# Chapter 6
# Summary

In this work, we study shock acceleration, which is commonly believed to be the main mechanism producing cosmic rays. Particle transport at shocks is simulated as well as at compression regions, which can also accelerate particles to high energy, by solving two types of transport equations, the "pitch-angle transport equation" and the approximate "diffusion-convection equation." The pitch-angle transport equation is solved by a finite-difference method while the diffusion-convection equation is much more simply solved by a shooting method.

Here, particle acceleration at shocks and compression regions is simulated in many cases by varying the magnetic configuration. For cases of shocks the field angle is varied for three cases: quasi-perpendicular, oblique, and quasi-parallel cases. Moreover, for each case of a shock, which can be considered as a zero-width compression, we also consider four corresponding compression regions, in which the magnetic field configuration is modelled by a hyperbolic function, with compression widths equal to $0.2\lambda_{\|}$, $0.5\lambda_{\|}$, $1.0\lambda_{\|}$, and $2.0\lambda_{\|}$.

In the results, we can conclude that to consider particle acceleration (or particle transport) in cases of strong magnetic mirroring (highly perpendicular and narrow compressions), the terms describing the mirroring effect should be taken into account, because they can markedly affect both the particle spatial distribution and particle momentum distribution. In cases where the mirroring effect becomes less important, such as cases of magnetic fields nearly or exactly parallel to the shock normal and cases of wide compressions, the equations can be simplified by using the diffusion approximation, which yields the diffusion-convection-acceleration equation and diffusion-convection equations. However, the diffusion-convection equation might be inappropriate for studying the particle momentum distribution, especially for cases of wide compressions. In addition, the differences between the results of the pitch-angle transport equation and the approximate diffusion-convection equation, pointing out the importance of using the pitch-angle transport equation, are more evident for a lower particle energy.