Chapter V
Discussion and Conclusions

The comparison of the piecewise linear method and conjugate direction optimization method (Figure 4.18) shows that both methods yield similar FWHM values. The best λ is very close, too. The advantages of the first method are that it is faster, guaranteed to get the best result because it uses linear least squares fitting, and works well with high statistics. In the other hand, the disadvantages are the subjective component (choosing the intervals), and that it does not work well with low statistics. The advantages of the second method are the world-wide usage of the Reid profile, purely objective, and it still works well with low statistics. The disadvantages are that it is slower, and not guaranteed to yield the best result because it uses nonlinear least squares fitting. In the flare events, we have no data with high statistics, so the conjugate direction optimization is more appropriate than the first method, and gives more facility in automatically finding the best results. We conclude that the conjugate direction optimization can be used to find the injection profile and λ for fitting solar cosmic rays from various spacecraft.

The results of fitting 1981 July 20 for each energy for λ =0.05 AU to 0.25 AU are shown in Table 4.1. We find that particles with low energy have a low λ and those with high energy have a high λ. We can conclude that λ is dependent on energy.

The results from simulations for 1981 July 20 compared with 1982 January 2 without energy separation show that the best λ for '81 is 0.10 AU and the best λ for '82 is 0.20 AU. The differences in the result are due to the daily condition of the interplanetary medium and the conditions of transport.

The flare of September 23,1978 is studied with three simulations. ULEWAT has results different from the two HELIOS spacecraft in the FWHM of injection profiles (Figures 4.20, 4.22, 4.24, and 4.26), because we have the data for fitting only the first stage of the flare. The different λ for the two HELIOS spacecraft (Tables 4.6 and 4.7) arise from the different spacecraft positions.

In summary, we used conjugate direction optimization to find the injection profile and the mean free path of particles released from the Sun. We adapted this method for fitting solar cosmic rays from various spacecraft. Finally, we obtained intesting results from this work as folows:

1. We developed computer programs for comparing the results from simulations with fluxes of cosmic rays from the solar flares that were measured by many spacecraft. Now we have the computer programs for the fitting process.

2. We improved the cosmic rays transport simulations for modeling the fluxes of cosmic rays that were measured by many detectors at many solar longitudes. Now we have cosmic ray transport simulations that can be used for various spacecraft and various conditions.

3. We compared the data from the detectors on multiple spacecraft with the results from simulations for determining the particle injection at many longitudes of the Sun. Now we have many data for distinguishing the flare physics, the injection profile, and the transport in the corona.

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