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ABSTRACTS
This volume contains the abstracts of contributed papers submitted to the 11th European Cosmic Ray Symposium, and received by July 20, 1988. Abstracts were faithfully reproduced from the originals, sent in by the authors. We are sorry, but there has been no possibility to either correct misprints or retype text.

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The differences between the nucleonic intensities recorded at the nearly north ( Alert, Thule ) and south ( McMurdo, South Pole, Terre Adelie ) polar cosmic-ray (CR) stations have been analyzed from 1965 to 1983, on daily basis. The origin of this difference is studied considering the presence in the interplanetary space of: i) a radial CR density gradient related to the solar activity cycle; ii) strong azimuthal CR density gradients associated with plasma streams coming from coronal holes and flare-related perturbations; iii) the CR anisotropy in the ecliptic plane, whose component along the north-south polar direction changes during the earth revolution. The existence in the neutron monitor data of an annual wave related to atmospheric temperature variations is confirmed.

SHORT-TERM COSMIC-RAY INCREASES AND MAGNETIC CLOUD-LIKE STRUCTURES DURING FORBUSH DECREASES

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The analysis of the nucleonic intensity recorded during Forbush decreases ( amplitude $\geq 1.5\%$ at high-latitude stations ), occurring in the period 1966-1979, allowed us to identify about 50 clear short term cosmic-ray increases (STIs) with time duration between 5 to 30 hours. They: - begin from 4 to 30 hours after the interplanetary shock arrival; - take place during the passage at the earth of singular solar wind structures, characterized by cold material ($\leq 6.10^4 \, ^\circ K$), intense magnetic-field strength ( $B \geq 10\, nT$ ) and regular changes in the $B$ direction ( one component of $\vec{B}$ rotates almost parallel to a plane ); - may present a two-peak structure in their temporal behaviour. A high-level for cosmic ray anisotropies is very often present. The occurrence of the STI seems to be an indicator of the passage at the earth of a magnetic cloud-like structure associated with flare ejecta material.
INTEGRAL MULTIPICITIES OF IONIZING COSMIC RAY COMPONENT IN THE ATMOSPHERE
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The calculations of the fluxes, angular distributions and proton, neutron, muon and electron-photon components of cosmic rays in the atmosphere of the Earth were carried out for various cutoff rigidities. Comparison of the obtained results on the spectra of secondary electrons and muons in the atmosphere, vertical flux of electrons with energy >10 MeV, vertical and global fluxes of ionizing component with experimental ones at various depths showed good agreement. Integral multiplicities of ionizing component of cosmic rays in the atmosphere of the Earth were calculated using the developed technique.

NONSTATIONARY EFFECTS OF GALACTIC COSMIC RAY MODULATION
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In the paper quasiperiodical (sectorial structure) and aperiodical (Forbush-decreases) variations of the state of space where cosmic ray propagate were examined. The phenomena of interest were analysed within nonstationary model of galactic cosmic ray propagation including diffusion, convection, energy changes and geometry of total solar magnetic field.

The nonsteady state of the propagation conditions gave rise to notable effects for density and flux of cosmic rays. Dependences of recovery time of Forbush-decreases and transverse fluxes on the solar magnetic cycle level were obtained. Obtained results were compared with available experimental data, their qualitative analysis was given.
STUDY OF SOLAR FLARE GENERATED NEUTRONS
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The paper presents the results of calculations of
the space-time and energy characteristics of electrons
produced by decay of neutrons generated by solar flare.
Existence of fluxes of electrons generated by proton
decay at the level of registration are predicted and
conditions of corresponding experiment are discussed.

It is shown, that the solar flares located west
of E 50° are of practical interest in order to reconstruct neutron energy spectra for E<100 MeV using
the data of satellite measurements.

SOLAR COSMIC RAY ENERGY SPECTRUM TRANSFORMATION
DURING PROPAGATION
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Transformation of solar cosmic ray energy spect-
trum during propagation of particles from a source to
the point of their registration in interplanetary me-
dium was investigated. The equation of isotropic dif-
fusion accounting for convection, energy changes and
particle drifts in interplanetary magnetic field was
calculated. The analysis of the proton event of
11.05.1974 is given as an example.

For energies less than 10 MeV one can observe
softening of the energy spectrum during propagation
of particles from the Sun to 1 a.u. due to Coulomb
losses and adiabatic cooling. Drifts of particles in
interplanetary magnetic field and limited dimensions
of the region of injection on the Sun are the reasons
of the softening of energy spectrum in the range of
energies >100 MeV.
COSMIC RAY ANISOTROPY IN GALAXY IN MODERATE ENERGY REGION

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The Fourier coefficients of the first and second harmonics of the daily variations in solar, sidereal and antisidereal time were calculated using the data of 12 neutron monitors of the worldwide network for the period of 22 years (1964-1985). The phase of the sidereal daily variation had no clear localization in space.

Obtained data were corrected on the contribution of solar semidiurnal variation in sidereal and antisidereal time. Taking into account the contribution of the apparent sidereal variation and influence of the atmosphere and magnetosphere of the Earth the amplitude of sidereal anisotropy was found to be \( < (0.059 \pm 0.005) \) and the phase was close to 18 1st.

Behaviour of the sidereal anisotropy was investigated for three periods of the heliomagnetic cycle: 1964-1969, 1971-1979, 1981-1983. There was no pronounced difference in the characteristics of anisotropy for the three subperiods.

APPLIED ASPECTS OF COSMIC RAY INVESTIGATION

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The paper presents the results of the study of various components of cosmic rays in the region of measurements of natural resources such as water, snow, biological mass of the vegetation, humus of the soil. Experimental and theoretical methods of determination of calibration dependences of various components of cosmic radiation on water contents of snow and soil are discussed. The results of the long measurements of snow in mountains and water content of irrigated and nonirrigated soils are given. Influence of dynamics of water content of snow and soil humidity on the results of their measurements and methods of their simultaneous and separate measurements are discussed. The description of apparatus for remote sensing of water content of snow and soil humidity are given.
THE ANALYSES OF THE EXPERIMENTAL DATA FROM GREAT SOLAR FLARES AT THE BAKSAN UNDERGROUND SCINTILLATION TELESCOPE

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This work is the continuation of the looking for solar flare neutrinos using the Baksan underground scintillation telescope. The Baksan data are analysed in two ways: in a single flare hypothesis and in multiple mode, the latter assuming that the neutrino signal is distributed among many small solar flares. We estimate the upper limit on summarized neutrino fluence with \( E \sim 100 \text{ Mev} \).

ANALYTICAL SOLUTION OF THE STATIONARY EQUATION OF COSMIC-RAY ISOTROPIC DIFFUSION IN THE INTERPLANETARY SPACE

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The analytical solution of a convection-diffusion equation is obtained with account of the change in the energy of galactic cosmic rays in the interplanetary space. The solution is obtained in an assumption that there is a power dependence between the arbitrary diffusion coefficient and the heliocentric distance and rigidity of particles as well as between the solar wind and the distance.
TIME VARIATIONS OF SOLAR NEUTRINO DATA AND SUNSPOT DATA

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The method developed by Jurkevich (1) is very powerful to find periods in unequal spaced observations. We have analysed both the solar neutrino data and sunspot data from 1970-1985 by Jurkevich method to see whether both the data exhibit the same periods as suggested by Raychaudhuri (2). We have found that solar neutrino data exhibits 0.4, 1.0, 1.5, 1.8, 2.1, 2.6, 4.9, 6.2, 7.8, 9.5, 11.2, 12.3 years period and sunspot data exhibits 0.3, 0.8, 1.2, 1.5, 2.5, 3.8, 4.8, 7.7, 10.5, 11.1, 12.2 years period. This observation suggests that both the production arises due to the instability inside the core of the sun.

References:
The behaviour of the solar wind parameters at the periods of the Forbush-decreases and geomagnetic storms was investigated. The comparison of the different class events, namely, the cosmic ray decreases without the storms (I), the Forbush-decreases followed by the storms (II) and geomagnetic storms without the Forbush-decreases (III) and the analysis of their recurrence were carried out. It is shown that the geomagnetic field disturbances are caused by a high-speed stream plasma region with the geoeffective $B_z$-component in the compressed solar wind. The most interesting are the cosmic ray decreases without the geomagnetic storms associated with intersection of double magnetic structures outside the stream. This may be the consequence of the limited magnetic region in sporadic streams. Observation of the above event classes is interpreted by peculiarities of the flanking (I) or central (II,III) passage by the Earth of the solar wind high-speed streams. Independence of the classification of the recurrence features allows to consider that the recurrent streams are formed by the discrete structures similar to the sporadic ones.
GALACTIC COSMIC RAY MODULATION MECHANISMS AND THEIR RELATION TO THE ACTIVE PROCESSES ON THE SUN

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Galactic cosmic ray monitoring data (with proton energies $E_p \gtrsim 30$ MeV) obtained from soviet space probes during 1959-1986 are analysed. These data are compared with the similar Deep River monitor ($E_p \gtrsim 2$ GeV) and balloon ($E_p \gtrsim 100$ MeV) data. Comparison is made by an empirical "parabolic" spectrum which is universal and rather simple. Galactic cosmic ray modulation is treated as a nonstationary process which is a superposition of Forbush-decreases caused by some magnetic discontinuities that move from the sun.

SOLAR MEV-PROTON PROPAGATION IN THE INNER HELIOSPHERE

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Big solar cosmic ray bursts (with proton energy $E_p \gtrsim 1$ MeV) obtained from soviet space probes during 1965-1986 are analysed. Solar proton time profiles are classified in four types: anisotropic, diffusive, with "overtaking" shock, with "guiding" shock. The model of coronal propagation with particles wandering between thin magnetic filaments is studied.
The application of drift chambers for heavy ion track detection

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The spatial resolution of a drift chamber telescope was measured for a variety of different heavy ions in the charge range from nitrogen to iron. It was shown that it is possible to measure the tracks of heavy ions with excellent spatial resolution, as long as one operates the detector at moderate charge amplification to eliminate δ-ray effects. From these measurements, performed under different signal processing techniques, we conclude that it is feasible to detect heavy ion tracks with a spatial resolution clearly below 100 μm.
QUASI-BI-ANNUAL VARIATIONS OF COSMIC RAY INTENSITY AND SOLAR VELOCITY

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Abstract

1. The features of quasi-bi-annual variations of the north-south asymmetry in cosmic ray heliolatitudinal distribution by the long-term data of the world network of the neutron monitors have been revealed.

2. The latitudinal dependence of the amplitude of the north-south asymmetry in cosmic ray heliolatitudinal distribution for the separate epochs of solar activity by the neutron monitor data has been established.

3. Quasi-bi-annual changes of solar wind velocity have been found. It has been revealed that the south hemisphere of the Sun plays more persistent role during 1968-1984 period in the formation of quasi-bi-annual variations of solar wind velocity.

4. The cyclic changes of quasi-bi-annual variations of cosmic ray heliolatitudinal distribution and solar wind velocity are pronounced.

5. The correlation between the changes of the dipole magnetic moment of the Sun and the amplitude of variation of the north-south asymmetry in cosmic ray heliolatitudinal distribution are observed.
QUASI PERIODIC COSMIC RAY VARIATIONS, SOLAR AND GEOMAGNETIC ACTIVITIES WITH THE PERIODS CLOSE TO THE PERIOD OF THE SUN'S ROTATION

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The investigation of the frequency dependence of the correlation coefficient between the amplitudes of cosmic ray (CR) power spectrum, solar and geomagnetic activities in the frequency range close to the frequency corresponding to the period of the Sun's rotation.

It has been established that the frequency distributions of the correlation coefficients (CC) between the amplitudes of the power spectrum of Wolf number W and CR (Kw, C), on one hand, and W and Ap (Kw, Ap) on the other hand, have the same character. However, the same CC distribution between CR and Ap (Kc, Ap) differs significantly from Kw and KwAp distributions.

The pikes on the frequencies corresponding to the periods of: 36.5; 27.0; 19.2; 13.2 (days) are separated in the frequency distribution. The magnitude of the pikes for the periods 36.5 and 19.2 are of the same order as for the well-known periods corresponding to 27 and 13 (days).
11-YEAR CHANGES OF THE ENERGY SPECTRUM OF COSMIC RAY RECURRENT VARIATIONS

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Abstract.

1. 27-day cosmic ray (CR) variations for different stages of solar activity development by the long-term data of the world network of the observation stations have been revealed.

2. The changes of the energy spectra of CR recurrent variations in connection with the changes of solar activity have been defined.

3. The characteristics of the energy spectrum of CR recurrent variations for different cycles of solar activity are compared. The corresponding interpretation is presented.
ON THE NATURE OF THE TEMPORAL CHANGES OF THE ENERGY SPECTRUM OF COSMIC RAY 11-YEAR VARIATIONS

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Abstract

The temporal changes of the energy spectrum of cosmic ray isotropic intensity variations have been investigated by the authors of the present paper by the data of the world network of neutron supermonitor stations for the 1955-1985 period and it has been shown that the energy spectrum of 11-year variations is hard in the minimum periods and is soft in solar activity maximum.

Further detail analysis shows that after the sign change of the general magnetic field of the Sun in 1969-1970 beginning with 1972 when solar activity is still high, a significant hardening of the energy spectrum is observed which is persistent ~ 6-7 years, including the period of the minimum epoch in 1976. The soft energy spectrum is also persistent, in the mean, during ~ 6-7 years.

The conclusion is made that the reasons of such cosmic ray energy spectrum change are different structures of solar wind magnetic inhomogeneities in different epochs of solar activity.

In the periods near the minimum and in the minimum of the Sun's activity the effective size of the inhomogeneities $l$ is comparable with Larmor-radius $\rho$ of cosmic rays with 10-50 Gev energies ($l \sim \rho$) and the dependence of the diffusion coefficient on the impulse of $P$ particles is weak ($\alpha \propto P^{0.5}$ and in $P^{5}$ type). In the periods of the Sun's activity $l > \rho$ and $\alpha \propto P^{4.5}$.

The above proposition is proved and on the basis of the solution analysis of the anisotropic diffusion equation taking into account the dependence of the diffusion coefficient on the helio-coordinates of $\alpha \propto P^{4.5}$ type, i.e. in the different points of the space that are at a distance more than several paths of cosmic ray particles the energy spectra of 11-year variations are different. In particular, at a distance from the Sun both by the radial direction and perpendicular to the ecliptic plane the energy spectrum of 11-year variations is harder than in the region of the Earth's orbit for any period of solar activity.
The features of connection of cosmic ray anisotropy with the sector structure of the interplanetary magnetic field for 1964-1985 period

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Abstract

The relation of cosmic ray anisotropy by the data of the world network of the neutron super-monitor stations with the sector structure of the interplanetary magnetic field (IMF) for a long period of time is studied. The anisotropy change for the different epochs of solar activity has been revealed, in particular, the displacement of the anisotropy vector to the early hours and the amplitude increase in "+" sector in respect to "-" sector both in the minimum and in the maximum of solar activity is observed. The effect is more pronounced in the epoch of solar activity minimum.

The dependence of cosmic ray anisotropy vector on the helio-coordinates of the neutral current sheet and solar wind parameters is studied. It has been shown that with the current sheet moving off from the helioequator up to 10-15° heliolatitude the tendency of the amplitude decrease and the anisotropy phase displacement to later hours is observed while with the further current sheet moving off from the helioequator the anisotropy phase is shifted to the early hours.

The conclusion is made that the main reason of cosmic ray anisotropy change depending on the IMF sign is the particle drift.
The influence of the change of the Sun's magnetic dipole on the different classes of cosmic ray variations—annual and semianurnal, Forbush-effects and anisotropy, on the expected spatial distribution of density and the radial and heliolatitudinal gradients of cosmic rays is studied on the basis of the experimental data analysis of the neutron and meson intensity of cosmic ray world network of stations and the theoretical calculations.

The temporal changes of the energy spectrum of 11-year variations and Forbush-effects of cosmic ray intensity for 1981-1984 period including the period of the anomalous increase of the Sun's magnetic dipole (1982) have been defined.

The conclusion is that in the effective energy range (10-70 GeV) the decrease of cosmic ray intensity in 1982 during the decay of XXI solar activity cycle is connected with the decrease of the diffusion coefficient at the expense of the Sun's magnetic dipole increase.
The behaviour of the barometric coefficients ($\beta$) for two neutron supermonitor sections in Tixie Bay for 1980-1987 was investigated. With statistically important difference $\beta = 0.035 \pm 0.005 \%/\text{mmHg}$, their consistent behaviour with the solar activity cycle is observed. The increase $\beta$ from 1.000 to 1.055 %/mmHg for one section and from 0.952 to 1.023 %/mmHg for another one is observed from solar activity maximum (1980-1981) to minimum (1987). This fact is interpreted in frame of the convective-diffusive model by softening of the galactic cosmic ray spectrum in the solar activity minimum in comparison with the maximum.
In the framework of the nonlinear model of the cosmic ray acceleration which takes into account the shock modification by the accelerated particle pressure, the dependence of the acceleration efficiency on the injection rate and the injected particle energy was investigated. Two types of injection were considered, namely, the injection of the superthermal particles at the shock front and the injection of the upstream pre-existing cosmic rays. It is shown that in both cases there exists a regime of the saturated injection under which the acceleration efficiency, i.e. the pressure fraction provided by the accelerated particles behind the shock is high (up to 80%) and practically independent of the injection rate. It is also shown that in the presence of the upstream cosmic rays the saturated regime is reached under the lower injection rate at the shock.
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COSMIC RAY CURRENT AND THE SOLAR WIND SPEED

IN 1964-1976

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By a method of global survey using the world net neutron supermonitor data the values of the cosmic ray current for 1964-1976 are calculated. The cyclic dependence of the cosmic ray current magnitude on the solar wind speed and on the area of the sun-spots of that Sun's hemisphere where the Earth is at this time projected is found out. The obtained results are discussed.

SH-27

11- AND 22-YEAR VARIATIONS OF COSMIC RAY DENSITY

AND OF SOLAR ACTIVITY

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The 11- and 22-year variations of the cosmic ray density in wide energy range and of solar activity for 1937-1986 are analyzed. The results confirm the earlier obtained presentations of the authors on small size of the cosmic ray modulation region in the analyzed energy interval. The 22-year variations of the cosmic ray density, the solar activity and solar wind speed are not found out but a change of their level approximately in 22 years is revealed. In this case the 22-year variations of the cosmic ray density in antiphase with the solar activity and the solar wind speed are observed.
Calculations concerning the solar cosmic ray propagation in the presence of the interplanetary shock wave are presented. The results are implied to the event on December 7, 1982 detected by Venera-13 and -14. The model parameters such as the injected particle spectrum, diffusion coefficients, propagation velocities of the shock wave and of the solar wind are experimentally determined. The comparison testifies on the whole the satisfactory agreement of the calculation and experiment.
On data of meson telescope at the observation level 60 m w.e. (E = 264 GeV) the correlational coupling between the amplitudes of the cosmic ray solar-diurnal variation and the magnetic dipole moment of the Sun for 1978-1985 was estimated. The small positive correlation (r ≤ 0.2) is observed. The estimation of the correlation coefficient on the results by Nagashima et al. (Nature, 1987, vol. 328, p. 600-601) yields $r = 0.3 ± 0.5$ (E = 331 GeV). It is concluded that the possible effect of the dominant correlation of the high-energy cosmic ray anisotropy by the magnetic dipole moment of the Sun can be observed at energies not lower than 200 GeV. In the above energy range this effect is associated with a change of the interplanetary magnetic field which is caused by the characteristic sweeping of the magnetic field of the Sun.

The dominant correlation effect of the magnetic dipole moment of the Sun and of the solar-diurnal variation observed at Sakashita station is determined by this variation radial component which is in good correlation with the IMF magnitude and by insignificant contribution of its azimuthal component.
Modulation of the galactic cosmic rays in the heliosphere and cosmic ray acceleration at solar wind terminal shock is studied in the frame of steady-state spherically symmetric model. The new method is developed to obtain a numerical solution of the transport equation inside the solar wind cavity with boundary condition applied at the shock. The method is valid for arbitrary dependence of diffusion coefficient on energy and radial distance.

The modulated spectrum of galactic cosmic rays is compared with that obtained in the conventional model of modulation. Solutions for nearly monoenergetic source at the shock front (or galactic spectrum) are obtained for different source energies. It is shown that the spectrum-averaged energy of particles at different radial distances might be higher or lower than the source energy dependent on the value of diffusion coefficient for corresponding energies.

The model is applied to discuss the possible origin of low-energy cosmic rays and anomalous component in the heliosphere.
The extensive use, during the last two decades, of instruments with large effective areas has made it possible to detect and study a new class of cosmic ray variations, namely, the small-scale fluctuations with periods from several minutes to several hours. According to the present-day concepts, cosmic ray fluctuations are produced in the cosmic ray generation processes and during cosmic ray propagation in the Galaxy, in interplanetary space, and in the Earth's magnetosphere and atmosphere. By now, the theory of cosmic ray fluctuations produced in multiple particle scatterings on inhomogeneities of magnetic fields of different scales in interplanetary space has been developed most rigorously. Namely, the kinetic examination is used to demonstrate a definite relationship between the IMF inhomogeneity spectrum and the cosmic ray fluctuation spectrum. Therefore, the ground-based cosmic ray fluctuation data can be used not only to obtain in practice continuous information about the dynamic processes in the space and to continuously diagnose the IMF inhomogeneity frequency spectrum, but also to predict the arrival of shock waves at the Earth.

Theoretical calculations of the variations of the form of the cosmic ray fluctuation power spectra
in case of interplanetary shocks approaching the Earth are used to demonstrate the feasible application of the rearrangement of the observed fluctuation spectra to predicting the interplanetary medium disturbances; in particular, the occurrence of individual high-frequency band fluctuations long before the arrival of a shock wave at the Earth is discussed. The comparison of the results obtained with the observations of the fluctuations carried out by the present authors and by other groups has demonstrated (with a sufficiently good agreement among the estimates) a complicated pattern of occurrence and disappearance of individual fluctuations. In this case the cosmic ray and IMF fluctuations in the frequency band $f \sim 10^{-5}$ Hz are meant, where the fluctuations are related directly to the turbulent IMF fluctuations, so the observed variability of the cosmic ray fluctuation spectrum characterizes a similar variability of the IMF inhomogeneity spectrum long before the arrival of given inhomogeneities at the Earth.
FORMATION OF LONG-TERM COSMIC RAY VARIATIONS IN THE HELIOSPHERE

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The mechanisms for forming the long-term variations of galactic cosmic rays in the heliosphere are examined. The mechanisms include convective transfer, anisotropic diffusion, drift effects (allowing for the sign reversal of the Sun's general magnetic field), variations of the dimensions of the heliosphere throughout solar activity cycle (due to the variations in the total pressure of solar wind and plasma ejections), possible resonant oscillations of the heliosphere, possible existence of a transient layer between the supersonic solar wind and the interstellar medium, nonlinear effects of the inverse influence of cosmic rays on solar wind. The theoretical estimates and the computer calculation results are compared with the ground-based and spacecraft observation data.
FEATURES OF ENERGETIC PARTICLE PROPAGATION AND ACCELERATION IN A TWO-COMPONENT MEDIUM

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The two-component medium is considered which comprise two types of magnetic inhomogeneities A and B characterized by the cosmic ray transport scattering paths $\Lambda_A$ and $\Lambda_B$, respectively, and by the mean motion velocities $U_A$ and $U_B$. The kinetic theory of cosmic ray propagation and acceleration in such a medium is constructed, the diffusion approximation is obtained. The features of cosmic ray modulation in the two-component medium and of anisotropy formation are studied. In the given case an additional cosmic ray acceleration occurs which is determined as $(\tilde{U}_A - \tilde{U}_B)$ and disappears at $\tilde{U}_A = \tilde{U}_B$. In particular, an acceleration analogous to that at shock front in an one-component medium is formed in the absence of jumps in the variations of $\tilde{U}_A$ and $\tilde{U}_B$, but in the presence of a jump in the diffusion coefficient when $\tilde{U}_A \neq \tilde{U}_B$. The theory developed is shown to turn, at $\tilde{U}_A = \tilde{U}_B$, into the commonly-accepted theory of cosmic ray propagation and acceleration in an one-component medium. Generalization is made to the case of a multicomponent medium.
FEATURES OF GALACTIC COSMIC RAY MODULATION IN 1982
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The period of 1982 was distinguished in quite a number of parameters, as inferred from galactic cosmic ray (CR) balloon and neutron monitor observations. (1) The >0.1 GeV galactic CR intensity in cycle 21 reached its minimum which can hardly be associated with the respective variations of the number and latitude of sunspots. (2) A high annual CR variation was observed in the stratosphere (~5%) and with neutron monitor (~2%). (3) A 27-day CR variation showed the highest amplitude in cycle 21: ~6% in stratosphere and ~4% at neutron monitor. (4) A significant negative north-south asymmetry of CR intensity was inferred from stratospheric measurements.

The comparison of the above mentioned features of CR modulation with solar activity shows that the increase of the Sun's magnetic moment during that period may be responsible for the features above mentioned.

NORTH-SOUTH ASYMMETRY OF GALACTIC COSMIC RAY INTENSITY IN THE NEAR-EARTH SPACE AND STRATOSPHERE.
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The north-south asymmetry of the cosmic ray intensity was investigated from 1963 to 1987. The stratospheric measurements of charged particles at the northern station (Murmansk, R_C = 0.6 Gv) and at the southern station (Mirny, Antarctica, R_C = 0.03 Gv) and "Meteor" Satellite data inside the northern and southern polar caps were used. The periods of forbush decreases and solar flares were excluded.

From the stratospheric data the existence of 22-year wave in N-S asymmetry was established: positive - in 1972-1979 and near zero - in 1963-1968 and 1982 till now. The positive value of N-S asymmetry increased with the growth of the atmospheric pressure from 20 to 600 g/cm². The 22-year wave in N-S asymmetry is difficult to explain by the particle drifts in the heliosphere. The anomaly large negative N-S asymmetry took place in 1982.
The Low Energy Telescope (LET) Experiment
On The Phobos Mission

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Abstract

The Low Energy Telescope (LET) experiment on PHOBOS forms part of the ESTER complex of instruments that will perform studies of the solar wind, the suprathermal and energetic particle populations, and low energy cosmic rays. Specifically, the LET experiment measures the flux, spectra and elemental composition of nuclei from hydrogen up to iron, in the energy range ~ 1 MeV/n to ~ 75 MeV/n, using a double dE/dX vs. E solid-state detector telescope. Isotope separation for light nuclei such as He can also be achieved. The sensor is mounted on a rotating platform to enable coarse anisotropy measurements of low energy protons to be made. Following a summary of the scientific objectives of the experiment, a brief description of the instrumentation is given, together with first results obtained in orbit.

THE PROTON ENERGY SPECTRUM
OF THE SOLAR COSMIC RAY EVENT ON FEBRUARY 16, 1984

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The energy spectra of the solar protons observed over a range from 25 MeV to 10 GeV during the anisotropic phase of the solar cosmic ray event on February 16, 1984 by the world-wide network of neutron monitors and by the cosmic ray telescopes on IMP-8 have been used to deduce the energy spectrum of the flare protons at the Sun. The energy spectrum at the Sun evolved with time both in amplitude and energy. The evolution of the spectrum will be discussed in the light of current models of the solar flare particle acceleration processes.
CUTOFF RIGIDITIES AND ASYMPTOTIC DIRECTIONS FOR THE GROUND-LEVEL COSMIC RAY EVENT ON 7 DECEMBER 1982 OBTAINED FROM TRAJECTORY CALCULATIONS IN A MAGNETOSPHERIC FIELD MODEL

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The ground-level cosmic ray event beginning about 2357 UT on 7 December 1982 occurred during a geomagnetically perturbed time period with Dst = -80 nT. For a detailed analysis of the event we therefore determined the cutoff rigidities and directions of approach for a number of cosmic ray stations, utilizing the trajectory-tracing technique in an appropriate model of the perturbed magnetospheric magnetic field (Tsyganenko and Usmanov, Planet. Space Sci. 30, 985, 1982). The results of the trajectory calculations are compared with data referring to the International Geomagnetic Reference Field for Epoch 1980.0, and the significance of the magnetospheric effects in the analysis of the event is discussed.

ON THE YIELD FUNCTION OF NEUTRON MONITORS FOR SOLAR NEUTRONS

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Analyses of neutron monitor observations of solar neutron events, as e.g. of the event on 3 June 1982, require a detailed knowledge of the response of the ground-based detectors to the impact of an anisotropic flux of neutrons upon the Earth's atmosphere. Following a theoretical approach we have been determining the yield function of neutron monitors at sea level and at mountain altitudes for solar neutrons with kinetic energies 100 MeV ≤ E ≤ 10 GeV. A Monte Carlo method is used to evaluate the secondary nucleon fluxes for E > 10 MeV in the atmosphere. Empirical and theoretical data on neutron monitor response are utilized to relate these calculated flux data to the counting rate of the detector. The paper describes the method and gives results for solar neutrons with vertical direction of incidence.
ENERGETIC PROTONS AND MAGNETIC FIELD FLUCTUATIONS
UPSTREAM OF THE EARTH'S BOW SHOCK

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Two types of proton (E_p = 12-1000 keV) events upstream of the bow shock according to Prognoz-10 data are marked. First, with high intensity and low anisotropy accompanied by strong fluctuations of IMF at 10^-3 to 10^-1 Hz, consistent with nonstationary regular acceleration process. Second, with high anisotropy (>100:1) and weak field fluctuations. Shock drift acceleration, solar wind convection and magnetospheric leakage contribute to the observed picture. First type is often observed at quasiparallel shocks while second one for quasiperpendicular shocks.

ON THE SIGNATURE OF PROMPT SOLAR COSMIC RAY EVENTS

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From the solar proton fluxes observed during the solar cosmic ray events on May 7, 1978 and February 16, 1984 by the world-wide network of neutron monitors and by the cosmic ray telescopes on IMP-7 and IMP-8 we deduced (i) the onset time of the events near Earth as a function of energy, (ii) the time from onset to maximum intensity as a function of energy, (iii) the proton spectra near Earth and at the Sun as a function of time, and (iv) the duration of the injection of the flare protons into the undisturbed interplanetary magnetic field as a function of energy. The results of the analysis will be discussed in the light of current models of the solar flare particle acceleration processes.
THE CONCEPT OF "FLAGSHIP" STATIONS FOR NEUTRON MONITOR DETECTION OF GROUND-LEVEL SOLAR COSMIC RAY EVENTS

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Ground-level solar cosmic ray events have been recorded by neutron monitors since 1949. The response of each neutron monitor to any individual event depends upon the cutoff rigidity of the neutron monitor, the asymptotic cone of acceptance, and the anisotropy of the particle flux in the interplanetary medium. Neutron monitors with asymptotic cones of acceptance along the interplanetary magnetic field lines toward the sun will probably record the highest increase during an anisotropic solar cosmic ray event. Stations with a cutoff rigidity of approximately 1 GV have asymptotic cones of acceptance that sweep halfway around the globe in the equatorial plane. Therefore these stations are the most likely to record at least part of every solar cosmic ray increase. We suggest that the Deep River, Canada and the Kerguelen Island neutron monitors, located in opposite hemispheres approximately 180 degrees apart, are ideally situated for recording these unusual solar events and could be designated as "Flagship" stations to provide a quick overall picture of any event to the cosmic ray community.

PROBLEMS ASSOCIATED WITH ASSEMBLING NEUTRON MONITOR DATA FOR GROUND-LEVEL SOLAR COSMIC RAY EVENTS

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J. E. HUMBLE (University of Tasmania)
E. O. FLÜCKIGER (Universität Bern)
L. C. GENTILE and M. NICHOL (Emmanuel College)

We have been assembling cosmic radiation data obtained for the 35 ground-level cosmic ray events observed since 1955. Once assembled, these data will be placed in computer useable format for various analyses and for archiving. Problems encountered in assembling these relatively recent data have ranged from incomplete and/or incorrectly labeled data with insufficient documentation to the loss of key data sets. Many of the problems can be attributed to the non-existence of a standard system for the recording of these data. Examples of problems encountered are given in addition to a suggested format for the future exchange and archival of data acquired for these relatively unusual events.
ANOMALOUS EPISODES OF SOLAR ACTIVITY SINCE THE IGY

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J. A. McKINNON, C. C. ABSTON and H. E. COFFEY (NCDC, NOAA)
D. B. SWINSON (University of New Mexico)
J. E. HUMBLE (University of Tasmania)

We have found periods of North/South asymmetry in solar flare activity during the last 3 solar cycles. The greater activity in the northern hemisphere of the sun during the latter portion of sunspot cycle 19 and the first part of sunspot cycle 20 may be responsible for the north/south gradient in the high energy cosmic ray intensity measured during this time period. Excess activity in the northern solar hemisphere between 1959 and 1970 is found in all the solar activity parameters investigated: solar flare reports, solar related phenomena such as type II radio bursts, sunspot numbers and sunspot areas. In a longer term study based on the sunspot area for nine solar cycles we have found only one other lengthy time period (1883-1900) when one hemisphere of the sun was persistently more active than the other. For the remaining periods, the sunspot areas appear to be approximately equal for each hemisphere. From these results we suggest the possibility that high energy galactic cosmic ray measurements from 1959 to 1970 may not be representative of "normal" conditions primarily because solar activity was not evenly distributed between the two hemispheres, and consequently the cosmic ray propagation characteristics may not have been symmetric between the northern and southern portions of the heliosphere.

FIRST QUICK LOOK DATA FROM TWO ENERGETIC PARTICLE DETECTORS (SLED 1 AND SLED 2) FOR THE PHOBOS MISSION TO MARS

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Abstract

Two sophisticated, light weight, dual telescope detector systems codenamed SLED 1 and SLED 2, with the capability to monitor electron and ion fluxes in selected channels within an energy range spanning several tens of KeV to a few MeV, have been designed for the twin spacecraft of the Phobos Mission to Mars and its moons. This paper describes the first quick look data from these instruments.
PERIODIC COSMIC-RAY SCINTILLATIONS OBSERVED BY NEUTRON MONITORS IN THE RANGE 2-50 mHz

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Data collecting for search and analysis of very rapid (2-50 mHz) semipersistent periodicities in cosmic ray flux, were started in September 1987 using neutron monitors in Turku and Oulu. The effect of poor signal to noise ratio resulting from short recording interval (10 s) is dealt with by requiring data from independent neutron monitor blocks to behave similarly and by using powerful Maximum Entropy Method in creation of the spectral estimates. Number of parameter values describing detected events are stored for later statistical study. Statistical parameter distributions are compared to corresponding distributions resulting from analysis done with pure random data. Results from the first half year of operation are presented.

COSMIC RAY RIGIDITY SPECTRUM AT 1 AU DURING INTERPLANETARY MAGNETIC CLOUDS

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Cosmic ray intensity data from various neutron monitors, having different median rigidity of response, have been used to study the rigidity spectrum during interplanetary magnetic clouds. Three different categories of clouds have been utilized, e.g. (a) those preceded by shocks, (b) those followed by interaction regions, and (c) those associated with cold magnetic enhancements. The rigidity spectrum of cosmic rays is found to be different during different categories of clouds. These results can be used to give further insight about the modulation mechanisms.
EVIDENCE FOR GRADIENT AND CURVATURE DRIFTS AT A SLOW SHOCK

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The evolution of the intensities, energy spectra and pitch angle distributions of \( \geq 105 \) keV ions across a quasi-perpendicular, slow forward shock wave at 0.31 AU is studied. It is shown, (i) that up-stream diffusive acceleration is not observed; (ii) that one part of the downstream, field-aligned particles are first scattered at the shock into the 90° pitch-angle regime and then decelerated owing the gradient-drift, resulting in an "inverted shock-spike event" at the shock; (iii) that a second part is transmitted field-aligned into the upstream region thereby experiencing an acceleration at the shock, which leads to a hardening of the energy spectrum and to an ESP-type intensity enhancement in the foreshock regime; and (iv) that a third part is reflected at the shock back into the postshock regime exhibiting a harder spectrum than the incident particles. Thus, direct observational evidence is provided for the existence and importance of gradient-drifts and of curvature-drifts of low energetic ions at an interplanetary slow shock.

SOLAR MODULATION OF UNDERGROUND MUONS FROM 2000 GV PRIMARIES

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In a recent letter to Nature (1) Nagashima, Uno and Fujimoto have reported on the existence of a correlation between the magnitude of the Sun magnetic dipole moment and the daily variation of underground muons from cosmic ray primaries of rigidity 331 GV. Here we present the results of the spectral analysis of a muon time series recorded at 570 m.w.e., which extends the range over which this correlation occurs to primary rigidities of 2000 GV. In coincidence with the maximum in the Sun magnetic dipole in fact the diurnal variation observed at 570 m.w.e. increases in amplitude by a factor of 4 while its phase, usually around 18 hr shifts toward 12 hr, indicating a time of major efficiency of the convection mechanism (2). The power spectrum of the intensity fluctuations indicates modulation also by the small scale irregularities of the interplanetary magnetic field (IMF).
The heavy ion component of cosmic rays represents the greatest radiation danger for living organisms during space missions.

We have carried out cosmic ray heavy ion LET (Linear Energy Transfer) spectra measurements on the board of Cosmos satellites with stacks of MA-ND/alpha (CR-39) nuclear track detector sheets (produced by Hungarian Optical Works) which have sensitivity high enough to measure the LET in the range of 60-800 MeVg cm$^{-2}$.

In addition, low energy solar flare particles were detected on the top sheet of stacks on Cosmos-1514 and 1887. The track density of these (mainly proton) particles was about 1000 and 7000 tracks/mm$^2$ in the 5 and 14 days flight, respectively.
OG-1

Self-consistent solutions for strong electromagnetic waves in a plasma

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Abstract

The influence of radiation damping on strong electromagnetic waves in cold plasmas, a problem of high interest for the emission of pulsars and the structure of the pulsar magnetosphere, is estimated. This is done by considering the motion of the plasma particles in the macroscopically selfconsistent field and calculating the incoherent part of the radiation field. This allows to estimate the range of physical parameters for which the macroscopically selfconsistent description is a valid approximation.

OG-2

THE CHARACTERISTICS OF THE NEUTRINO SIGNAL FROM SN 1987A IN THE LMC ON FEBRUARY 23

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A signal of 5 events within 9.1 seconds was found in the fiducial mass of 200 tons of the Baksan scintillation telescope at the KAMIOKANDE-II - IMB time on February 23. We have performed an analysis of temporal distribution of the signals and obtained energy estimates of the signals. The properties of the Baksan events are very close to those of the KAMIOKANDE-II signal.
Determining the elemental composition of cosmic-rays is essential to the understanding of their propagation through the galaxy. The secondary to primary ratios at low energy are very sensitive to the details of the cosmic-rays propagation, and allow the investigation of current problems such as the limit on the amount of reacceleration of cosmic-rays or the shape of their pathlength distribution.

We have analysed the cosmic-ray data from the Voyager 2 spacecraft collected in 1986 and 1987 at a time when Voyager 2 was at ~ 20 A.U. The abundances of elements between Li and Ni have been determined at energies ~ 100 MeV/n (12-130 MeV/n for C, 56-298 MeV/n for Fe). These new measurements, which correspond to a very low amount of solar modulation ($\phi \sim 250$ MV), will be presented and discussed within the current propagation models. A special emphasis will be given to the B/C and Sc-Mn/Fe results.

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We illustrate the detailed correlation between the 60 micron band emission from the galactic disk, measured by IRAS and most of the features of the radio continuum emission as measured by Reich et al. (1986) at 11 cm and by Haynes et al. (1978) at 6 cm. The only bright radio sources that appear on the 60 micron survey are supernova remnants. (This provides a method of picking out hitherto unidentified remnants). We have modelled in detail the infrared emission from HI-associated dust. When this component is removed the strong correlation of the remainder with the radio continuum indicates that the former arises from both compact and extended, low-density HII regions. An important result of this is that it allows the detailed separation of the thermal and synchrotron components of the radio emission leading to a clearer picture of the distribution of cosmic ray electrons and magnetic field in the galactic disk.
THE ROLE OF COMPTON SCATTERING IN THE ULTRAHIGH ENERGY ELECTRONS SPECTRUM FORMATION IN GALAXY

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The formation of ultrahigh energy electrons spectrum in Galaxy is considered. For the first time the peculiarity of electrons energy Compton loss, i.e. the fact that the efficiency of this loss on the optical radiation falls sharply starting from $E_e \geq 10^9$ GeV ($E_e$ - electron energy), is noticed. The account of this peculiarity, connected with the Compton scattering cross section behaviour at the values of $b=4E_e\omega/m_e^2\gamma^4(\omega$ - photon energy, $m_e$ - electron mass) leads to noticeable increase of the electron flux in this energy region. Essentially, different behaviour of the electrons spectra within the framework of capture models in disk and halo in the energy range $E_e \geq 10^9$ GeV is revealed. It is shown that the account of the relativistic corrections in the energy loss of electrons at inverse Compton scattering leads to a better agreement with the existing experimental data in the energy range $E_e \geq 10^9$ GeV.

HIGH ENERGY COSMIC GAMMA-RADIATION AND IMPROVEMENT OF ITS REGISTRATION EFFECTIVENESS ON THE BASES OF THE CHERENKOV LIGHT TECHNIQUE

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ABSTRACT

The high energy gamma-ray astronomy is based on the registration of the cherenkov images formed by the atmospheric showers.

In present work we obtained the estimation of the gamma-shower discrimination effectiveness using the number of the cherenkov light angular distribution parameters.

It was shown that the highest effectiveness is provided by the parameters connected with the orientation of the cherenkov image in the focal plane of the telescope.
SYSTEM OF THERMOLUMINESCENCE ANALYSIS USING MICROCOMPUTER: APPLICATION TO DATING OF ANTARCTIC METEORITE

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Thermoluminescence (TL) dating technique has been widely used in cosmo-geophysical field. Increasing of samples to be measured makes analysis of glow curve too complicated. To simplify glow curve analysis a microcomputer (NEC PC-8801 mkII) is connected with TL analyzer through analog to digital (A/D) converter. Using this system it is simplified not only to analyze glow curve, but also to take data from TL analyzer and to check linearity of heating rate. The software programs for the TL measurement and analysis of glow curve is described in BASIC. After data taking glow curve data is stored in floppy disk.

Terrestrial age of antarctic meteorites is important for the studies of frequency of falls, its time variation and the mechanism of their accumulation. Thermoluminescence measurement of meteorites enables us to determine terrestrial age. We estimate terrestrial age by measuring the TL in fusion crust, which was reset to zero at the time of fall as a result of atmospheric heating and subsequently has grown up with time due to environmental radiation.

BLACK MAGNETIC SPHERULES IN THE RADIOLARIAN CHERT

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Present cosmic dust and spherules are researched from various points of view, but the past records of cosmic dust and spherules are scarce because of bad environment for conservation and of terrestrial contamination etc.

This time we investigated the radiolarian chert which had been sedimented in Jurassic, finding the black magnetic spherules which were well-conserved. The radiolarian chert is located along the Kiso river, Inuyama, Gifu Prefecture, Central Japan. In this chert hardstone and claystone layers are alternately bedded. Hard layers are mostly 2-4 cm thick and claystone layers few mm.

Samples were collected from Upper Jurassic hardstone and claystone, and from Jurassic-Triassic boundary layer which is composed of clay-like stones. We separated spherules using hand magnets under binocular microscope. Total weight of the observed samples was 52.1 g (wet weight) and the number of collected spherules was 633. The size of spherules was determined using an optical microscope and computerized image processing system. Range of size is 10 pm to 160 pm. The differential distribution was fitted with

\[ dn = C S^{-3.03} \delta S \]

where \( dn \) is the number of spherules with diameters in the range \( S \) to \( S + \delta S \) (10 pm-intervals). This distribution is consistent with the size distribution of cosmic spherules ordinary used.

We examined a few spherules under scanning electron microscope (SEM) and then these results of this examination showed high Fe content with appreciable amounts of Ni, Cr, and Co. So spherules we found are probably conjectured extraterrestrial origin. In order to assure this fact, instrumental neutron activation analysis (INAA) is now in progress.
OG-9

THE KIEL DETECTOR ARRAY FOR UHE-GAMMA-RAY-ASTRONOMY

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ABSTRACT. A detector array specially designed for the observation of gamma-rays from point sources has been built up. It is sited at an altitude of 2.200 m at the Canary Island La Palma. At the first stage the array consists of 37 scintillation detectors of 1 m² each. The number of detectors will be enlarged in collaboration with groups from Hamburg, Munich and Madrid.

Experimental details and the results of a first test run will be presented.

OG-10

A STUDY OF CHARGE DISCRIMINATION FOR THE UH COSMIC RAY COMPONENT WITH POLYCARBONATE DETECTORS

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A study of the charge resolution that can be obtained with polycarbonate detectors for UH cosmic rays is carried out. Two methods are used: one for relativistic ions which do not lose a significant amount of energy in the detector, and another one for particles that come to rest in it. Results of the calibration of detectors exposed to relativistic La, Au and U ions are presented and implications on the interpretation of the results of the UHCRE experiment, which is at present in Earth orbit, are discussed.
The process of the regular cosmic ray acceleration by the Supernova blast wave is studied in the framework of the linear theory.

The time-dependent distribution function of the accelerated particles is obtained as a solution of the cosmic ray transport equation in a spherically-symmetric case. The particle injection rate at the shock is treated as a given function of time.

The energy distribution of the space-integrated cosmic ray end product is obtained in the range from the injection energy up to the cut-off energy which is determined by the parameters of the initial stage of the adiabatic phase of the Supernova explosion.
COSMIC RAY DIFFUSION IN INTERSTELLAR MAGNETIC FIELDS

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The kinetic equation for charged relativistic particles with quasilinear collision integral of the general form is used to obtain the transfer equation for the isotropic part of the cosmic ray distribution function. The latter equation is of the form of the Skilling equation and describes diffusion, convective transfer, regular and stochastic variations of particle energy. The polarization properties of MHD turbulence are set using the polarization matrix.

The effect of magnetic traps on cosmic ray propagation is examined. The presence of particles trapped affects the coefficient of spatial diffusion of cosmic rays and their angular distribution.
Spectrum and anisotropy of ultra-high cosmic rays in a one-source model

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Abstract

The diffusive propagation of ultra-high energy cosmic rays from a single source is considered. We found the solution of transport equation for this problem with energy losses on relic radiation taken into account. The solutions give the energy spectrum and anisotropy for the burst of c.r. generation of arbitrary duration T in the source. For instantaneous, i.e. short duration, source (T < t, where t is propagation time) anisotropy is shown to decrease with growth of energy at E ~ (3-5) x 10^9 eV. As the duration of the burst increases, the dependence of anisotropy on energy comes to the usual regime of energy increasing anisotropy. The results are used for the realistic model with NGC 4151 as the source.

Cygnus X-3: analysis of 6 years data from the Plateau Rosa array

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The Plateau Rosa array is in operation in the field of UHE gamma-ray astronomy (E = 10^{13} - 10^{14} eV) since 1981. We present the Cygnus X-3 data recorded between 1981 and 1987. In the whole period the D.C. excess from the source amounts to 2 s.d. (0.15%). This is essentially due to the observations of 1982 (0.42%) and 1986 (0.3%).
Search for 100 TeV Gamma-Rays from SN 1987a

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A search for UHE gamma-ray emission from SN 1987a has been performed from the Chacaltaya laboratory. The array is in operation since August 1987. Up to the end of March 1988 no significant signal has been observed (maximum excess 1.5 s.d. in January '88) and the derived upper limit to the SN proton luminosity is \( L_p \leq 10^{41} \text{ erg/sec} \). Up-to-date results are presented.

First results from the EAS-TOP array at Gran Sasso

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11 modules of the detector of the e.m. component of the EAS-TOP array are in operation since beginning 1988. We present results on the operation of the array, on some characteristics of the showers recorded at the threshold (shower age, radius of curvature, thickness of the disc) and a first study of gamma-ray sources at \( E_0 \sim 100 \text{ TeV} \).
PROPAGATION OF ELECTRONS IN SPIRAL GALAXIES

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Abstract

A study is made of the relationship between the far infra-red flux, the radio flux and the scale height of radio emission for spiral galaxies. The manner in which cosmic ray electrons propagate in these galaxies is thereby investigated.

SPIRAL ARM EFFECTS IN COSMIC RAY SPECTRA

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Abstract

Comparisons of cosmic gamma ray spectra are made between spiral arm and interarm directions and the corresponding shapes of the spectra of the initiating particles are determined. There is evidence for flatter spectra within the spiral arms.
COSMIC RAY PRODUCTION IN GIANT MOLECULAR CLOUDS

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Abstract

Detailed studies of GMC have been made using star counts, CO-observations and gamma ray measurements to examine the way in which the cosmic ray intensity varies from point to point within the clouds. It is concluded that some GMC have cosmic ray sources within them.

THE SPECTRAL SHAPE OF COSMIC GAMMA RAYS

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Abstract

An examination is made of the dependence of spectral shape of cosmic gamma rays on Galactic longitude and latitude. A new estimate of the spectrum of cosmic ray electrons is derived.
SEARCH FOR PHOTON FLUX FROM THE DIRECTION OF HERCULES X-1

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The phase curve analysis of Hercules X-1 for the orbital period of 1.7 days was performed on the base of Tien Shan experimental data, obtained during 1974–82. A peak with a 2.5σ excess is observed at the phase interval 0.86–0.96 and is confirmed for a selection of events with low (<Nμ/Nμ> ≤ 0.3) muon content. The photon from the direction of Hercules X-1 is estimated as

\[ I \left( E > 1.5 \times 10^{14} \text{eV} \right) = (4.2 \pm 0.9) \times 10^{-14} \text{cm}^{-2} \text{s}^{-1} \]

The interpretation of the radioactive cosmic ray isotopes under the condition of reacceleration

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The cosmic ray data are normally interpreted in the standard Leaky-Box-model and one knows from measurements of the abundances of stable, secondary nuclides that the cosmic ray traverse ~7 g/cm² of interstellar matter in travelling from their sources to the Earth. The interpretation of the observed abundance of radioactive isotopes such as Be10 and Al26 have been used as tools to determine the interstellar gas density in which the cosmic ray propagate. If one allows that the cosmic ray particles encounter reacceleration while they propagate the observed data lead to different astrophysical conclusions. Not only that the secondary to primary ratios require less traversed interstellar matter and a weaker energy dependence of the escape length, \( \lambda_{\text{esc}} \), the interpretation of the Be10 data lead also to denser regions of cosmic ray propagation than in the Leaky Box model. These results will be discussed.
Interaction of Cosmic Ray Protons with Hydrogen Molecules inside Dense Interstellar Clouds

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Cosmic rays traversing the interstellar medium produce excitations, ionizations, dissociations and heating. These processes greatly affect the physical and chemical state of the medium. In particular, ionization initiates ion-molecule reactions leading to the formation of interstellar molecules in the gas phase. Moreover, in dense interstellar clouds, where the interstellar radiation does not penetrate because of dust screening, the excitation of the Lyman and Werner systems of \( \text{H}_2 \) may produce a flux of UV photons capable of contributing in consistent manner to the photochemical processing of the grain mantles, as well as constituting the first step of a more general mechanism which circulates molecules in the gas phase.

In this work we examine the case in which the interaction region is a dense cloud \((n \approx 10^4 \text{ cm}^{-3})\), in which the gas is basically molecular hydrogen, and we carry out detailed calculations for protons with energies between 1 and 100 Mev. The results include the derivation of the equilibrium spectrum of secondary electrons and an evaluation of the ionization rate and of the excitation rate of electron levels of \( \text{H} \) molecules.

Underground Muons from the Directions of Astrophysical Sources

Soudan 1 Collaboration
(Argonne National Laboratory—University of Minnesota)

The Soudan 1 Detector consists of a 3,456 proportional tube array (area 8 m\(^2\)) located at a depth of 1800 m water equivalent. We report on about \(2 \times 10^6\) single muon events (live time of about 2.5 years) recorded during the interval 1981–1988. In particular, we examine the hypothesis that some of these events may be correlated with the x-ray binaries Cygnus X-3 and Hercules X-1. Since 1987, we have also operated a proportional tube array in coincidence with underground detector. We report on an analysis of the correlation between surface and underground measurements on identical events.
AN UPPER LIMIT ON 100 MEV GAMMA RAY FLUX FROM VELA X-1 USING COS-B OBSERVATIONS

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The entire COS-B data base has been analyzed and shows no significant orbital or rotational modulation of gamma ray emission from the X-ray binary source Vela X-1. From a calculation of the sensitivity of the instrument, it is determined that the integral gamma ray flux (E > 100 MeV) from Vela X-1 is less than $0.5 \times 10^{-7} \text{cm}^{-2} \text{s}^{-1}$. However, strong evidence exists for TeV gamma ray emission with modulation at the rotational frequency. Constraints on gamma ray emission models are discussed.

ATMOSPHERIC EFFECTS ON COSMIC RAYS. ADJOINT APPROACH.

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The method for calculation of the atmospheric effects on cosmic rays is discussed. The technique of adjoint equations is used to mathematical formulation of problem. The results of the theoretical calculation of the partial temperature coefficient of the cosmic ray muon component for various primary and threshold energies are presented.
SEARCH FOR UHE GAMMA RAYS FROM POINT SOURCES
WITH THE KGF AIR SHOWER ARRAY

B.S. Acharya, P.N. Bhat, S.G. Khairatkar, M.R. Rajeev, M.V.S. Rao,
S. Sinha, K. Sivaprasad, B.V. Sreekantan, S.C. Tonwar,
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ABSTRACT

An extensive air shower array is in operation at Kolar Gold
Fields, India, since October 1984 to look for point sources of
Ultra High Energy (UHE) gamma rays. During the period from
October 1984 to January 1987 the array operated with 61
scintillation detectors, spread over an area of 1.7 × 10^4 m^2 with a
detector separation of 20 m, to measure shower size and arrival
direction. The array has a pointing accuracy of better than
1.5°. No steady excess of showers with energy > 5 × 10^14 eV from the
directions of Cygnus X-3 and Hercules X-1 was observed during
October 1984 to January 1987. However, episodic emission from
both the sources was detected during the year 1985. Results
from these observations will be presented. From April 1986,
muon detectors of total area 200 m^2 have also been in operation.
We demonstrate the usefulness of our muon detectors in
improving the signal to noise ratio for gamma ray showers, if
conventional interaction models are valid.

A POSSIBLE MEANS OF SEPARATING VHE GAMMA RAY SHOWERS
FROM PROTON SHOWERS

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ABSTRACT

Using detailed Monte Carlo simulations, the hump at a core
distance of ~135 m in the lateral distribution of Cerenkov
light emitted by 100 GeV gamma ray cascades is shown to be
real. It is analytically shown that the hump is due to
electrons of such energy above which the RMS scattering angle
is less than the Cerenkov emission angle. This energy turns out
to be about a GeV for cascades in the TeV energy range. In
proton showers, the angular distribution of electrons is
broadened by the opening angles at production of τ mesons ( due
to the transverse momentum they acquire ). This results in the
energy above which the RMS opening angle becomes less than the
Cerenkov emission angle, to be about twice that in gamma ray
cascades. It is shown that this obliterates the hump in proton
showers. A typical experimental arrangement of a large number
of mirrors is suggested with which the signal to noise ratio
for gamma ray cascades can be improved by at least a factor of
2.
ON THE CONTINUOUS ACCELERATION OF COSMIC RAYS.

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2 - Physics Department, University of Durham, England
3 - Institute of Terrestrial Magnetism, USSR Academy of Sciences Troitsk, Moscow, USSR
4 - Institute of Nuclear Studies, Lodz, Poland

It is shown that the secondary to primary ratios decreasing with energy as it is observed can be explained by the diminishing role of the continuous acceleration during the c.o.r. propagation through the ISM. The escape path length is assumed to be constant and would be smaller /2g/cm\textsuperscript{2}/ than in the standard leaky box model. The constant lifetime, extrapolated to higher energies, agrees well with the observed constant anisotropy of cosmic rays.

ON POSSIBILITY OF DETECTION OF HIGH ENERGY NEUTRINO FROM $\gamma$-RAY POINT SOURCES.

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It is pointed out that neutrinos from point sources should be significantly enriched in electron neutrinos compared with the atmospheric neutrinos. That would make possible detection of such neutrinos in DUMAND type arrays. The numerical predictions are given including results on increase of the collection volume due to the Landau-Pomerancoz-Migdal effect. It is shown that, if high energy cosmic rays originate in the point sources the expected fluxes of high energy electron neutrinos originated at those point sources are detectable in the Dumand type arrays. They can be distinguished from the atmospheric background by anisotropy associated with the Galactic plane.
POSSIBILITY OF HIGH ENERGY ELECTRON NEUTRINO DETECTION BY REGISTRATION OF SUBHORIZONTAL SHOWERS.

E. Kryš, W. Michalak and A. Wasilewski.

University of Lodz and Institute of Nuclear Studies.

Evaluations have been performed of the expected detection rate of the subhorizontal showers initiated by interactions in the earth of high energy electron neutrinos generated in interactions of cosmic rays. Both the interactions in the atmosphere and in the cosmic space are considered. The particular attention is paid to the interactions of very high energy cosmic rays with thermal radiation of various temperatures.

In the analysis the important effect of the target volume increase due to the LPM effect in cascade development has been accounted for by detailed M-C simulation. The solid angle factors for the most favourable detector location are examined.

COSMOGENIC NUCLIDE PRODUCTION MODULATED BY THE GALACTOVERTICAL MOTION OF THE SOLAR SYSTEM; A STUDY OF THE EFFECTS IN METEORITES

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It has been studied a model of variable-cosmogenic-nuclide-production which takes account of the changes in galactic cosmic-ray (GCR) irradiation conditions arising from the vertical oscillation of the Solar System about the galactic plane. At low galactolatitudes, where magnetic fields are expected to be stronger, the confinement of GCR below 10^{16} eV is more effective and the resulting GCR flux entering in the inner Solar System is larger. As a first-order approximation the production rate may be represented by a dominant constant term plus a time-dependent component of harmonic form, whose period is the half-period of the dynamical Solar System oscillation: \( P(\tau) = P_0 + P_1 \sin(\beta - \alpha \tau); \) \( \beta \) has been adjusted in order to fit the deep-sea sediment data on \(^{10}\text{Be}\) and to agree with the present values for the height above the galactic plane and for the velocity vertical component of the Solar System. The modulation of the cosmogenic nuclide production rate by the galactovertical motion affects the time-integrated cosmogenic content in meteorites exposed to GCR flux, giving exposure and terrestrial ages which are different from the ages estimated with a constant (non-modulated) production rate. A comparison has been worked out using the 5 long-lived cosmogenic radionuclides \(^{36}\text{Cl}, \:^{26}\text{Al}, \:^{10}\text{Be}, \:^{53}\text{Mn}, \:^{129}\text{I}\), of interest in meteorite studies, to be measured with AMS technique.
We describe the new characteristics of the LSD-2 detector for search low energy extraterrestrial neutrinos. With this detector we can exploring low energy neutrinos (few MeV) signals in a very low background environment.

We present and discuss in this paper the scientific goals of the present LSD-2 detector mainly dedicated to search neutrino burst from collapsing stars.
Universal Description of Inelastic and Non(single)-Diffractive Multiplicity Distributions in pp and $\bar{p}$p Collisions at ISR and SppS Energies.
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We propose a distribution function for multiplicity in accordance with the stochastic number evolution. This function gives a universal description of inelastic and nondiffractive multiplicity distributions and scaled moments in pp collisions at four different energies $s = 30.4, 44.5, 52.6$ and $62.2$ GeV, and in $\bar{p}$p collisions at CM energies $s = 200, 540$ and $900$ GeV.

ATTENUATION OF HIGH ENERGY HADRONS IN THE ATMOSPHERE *

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Hadron attenuation in the atmosphere is examined in an approach of quark-gluon model. Assuming the gluonic nature of the cross section growth, decrease of the inelasticity arises as a consequence of the gluon-gluon collisions. A set of extensive calculations is presented to provide for comparison with experimental data. A preliminary examination of existing data showed that the two-component interaction model (valon or gluon collisions) corresponding to the constant Regge part and the gluonic rising part of the cross section manages to account for the rapid attenuation ($L \sim E^{-0.05}$). The feasibility of the model is discussed in connection with the primary cosmic-ray spectrum. The experimental data suggest $(0.75\pm0.10) \times 10^{-10}$ cm$^{-2}$sr$^{-1}$s$^{-1}$ for all nucleons flux above $10^{15}$ eV with a spectral index of $1.70\pm0.05$.

* Work supported by Polish Central Programme of Fundamental Research, contract CPAP 01.09
The analysis of gamma and hadron component of atmospheric families gives the possibility to get information about the scaling violation and the primary mass composition at high energies. The energy dissipation increment leads to increase of the rejuvenated multiplicity $N'$ as well as the share of the single hadrons from the total hadron flux ($R = N_{hs}/N_h$). Enlargement in contribution of heavy nuclei in primary mass composition influences $N'$ and $R$ in contrary directions. $N'$ increases to imitate the scaling violation, while $R$ decreases.

Preliminary comparisons of Monte-Carlo computation to the experimental data suggest violation of scaling in agreement with accelerator data ($E_0 \sim 10^{15}$) as well as proton contribution limited to about 30% and the iron nuclei content 25% - for energy above $10^{15}$ eV.

# HEAVY NUCLEI ORIGIN OF GAMMA - HADRON FAMILIES WITH UNUSUAL LARGE LATERAL SPREAD *

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Very high energy gamma-hadron families with ER-flow density ($dE_{SK}/dlnR$) larger than 10 GeV·km were detected. Comparison of the Monte-Carlo simulation results with experimental data heavily indicates that the heavy primary nuclei (iron) can explain experimental data. Hadron-rich high energy families unaccompanied by "halo" with high rejuvenated multiplicity and large ER-flow density are effectively produced by heavy primary nuclei.

Analysis of the events with extraordinary large ER-flow density suggests that standard mass composition (Nikolski spectrum: 30% - p, 15% - Fe above $10^{16}$ eV) can explain observed events (without a rapid increase of the transverse momenta). No dramatic changes seem to occur.

* Work supported by Polish Central Programme of Fundamental Research, contract CPBP 01.09

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CONCLUDING FROM THE ANALYSIS OF KAIĐALOV QUARK–GLUON STRING MODEL

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ABSTRACT

Simple parametrization of secondaries spectra is derived on the basis of Kaidalov model. For pions spectra in p-p interactions it has the following parametrization in CMS:

$$\frac{d\sigma}{dx} = 0.63 (\frac{s}{s_0})^{0.9} \exp\left(-\frac{8}{s/s_0}\right) \times 1.8 (\frac{s}{s_0})^{16.7}$$

It reveals violation of Feynman scaling ($x = 0.00$) less than that observed in accelerator experiments ($x < 0.25$) and energy dependence of the mean number of charged particles and total coefficient of inelasticity:

$$n_A = 3.7 - 0.07 \ln x + 0.117 \ln s, \quad k_{in} = 0.38 + 2.2 \times 10^{-5}$$

Scaling violation parameter increases in the central region ($x < 0.20$) with the mass of target nucleus $x < 0.17$ and 0.19 for air and Pb nuclei correspondingly, but does not change in the fragmentation region. It reduces the energy range where this model can be applied for interactions with heavy nuclei.

In case of p–air interactions the following relations are derived:

$$\frac{d\sigma}{dx} = 1.04 (\frac{s}{s_0})^{10} \exp\left[-10(\frac{s}{s_0})^{2} + 4(\frac{s}{s_0})^{2} x^2\right],$$

$$n_A = 2.9 - 0.76 \ln x + 0.115 \ln s, \quad k_{tot} = 0.385 + 3.6 \times 10^{-5}$$

that can be applied in EAS range from $10^3$ to $10^8$ GeV (1–b).

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APPLICATION OF KAIĐALOV MODEL IN EAS CALCULATIONS

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ABSTRACT

The cross sections for production of different particles are calculated using Kaidalov quark–gluon string model for hadron interactions. They are parametrized by simple expressions and used in calculations of energy distribution of hadrons in extensive air showers and the characteristics of high energy muon component. Comparison with experimental data at mountain altitudes and from deep underground detectors is made for verification of this model in energy range from $10^2$ to $10^8$ GeV.
ABSOLUTE SPECTRUM AND ZENITH-ANGLE DISTRIBUTION OF HADRONS WITH ENERGIES ABOVE 1 teV

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Yerevan Physics Institute

Absolute spectrum of hadrons above 1 teV is obtained. Spectrum index is equal to 2.88 +/- 0.01. Angle distribution index is equal to 6.6 +/- 0.2. Ratio of neutral to charged hadrons in independent of energy and is equal to 0.63 +/- 0.03. The results are given in comparison with the well-known data and agree theoretical Monte-Carlo value.

PERFORMANCE CHARACTERISTICS OF THE MULTIPLE HADRON DETECTOR


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A multiple hadron detector has been constructed at the University of Turku, Finland. The investigation method is based on the detection of simultaneously arriving cosmic ray hadrons at sea level. These hadrons are produced in high-energy hadron-nucleus interactions at the height of about 500 m above sea level. The position sensitive detector consists of three layers of streamer tubes mounted on top of the hadron spectrometer in order to enable energy measurements. Basic performance characteristics and data analyzing algorithms will be presented.
The width of lateral density distribution of hadrons in extensive air showers (EAS) initiated by primary cosmic rays in simple analytically solvable models is computed and the equations for $\langle \sigma^2 \rangle, \langle R^2 \rangle$ in more real model are numerically solved. It's obtained that the width of the lateral distribution decreases with the depth in the atmosphere, the rate of this decrease $\frac{d\langle R^2 \rangle}{dy}$ depends on the rapidity distribution of secondaries in nuclear interaction. The approximate lateral distribution function of hadrons is proposed on the assumption that the lateral distribution of previous generations is negligible.
The inverse problem of the cascade curve recovery on data of simultaneous measurement of the lateral distribution and of the EAS Cerenkov light impulse form is set and solved. Unlike /1/ in this paper the Tikhonov's regularization method with a choice of the regularization parameter by a principle of generalized residual is used /2/. A numerical experiment which was carried out to verify the obtained results showed the stability of the solution under the experimental measurement errors available at the Yakutsk EAS array. Using the described algorithm the individual cascade curves for some EAS events are recovered. It's shown that when the impulse form at the shower core distances above 200 m is synchronously measured with the EAS Cerenkov light lateral distribution within 20 * 1000 m core distances one can recover the maximum depth with accuracy ± (40 * 70)g/cm² and the particle number in shower maximum with accuracy ±(10 * 15)% in individual EAS events.

THREE DIMENSIONAL MODELING OF CHERENKOV LIGHT FROM EAS
INITIATED BY 1 TeV GAMMA QUANTA.
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P.N.Lebedev Physical Institute, USSR.

ABSTRACT.

Three dimensional Monte-Carlo modeling of 1 TeV electron-photon cascade in atmosphere was performed to get the angular and lateral distribution of Cherenkov light at the level 3340 meters above sea level taking into account angular resolution of experimental array.

Angular distributions of Cherenkov light at distances 0, 20, 40, 80, 120, 140 meters from shower axis were received. The form of Cherenkov light spot, detected by experimental installation, and its fluctuations were also investigated.

ON THE ENERGY FLUXES IN EAS CORBS.
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ABSTRACT.

Energy fluxes attenuation in EAS cores measured by calorimeter demonstrates the fast decreasing of attenuation while energy of hadronic cores increase from 4,8 to 39 TeV. Attenuation in the cascade center occurs much slower comparing with peripheral part: $L_{\text{center}} = 896 \text{ g/cm}^2$, $L_{\text{periph}} = 722 \text{ g/cm}^2$. The Monte-Carlo calculations show expected value of attenuation length of hadronic component in EAS cores could not exceed value of $L=710 \text{ g/cm}^2$.

Investigation of energy flux behaviour at depths levels 374 and 924 g/cm$^2$ demonstrates the fast energy carrying deep into absorber exceeded 1,37 times the calculated one and correlated with the behaviour of attenuation length with energy.

The evaluation of production cross-section of unstable particles (charmed particles are assumed) carrying the energy deep into cascade at energy of leading hadrons equal 10 TeV gives $\sigma_{\text{charm}} / \sigma_{\text{in}} = 0.28 - 0.3$ by the interaction with lead.
Electrons in pair creation and Compton-effect
by Erich R. Bagge (1), Abu El-Ela (2) and Soad Hassen (3)

Further investigations of Wilson-cloud-chamber pictures on energy deficits in pair creation by gamma quanta of 6,14 MeV (-11 %), confirming former results and reported at the La Jolla Conference 1985, suggested the study of all single-electron paths of the same experiment. These electrons can be produced on the one hand as pair electrons whose undetected positrons have been stopped within the 25 μ gold-target for the pair production. On the other hand they can be Compton electrons by straight-on collisions with the Au-atoms of the target. The energy distribution of all particles shows a clear two peak's structure with a well established energy difference of a little more than 0,51 MeV. This difference is produced mainly by the rest-mass of the missing positrons. In this way the two sorts of electrons of different origin can be separated statistically.

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(2) A. Abu El-Ela, Phys. Dpt., Mansoura Univ., Mansoura, Egypt

The Hadron Component of \(10^{14} - 10^{16}\) eV Extensive Air Showers

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and
R. M. Bull
Department of Physics, University of Nottingham, Nottingham, U.K.

Abstract

An experiment in progress at Leeds (1020 g cm\(^{-2}\)) investigating the hadron component within a few metres of the axes of the \(10^{14} - 10^{16}\) eV extensive air showers is described. Preliminary results indicate a flattening of the hadron lateral distribution and a rise in the mean hadron energy \(<E>\) at a fixed distance from the shower axis with increasing shower size. Comparison with Monte Carlo simulations suggests a strongly rising \(<p_T>\) above about 3 x \(10^{15}\) eV.
HE-15

Observation of Unusual Near-Horizontal Showers

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and
R. M. Bull
Department of Physics, University of Nottingham, Nottingham, U.K.

Abstract

Unusual near-horizontal jets of particles have been observed at Leeds in a 35 m$^2$ discharge-chamber array and a 3 m$^2$ cloud chamber. A time-of-flight system is now being used to detect these showers and trigger the cloud chamber.

HE-16

Monte Carlo Simulations of the Hadron Component of $10^{14} - 10^{16}$ eV Extensive Air Showers

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Abstract

A radial-scaling model of hadron interactions is applied to Monte Carlo simulations of the development of the hadron cascade in the atmosphere. The effect of changing the primary composition is investigated, and the model is altered to introduce scaling violations at high energies. A very useful relation describing the hadron component at ground level is the mean hadron energy $\langle E \rangle$ as a function of radial distance from the shower axis, which is found to be dependent only on certain features of the interaction model.
Electromagnetic cascades arising from interaction of electrons and photons with magnetic fields

Goncharov A.I. and Kanevsky B.L.

Propagation of electrons and photons through the space containing magnetic fields can be accompanied by electromagnetic cascades. Cascade arise if the primary particle energy \( E > E_c = 0.541 \text{ MeV} \times (4.41 \times 10^{-13} \text{ Oe} / H_z) \), where \( H_z \) is the normal projection of magnetic field.

By means of integration of the cascade equation system, the mean characteristics of longitudinal development of cascades in magnetic fields we obtained. It was shown that cascade turns into the bunch of photons with energies \( E < E_c \) when the electron component die out.

THE INVESTIGATION OF LATERAL DISTRIBUTION OF CHERENKOV LIGHT FLUX AND MAXIMUM POSITION OF EAS AT \( E = 10^{13} \text{ ev} \).


ABSTRACT.

Investigations were performed using the installation consists of 10 Cherenkov light detectors distributed from 0 to 302 m from EAS array center and spetial detector of Cherenkov pulse form. Its resolution time is equal 7.5 ns. Lateral distributions of Cherenkov light were received by selection according to EAS particle number or to quantity of the light in showers.

The energy dependence of lateral distribution of Cherenkov light demonstrates the increasing part of the light are released at small distances from cascade axis when its energy increase, that indicates on the fast shifting of cascade maximum deep in the atmosphere with energy increasing.

The EAS maximum position was investigated by simultaneous analysis of Cherenkov light lateral distribution and the shape of Cherenkov light pulse for the first time.
ANALYSIS OF MULTIPLE MUON EVENTS IN THE ENERGY RANGE
\((10^{43} - 10^{46})\) eV FROM THE NUSEX EXPERIMENT

M. Aglietta, G. Badino, G. Bologna, C. Castagnoli, A. Castellina,
B. D'Ettorre Piazzoli, W. Fulgione, P. Galeotti, G. Mannocchi,
P. Picchi, O. Saavedra, G. Trinchero, S. Vernetto

Ist. CosmoGeofisica del C.N.R., Torino, Italy.

Abstract: The multiple muon rates measured in the Mont Blanc Nusex experiment are compared with the results of a three dimensional Monte Carlo program, which simulates the primary interactions, atmospheric cascade and muon transport in rock. It is possible, in this way, to obtain some informations about the heavy nuclei fraction which is present in the energy range corresponding to the primary cosmic ray spectrum knee, at about \(5 \times 10^{45}\) eV.

INFLUENCE OF THE STRONG INTERACTION PARAMETERS ON THE
MUON COMPONENT FLUCTUATIONS

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The influence of the strong interaction parameters on the different components of the EAS is analysed. It is demonstrated that the rigorous account of fluctuations of the partial inelasticity coefficients (especially \(K_p\)) leads to the more high level of the muon component fluctuations. It leads to considerable increase the part of the heavy nuclei in the primary cosmic rays composition for the energy range \(10^{15} - 10^{16}\) eV.
OBSERVATION OF COPIOUS CHARM PRODUCTION IN HIGH ENERGY COSMIC RAY INTERACTIONS.

B. Wilczyńska(b,d), H. Wilczyński(b,i), T.H. Burnett(i), S. Dake(c), J.H. Derricksom(e), W. Fountain(e), M. Fuki(f), J.C. Gregory(h), T. Hayashi(h), R. Hołyński(b), J. Iwai(i), W.V. Jones(d), A. Jurak(b), T. A. Koss(i), J.J. Lord(i), O. Miyamura(g), T. Ogata(a), T. Parnell(e), T. Saito(a), S. Strausz(i), T. Tabuki(e), Y. Takahashi(h), Y. Tominaga(g), J.W. Watts(e), J.P. Wefel(d), R.J. Wilkes(i), W. Wolter(b), B. Wosiek(b).


High energy (several TeV/nucleon) cosmic ray interactions were recorded in a balloon-borne emulsion chamber. Many secondary hadronic tracks kinks were observed which can be interpreted as charmed particle decays. Angular distributions of the kinked tracks are studied along with those of other hadronic tracks, electrons and photons emitted from the interaction vertex.

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The Muon Content of Y-Ray Induced EAS

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Abstract

A 40 m² shielded scintillator has been used to measure the muon content of EAS detected by the Haverah Park G Ex array. The average number of muons detected in background events is ~ 4 with 20% of EAS having no detected muons. In the present analysis of events recorded 1986-87, 412 EAS have been observed from a 3°(RA) x 2°(δ) window centred on Cygnus X-3 compared with 382 EAS expected from background. On a 4.8 hr phase plot a peak signal occurs at a phase of ~ 0.6. If muon-poor EAS only are selected the phase peak disappears, but if EAS with more muons than expected are selected then the peak is distinctly enhanced. This suggests that Y-ray induced EAS are not muon-poor but may well be muon-rich.
A review of the works on radioemission from extensive air showers done by different workers is presented in this paper. A comparative study of the experimental observations in a wide frequency range has been made with the theoretical models. It may be concluded that the theoretical basis of radioemission is now well established for high frequencies (>20 MHz) and to some extent for very low frequencies (<1 MHz) but for low frequencies (1 to 20 MHz), theory is yet to be developed.

ABSTRACT

The strange event Centauro-I observed by the Brasil-Japan collaboration group in their emulsion chamber exposed to cosmic rays at mountain altitude has attracted a great deal of attention. Numerous attempts were made to understand this event. Here we show, by detailed Monte Carlo simulation of cascades initiated deep in the atmosphere, that it is possible for a primary cosmic ray iron nucleus with normal interaction characteristics, to reproduce all the features of Centauro-I event. However, the expected number of such events works out to be $1.4 \times 10^{-7}$ as against the single event observed. We also show that the estimation of the height of initiation of the event depends on the spatial resolution of the detector.
SCALING BREAKING MODEL AND ITS COMPARISON WITH CERTAIN THEORETICAL PICTURES.

L. Popowa, J. Wdowczyk and A. W. Zolfendale

Institute of Nuclear Research, Sofia, Bulgaria
Institute of Nuclear Studies Lodz, Poland
and University of Durham.

Detailed analysis of SBM model has been carried using the data on semi-inclusive distributions of the secondary particles from UA5 experiment. Parametrisations for different multiplicities are obtained using the informations on various correlations.

The results are compared with predictions of the models based on the quark gluon strings picture. It is pointed out that relatively strong violation of scaling in those models makes them more similar to the SBM model when applications to cosmic ray calculations are considered.

FLUCTUATIONS OF THE EAS MUON COMPONENT AND THE PROBLEM OF THE MUON POOR AIR SHOWERS.


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The experimental data from the Lodz EAS array have been used for searching the anisotropy of extensive air showers with different content of muons. The showers were first grouped according to electron densities and then divided into groups containing different muon numbers in the ground level and underground detectors. The obtained histograms were compared with ones predicted taking different assumptions about muon to electron ratio fluctuations due to shower development.

The distributions of the galactic longitude "b" for muons with different muon content are presented.
Monte Carlo Simulation of Cerenkov Light in Electromagnetic Cascades.

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Simulation of the Cerenkov light /0.4-0.67 μm/ from the electromagnetic cascades have been performed for various energies of the primary photon /10^{14} - 10^{16} eV/ and for 1 g/cm² depth of origin of cascade development in the atmosphere /for vertically incident showers/.

In the calculations of both the cascade development and Cerenkov light production full Monte-Carlo method have been applied to allow for all processes involved /also the LPM effect/ and for all possible fluctuations. In calculations the so-called "thinnig method" was used. Differences between these results and those of Zatsepin are shown.

About Muon Electron Abundance in EAS

Capdevielle J. N., Gabinski P., Kouider akil A., Bordeaux Gawin J., Lodz

A new correlation between longitudinal age parameter and muon size has been pointed out from a large sample of Monte Carlo simulations, based on dual parton model and including the rise of <p> versus central rapidity density. The lateral muon structure function appear to steepen when the energy is rising. The exponent α in ΔA ~ N^α appears to decrease versus axis distance from 0.85 at 5m down to 0.45 at 2Km; then the large values measured in experiments could be explained by muon registration mainly inside 50m from axis and artificially overestimated.
MONTE CARLO GENERATOR FOR HIGH ENERGY COSMIC RAY COLLISIONS

J.N. CAPDEVIELLE University of Bordeaux

A M.C. generator incorporating the recent features of hadronic multiproduction observed at the CERN collider and with the European hybrid Spectrometer has been developed using considerations based on dual parton model. This semi-empirical model is especially efficient at reproducing the complex characteristics of semi inclusive data under the principle of scaling in central region for relative rapidity density versus z and violation of KNO scaling. Extended to include p-A collisions such as a triple gaussian generator, it has been inserted in a EAS simulation.

VIOLATION OF KNO SCALING IN P-A COLLISIONS

Bourdeau M.F., Capdevielle J.N., Bordeaux

The negative binomial distribution in place of Slattery's describes correctly the fluctuations of multiplicity in cosmic ray collisions. Those fluctuations increase with energy, but also with the mass of the target. Rapidity distributions obtained are compared with accelerators results at 360 GeV/c; the extrapolation is considered at higher energy $10^{6}$-10 for p-Air collisions or p-Pb collisions near $10^{6}$ GeV.

Hadron electron cascades simulated with NBD in dense media are in agreement with CERN results at 300 GeV in lead and iron.
Quark gluon plasma signatures in Cosmic Rays?

J.N. CAPDEVIELLE/LPT Bordeaux

Some remarkable events from Concorde experiment and other emulsion chamber observations exhibit rise of $\langle n_{\pi} \rangle$, abnormal $\gamma$-ray multiplicity, spikes in pseudo-rapidity and circularity in those spikes; some others show planarity and multi-jet emission according to QCD predictions.

Simulation of cascade including those effects and also the rise of $\langle p_T \rangle$ versus central rapidity density measured in Fermilab collider at $\sqrt{s} = 1.8$ TeV are performed.

Several consequences in hadron, muon, electron distributions at ground level are derived from different QGP synopses.

Measurement of $K^+$ decay in a large liquid scintillator detector.

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Abstract

We discuss the results of experiment at KEK, Japan, looking for the $K^+$-decay by using large liquid scintillator counters, similar to those which will be used at LVD experiment.

The aim of this experiment is to study the temporal response of these counters to the proton decay through $p \rightarrow K^+ +$ supersymmetric channel and to the time of flight measurements in the future LVD experiment at Gran Sasso laboratory.
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