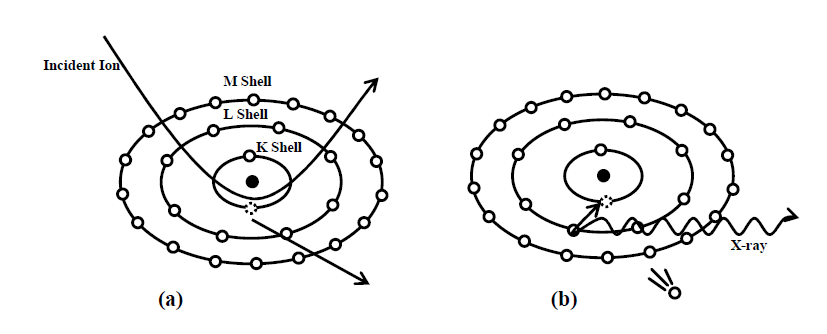
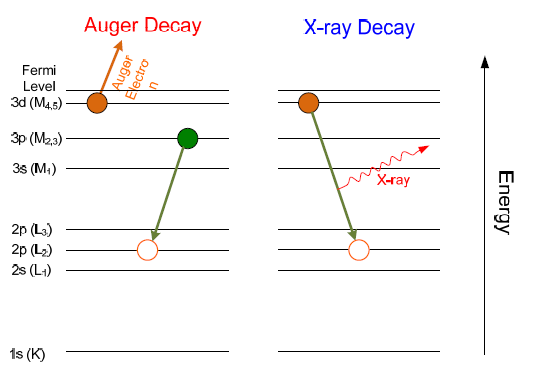
**Figures**



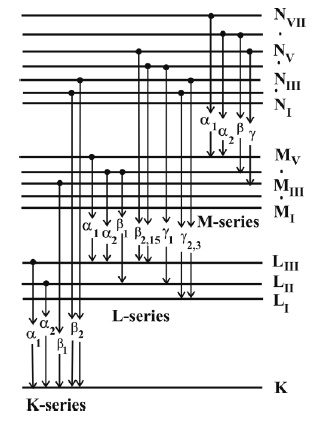
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Figure 1. 1: Fundamental Principle of PIXE. (a) Showing the interaction of an ion wi

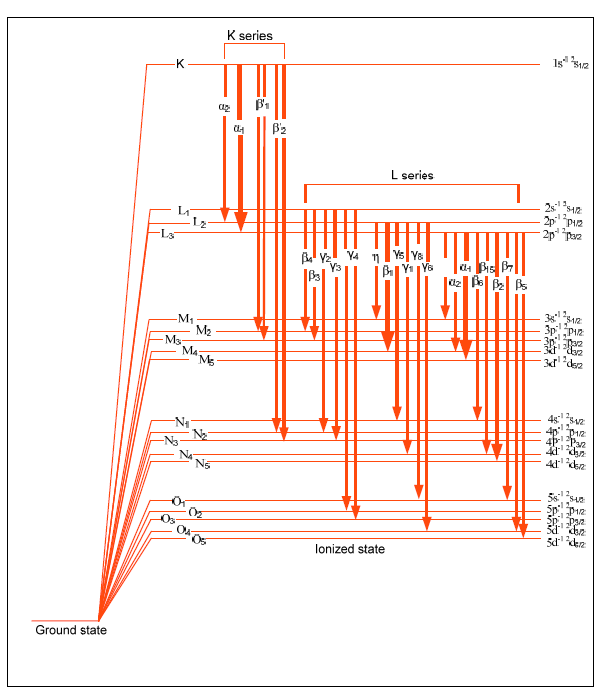
*Figure 1. 1: Fundamental Principle of PIXE. (a) Showing the interaction of an ion with the inner shell electron of an atomic species. (b) Showing excitation of an atom, the subsequent ejection of an electron from the inner shell, and the subsequent emission of characteristics X-ray.*



*Figure 1. 2: Auger electron emission.*



*Figure 1. 3: Diagram showing energy levels with K, L, and M X-ray.*

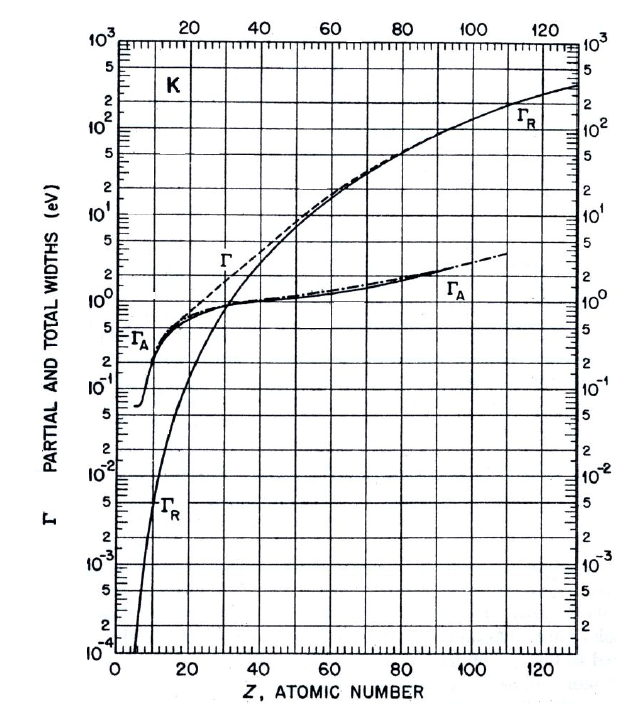


*Figure 2. 1: Schematic diagram showing allowed X-ray ray transitions to K and L shells with*

*single-vacancy atoms [5].*

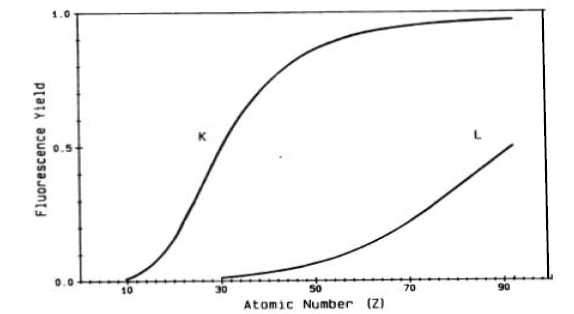
*Figure 2. 1: Schematic diagram showing allowed X-ray ray transitions to K and L shells with*

*single-vacancy atoms.*



*Figure 2. 2: Theoretical level widths for atomic K shells as a function of the atomic number*

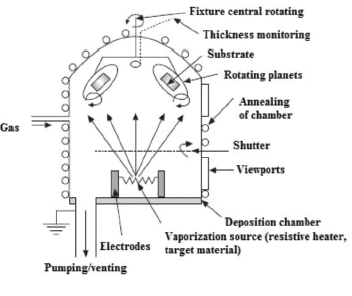
*Where is the Auger width.*



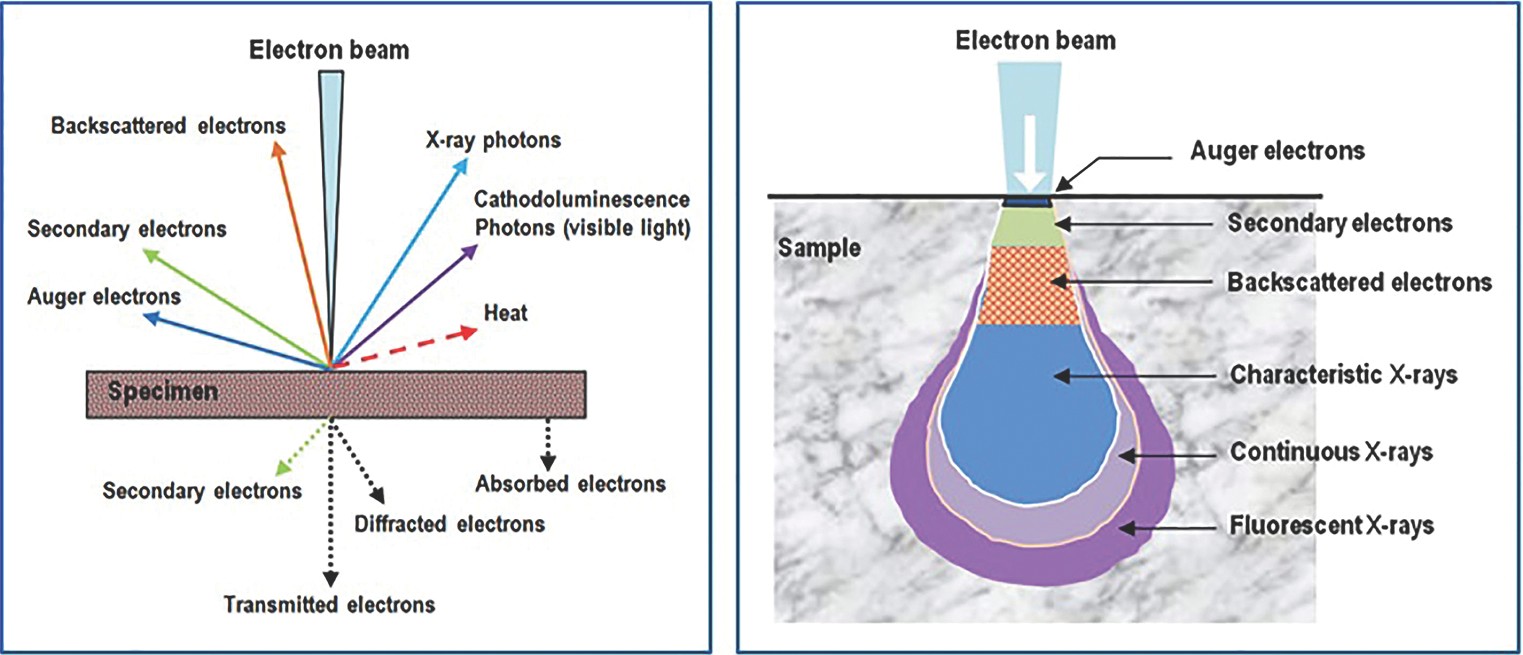
*Figure 2. 3: A diagram showing the K-and L-shell fluorescence yields as functions of atomic number Z.*



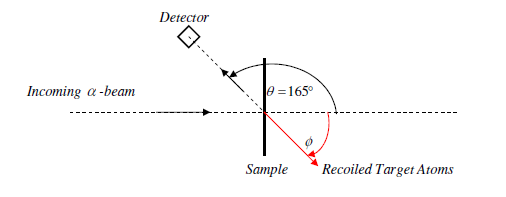
*Figure 3.1: A photograph of electron beam deposition at University of Pretoria.*



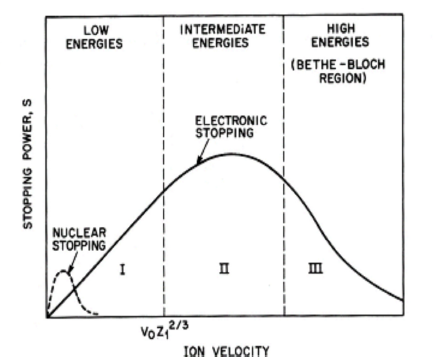
*Figure 3.2: A Schematic diagram of thermal evaporation system.*



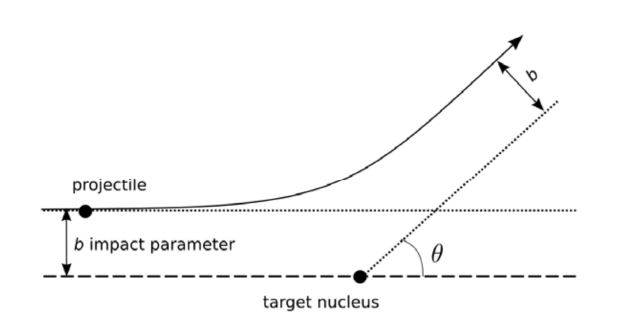
*Figure 3.3: Diagram of the interaction between the electron beam and a target material.*



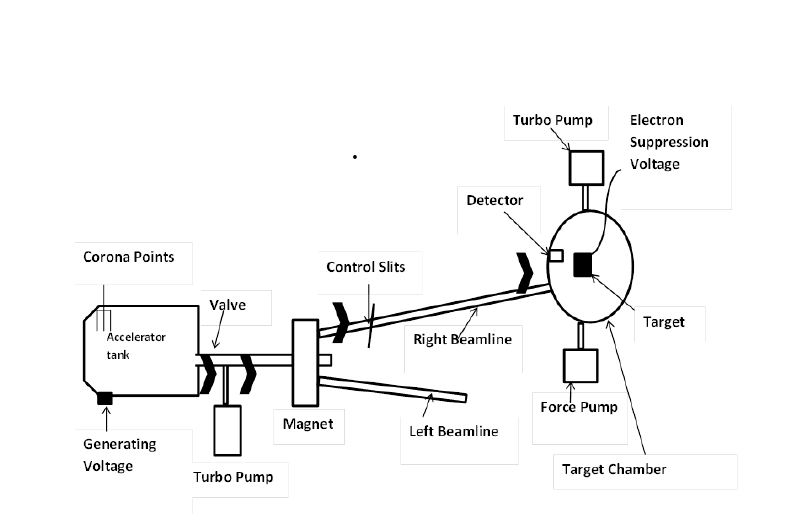
*Figure 3.4: Schematic diagram showing the position of the detector of the RBS experimental setup at the University of Pretoria.*



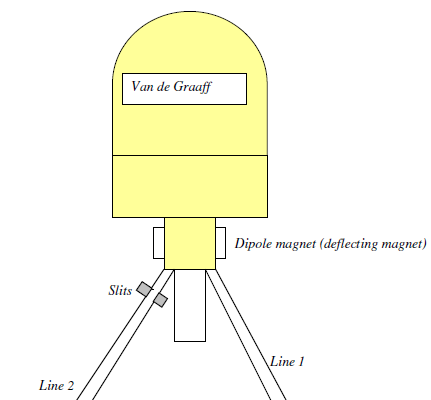
*Figure 3. 5: Nuclear and electronic components of the ion stopping power as a function of ion velocity.*



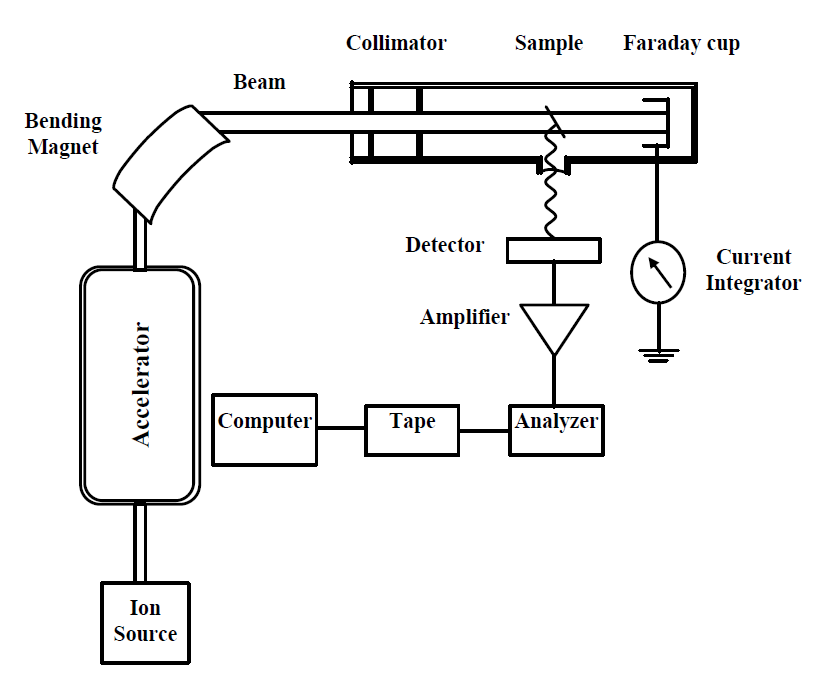
*Figure 3. 6: Scattering of a projectile ion by a stationary atom in the laboratory.*

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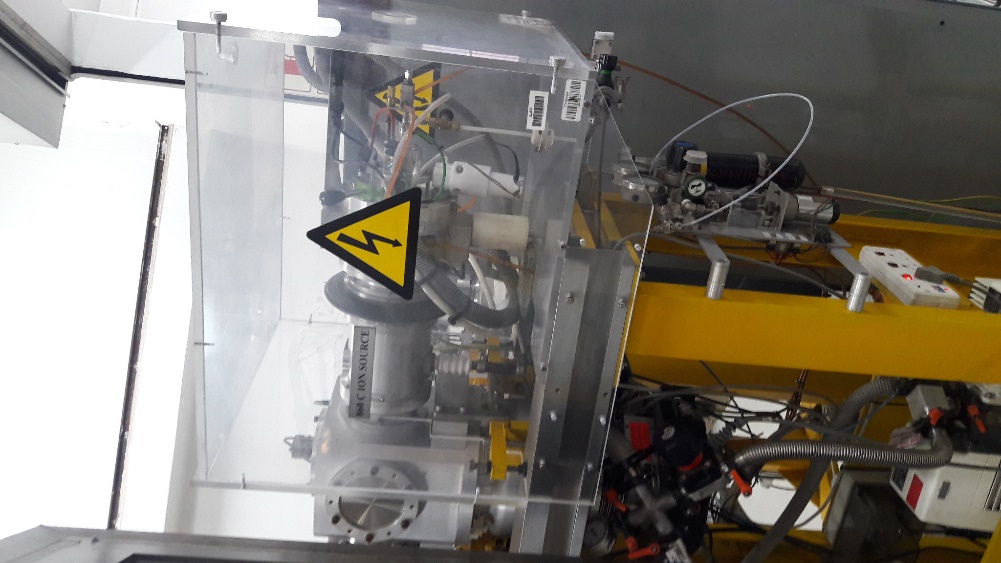
*Figure 3. 7: A typical RBS design.*



*Figure 3. 8: A schematic diagram of the Van de Graaff accelerator.*



*Figure 3. 9: A schematic diagram representing PIXE technique experimental set-up.*

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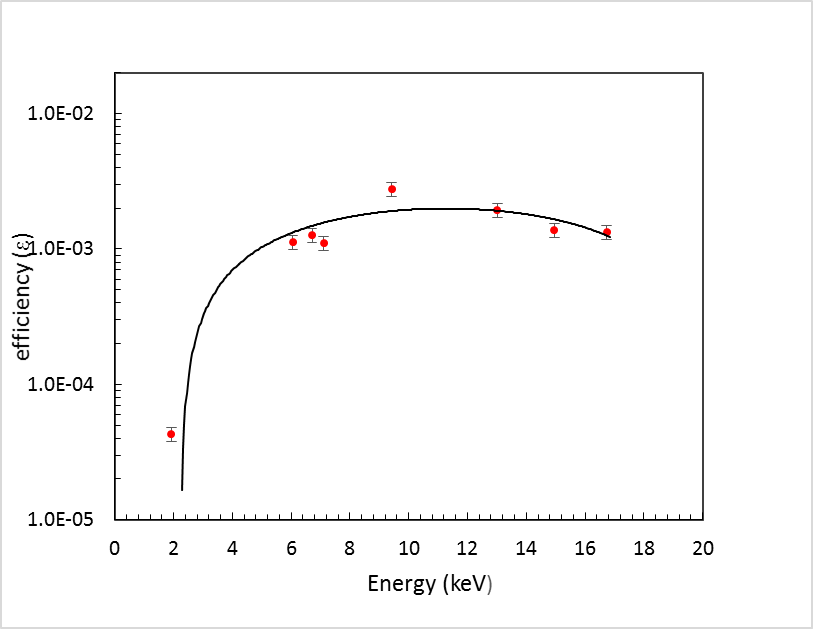
*Figure 3. 10: Photograph of the heavy ion source at iThemba LABS, Johannesburg South Africa.*

*Figure 4. 1: RBS energy calibration curve***.**

 *Figure 4. 2: A spectrum from SIMNRA simulation of gadolinium thin film*.



*Figure 4. 3: Energy spectrum of Bi L-shell X-rays induced by 12 MeV carbon ions****.***



*Figure 4. 4: Efficiency curve of the Si (Li) detector*.

EI Ef

Thin film

*Figure 4.5: Schematic diagram of a thin film****.***

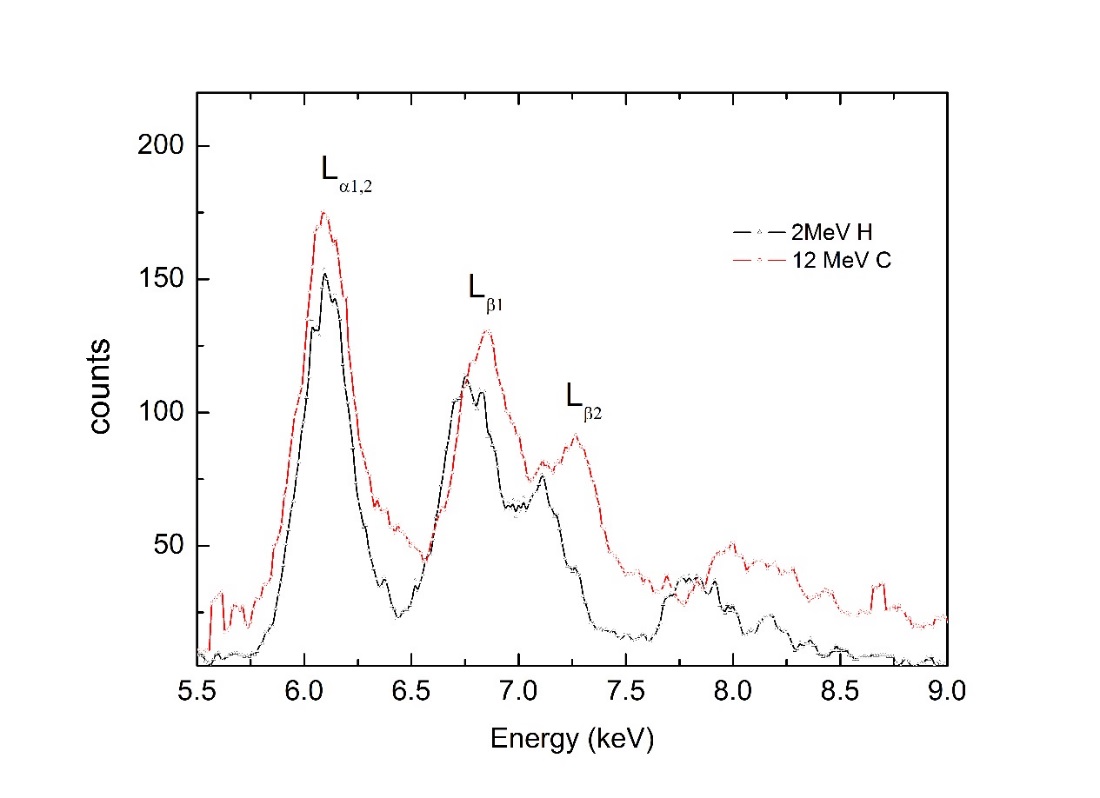
*Figure 4.6: A graph of 1/S against Energy*

*Figure 4.7: A graph of T (E) against Energy to obtain the exit energy Ef of carbon.*

*Figure 4. 8: A graph of 1/S against E (MeV).*

*Figure 4.9: A graph of Y (E) against E (MeV****).***

*Figure 4.10: A graph of ECPSSR against E (MeV).*



*Figure 5.1: Multiple ionization effect on gadolinium L-shell X-ray energies due to 12 MeV carbon projectiles.*

*Figure 5.2: Comparison of Experimental L-line intensity ratios, for C-Zr and Cl-Zr*

*Figure 5.3: Comparison of Experimental L-line intensity ratios, for C-Sn and Cl-Sn.*

*Figure 5.4: Comparison between the energy shifts in Zr ( due to C ions and Cl ions.*

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*Figure 5.5. Comparison between the energy shifts in Zr due to C ions and Cl ions.*

*Figure 5.6: Experimental X-ray production cross sections in Bi induced by carbon ion (4 MeV-12 MeV) in barns without MI effect.*

*Figure 5.7. Experimental X-ray production cross sections in Gd induced by carbon ion (4 MeV-12 MeV) in barns without MI effect.*

*Figure 5.8: Experimental X-ray production cross sections Y induced by carbon ion (4 MeV-12 MeV) in barns without MI correction.*

*Figure 5.9: Experimental X-ray production cross sections Gd induced by Cl ion (7 MeV-35 MeV) in barns without MI correction.*

*Figure 5.10: Experimental X-ray production cross sections in Bi induced by C ion (4 MeV-12 MeV) in barns MI correction.*

*Figure 5.11: Experimental X-ray production cross sections in Gd induced by Cl ion (7 MeV-35 MeV) in barns MI correction.*

*Figure 5.12: Experimental X-ray production cross sections Y induced by carbon ion (4 MeV-12 MeV) in barns without MI correction.*

*Figure 5.13: Experimental X-ray production cross sections in Gd induced by Cl ion (7 MeV-35 MeV) in barns MI correction.*

*Figure 5.14: Comparison between C-Bi measured cross section with ECPSSR and ECPSSR+MI.*

*Figure 5.15: Comparison between C-Gd measured cross section with ECPSSR + UA and ECPSSR + UA + MI.*

*Figure 5.16: Comparison between C-Y measured cross section with ECPSSR and ECPSSR+MI.*

*Figure 5.17: Ratio of the experimental C-Bi data to three sets of theoretical model, ECPSSR, ECPSSR+EC and ECPSSR+UA.*

*Figure 5.18: Ratio of the experimental C-Gd data to three sets of theoretical model, ECPSSR, ECPSSR+EC and ECPSSR+UA.*

*Figure 5.19: Ratio of the experimental C-Ydata to three sets of theoretical model, ECPSSR, ECPSSR+EC and ECPSSR+UA.*