

An Analytical Study of Proton-Nuclei Interactions at High Energies

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Introduction

Several experimental techniques have been demonstrated for hadron-nucleus absorption cross-sections of charged Pions, charged Kaons, protons, and antiprotons on several target nuclei. [1-2]. Many theoretical models [3-4] have been proposed for the study of such interactions. In the present paper we are including only one hadron (i.e. proton) in our study.

In this work we proposed a universal approach to calculate the absorption cross-sections for proton interacting with target nuclei. Earlier [5-7] we had applied our universal approach to calculate the absorption cross-sections for charged pions (i.e. π^+ & π^-) interaction with target nuclei.

Present Parameterization

The energy dependence of the hadron-nucleus absorption cross-sections tends to follow that of the hadron-hadron cross-sections, but is somewhat slower. The available data at given energy were fitted to the simple expression

$$\sigma_{\text{abs}}(A) = \sigma_0 A^\alpha \tag{1}$$

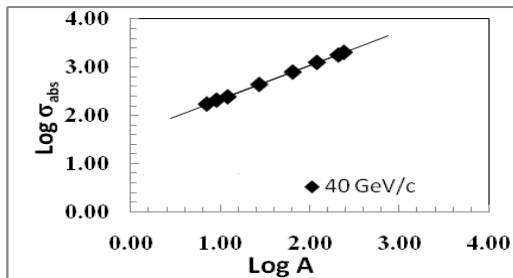
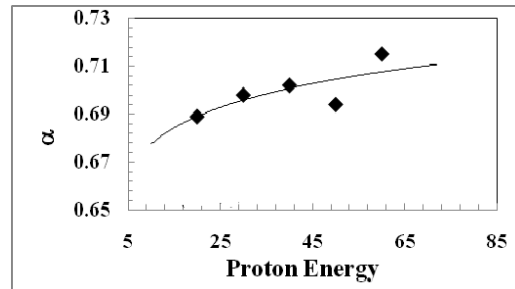
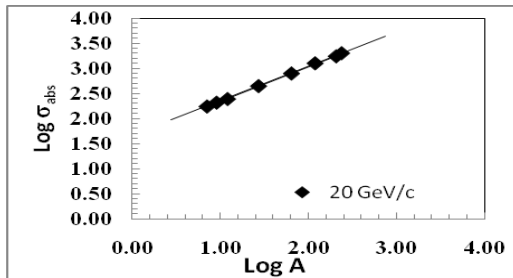
Here we take A is the atomic weight of the target nucleus and σ_0 & α taken as two adjustable parameter so that we modify the above formula by taking log of both sides. Now the above formula becomes

$$\log \sigma_{\text{abs}} = \alpha \log A + \log \sigma_0 \tag{2}$$

This equation (2) is the equation of straight line, the slop of the line gives the value of the parameter α , while the intercept of the line provides that of the parameter σ_0 .

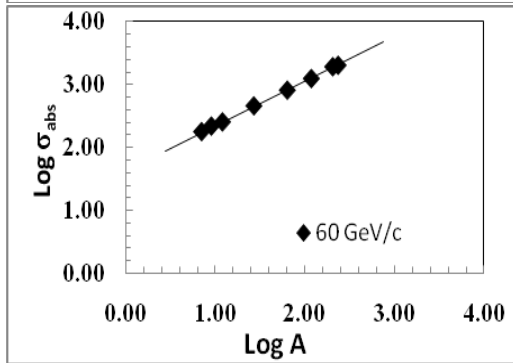
Table and Graphs

p (GeV)	Target Nuclei	σ_{abs} (mb) Exp.	σ_{abs} (mb) Calc.
20	Li ⁷	175±2	174.28
	Be ⁹	209±3	207.22
	C ¹²	247±2	252.65
	Al ²⁷	447±4	441.75
	Cu ⁶⁴	794±9	800.61
	Sn ¹¹⁹	1264±18	1227.48
	Pb ²⁰⁷	1739±30	1797.49
	U ²³⁸	2006±37	1978.91
30	Li ⁷	174±2	173.3
	Be ⁹	210±3	206.54
	C ¹²	247±3	252.47
	Al ²⁷	445±5	444.67
	Cu ⁶⁴	811±9	812.19
	Sn ¹¹⁹	1235±16	1252.20
	Pb ²⁰⁷	1870±23	1842.86
	U ²³⁸	2026±27	2031.40
40	Li ⁷	175±2	169.13
	Be ⁹	210±2	201.77
	C ¹²	246±2	246.92
	Al ²⁷	441±6	436.31
	Cu ⁶⁴	794±10	799.68
	Sn ¹¹⁹	1254±12	1235.98
	Pb ²⁰⁷	1780±20	1823.02
	U ²³⁸	2019±23	2010.65
50	Li ⁷	174±2	179.54
	Be ⁹	210±3	214.88
	C ¹²	247±3	163.95
	Al ²⁷	440±6	471.35
	Cu ⁶⁴	806±10	873.64
	Sn ¹¹⁹	1240±17	1361.24
	Pb ²⁰⁷	1785±29	2022.26
	U ²³⁸	2019±26	2234.45
60	Li ⁷	176±2	162.67
	Be ⁹	216±2	193.71
	C ¹²	252±4	236.59
	Al ²⁷	455±7	415.69
	Cu ⁶⁴	812±13	757.29
	Sn ¹¹⁹	1247±33	1165.40
	Pb ²⁰⁷	1930±50	1712.26
	U ²³⁸	2032±41	1886.65



Result & Discussion

The result of this work is shown in different graphs. First three graphs show the variation of $\text{Log } \sigma_{\text{abs}}$ versus Log of target mass 'A' for proton energy between $20 \text{ GeV/c} \leq \text{p mom} \leq 60 \text{ GeV/c}$. The slope $\tan\theta$ of the curve and their intercepts on the $\log \sigma_{\text{abs}}$ axis provides the values of α and σ_0 respectively. The values of α , σ_0 , σ_{abs} at different energies and for different target nuclei are shown in table-1 while the last two graphs show the variation of σ_0 and α with proton energy.



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