Proton-Nuclei Interactions at High Energies

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Introduction

Hadron-Nucleus interactions have been playing an important role in nuclear physics for last five decades. 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 [3-6] 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 [7, 8] we had applied our universal approach to calculate the absorption cross- sections for charged pions (i.e. π+ & π^-) interaction with target nuclei. The cross-sections represented in the unit of milli barn (mb) in this paper.

Formulation

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 data is at each energy were fitted to the simple expression

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

Where, A is the atomic weight of the target nucleus σ_0 and α are two adjustable parameters. We modify the above formula by taking log of both sides. Now the above formula becomes

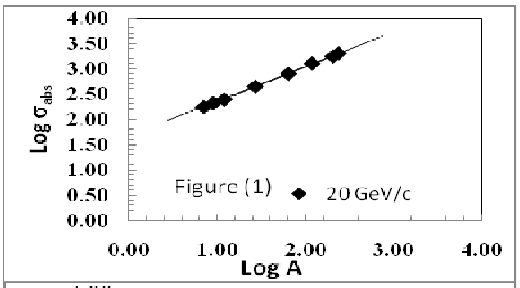
$$\text{Log } \sigma_{abs} = \alpha \text{ Log } A + \text{Log } \sigma_0 \qquad (2)$$

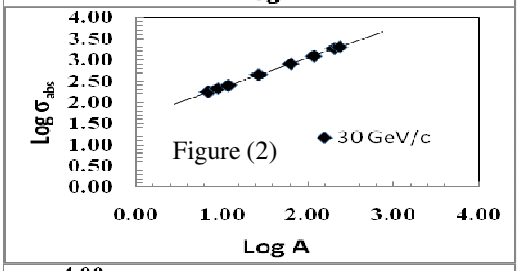
This equation (2) is the equation of straight line, the slop of the line gives the value of the parameter α, while the intercept of the line provides that of the parameter σ_0.

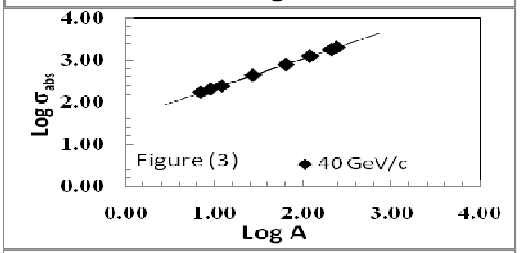
Table and Figures

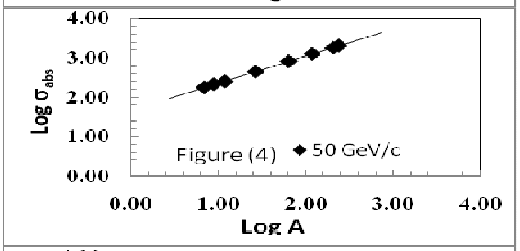
Table 1: Values of parameters σ_0, α and σ_{abs}

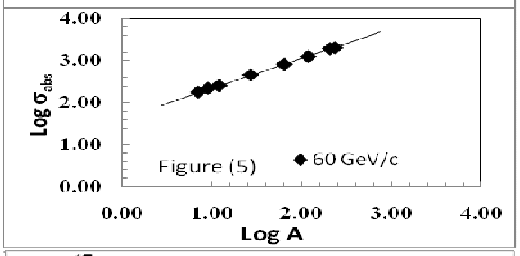
p (GeV)	Target Nuclei	σ_{abs} (mb) Exp.	σ_{abs} (mb) Calc.	σ_0	α
20	Li^7	175±2	174.28	45.6	0.689
	Be^9	209±3	207.22		
	C^{12}	247±2	252.65		
	Al^{27}	447±4	441.75		
	Cu^{64}	794±9	800.61		
	Sn^{119}	1264±18	1227.48		
	Pb^{207}	1739±30	1797.49		
	U^{238}	2006±37	1978.91		
30	Li^7	174±2	173.3	44.56	0.698
	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	43.15	0.702
	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	44.66	0.715
	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	42.07	0.695
	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		

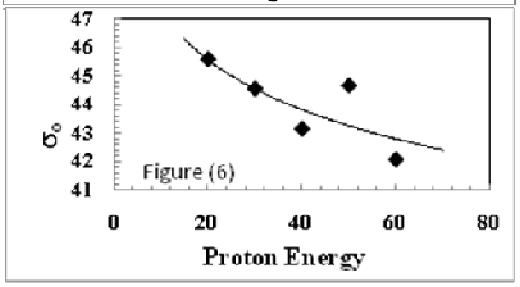


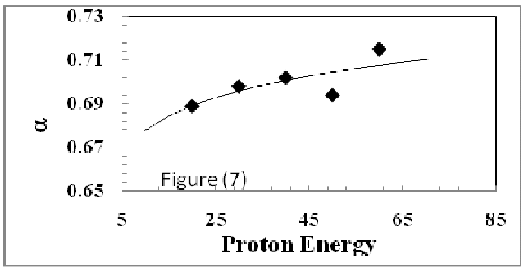












Result and Discussion

The result of this work is shown in fig. (1-7). Now in figure (1-5) the variation of Logσ_{abs} versus Log of target mass 'A' has been shown for proton energy between 20 GeV/c≤pmom≤60 GeV/c. The slope tanθ of the curve and their intercepts on the log σ_{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 in the figure (6) and (7) we the variation of σ_0 and α with proton energy have been shown respectively.

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