Early history of cosmic rays and solar wind – Some personal remembrances

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Abstract

The early history of solar wind was replete with prejudices and strong opposition to Parker’s formulation. It was only after conclusive evidence from satellite data was obtained that the idea of solar wind was accepted. Some personal experiences of mine during my stay at the University of Chicago in 1953–1954, including the encounter of Dr. Simpson with Dr. Biermann and the inconclusive discussion between them about a possible perpetual solar outflow of particles are presented and further developments when Parker came to Chicago in 1956 and formulated his idea of solar wind, as narrated to me later by Dr. Simpson, are described.

Keywords: Cosmic rays; Solar wind

1. Introduction

Cosmic ray (CR) measurements started in right earnest in early 1930s, first with ionization chambers and later with muon telescopes. In early 1950s, neutron monitors came into operation and since then, several locations have provided CR neutron monitor data of high quality and good accuracy (statistics). Some features of cosmic ray variations were established long ago (daily variation, 27-day variations, 11-year cycle), but their origins remained a puzzle, notably for violent changes (now called Forbush decreases) which could be explained properly only when solar wind was discovered. In the present note, I give some remembrances of my association with CR research, first at PRL (Physical Research Laboratory, Ahmedabad, India) and later at Prof. John. A. Simpson’s group at the Institute for Nuclear Studies, University of Chicago, USA.

2. My early work

After my M.Sc., I joined PRL in 1948 and obtained my Ph.D. in 1953 from the University of Bombay, India. My thesis was entitled “Time Variation of Cosmic Ray Intensity near Geomagnetic Equator” and dealt with muon measurements only, as Cosmic ray neutron monitor data did not then exist. Also, JGR, JASTP, etc. did not exist and we used to send papers to Physical Review in its Nuclear Physics section. Using the Indian muon data obtained at Ahmedabad (western India) and Kodaikanal (a hill station in South India), two papers were published (Sarabhai et al., 1953a,b), which were considered as a sort of pioneer papers in cosmic rays in those days. I also used the Carnegie Institute of Washington ionization chamber data (Lange and Forbush, 1948) and found a world-wide effect of CR diurnal variation amplitude (Sarabhai and Kane 1953; Kane and Sarabhai, 1953). I heard later that Forbush was furious that he published the data without investigating CR diurnal variation himself!

3. Chicago story

In 1953, I went as a Fulbrigh–Smith–Mundt post-doc scholar to the Institute for Nuclear Studies, University of Chicago to work with Dr. John Simpson and had my first glimpse of CR neutron monitor data which started in Chi-
said “come in, discuss something with him, so I tapped on his door. He

There was John Simpson on one side of the table and a

initely no

repeating “No, once a while, yes, but all the while, no, def-

tron monitor data at Climax (Kane, 1955).

ray diurnal variation (day–night difference) in the CR neu-

day recurrence tendency of the high amplitudes of cosmic

been a pillar of cosmic ray research, used all over the

1953. Since then, the Climax neutron monitor data has

1951–1952 were intermittant and started completely only

in 1953. Since then, the Climax neutron monitor data has

worked on astrophysical dust and plasma. But the moment

was Dr. Biermann, from Germany. He was saying that

out, but next day, Simpson accosted me and asked “Do

I was saying no, only occasionally but not always

was an astrophysicist, with Ph.D. from Caltech and had

In 1956, Eugene Parker came to Simpson’s group. Parker

approached him and showed his manuscript and men-

a blasphemy. Chapman was a bosom friend of Simpson.

Parker was sceptical but did not say anything. For the

And one day, he came and told Simpson, “John, Biermann

I suggested a way out. The Sun is emitting in visual and

I suggested a way out. The Sun is emitting in visual and

In the whole world, it seems there was only one sym-

no, no, no, no, we are very open minded here. Do what

When it rains, the pressure may vary a milibar or two, but

exponentially, but at any altitude, the pressure is constant.

exhausted quickly!

would like to call it SOLAR WIND!”. That was it. Simp-

I suggested a way out. The Sun is emitting in visual and

I suggested a way out. The Sun is emitting in visual and

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4. Birth of the idea of solar wind

In 1956, Eugene Parker came to Simpson’s group. Parker

was an astrophysicist, with Ph.D. from Caltech and had

worked on astrophysical dust and plasma. But the moment

he came to Chicago, Simpson put this issue in his lap, say-
pathetic soul, Thomas Gold of Harvard Observatory, who immediately realised that there was a gold mine here. He contacted Parker and from that day onward, both these stalwarts made a point to attend all important geophysical meetings together and present papers and to expound their own viewpoints. The climax came on April 29–30, 1959 when both attended the first nationally (American) sponsored conference devoted to the special problems of space physics, held in Washington, DC under the auspices of the National Academy of Sciences, National Aeronautics and Space Administration, and the American Physical Society. The proceedings of this ‘Symposium on the Explo-
ration of Space’ were published in the Journal of Geophysical Research, Vol. 64, November 1959 and had papers by Parker (1959) and Gold (1959) also. Parker dealt mostly with the effect of solar wind on the general dipole magnetic field of the Sun and predicted that the solar magnetic field lines would be stretched out in the equatorial plane as an Archimedes spiral, with fields outgoing above the plane and incoming below the plane. During the 27-day solar rotation, the Earth would be above or below the plane for several days at a time and would see magnetic field sector structures of “in” and “out” fields. All this was said in 1959 when no satellite observations were available. Gold concentrated on the effect of strong solar wind on the weak prevailing solar wind, forming magnetic bottles containing abnormal interplanetary structures, which if encountered by Earth, would produce geomagnetic storms. Again, in 1959, when no satellite observations were available.

Parker and Gold did not agree on everything. Parker thought the solar wind would land on the surface of the Earth at some places. Gold claimed that this will not happen and the solar wind would restrict geomagnetic field in a region which he called as “Magnetosphere”. Gold also introduced the term “Space Meteorology”, harbinger of what we now call “Space Weather” (some of these details are described in Kane, 2006).

In all the meetings, Parker’s ideas of solar wind and its expected effects were severely criticized. Frustrated, Parker says in his 1959 JGR paper, “One may ask how these theoretical proposals can be tested. I think the most crucial piece of evidence will come not too long from now, through observations that are being planned by Professor Rossi at MIT. Rossi proposes to measure directly the gas blowing outward from the Sun, by a plasma probe to be flown in a vehicle included in the NASA program”. The evidence came soon, from satellites Lunik 2 (Gringauz et al., 1960); Explorer 10 (Bridge et al., 1962) and Mariner 2 (Neugebauer and Snyder, 1962) and speaks volumes of the ingenuity and foresight of these two visionaries, Parker and Gold, who initiated Space Physics and revolutionized Geophysics.

5. Eulogies

In the Int. Conf. On Cosmic Rays – Kyoto, Japan, 1961, Eugene Parker was sitting on the dias, just smiling smugly, and speaker after speaker came to the dias, presented experimental evidence for solar wind, and eulogised Parker. For 2 years 1958–1959, he shouted hoarse pleading the case for Solar Wind. Now, his tribulations were over. He became a hero overnight. Rest is history.

6. Conclusions and discussion

This story is a glaring example of how even in the 20th century, prejudices prevailed and some important people actually harmed science by their adamant attitudes. Finally, truth prevailed, but there is a lesson. As a true scientist, never scoff at any idea. Examine it, and by all means, criticize it, but objectively, and always leave a margin that the idea may be after all, true.

After the initial work of Parker and Gold, many, many people have investigated the modulation effects of solar wind on galactic CR intensity (for example, Dorman, 1959, 2001; Jokipii and Davila, 1981; Jokipii and Thomas, 1981; Potgieter and Moraal, 1985) and explained many peculiar features (CR lags, different in alternate solar cycles, etc.), but the magnificent pillar stone is the solar wind theory which revolutionized Geophysics. My tributes to Parker and Gold.

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References

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