Anyhow at present it is not clearly established what is the nature of size spectrum below 10^{-5} ergs/cm^2 and here future balloon experiments could provide more useful data.

Prior to this conference, a number of theoretical models had been proposed. (For example, a rapidly cooling black body model of Ramaty and Cohen, comet infall on to the neutron star model of Salpeter et al., white hole model due to Apparao and Narlikar, accretion model due to Lamb, Lamb and Pines). In this conference, some more tentative models were proposed. Dr. Fabian proposed a model in which an "earthquake" on a neutron star surface is considered to give rise to GRB. Dr. Usov proposed a nuclear explosion on star (in binary system) surface giving rise to large ejection of matter when accreted by the dense object like neutron star could give rise to gamma-ray bursts. However, none of the models can explain all the observed features.

In the panel discussion at the end of meeting, future plans for observations in this field were discussed. It is reported that a number of satellite experiments to be launched in future have been now modified to suit gamma-ray bursts observations. To get accurate directions, a number of missions incorporating long base line observations from two widely spaced spacecrafts (typically one experiment on near earth satellite and the other on inter-planetary probe) are planned: Russian-French collaboration experiment on a near earth satellite and two interplanetary probes, planned for 1977 launch and the NASA experiments on HELIOS-B (for example) in conjunction with some earth orbiter such as ISEE-Mother, planned for launch in 1976. The capabilities of COS-B satellite (launch in September 1975) to measure GRB events were also discussed.

A number of groups from the USA (GSFC/NASA), UK (Southampton & Birmingham University), W. Germany, (Max Planck Inst.), Japan and India (Tata Institute of Fundamental Research) are planning balloon experiments with large area detectors. Damle presented the proposed TIFR balloon experiment in the panel discussion. Clearly, Gamma Ray Burst Astronomy holds considerable promise.

Transient X-ray Sources:

Several new observations on Transient X-ray sources were reported by University of Leicester, University of Birmingham, University College, London and Imperial College, London, based on results from UK Ariel-V Satellite launched in October 1974 in near circular equatorial orbit. All the experiments in the satellite are reported to be functioning satisfactorily. The most important results from the low energy X-ray telescope of Leicester groups were presented by Dr. Pounds. Some 91 new X-ray sources which were not earlier observed by UHURU, have been seen by Aerial-V. Also 16 other sources reported by UHURU seemed to have now disappeared. Thus it appears that there is a class of X-ray sources that are transient and some of the theoretical models predict that the now extinguished sources may reappear. The improved sensitivity of Leicester X-ray experiment, compared to UHURU is expected to provide exciting data in future on transient sources and other interesting X-ray sources. Aerial-V discovered a new transient source near Crab called Tau XF, in April 1975. The source gradually brightened and the peak intensity some three times the Crab level was observed in latter part of April 1975.

Some new OSO-7 results on Lup. nova 2U1543-47 and other interesting sources like Cen-A, NGC 5253 were reported by MIT group.

A theoretical model for the new transitent X-ray source discovered by Ariel-V and nicknamed Cen X-mas, has been proposed by Appa Rao and Chitre (TIFR). In this model the observed 6.75 minutes periodicity is thought to be somewhat like solar cycle periodicity for a rotating magnetic white dwarf and the transient nature of the source can be explained by pushing the solar analogy further and suggesting that the source resembles the solar activity with high and low activity periods.

The transient nature of X-ray sources seems to be well established. There is, however, no unique behaviour as regards temporal changes, spectral characteristic and intensity levels. A number of theoretical models have been proposed, mainly in terms of a binary system and accretion of matter on to compact companion object and most of them explain some of the observed features, but the field is wide open for theoreticians.

Miscellaneous:

Observations in the soft X-ray region (0.12 to 0.28 keV) from experiment on ANS (Astronomical Netherland Satellite) were reported. A search for soft X-ray emission from a number of stellar objects like dwarf novae, spectroscopic binaries, peculiar star (e.g. Eta Carine), coronas of supergiants, normal giants and of main sequence stars was made. The search revealed no evidence of soft X-ray emission above the instrument background (1 count sec^{-1}). There are, however, some positive results. A giant X-ray flare was observed in YZ-CM on October 19, 1974. Some four flares in optical and soft X-rays were seen on UV Ceti; for one X-ray flare there was no corresponding optical or radio flare.

There are now at least two satellites in orbit (Copernicus and ANS) that have capability for soft X-ray studies.

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THE 14TH INTERNATIONAL CONFERENCE ON COSMIC RAYS

The 14th in the series of International Conference on Cosmic Rays was held at Munich during August 15-29, 1975. In what follows the highlights of the Conference, of relevance to astronomy and astrophysics, are very briefly summarised.

In the field of X-ray astronomy the most spectacular achievement reported was the exciting findings on transient X-ray sources from the satellite Ariel 5. Though several transient X-ray sources have been seen before this satellite became operational, the unexpected finding was the large number of bright transients now expected—one in 10 days or so—on the basis of the initial observations with Ariel 5. The available information, which is yet very scanty, suggests that transient X-ray sources are essentially of two kinds : (i) events where the source flares and remains detectable for a period of months, steadily falling in intensity after reaching the maximum; and (ii) flare events which also exhibit pulsing periodicities in the range of minutes and having a total duration generally of only weeks. The most impressive example of the former is A0621-08 which in a matter of a few days became brighter than the brightest X-ray source, Sco X-1. This X-ray transient source has now been identified in the optical region where it is found to have flared into an object with magnitude 11 or 12 from one with magnitude greater than 20, the detectable limit for Palomar sky survey; it has also been seen in the radio region. Among the best examples of those with pulsing periodicities are A 1118-61 (Cen Xmas) with a periodicity of 6.5 min and A0535+26 with 104 sec; furthermore, there is a possible optical identification of the former as a Mira variable. Understanding of transient X-ray sources is still in a rudimentary stage but it is speculated that the first category may be caused by some triggering action of accretion of matter from a star by a condensed binary object such as a white dwarf, neutron star or black hole. It is certain that before soon we will hear more exciting news on the observational and interpretational aspects of this class of events.

In the field of gamma ray astronomy significant progress was reported in the following four areas. (i) Gama Ray Bursts : These are events in which a sudden burst of gamma rays lasting from about 0.1 to 100 seconds is seen in the MeV region from instruments carried on satellites and balloons. As of now it is not known whether they are of galactic or extragalactic origin; nor is anything sensibly known about their energy source. Such events now total about 50 well indentified ones, of which the direction of arrival is known for only about 35. If these sources are located at a typical distance of 300 pc, then the total energy involved will be $10^{38\pm1}$ ergs while if they are at 3 Mpc, it is $10^{46\pm1}$ ergs. The Los Alamos Group which first observed these events a few years ago from their instruments on board Vela satellites have inferred from the available data, some well established and others not so well established, that the sources lie at distances possibly between 100 pc and 3 kpc, have luminosities roughly in the range of 10^{38} to 10^{40} ergs sec $^{-1}$ and have sizes of about 10^4 km; they also deduce that more than one source mechanism is required to understand the observed spectra. However, there was no general agreement among the delegates on all these deductions. It was also noted that there were three events all having similar time durations and total energy content which had arrival directions close to Cyg X-1; what this implies and whether it is a chance coincidence is still under debate. (ii) Mapping the Galaxy: At energies greater than 30 MeV where galactic gamma rays result predominantly from the decay of neutral pions produced in nuclear collisions of energetic cosmic rays with interstellar matter, considerable work, particularly by the Goddard Space Flight Center using their instrument in the satellite SAS-2, was reported. Though the quality and quantity of the observations have yet to be improved upon in future, it was clear that this window in the electromagnetic spectrum too holds great possibilites for the future to study the distribution of the total matter (ionised, atomic and molecular hydrogen, and similarly He and other nuclei) in galactic space. This arises from the fact that the intensity of gamma rays at these energies seen from any direction will only depend on the product of the high energy particulate cosmic ray flux and the matter density along the line of sight. Sensing the implications of these observations, many attempts to interpret the initial observations were also reported. (iii) Gamma Ray Sources : In the area of gamma ray sources one notable observation from SAS-2 was on the Vela Pulsar PSR 0833 at energies greater than 35 MeV. It is seen that while the pulsar period in the gamma ray region is the same as that in the radio, the position of the gamma ray peak is shifted with respect to the radio peak slightly to the right in the pulse period by about 13 m. sec., and unlike the case of radio, there is a second peak in the gamma rays at about 48 msec from the radio pulse. About 70 percent of the radiation is in the pulsed mode and it does not vary, within experimental uncertainties, from 35 MeV to 200 MeV. The pulsed peak is wider for the gamma rays compared to the radio indicating thereby that the emitting region is larger in the case of the former. From the various observations it is also inferred that the mechanism of emission from the Vela pulsar is probably different for the low and high energy photons. In the case of the Crab pulsar NP0532 it has been reported that it also has much of its emission at gamma ray energies in the pulsed mode. Interesting evidence has been found for a second gamma ray source near the Crab pulsar at $l''=195°$ and $b''=+5°$ with an uncertainty of $\pm2°$. The Group from Rice University at Houston claim to have detected gamma rays at 33 keV to 10 MeV from the direction of Cen A; they also claim to have seen evidence for nuclear lines, at 1.6 and 4.5 MeV at a confidence level corresponding to 3σ. If confirmed, this observation will have great implications for galactic and extragalactic gamma rays astronomy. (iv) Diffuse Gamma Rays : In the area of diffuse cosmic gamma rays attributed to extragalactic background emission, earlier work by a number of workers had indicated a shoulder in the energy spectrum between about 0.5 and 20 MeV. Further work by three of these Groups now strongly suggest that the extent of this shoulder is likely to be less pronounced than thought earlier. In view of the cosmological origin attributed to this shoulder by some scientists, the reliability of the observational evidence now needs to be confirmed with improved experiments.

Over a period of the last decade or so, the confinement time of cosmic rays in the Galaxy has been continuously revised from about 10^8 years down to 10^6 years from a variety of considerations. Consequently, the region of confinement which was originally thought to be a near spherical galactic region, was contracted into the disk. During the present conference there was a definite trend for upward revision of the confinement time to about 10^7 years and for expanding the confinement volume to the galactic disk with a significant cosmic ray halo in the z-direction on the basis of new observations. Recent improvements in the experimental methods reported at the conference, hold considerable promise for measuring the intensity of beryllium isotopes as a function of energy thereby obtaining a direct measure of the mean life of cosmic rays using ^{10}Be as a clock. One is also on the threshold of witnessing a capability for resolving isotopes of elements upto iron in the near future; such advances will then permit us to make important deductions about the processes of nucleosynthesis involved.

At extremely high energies—greater than about 10^{17} eV—some interesting results were presented. Of the three major groups working in this area from the UK, USA and Australia, the former two presented evidence for a flattening of the energy spectrum beyond 10^{17} eV extending upto 10^{20} eV. If confirmed this will have very important implications as can be seen from the following. It is generally believed that since the radius of gyration of such particles in galactic magnetic fields have values larger than galactic dimensions, they should be of extragalactic origin. On the other hand at energies in excess of 10^{19} eV, the protons, if they are, universal, will be effectively eliminated from the cosmic ray beam because of the onset of their interactions with photons of the universal microwave background radiation at 2.7°K. The observed flattening of the cosmic ray spectrum will therefore imply that cosmic rays at these energies are either reasonably " local " or that the microwave background radiation is not universal. If the former alternative is the case, cosmic ray particles at these energies should show preferred directions of arrival. Attempts made by the same three groups so far regarding the anisotropy in arrival directions have resulted in contradictory findings and hence this problem will have to await better statistcis bearing in mind the fact that the particle intensities involved at energies greater than 10^{17} eV are less than one per year per square kilometer.

For the first time convincing evidence was presented for the emission by Jupiter of electrons between about 1 and 30 MeV. This conclusion was derived from the following two observations: (i) the 13 month periodicities of electron intensity enhancements obtained from various satellites when the Earth and Jupiter came within the same solar magnetic field structure permitting thereby the Jovian electrons to spiral along field lines connecting the Earth and Jupiter; and (ii) the positive intensity gradient of about 150 percent per AU observed while approaching Jupiter from the Earth. Such observations have become possible because of deep interplanetary missions particularly Pioneers 10 and 11; attempts to understand how Jupiter accelerates these electrons are now the subject of study by several workers. Interesting findings were also reported about certain correlations associated with solar events which are rich in energetic ^{3}He. These events show the following features: (i) they are generally associated with weak or no observable flare; (ii) there is pronounced enhancement of heavier nuclei including iron among the energetic solar particles emitted; (iii) at least 8 events with ^{3}He / ^{4}He ratio greater than 0.5 have been seen; (iv) the ^{3}He enhancement is seen to an energy down to 1 MeV per nucleon; and (v) there is no detectable flux of ^{3}H or ^{2}H in these events. There were indications that a suitable interpretation of these observations will hold the key to a better understanding of some aspects of the happenings in the inner parts of the Sun.

Finally it may be of general interest here to comment on the reported discovery of a moving monopole (for details see Apparao's article in this issue). Three important points emerged from the discussions at the conference. (i) With the evidence presently available one can advance a not too unlikely alternate interpretation to the observations wherein a cosmic ray nucleus of charge 79 with a velocity close to 0.7c makes two successive nuclear collisions within the detector assembly losing in each case two to three charges. If this were the case there is nothing unusual in the event. (ii) A nuclear collision of a superenergetic cosmic ray nucleus in the air above the balloon could not have produced the monopole observed because of its relatively low velocity of 0.5c and high mass; hence if it is a monopole it should be of cosmic origin. (iii) While, on the basis of the single event seen, the authors assign a flux value of the order of 10^{-13} monopoles cm^{-2} sec^{-1} sr^{-1}, many searches to detect trapped monopoles from lunar, meteoritic and terrestrial samples have only yielded upper limits of 10^{-18} so far. Because of the profound implications of such a discovery and the lack of finality of the present evidence, delegates were generally of the view that for final acceptance, one would need another unambiguous event.

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ASTROPHYSICAL CONVECTION

An informal meeting of the Fluid Dynamicists and Astrophysicists was held at the Institute of Astronomy from June 16-27, 1975. The primary motive of the meeting was to highlight those recent developments in Fluid Dynamics that may be relevant in developing 'theories' of convection that can be used by the Astrophysicists.

The necessity to have an experimental basis for any theory applied to stars was emphasized by Spiegel. He pointed out the astrophysicists desire for fluids like Na with low Prandtl number (10^{-2}) and high Rayleigh number (10^{15}). Even though these are far removed from the astrophysical situations with Prandtl numbers of$\sim 10^{-8}$ and Rayleigh numbers$\sim 10^{20}$, he wanted the astrophysicists to see whether their mixing length theory extended to these limits yield correct results. He outlined the major astrophysical problems which have a fluid dynamical basis like the solar granulation, penetrative convection or overshooting, semiconvection or double diffusive convection, the effects of rotation on convection and the relationship between convection and pulsation.

Hill presented the recent experimental observations on the solar oblateness. By eliminating major systematic errors, the measurement of the edge of the Sun were made seeing independent, and the oblateness yielded a low value of 18 $\pm$ 12 m arc sec. Another major importance of the experiment lies in the detection of periodic varia-