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A Calculation of Absorption Cross-SectionforProton – Nucleus Collisions at Different Energy Ranges

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ABSTRACT

In the present work an attempt is made to calculate the absorption cross-section for proton interacting with target nuclei. The absorption cross-section has been calculated for energies ranging between 20 GeV/c to 60 GeV/c with different nuclei also the results is compared with experimental data.

Keywords: Hadron-Hadron Collisions, Hadron-Nucleus Collisions and Absorption Cross-Section.

I. INTRODUCTION

During few decades hadron-hadron and hadron-nucleus collisions have been playing an important role in nuclear high energy physics for physicists. Several experimental technique have been demonstrated for hadron-hadron and hadron-nucleus absorption cross-section of charged pions, charged kons, protons and antiprotons on several target nuclei [1-4]. Many theoretical models [5-7] have been proposed for the study of such collisions. In the present work we are including only one hadron (i.e. proton) in our study.

In the proposed work, we proposed a universal approach to calculate the absorption cross-sections for proton interacting with target nuclei. Earlier work [8-10] we had applied our universal approach to calculate the absorption cross-sections for charged pions ($\pi+$ and π^-) collisions with target nuclei. The cross-sections calculated in the unit of millibarn (mb) in this proposed work.

II. METHODS AND MATERIAL

Calculations

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 calculate data is at each energy were fitted to the simple formulation as

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

Where A is the atomic weight of the target nucleus, σ_0 and α are two adjustable parameters. We modify in the present work by taking log of both sides of eq. (1). So the new modify formula becomes

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

Here eq. (2) is the nature of equation of straight line,the slope of the line gives the value of the parameter α, while the intercepts of the line provides that of the parameter $\sigma_{0.}$

III. RESULTS AND DISCUSSION

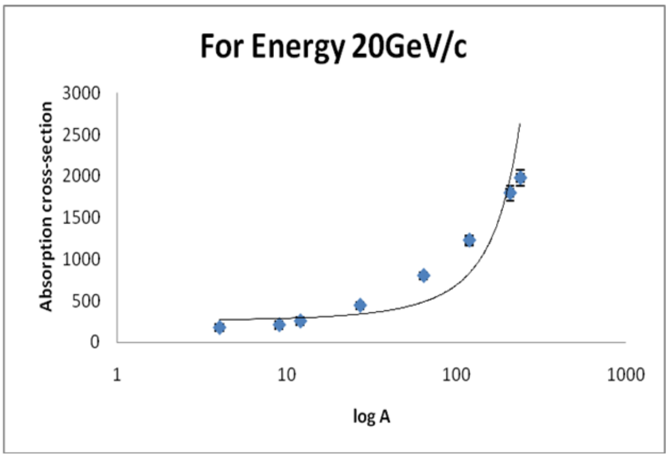
The present work is given in Table and result shown in different figures. Now in fig.(1-4) the variation of log of target mass 'A' versus log $\sigma_{abs.}$ has been shown for proton energy between 20 GeV/c $\leq p_{mom.} \leq$ 60 GeV/c. The slope is tanθ of the curve and their intercepts on the log $\sigma_{abs.}$ axis provides the values of α and σ_0 respectively.

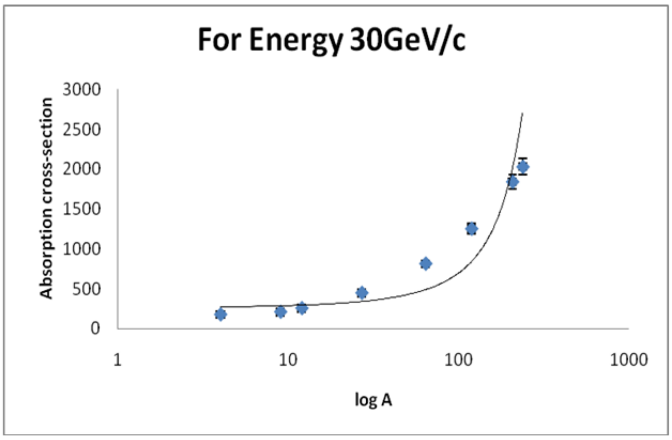
Table: Values of Parameters σ_0, α and $\sigma_{abs.}$ Absorption Cross-Section at different Energy with available experimental data.

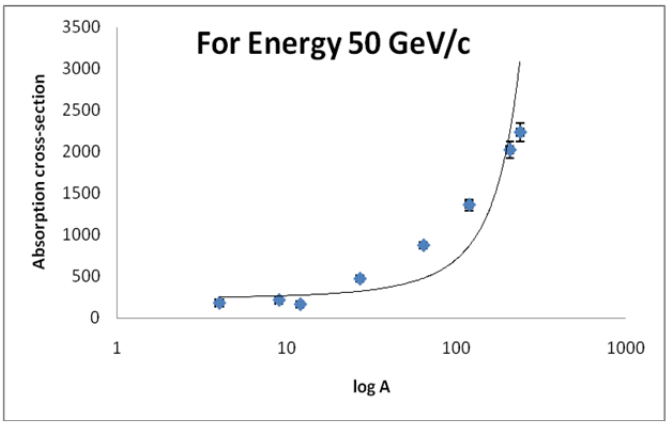
p (GeV/c)	α	σ_0	Target Nuclei	$\sigma_{abs.}$ (mb) Calculated	$\sigma_{abs.}$ (mb) Experimental
20	0.689	45.6	Li(7)	174.28	175±2
			Be(4)	207.22	209±3
			C(12)	252.65	247±2
			Al(27)	441.75	447±4
			Cu(64)	800.61	794±9
			Sn (119)	1227.48	1264±18
			Pb(207)	1797.49	1739±30
			U(238)	1978.91	2006±37
30	0.698	44.56	Li(7)	173.30	174±2
			Be(4)	206.54	210±3
			C(12)	252.47	247±3
			Al(27)	444.67	445±5
			Cu(64)	812.19	811±9
			Sn (119)	1252.20	1235±16
			Pb(207)	1842.86	1870±23
			U(238)	2031.40	2026±27
50	0.715	44.66	Li(7)	179.54	174±2
			Be(4)	214.88	210±3
			C(12)	163.95	247±3
			Al(27)	471.35	440±6
			Cu(64)	873.64	806±10
			Sn (119)	1361.24	1240±17
			Pb(207)	2022.26	1785±29
			U(238)	2234.45	2019±26
60	0.695	42.07	Li(7)	162.67	176±2
			Be(4)	193.71	216±2
			C(12)	236.59	252±4
			Al(27)	415.69	455±7
			Cu(64)	751.29	812±13
			Sn (119)	1165.40	1247±33
			Pb(207)	1712.26	1930±50
			U(238)	1886.65	2032±41

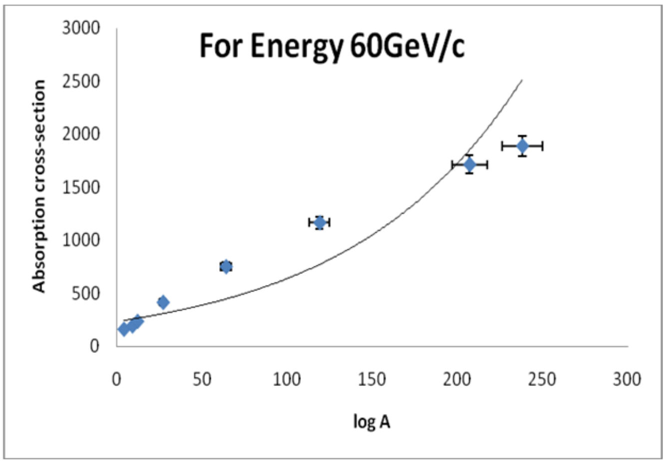
The value of α, σ0 and σ_{abs} at different energies and for different target nuclei are shown in table 1. While in the fig. 5 and 6 we have given the variation of σ_0 and α with proton energy shown respectively.

Graphs:









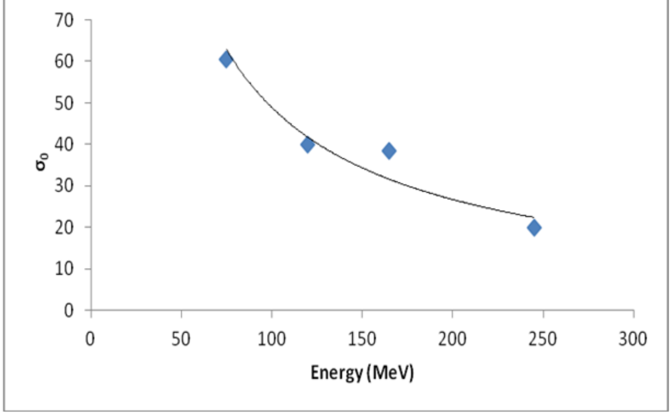


Fig.5 Graph between Energy(MeV) and σ_0

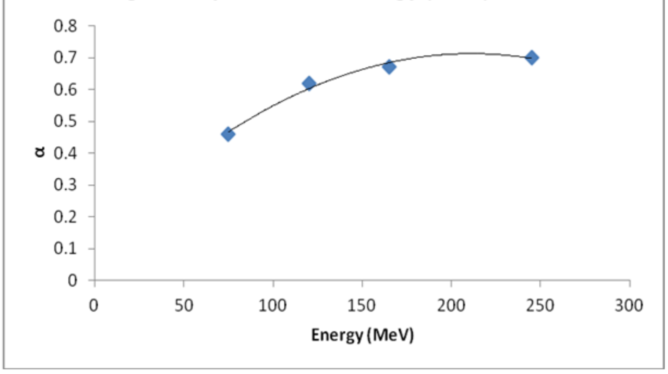


Fig.6 Graph between Energy (MeV) and α

IV. ACKNOWLEDGEMENT

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