

Data review of $^{23}\text{Na}(p,p_0)^{23}\text{Na}$ cross-sections

M. Chiari

INFN Florence - Italy

As a first step, the only existing data set on IBANDL was compared with the data in the original reference [1] and the agreement was good.

The second step was a thorough search in the literature and in nuclear databases for other available experimental data. Very few data of interest for application in Ion Beam Analysis (i.e. for backscattering angles in the 100° - 180° range) were retrieved [2-3]. Another paper [4] was found, anyway it was considered of limited interest since it focuses only in the measurement of the width of a resonance at 3.90 MeV proton energy. All data appeared in graphical form in the original references; the data were then digitized using the DataThief software [5]. All the relevant quantities were converted to the laboratory frame of reference when necessary. Table 1 lists the data sets found in the literature, both already existing on IBANDL and new ones. These new data will be uploaded into IBANDL if deemed appropriate.

Reference	Data source	θ_{lab}	E_p (MeV)	Target	Quoted uncertainties	Data presentation
[1]	IBANDL	156.5°	0.57-1.48	Metallic sodium evaporated onto Nylon films	-	Tabular
[2]	Original paper	123.2° 139.2° 158.9°	0.4-1.0	Na metal evaporated on a C backing	-	Graphical
[3]	Original paper	165°	1.08-3.50	1-3 $\mu\text{g}/\text{cm}^2$ Na evaporated on Au coated ($1 \mu\text{g}/\text{cm}^2$) C foils ($5 \mu\text{g}/\text{cm}^2$)	1-2% statistical	Graphical

Table 1: Available data in the literature on $^{23}\text{Na}(p,p_0)^{23}\text{Na}$ cross-sections.

Figures 1 and 2 present in graphical form all the cross-sections listed in Table 1; data referring to similar scattering angles are shown together. In the graphs the proton energy and

the differential cross-section are given in the laboratory frame of reference, with energy units in MeV and cross-section units in mbarn/sr.

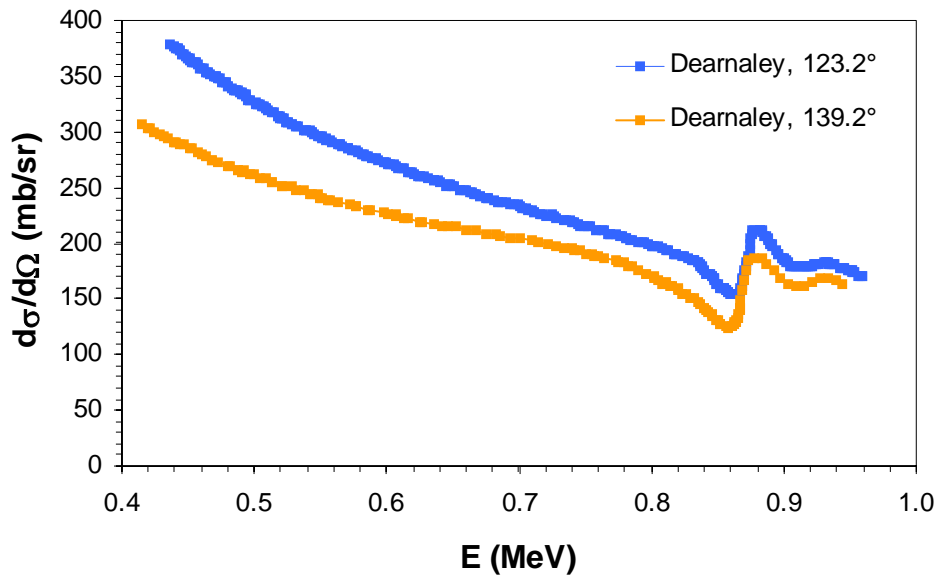


Figure 1: Cross-section values of proton elastic scattering on ^{23}Na versus proton energy at scattering angles in the 123° - 140° range. All the quantities are given in the laboratory frame of reference.

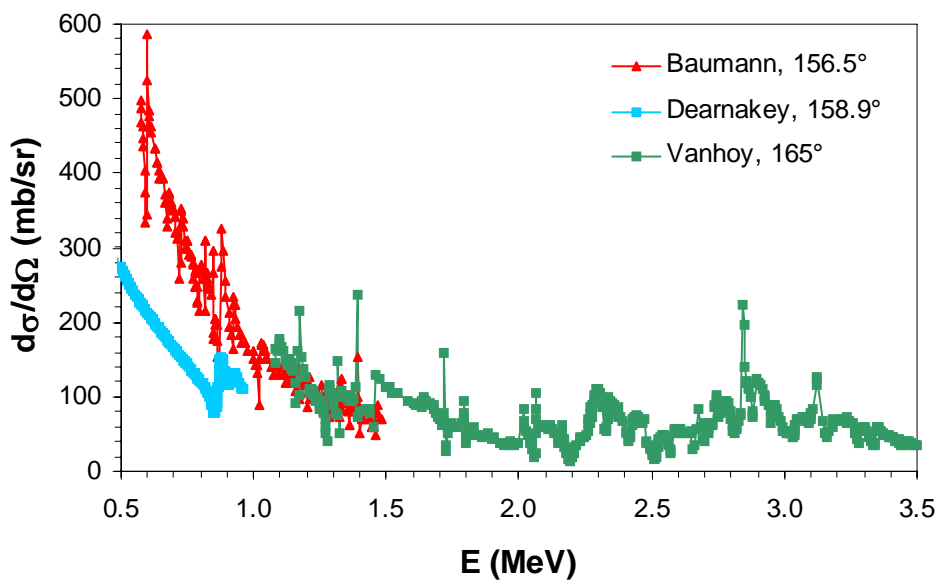


Figure 2: Cross-section values of proton elastic scattering on ^{23}Na versus proton energy at scattering angles in the 155° - 165° range. All the quantities are given in the laboratory frame of reference.

From Figure 2 a striking discrepancy is observed for the data from [2]: these data are about a factor 2 lower than those from [1] and several resonances are missing. On the contrary -keeping in mind that they refer to slightly different scattering angles- the overall agreement between data from [1] and [3] is reasonably good. In addition, note that the cross-section values for the three scattering angles from [2] are consistently lower than the Rutherford value even at proton energies of a few hundreds keV.

In conclusion, due to the scarcity of available experimental data, new cross-section data should be obtained for proton energy and scattering angle ranges suited for Ion Beam Analysis.

References

- [1] N.P. Baumann et al., Phys. Rev. 104 (1956) 376
- [2] G. Dearnaley, Philos. Mag. ser. 8, 1 (1956) 821
- [3] J.R. Vanhoy et al., Phys. Rev. C vol. 39 (1987) 920
- [4] J.F. Wilkerson et al., Nucl. Phys. A549 (1992) 223
- [5] <http://www.datathief.org/>