Chapter 5

Summary and conclusions

Studies of analyses of plasma and field characteristics of certain transients and corotating emission from the Sun, their structural evolution interplanetary space and recurrent and non-recurrent modulation of cosmic ray intensity due to these structures, the results obtained, and conclusions drawn, as given below:

- It is found that the amplitude of Forbush decreases in two polarity states of the heliosphere ($A < 0$ and $A > 0$) are not significantly different, consistent with the simulation results of including drifts.

- The values of exponent $\gamma$ for a power law rigidity spectrum are found to be closer to the values given by model calculations including drifts as compared to no-drift case.

- It is also found that the recovery rate is faster in $A > 0$ epoch as compared to $A < 0$ epoch.

- These results provide another experimental evidence that drift effect plays an important role in the modulation of galactic cosmic rays.
Galactic cosmic ray depressions due to CSWS are significantly larger during $A > 0$.

Correlation analysis between cosmic ray variation and solar wind velocity during high speed streams shows much better correlation during $A > 0$ as compared to $A < 0$ epochs. Whether this reduced response of cosmic rays to solar wind enhancement is due to different paths of cosmic rays entering in the heliosphere during $A < 0$ and $A > 0$ (through equatorial region and polar regions respectively) or due to polarity dependent transport coefficients, is not clear yet.

There are significant differences in amplitude and time profile of depressions in cosmic ray intensity due to (a) isolated magnetic clouds of magnetically quiet regions of high field strength, (b) magnetic clouds with preceding shock/sheath region of compressed plasma and magnetically turbulent field, (c) magnetic clouds with interaction region of fluctuating magnetic field and high speed streams from open field regions following them, and (d) magnetic clouds with preceding shock/sheath region and high speed stream following them.

Magnetic clouds with preceding shock/sheath produce Forbuse-like decrease, while isolated magnetic clouds may produce transient decreases of smaller amplitude with fast recovery, as observed by neutron monitors.

Magnetically quiet, high field structure of magnetic clouds are less effective in transient modulation of cosmic rays as compared to magnetically turbulent high field region of sheath. The presence (or absence) of HSS influence the recovery rate; it is faster in the absence of HSS.
• Shock associated magnetic clouds (both NS and SN) may produce two-step Forbush decreases, the first step of larger amplitude starts a few hours before, while second step of smaller amplitude coincides with the arrival time of magnetic clouds.

• Recovery rate of Forbush decreases due to transient interplanetary structure is somewhat different during different polarity states of the heliosphere consistent with the prediction of drift models. However, recovery rate is also influenced considerably by the presence of HSS; recovery is faster in absence of streams. In other words, HSS appear to slow down the process of filling the lower density region created by passing interplanetary disturbances responsible for initial decrease. It is therefore expected that theoretical modeling efforts of Forbush decreases, may provide results that are more closer to observations, particularly the recovery rate, if the effects of HSS are also incorporated.