. The remaining two modes that lie below 120 cm^{-1} could be assigned using combination and overtone bands.

Keywords : IR and Raman spectra, vibrational spectra, fundamental frequencies.

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Exact solution for light propagation through inhomogeneous media

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Abstract : In inhomogeneous media, the index of refraction is a coordinate-dependent parameter. In this domain, the exact analytical solutions for the electric and magnetic fields can not in general, be found and numerical methods must be used. In this paper, a suitable algorithm, using the supersymmetric quantum mechanical approach has been given for the transmission of light through some special cases of these media which have spatial one-dimensional coordinate-dependent index of refractions (shape-invariant index of refractions). Exact solutions for electromagnetic fields in these media are expressed in terms of well known special functions.

Keywords : Light propagation, exact solution, inhomogeneous media.

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Study of plasma parameters of a discharge

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Abstract : Plasma parameters viz. electron temperature, electron-, ion-saturation current density, electron density *etc.* have been measured for the discharges of N_2 , O_2 and Ar under various excitation conditions of discharge using a triple probe method. It is found that electron temperature for monoatomic gas argon is much larger compared to diatomic gases oxygen and nitrogen in the same experimental conditions. A reverse thing is observed for electron density. The electron temperature increases whereas electron density decreases with the increase of discharge voltage (discharge current).

Keywords : Discharge plasma, plasma parameters, triple probe method.

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Transition from chaotic to regular behaviour in superposed matrix ensemble

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Abstract : An expression has been derived for the probability density function of the nearest level spacing using superposed matrix ensemble. In one limit, it gives Poisson distribution and in the other, Wigner distribution. The explicit form of the spacing distribution is Brody distribution which was given earlier by Brody empirically.

Keywords : Nearest level, spacing distribution, chaotic to regular limit transition, superposed matrix ensemble.

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Vibrational spectra of 2,4- and 3,4-dimethyl phenols

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Abstract : The infrared and laser Raman spectra of 2,4- and 3,4-dimethyl phenols have been recorded. The vibrational spectra have been analysed assuming C_s point group. Assignments for fundamental vibrations, internal modes of vibration of CH_3 and OH groups and combination and overtone frequencies have been proposed.

Keywords : Raman spectra, infrared spectra, dimethyl phenol.

PACS Nos. : 33.20.Ea, 33.20.Fb, 33.20.Tp
