8.1 Conclusions

In the present thesis the spectra of moderately ionized barium (Ba IV-Ba VII) are investigated in the ultra violet region. The earlier studies done on each spectrum is verified by analysing the spectra independently. The investigations of the present work are based on the excitations of n=5 electrons.

The spectra for these analyses were photographed in the 350-2080 Å wavelength region on a 3-m normal incidence spectrograph at the Antigonish laboratory (Canada). The data below 350 Å was supplemented from the spectrograms recorded on a 10.7- m grazing incidence spectrograph of NIST laboratory Gaithersburg, MD (U.S.A) by Y.N. Joshi and V. Kaufman. The spectrograms were measured with the help of a Zeiss Abbe comparator at Aligarh. The lines of C, O, N, Al and Si present on the spectrograms as impurities were used as internal standards for wavelength reduction. Using MOSFIT, a polynomial fit program, the measured data was calibrated into the wavelength. For the optimization of energy levels we have used the computer program KLAS developed by G. J. Van Het Hof of Amsterdam and the program LOPT developed by A. Kramida. To transform the final least square fitted output in the publication form a computer programme TROUTK is used.

The multi configuration interaction calculations for the precise prediction of energy levels and transition arrays were done using the Cowan’s computer programmes (RCN, RCN2, RCG, and RCE). The scaling of energy parameters used for the ab-initio calculations for each spectrum is derived from the corresponding isoelctronic sequence.

The results of the analyses carried out for each spectrum are as follows:

In the fourth spectrum of barium, we have investigated 5s^25p^46p configuration in odd parity matrix and 5s^25p^4(6d+7d) and 5s^25p^4(7s+8s) configurations in even
parity matrix in addition to the earlier studied configurations. All the previously reported levels are confirmed and the \( J \geq 7/2 \) unknown levels of \( 5s^25p^45d \) configuration and the \( ^3P \) \( ^4P_{5/2} \) level of \( 5s^25p^46s \) configuration have been established. All the levels of \( 5s^25p^46p \) and \( 5s^25p^47s \) configurations, 23 levels out of possible 28 levels of \( 5s^25p^46d \) configuration, 6 levels of the \( 5s^25p^48s \) configuration and 15 levels of the \( 5s^25p^47d \) configuration have been established.

In the fifth spectrum, the spectral analysis has been extended considerably to include new configuration \( 5s^25p^36p \) in even parity configuration and, \( 5s^25p^3(6d+7d) \) and \( 5s^25p^3(7s+8s) \) in odd parity configuration. First of all we verified the earlier work and confirmed previously reported levels. All the \( J \geq 4 \) unknown levels of \( 5s^25p^35d \) configuration have now been established. All the levels of \( 5s^25p^36p \) configuration and thirty seven out of forty eight levels of the \( 5s^25p^36d \) and \( 5s^25p^37s \) configurations have now been established. Out of possible 38 levels of \( 5s^25p^37d \) and \( 5s^25p^38s \) configuration only 27 levels could be established.

In the sixth spectrum of barium we have extended the spectral analysis by including new configuration \( 5s^25p^26p \) in even parity configuration and, \( 5s^25p^2(6d+7d) \) and \( 5s^25p^2(7s+8s) \) configurations in even parity configuration. All the previously reported levels have been confirmed and the two unknown levels with \( J = 9/2 \) of the \( 5s^25p^25d \) configuration have now been established. All twenty one levels of \( 5s^25p^26p \) configuration and twenty nine levels out of thirty six levels of the \( 5s^25p^26d \) and \( 5s^25p^27s \) configurations and 16 levels of \( 5s^25p^2(7d+8s) \) configurations have also been established.

In the seventh spectrum of barium, the analysis has been extended considerably to include new configurations \( 5s^25p^6d \) and \( 5s^25p^7s \) in odd parity configuration and \( 5s^25p^6p, 5s^25p^4f, 5s^25p^5f, 5p^4, 5s5p^25d \) and \( 5s5p^26s \) in even parity configuration. In this work we have confirmed all the previously reported levels except the \( ^1P_1 \) level of \( 5s^25p^5d \). All levels of \( 5s^25p(4f+5f) \) configurations, all ten levels of \( 5s^25p^26p \) configuration and thirty six levels out of possible seventy two levels of \( 5s5p^2(5d+6s) \) configurations have been established. All five levels of \( 5p^4 \) configuration and sixteen levels of \( 5s^25p^6d \) and \( 5s^25p^7s \) configurations were found.
Our findings are based on confirmation of most of the previously reported transitions and classification of 211, 311, 190 and 326 new lines of Ba IV, V, VI and VII spectra respectively.

8.2 Future Scope

As evident from literature, the atomic data and informations available on simple spectra are more than that on complex spectra. A survey of the past investigations done so far reveals that, most of these deal with the closed d shells. The progress on the analyses of configurations involving open d shells is not satisfactory as the spectra in open d shell transitions become very dense. In barium one such study has been done by Murphy et al. Therefore we too are planning for the study of such transitions in near future.

In the present work, we have studied mostly the excitations of electrons from s orbital to p orbital, from p orbital to d orbital, except in Ba VII spectrum, where the excitation from d to f orbital is also studied. In future investigations we may go for the d to f orbital and f to g orbital transitions.

In the near future we are planning to enhance our spectral data by extending the wavelength region of investigation. We will make some recordings in the lower wavelength region extending up to a few tens of angstroms as well as in the higher region above 2000 Å with higher accuracy and better dispersion. This enhanced data will facilitate us in the further extension of the spectral analyses.