

APPENDIX

9

Evaluated Elastic Scattering Cross Sections

Compiled by

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The utilization of protons and ^4He beams with energies at which the elastic scattering cross section is non-Rutherford has become very common. Consequently, the differential cross sections for elastic backscattering of protons and alphas from light nuclei have become among the most important data for IBA. The linear dependence of the registered signal on the cross section results in obvious requirements for accuracy of the data. It is evident that the concentration cannot be determined with the accuracy exceeded that of the cross section. Thus the importance of a precise knowledge of the differential cross sections does not need to be emphasized.

The cross-sections are usually obtained by experimental means and are hence subject to statistical fluctuation, the reliability of the sample preparation and the pitfalls inherent in any experiment. Highly reliable data are available, and confidence is high where values from many different laboratories agree, however even reliable experimental data usually remains discrete in both energy and angle.

The nuclear data evaluation is a routine procedure in preparing neutron data for different applications. It was also successfully extended to the charged particle cross sections (see Chapter 3, Section 3.5). The evaluation of the cross-sections for any particular reaction consists in the elaboration of the most accurate possible cross-sections through incorporation of the all relevant experimental data in the framework of nuclear physics theory. Though nuclear physics theory cannot provide cross section data with required accuracy by calculations based on the first principals it does provide a powerful tool for the data evaluation. The nuclear model parameters are adjusted using the experimental information taken from different sources. When experiment and theory lock into a coherent whole this gives proof that a reliable result has been obtained. Then the required excitation functions for analytical purposes may be calculated for any scattering angle. Reliability of the evaluated cross sections was proved by numerous comparisons with posterior measurements and benchmark experiments. Therefore the use of evaluated data leads to substantial improvement in the accuracy of the analytical results obtained by IBA.

The evaluated cross sections in this appendix are presented in graphical form only, as plots where theoretical data shown as lines are compared with experimental results at limited number of angles. The corresponding numerical data can be obtained by means of the on-line calculator SigmaCalc (<http://www-nds.iaea.org/sigmacalc/>). The SigmaCalc tool is also integrated into the web site IBANDL (<http://www-nds.iaea.org/ibandl/>) where a comparison of the available experimental data with results of the evaluation can be easily made. Theoretical and methodological issues of the evaluation procedure can be found elsewhere (Gurbich, 2007).

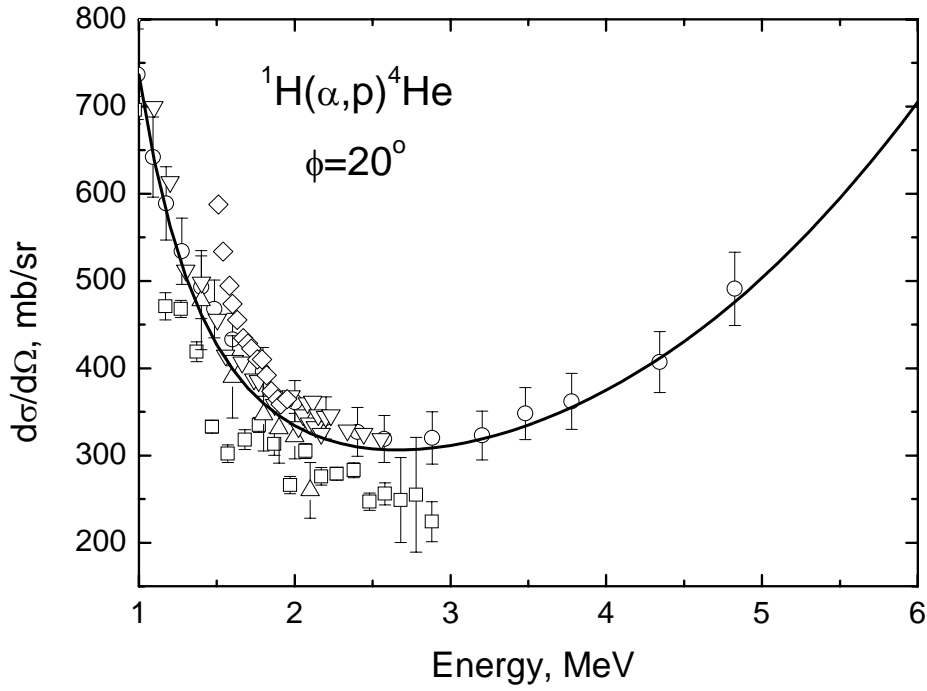


FIG. A9.1. \square – Baglin *et al.* (1992), \circ – Kim *et al.* (1999), \triangle – Wang and Zhou (1988), ∇ – Quillet *et al.* (1993), \diamond – Nagata *et al.* (1985), solid line – Pusa *et al.* (2004).

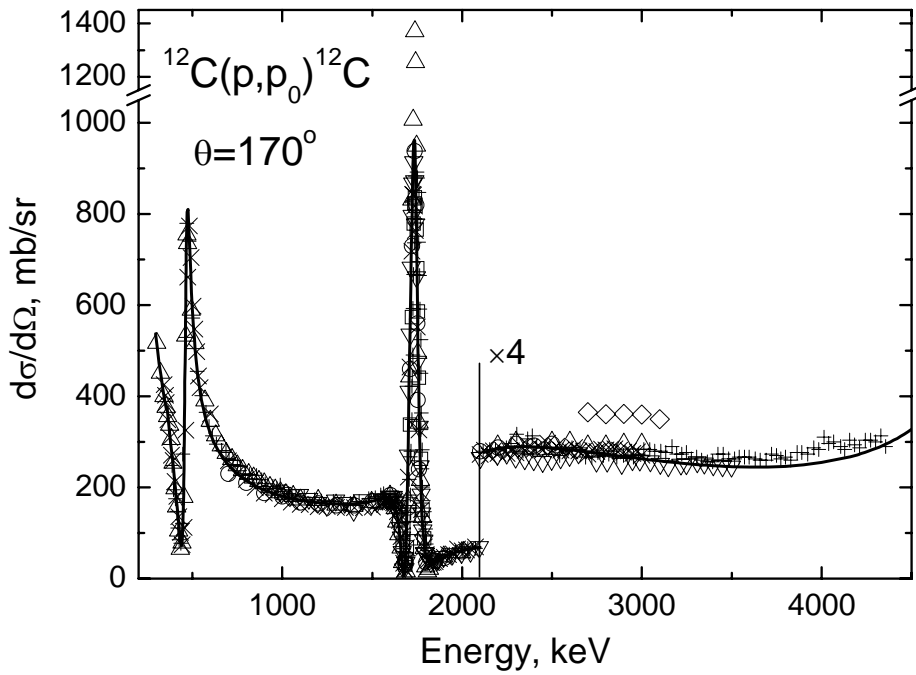


FIG. A9.2. \circ – Rauhala (1985), \triangle – Liu *et al.* (1993), \square – Salomonovič (1993), ∇ – Amirikas *et al.* (1993), \diamond – Yang *et al.* (1991), $+$ – Jackson *et al.* (1953), \times – Mazzoni *et al.* (1999), solid line – Gurbich (1998a).

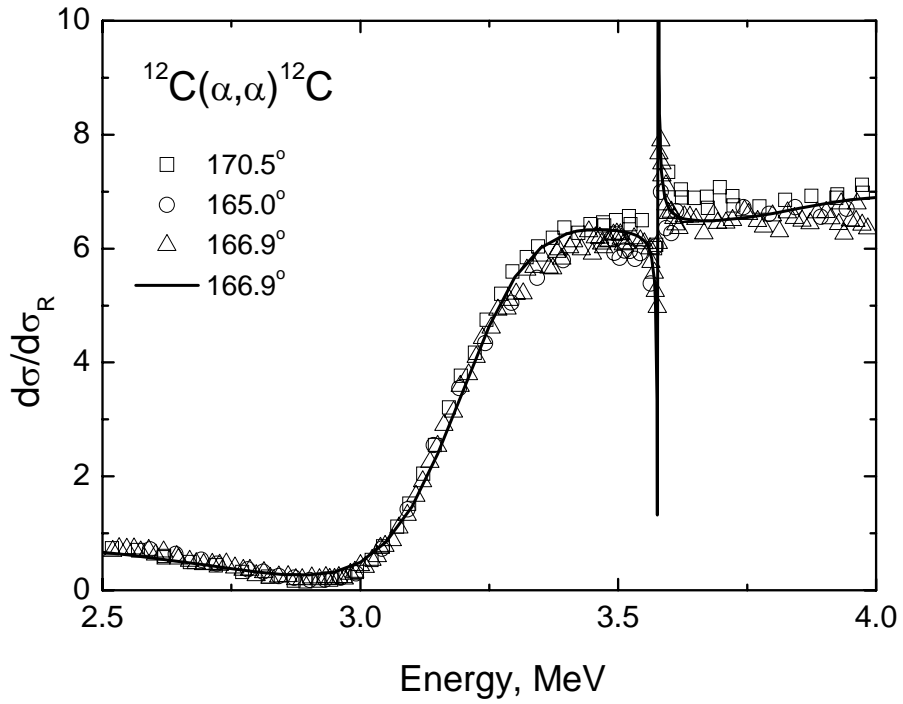


FIG. A9.3. \square – Leavitt *et al.* (1989), \circ – Feng *et al.* (1994), \triangle – Hill (1953), solid line – Gurbich (2000).

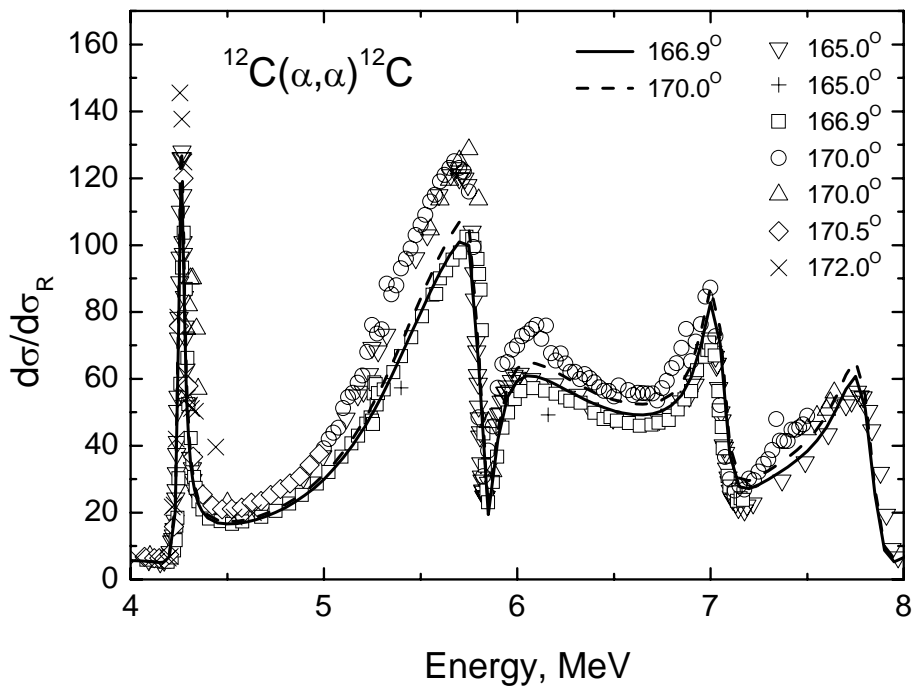


FIG. A9.4. ∇ – Feng *et al.* (1994), $+$ – Gosset (1989), \square – Bittner and Moffat (1954), \circ – Cheng *et al.* (1994a), \triangle – Davies *et al.* (1994), \diamond – Leavitt *et al.* (1989), \times – Somatri *et al.* (1996), solid and dash lines – Gurbich (2000).

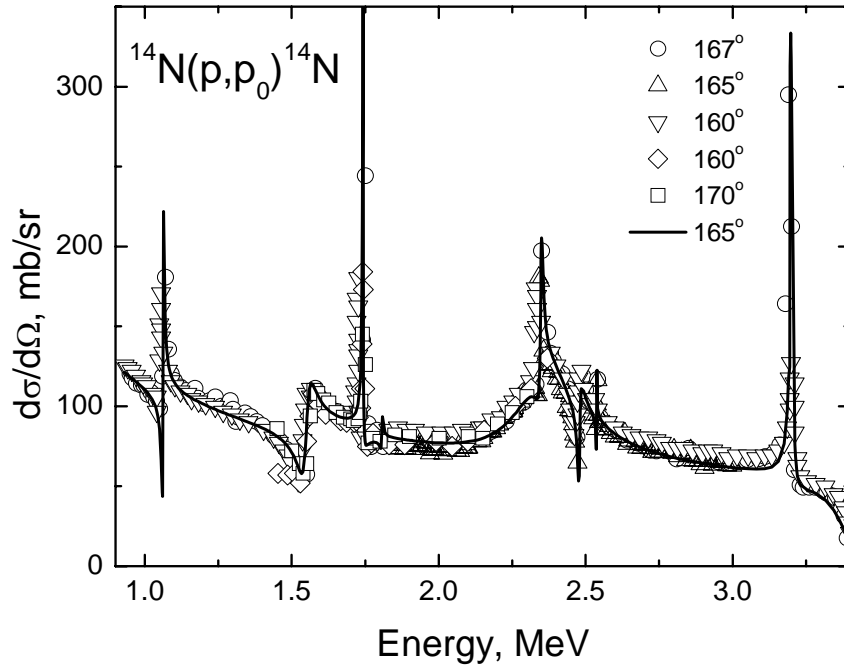


FIG. A9.5. \circ – Olness *et al.* (1958b), \triangle – Lambert and Durand (1967), ∇ – Bashkin *et al.* (1959), \diamond – Havranek *et al.* (1991), \square – Rauhala (1985), solid line - - Gurbich (2008).

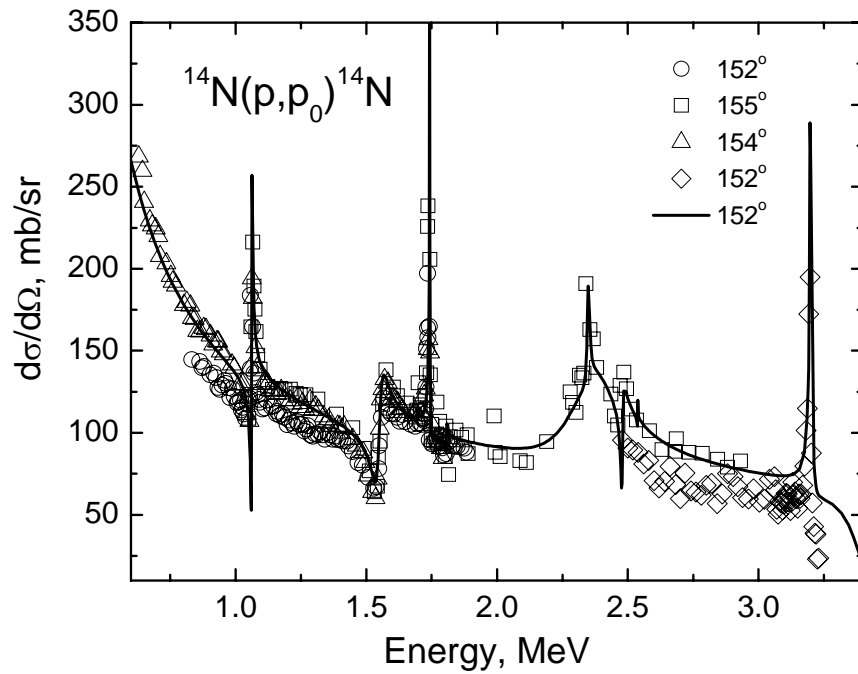


FIG. A9.6. \circ – Tautfest and Rubin (1956), \circ – Ferguson *et al.* (1959), \triangle – Hagedorn *et al.* (1957), \diamond – Jiang *et al.* (2005), solid line – Gurbich (2008).

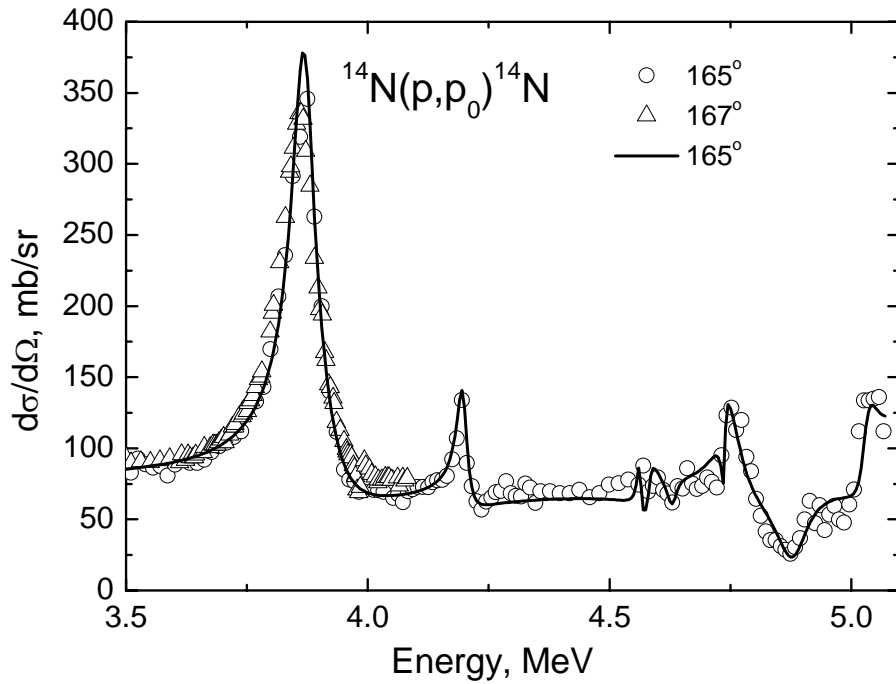


FIG. A9.7. \circ – Bogdanović Radović *et al.* (2008), \triangle – Olness *et al.* (1958a), solid line – Bogdanović Radović *et al.* (2008).

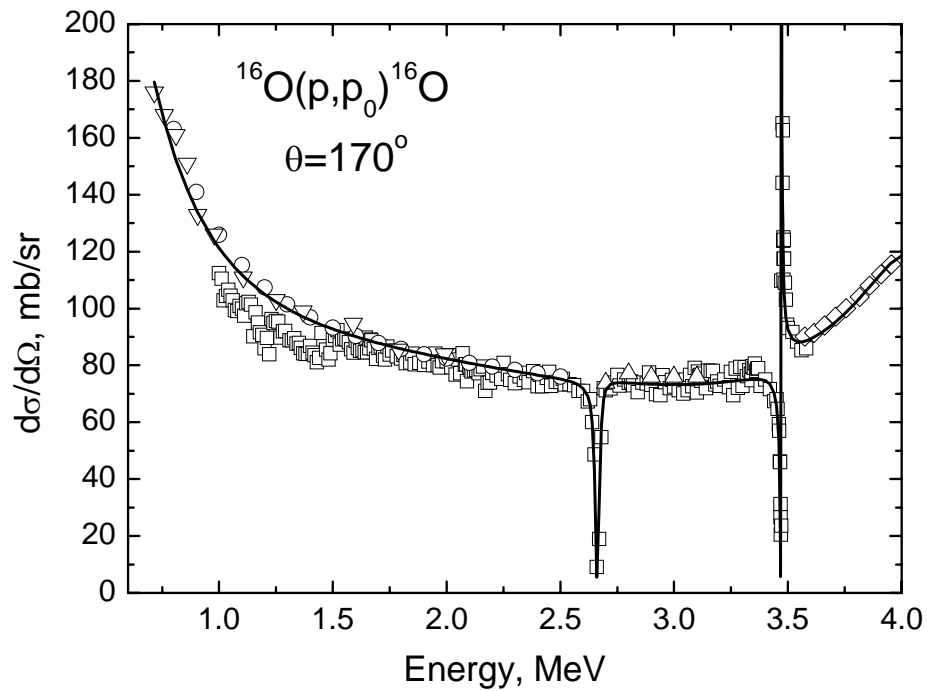


FIG. A9.8. \square – Amirikas *et al.* (1993), \circ – Luomajarvi *et al.* (1985), \triangle – Yang *et al.* (1991), ∇ – Chow *et al.* (1975), \diamond – Eppling *et al.* (1953), solid line – Gurbich (1997).

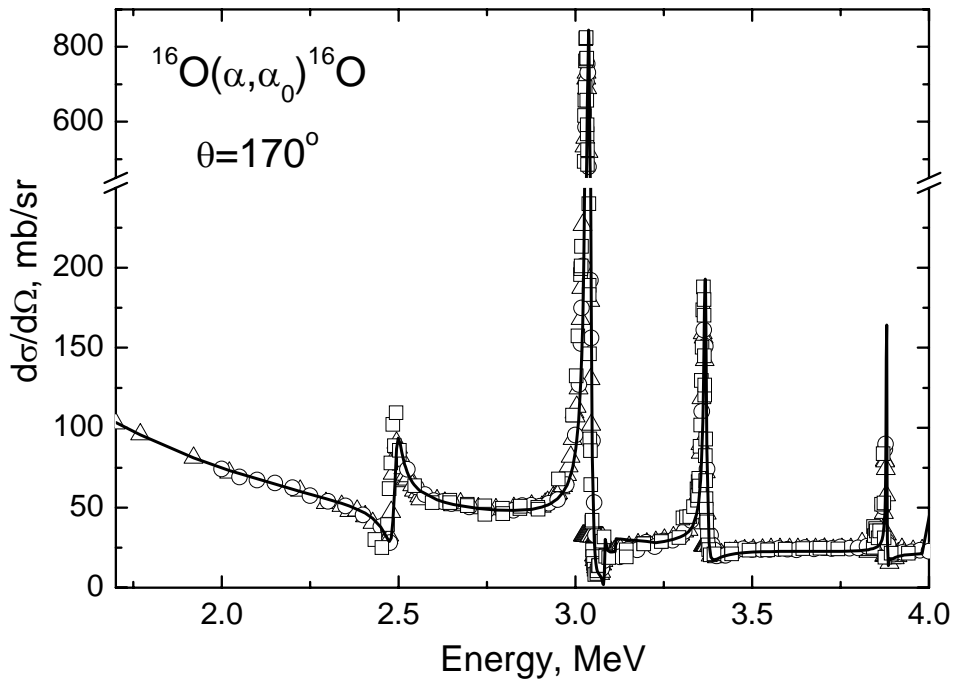


FIG. A9.9. \triangle – Leavitt *et al.* (1990), \circ – Cheng *et al.* (1993),
 \square – Demarche and Terwagne (2006).

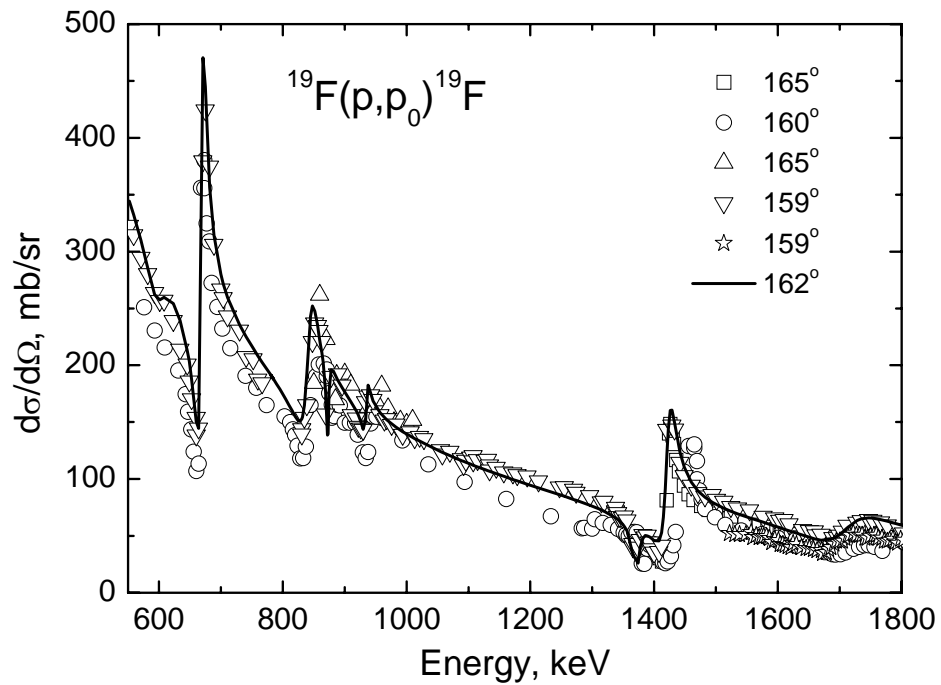


FIG. A9.10. \square – Jesus *et al.* (2001), \circ – Dearnaley (1956), \triangle –
Knox and Harmon (1989), ∇ – Webb *et al.* (1955), \star – Ouichaoui
et al. (1986).

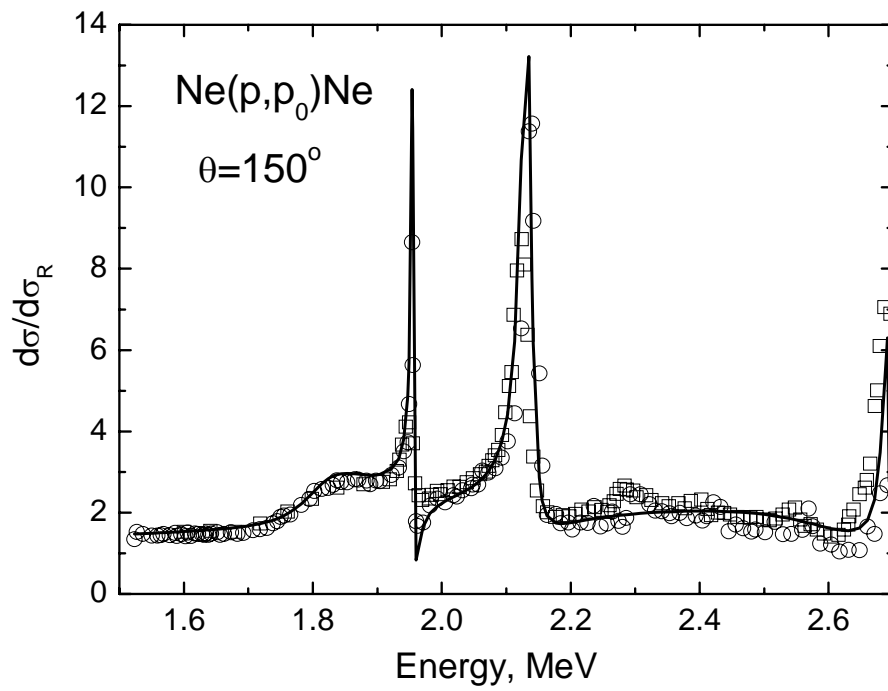


FIG. A9.11. ○ – Lambert *et al.* (1972), □ – Valter *et al.* (1960).

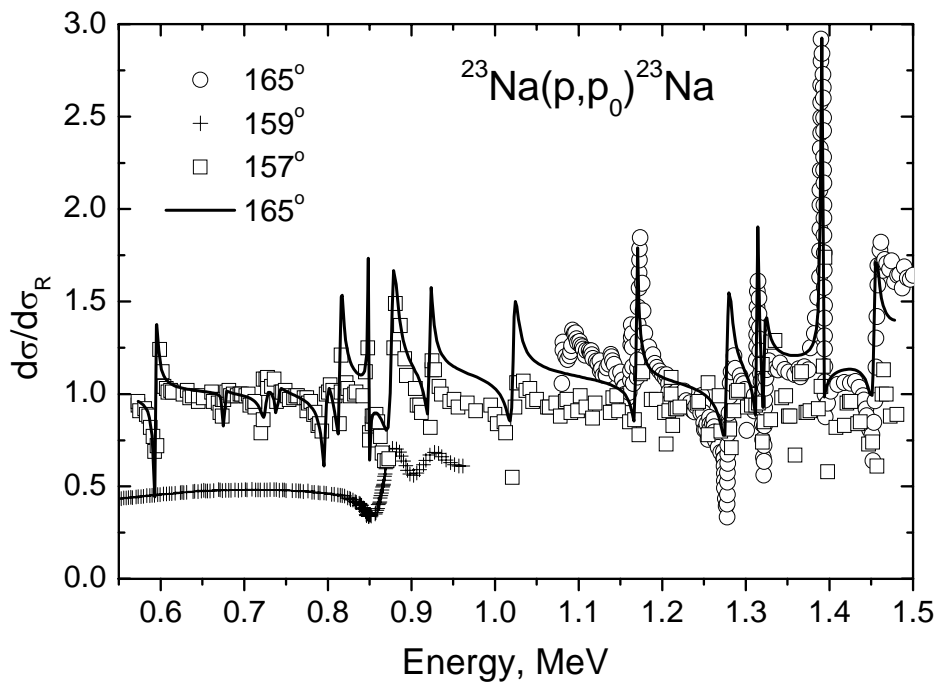


FIG. A9.12. ○ – Vanhoy *et al.* (1987), + – Dearnaley (1956), □ – Baumann *et al.* (1956).

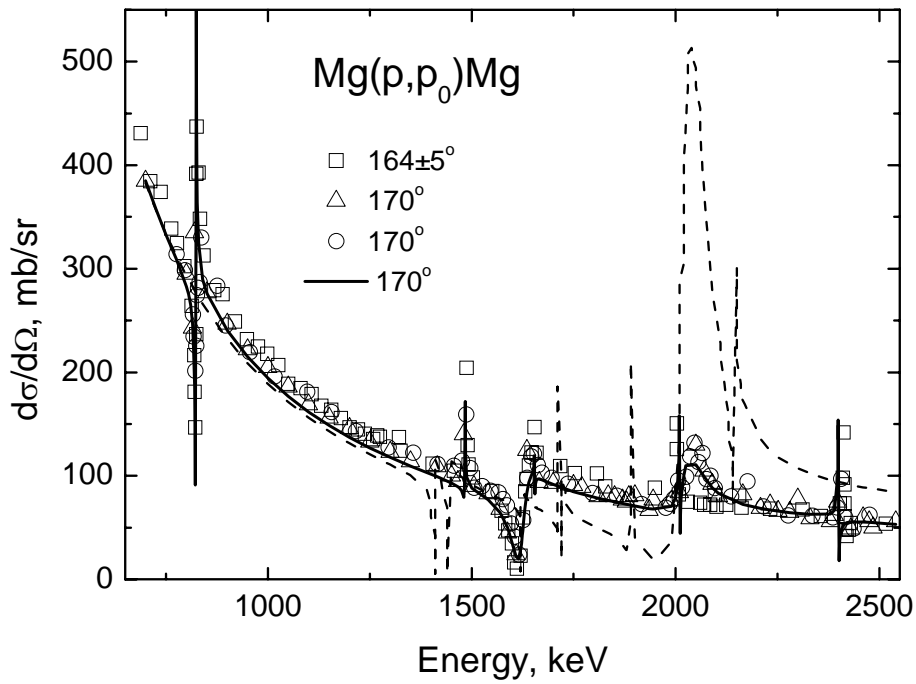


FIG. A9.13. □ – Mooring *et al.* (1951), △ – Rauhala and Luomajärvi (1988), ○ – Zhang *et al.* (2003), solid line – Gurbich and Jeynes (2007), dash line – theoretical cross-section for ^{26}Mg .

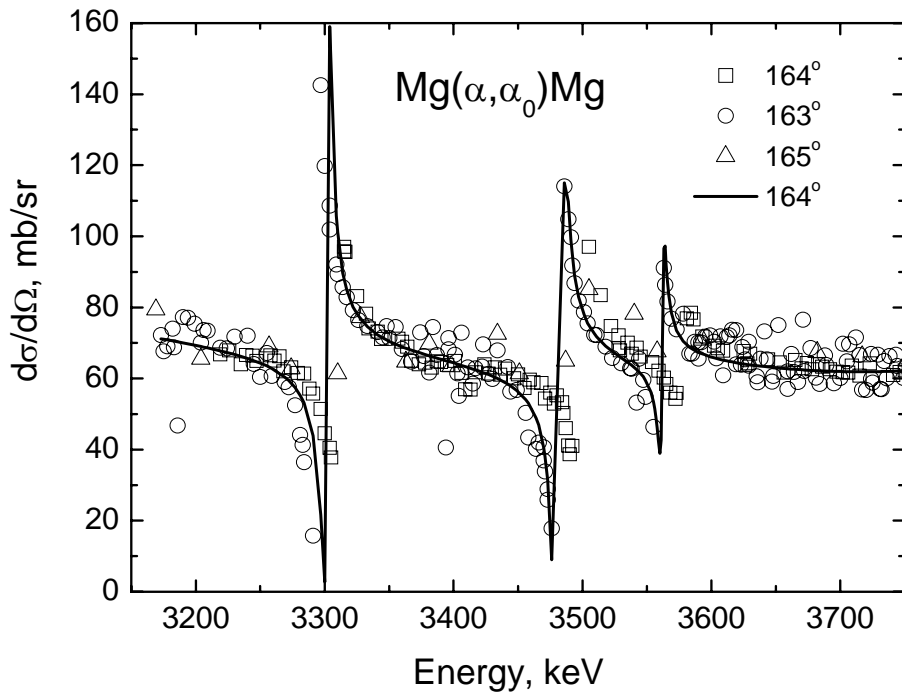


FIG. A9.14. □ – Kaufman *et al.* (1952), ○ – Cseh *et al.* (1982), △ – Cheng *et al.* (1994b).

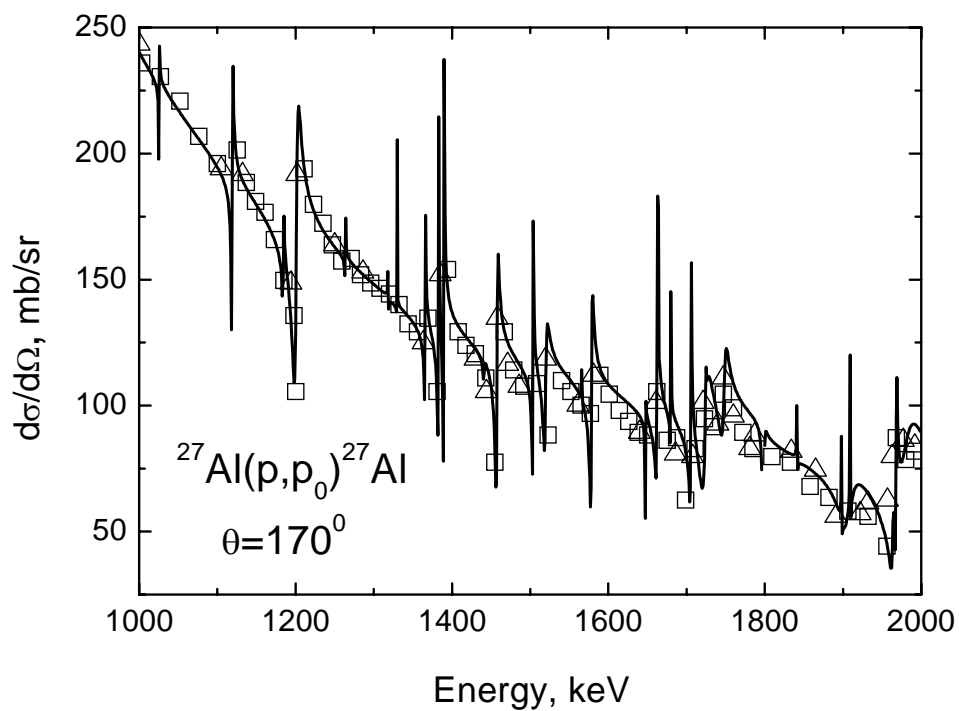


FIG. A9.15. \triangle – Rauhala (1989), \square – Chiari *et al.* (2001), solid line – Gurbich *et al.* (2002).

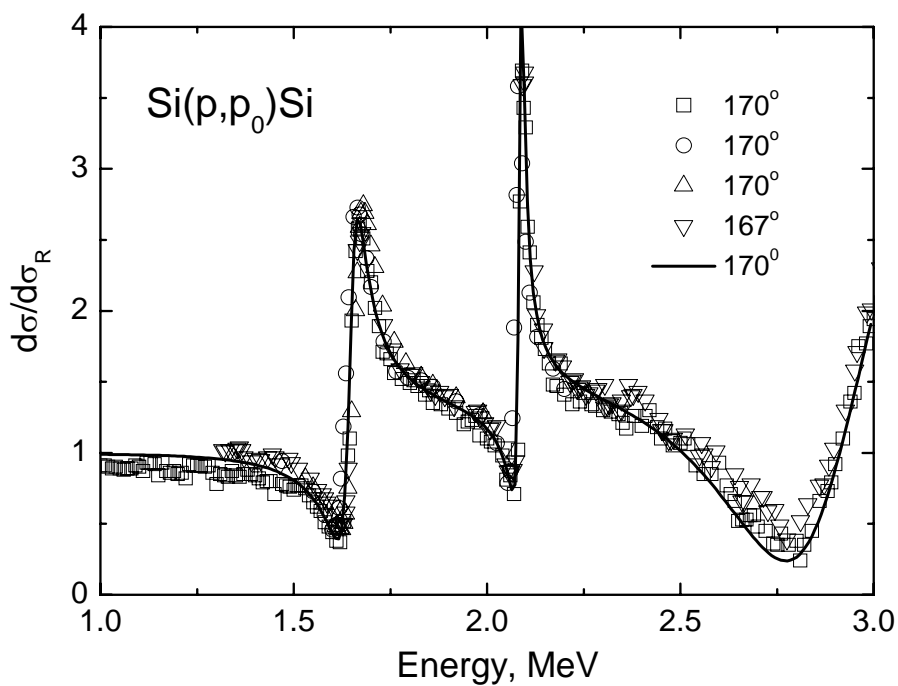


FIG. A9.16. \square – Amirikas *et al.* (1993), \circ – Rauhala (1985), \triangle – Salomonovič (1993), ∇ – Vorona *et al.* (1959), solid line – Gurbich (1998b).

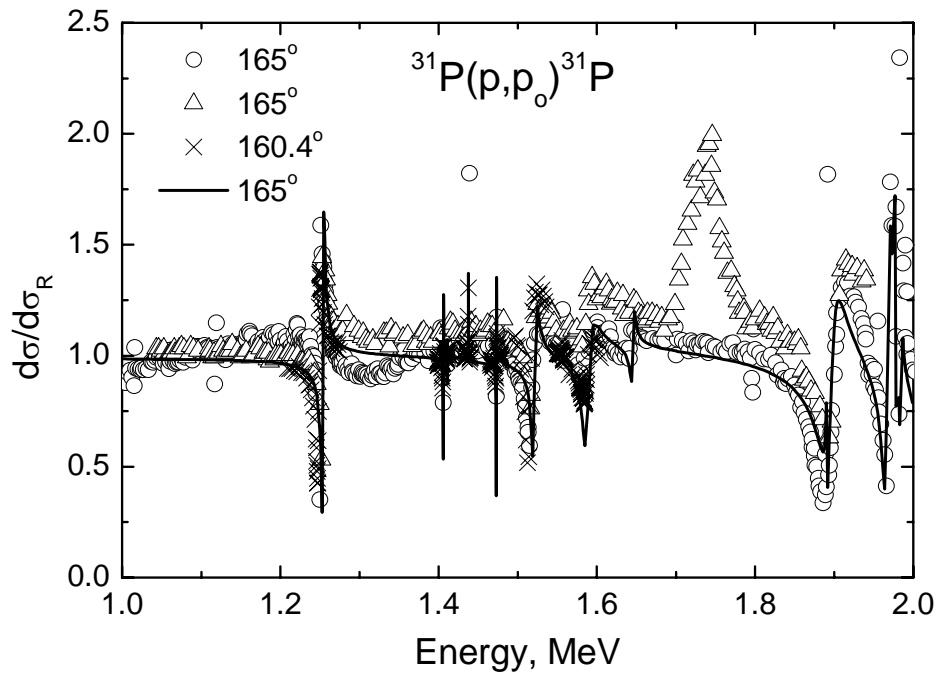


FIG. A9.17. \circ – Fang *et al.* (1988), \triangle – Cohen-Ganouna *et al.* (1963), \times – Vernotte *et al.* (1973).

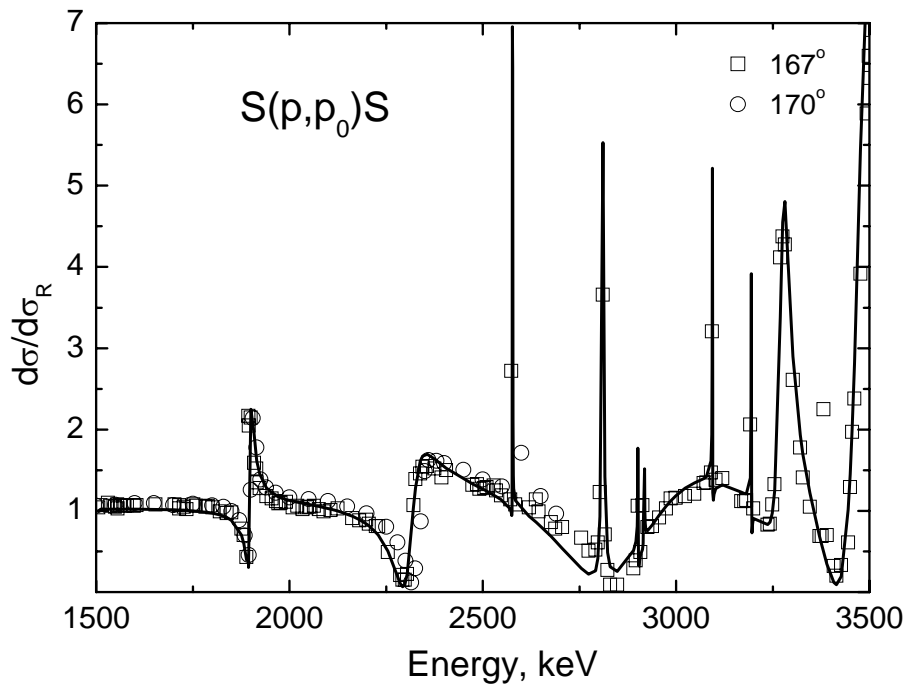


FIG. A9.18. \square – Olness *et al.* (1958a), \circ – Rauhala and Luomajärvi (1988).

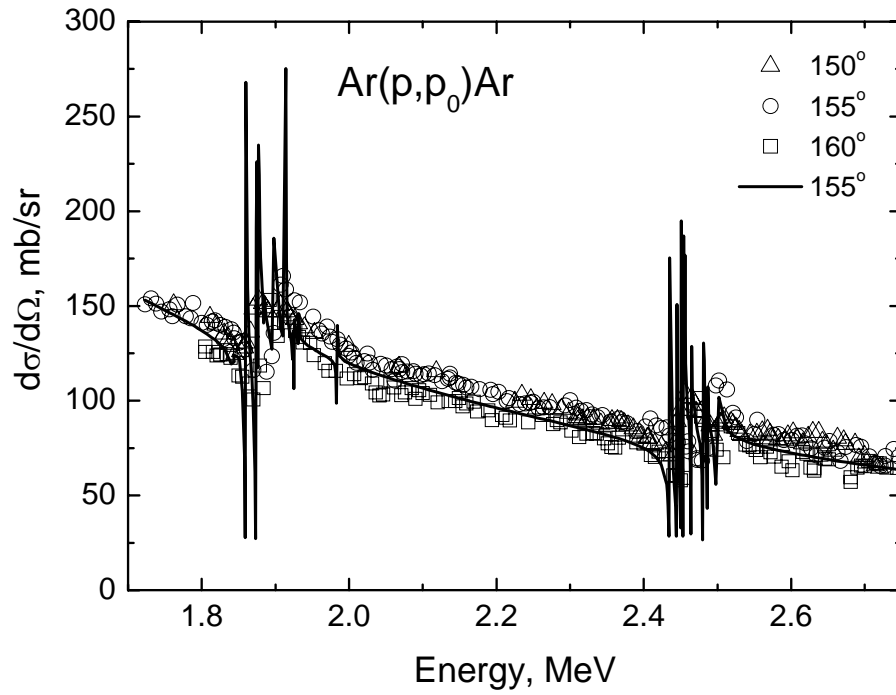


FIG. A9.19. \triangle – Valter *et al.* (1959), \circ – Frier *et al.* (1958), \square – Barnhard and Kim (1961).

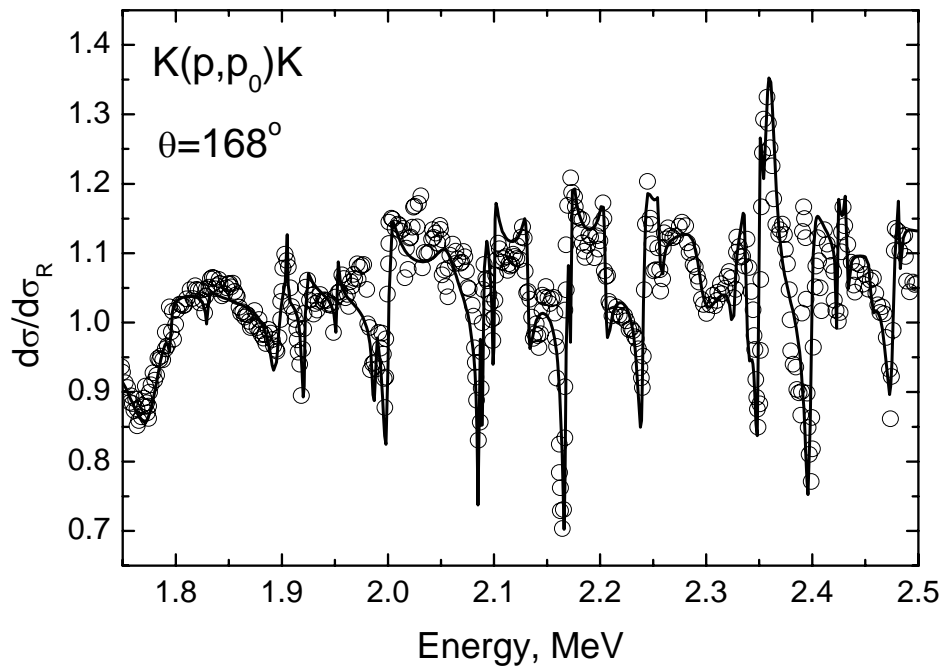


FIG. A9.20. \circ – De Meijer *et al.* (1970) normalized against theory.

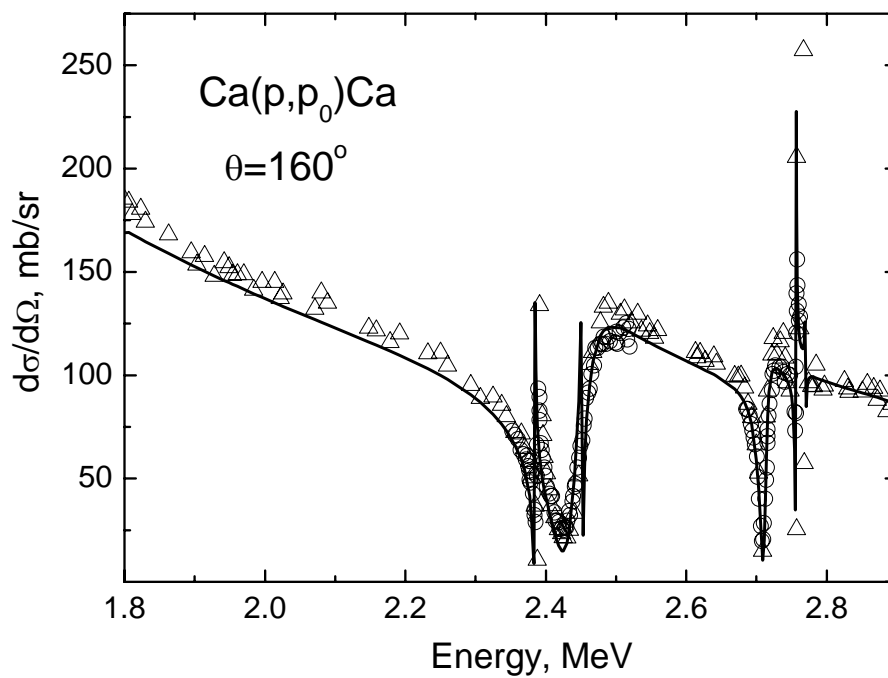


FIG. A9.21. \circ – Koltay *et al.* (1975), \triangle – Wilson *et al.* (1974).

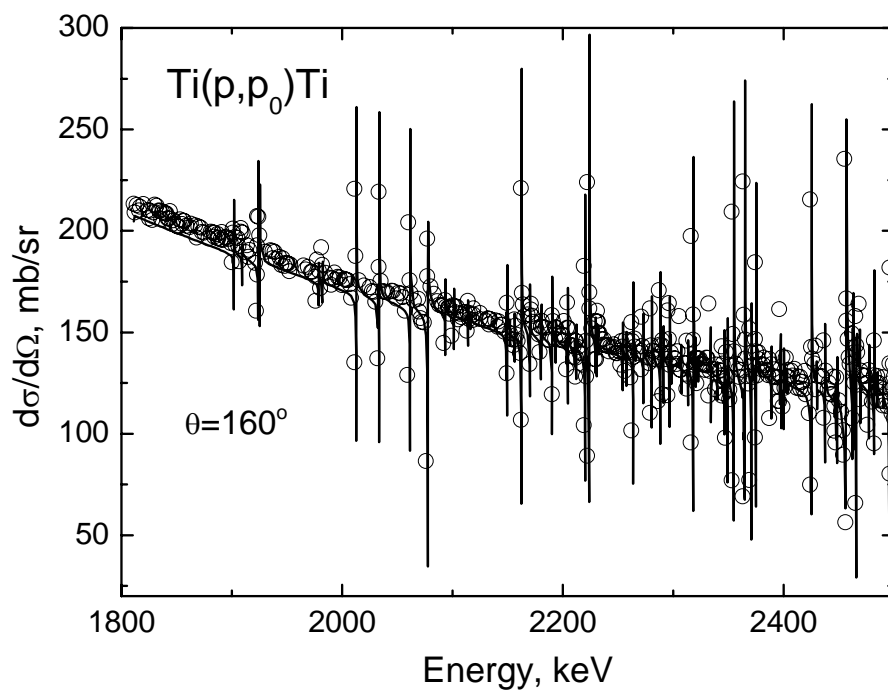


FIG. A9.22. \circ – Prochnow *et al.* (1972).

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