Concluding Remarks
The field of atomic physics has served astronomy for a long time and it has also been stimulated by it. Atomic data in the form of oscillator strengths, radiative rates, lifetimes, energy levels and photoionization cross section are required in a steadily increasing number of research areas like astrophysics, fusion research and laser research. Calculation of atomic data of highly charged ions have been undertaken in recent years because of an increase in available experimental data and the advent of supercomputers has made such calculations more tractable than in the past. Large multiconfiguration Dirac-Fock (MCDF) code, which has been used in present work, allow a fully relativistic treatment of the atomic structure of such system. Further, the requirement of atomic data gives a tremendous motivation to exploit other powerful computational methods, such as the R-matrix method etc.

In this thesis, we have presented new atomic data for atomic structure and photoionization cross section of highly charged ion. We have presented energy levels, transition probability and oscillator strength for S-like Fe XI and Ti VII using CIV3 technique. We have also presented level energies, oscillator strength, line strength and radiative rates for W XI and Kr XXXV using fully relativistic multiconfigurational Dirac-Fock (MCDF) method applied in General purpose relativistic atomic structure code (GRASP) code. Furthermore, we have applied R-matrix method to calculate the photoionization cross-section for Si II and Fe X. The energy structures and the spectra of sulphur like ions have been a subject of intense investigations in theory, experiment and application. We have compared our calculated energy levels and other results with the available experimental and theoretical results and were found in good agreement both for Ti VII and Fe XI. Energy levels and emission lines for many levels has been given for the first time. We have also compared length and velocity forms of oscillator strength, as it is a necessary condition to have close agreement between both forms. We found that there is a good agreement between length and velocity forms of oscillator strength in our calculation of Fe XI and Ti VII, which shows the qualities of the wave functions considered in present calculations. We believe that our results are most extensive and will be useful in astrophysical and plasma application.
Extensive studies of transition wavelengths, oscillator strengths and radiative rates in He-like and Br-like ions are strongly needed due to their wide applications in numerous types of plasmas, including astrophysical plasmas and fusion plasmas. Therefore, we have performed calculation of Br-like tungsten (W XL) and He-like krypton (Kr XXXV) using a fully relativistic GRASP code. In case of W XL, we have presented lifetimes, level energies, wave function compositions in both LSJ and JJ coupling among the $4s^24p^5$, $4s4p^6$ and $4s^24p^4d$ configurations. We have also presented the energy levels, radiative rates, oscillator strength and line strength for the lowest 67 levels of He-like Kr XXXV. In our calculations, some of the levels show very strong mixing as discussed in Chapter 3. In spite of the fact that the energy gap between many of these levels, the calculated energy agree well with the National Institute of Standards and Technology (NIST) results, which gives us confidence in the high quality of our wave functions. Our results are intended to plasma physicists for interpretation of spectra emitted by plasma produced in fusion reactors.

Accurate cross sections for photoionization of atoms and ions are essential for modeling a broad range of astrophysical plasmas, the atmosphere of hot stars and supernovae. The principle objective of present photoionization cross section calculations on Fe X and Si II using R-matrix method is to produce cross section to the accuracy required to exploit the high quality of observations from the space and ground based telescopes, as these ions have particular significance to the astrophysical community. We have calculated photoionization cross section for the lowest three and six states of Fe X and Si II respectively, where no other theoretical and experimental results are available. We have calculated target states of Fe XI and Si III using configuration interaction technique and obtained energy levels for photoionization cross section of Fe X and Si II. We have used the fine-tuned energies of STGH of R-matrix to ensure correct positioning of resonance. In these calculations we have used lowest 41 target states of Fe XI, while 20 target states of Si III have been considered. Our present results should provide complete and accurate database for modeling ionization balance of these atom and ions in astrophysical and laboratory plasmas.

In the last, the work done in this thesis may contribute advances in the performance and understanding of tokamak and the necessary fusion conditions of confinement
configurations, density and temperature. Also, these studies may be used in the diagnostic analysis of fusion plasma inside the tokamak machines, like the ITER, for future source of energy in the world. Finally, we believe that calculated data may contribute the necessary impetus for understanding solar, astrophysical and laser applications.