Theoretical Calculation of the Photons Rate for the Quark-Gluon System at Compton Scattering

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Abstract: ***The quantum chromo dynamic theory have been used to calculation the photons rate in the quark-gluon collisions at Compton scattering depending on the quantum consideration. The effective strength coupling α_{esc} the quantum electro dynamic constant α, photons energy E_{phot}, square charge of the quarkse^2_{QCD},thermal energy T and Euler constant θ_{Euler}coefficients are using to calculation the rate of photons at QCD. Photons rate at $ug \rightarrow d\gamma$and $cg \rightarrow d\gamma$systemsare emission in the range $2.33577x10^{-7} \geq \mathbb{R}_{Compton}(\alpha_{esc}, T, E_{phot}) \leq$ to $3.328 * 10^{-20}$ with flavor number $N_f = 3$due to the effective coupling strength energies between $\alpha_{esc} = 0.3787Ge$ and $\alpha_{esc} = 0.2752GeV$ and in the range $7.3705x10^{-7} \geq \mathbb{R}_{Compton}(\alpha_{esc}, T, E_{phot}) \leq$ to $5.85914 * 10^{-20}$ with flavor number $N_f = 5$due to the effective coupling strength energies between $\alpha_{esc} = 0.444667GeV$and $\alpha_{esc} = 0.32313GeV$ due to the critical temperature $T_c = 190MeV$.A MATLAB designed program have been used to estimation all parameters and the photons rate.In both cases, the photons rate are large for system have a small effective strength coupling and increases with decreases the photons energy and that's for high thermal energy the force of QCD becomes weak and quark-gluon systems are collective excitations particles and should to be good approximation become hadronic system.***

Keywords: Photons Rate,Quark-Gluon System, Compton scattering

1. Introduction

Elementary particle physics deals with the search and the study of the ultimate constituents of matter as well as of their interactions. It"s the smallest constituents of matter[1].In particle physics, an elementary particle or fundamental particle is a particle whose substructure is unknown. Thus, it is unknown whether it is composed of other particles. Towards the end of the nineteenth century, the word "atom" i.e. indivisible, was attributed to objects that were actually quite indivisible[2]. Indivisible idea for the building blocks goes back to 1803 due to the atom of Dalton that"s introducing in nineteen century ago . For that time, the atom is regarding as the basic of elementary particle to the building matter. On the other hands ,at the 20th century, the scientist discoveries that the atom isn"t an elementary particle after all, but its consists of a positively charged nucleus and negatively charged electrons orbiting the nucleus of matter . [3].The atomic of nucleus with its two different constituents represents a unique finite quantum of many body systems. The evolution of its properties can be investigated in detail by varying the finite numbers of nucleons (protons and neutrons) [4].The elementary particle was regarded as "unbreakable" constituent consists of smaller particles. Such a change of picture of the elementary particle was repeated in the history of science[5]. Gell-Mann and Zweig introduced independently the quarks particles to discussion the building blocks of hadronic matter in 1964. Today, the quarks are known an indivisible fundamental elementary particles. The quarks inside the proton and neutron are held together by the strong nuclear force, which is transmitted by uncharged particles called gluons[6]. Elementary Particle Physics has provided us with a comprehensive theory of particle interactions . Quantum Chromodynamics (QCD) is one of the three pillars of the Standard Model, being the accepted theory of the strong force. Nevertheless QCD is distinguished from the other interactions forming the Standard Model, by describing only the interaction of elementary particles quarks and gluons[7].More than twenty years after quantum chromodynamics (QCD) was introduced as a microscopic theory of strong interactions, at least in principle, it should be possible to describe theinteraction of nucleons with external probes using quark and gluon degreesof freedom on the basis of QCD[8].Quarks are found in six different flavors, all having spin 1/2 .The corresponding antiparticles have antiquarks instead of quarks, and opposite electric charges. The mass of an antiparticle is the same as for the corresponding particle. In addition to the electric charge, quarks have a color charge responsible for the strong interaction[9] . All particles that contain quarks are known as hadrons. Hadrons are divided into two groups. One group called baryons. Baryons contain groups of three bound quarks (such as the proton and neutron) or antiquarks (such as the antiproton and antineutron). The other group called mesons, contain bound quark-antiquark pairs. In both cases the quarks (and antiquarks) are confined by gluons. Under normal conditions it is not possible to observe „free" quarks, antiquarks and gluons. But under extreme conditions of temperature or pressure, for example those similar to what is believed to have existed up until 10^{-5} seconds after the Universe began, hadronic matter undergoes a phase transition into a hot dense „soup" of matter known as a Quark-Gluon Plasma (QGP) in which quarks, antiquarks and gluons become deconfined[10]. The first theoretical approach to order all of these particles in a systematic way in terms of certain internal symmetry properties was the Standard Model of Elementary of Particle Physics which has evolved in the 1970"s. The two main ingredients of the Standard Model are the Electroweak Theory and Quantum Chromodynamics. It was based upon six spin 1/2 quarks. In this model the strong interaction is mediated by the exchange of gluons[11].However , masses of an antquarks are same for the masses corresponding of quarks particle. The quarks have a new charge addition to the electric charge called color charge indicate that interaction of quarks is in the strong interaction [6]. The particles that contain quarks are called as hadrons. Hadrons were divided into two categories baryons and mesons . Baryons contained of three bound quarks such as the proton and neutron and mesons that contained pairs of quark-antiquark [12]. The first theoretical approach to order all of these particles in a systematic way in terms of certain internal symmetry properties was the Standard Model of Elementary of Particle Physics which has evolved in the 1970‟s [13].

2. Theory

The photons have been produce at quark gluon interaction system at the collisionof primary hard parton It isgive us many important feature on the structure of protonsand neutrons according on the quantum chromodynamic theory[14].The photons rate (the number of photon emitted per unit time and per unit volume) is relative with retarded polarization tensor of the photons according to [15].

$$\mathbb{R}_{Compton}\left(\alpha_{esc}, T, E_{phot}\right) = E\frac{dN}{d^3Pd^4x} = -\frac{1}{(2\pi)^3}\mathrm{Im}\prod_{\mu\vartheta}^{R}\frac{1}{e^{E_i/T}-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where E_i is the energy of the emitted photon and $\prod_{\mu\vartheta}^{R}(E,q)$ is the retarded photon self energy for the finite temperature T. The retarded propagators self-energy with spectral representation may be written as [16].

$$\mathrm{Im}\prod\nolimits_{\mu}^{R,\mu} = -\frac{10\pi}{3}e^2\sum e_{QCD}^2\left(e^{\frac{E_i}{T}}-1\right)\int\frac{d^3k}{(2\pi)^3}\int_{-\infty}^{\infty}dw\int_{-\infty}^{\infty}dw^{\sim}\,\delta(E-$$

w−w~[fFD(q)w.fBE(g)w~]Tr[ξμk,k,−pρ∗w,kρ(w−E,k−p)ξϑ−k,−k,p]……… ……….(2)

Then integral Eq.(2) may be solve and resulte to .

$$Im\prod\nolimits_{\mu}^{R,\mu} = -4\pi\frac{5}{12\pi^2}e^2\sum e_{QCD}^2\left(e^{\frac{E_i}{T}}-1\right)\left[e^{-\frac{E_{phot}}{T}}\right]\{2m_q^2\int_k^{\mu}\frac{w_+(k)-w_-(k)}{m_q^2}dk+\Omega_{corection}\ \ldots\ldots\ldots\ldots(3)$$

the solution integral in the first term of Eq.(3) leads to.

$$2\int_k^{\mu}\frac{w_+(k)-w_-(k)}{m_q^2}dk = 2\int_k^{\mu}\frac{1}{k}dk = Ln\frac{\mu^2}{k^2})\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

Then Eq.(3) lead to $Im\prod_{\mu}^{R,\mu} = -4\pi\frac{5}{12\pi^2}e^2\sum e_{QCD}^2\left(e^{\frac{E_i}{T}}-\right.$ *e−EphotT(mq2Lnμ2k2+Ωcorection)*……..(5)

Where $\Omega_{corection}$ is the corection term is given by [17].

$$\Omega_{corection} = \int kdk\beta\ (w,k)\quad\theta(k^2-w^2) \cong m_q^2\left(\frac{1}{2}-\theta Euler\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)\right.$$

where $\theta_{Euler} = 0.577216$. Similarly, the production rates of photons due to[18]. Inserting Eq.(6)in Eq.(5) to result

$$.\ Im\prod\nolimits_{\mu}^{R,\mu} = -4\pi\frac{5}{12\pi^2}e^2\left(e^{\frac{E_i}{T}}-1\right)\left[e^{-\frac{E_{phot}}{T}}\right][m_q^2Ln\frac{\mu^2}{k^2}+m_q^2\left(\frac{1}{2}-\theta_{Euler}\right)]\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)$$

Substituting Eq.(7) in Eq.(1) leads to photons rate equation$\left(\alpha_{esc}, T, E_{phot}\right)$

$$= \frac{1}{8\pi^4}\ \frac{5}{3}e^2\sum e_{QCD}^2\ \left[e^{-\frac{E_{phot}}{T}}\right]\ m_q^2[Ln\frac{\mu^2}{k^2}+\frac{1}{2}-\theta_{Euler}]..(8)$$

Where $\alpha = \frac{e^2}{4\pi}$ [19],and m_q^2 is the square of quarks masses given by [20].

$$M^2 = \frac{g^2C_FT^2}{4}\ldots\ldots\ldots\ldots\ldots\ldots(9)$$

Here $g^2 = 4\pi\alpha_{esc}$ is the strong gauge of quantum chromodynamic theory related to effective strength coupling α_{esc} , T is the thermal energy and C_F is the Casimir of quark representation and given to[21].

$$C_F = \frac{N_c^2-1}{2N_c}\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(10)$$

Where $N_c$is colour number is equal $N_c = 3$. Then the photons rate expression in Eq.(8) with $\alpha = \frac{e^2}{4\pi}$ and $g^2 = 4\pi\alpha_{esc}$ is giving the asymptotic solution .

$$\mathbb{R}_{Compton}\left(\alpha_{esc}, T, E_{phot}\right) = \frac{1}{8\pi^4}\ \frac{5}{3}\sum e_{QCD}^2\quad\pi\alpha\left[e^{-\frac{E_{phot}}{T}}\right]\ \frac{4\pi\alpha_{esc}T^2}{4}\ \frac{8}{6}[Ln\frac{\mu^2}{k^2}+\frac{1}{2}-\theta_{Euler}]\ldots\ldots\ \ldots\ (11)$$

The lower limit of $k$and μ comes from $k\sim gT$, and $\mu\sim\sqrt{2ET}$ and in which Eq. (14) becomes.

$$\mathbb{R}_{Compton}\left(\alpha_{esc}, T, E_{phot}\right) = \frac{10\alpha\alpha_{esc}}{9\pi^2}\sum e_{QCD}^2\ T^2e^{-\frac{E_{phot}}{T}}[Ln(\frac{2E_{phot}}{4\pi\alpha_{esc}T})+\frac{1}{2}-\theta_{Euler}]\ldots\ldots\ldots\ldots(12)$$

Where α is the quantum electrodynamic constant is equal($\alpha = \frac{e^2}{4\pi\varepsilon_o\hbar c} \approx \frac{1}{137}$) ,$e_{QCD}$ is the electric charge of the quark. The effective of strong coupling constant.at high energy collision the expression in Eq. (12) may be written as[22]:

$$\alpha_{esc}\left(P_{eff}\right) = \frac{6\pi}{(33-2N_f)ln(\frac{P_{eff}}{T_c})}\ldots\ldots\ldots\ldots(13)$$

Here P_{eff} is the effective momentum transfere,T_c is the transition temperature, and N_f is the favor number.

3. Results

A quantum chromodynamic theory has been applied for a strong interaction to study the photons rate produce in the quark gluon system at Compton scattering processes . The photons rate can be calculated by using Eq.(12) for two systems $ug \rightarrow d\gamma$and$cg \rightarrow u\gamma$as a relative to the effective strength coupling gluonparticle is adapted to the exchange in the $ug \rightarrow d\gamma$and$cg \rightarrow u\gamma$systems for the investigation of the probability of photon rate spectrum depending on quantum scenario. It involves many important coefficients , they are the effective strength coupling α_{esc} , quantum electro dynamic constant α, photons energy E_{phot}, square charge of the quarkse_{QCD}^2,thermal energy T and EulerThe results are summarized in Tables (2and 3) and figures(1 to 2) for $ug \rightarrow d\gamma$'and$cg \rightarrow d\gamma$systems at Compton scattering , respectively constant θ_{Euler} .The effective strength coupling α_{esc} can be estimation for system $ug \rightarrow d\gamma$ have flavour number 3 and charge of quarks $\frac{5}{9}$and system$cg \rightarrow u\gamma$ have have flavour number 5 ,and charge of quarks $\frac{8}{9}$by using Eq.(13) with color charge 3 , critical temperature $T_c =$ 190 MeV and thermal energy T=150,200,250and 300 MeV for both system .The results are listed in Table (1) for

$ug \rightarrow d\boldsymbol{\gamma}$, and $cg \rightarrow u\gamma$, respectively. A Matlab program is used to evaluation the parameters leading to the computation of the Photons rate at quark gluon system using Eq.(12) for $ug \rightarrow d\boldsymbol{\gamma}$ and $cg \rightarrow d\gamma$ systems for one loop contributions due to the photons energy $E_{Phot} = 1 \rightarrow 5$ GeV[23].

Table 1: Theoretical estimation of the effective strength coupling α_{esc} due to critical temperature Tc=190 Mev for $ug \rightarrow d\gamma$ and $cg \rightarrow u\gamma$ systems

		$\alpha_s(P)$			
		P=1.2 GeV	P=1.6 GeV	P=2 GeV	P=2.4 GeV
		T= 150 MeV	T= 200 MeV	T=250 MeV	T=300 MeV
$ug \rightarrow d\boldsymbol{\gamma}$	3	$a_{esc} = 0.378790$	$a_{esc} = 0.327648$	$a_{esc} = 0.296587$	$a_{esc} = 0.27526$
$cg \rightarrow u\gamma$	5	$a_{esc} = 0.444667$	$a_{esc} = 0.384630$	$a_{esc} = 0.348168$	$a_{esc} = 0.3231$

Table 2: The result of photon rate production $\mathbb{R}_{Compton}\left(\alpha_{esc}, T, E_{phot}\right)$in ug→dγ sytem at Compton scattering due to T_C=190 MeV with flavor number =3

E_{phot} GeV	$\mathbb{R}_{Compton}\left(\alpha_{esc}, T, E_{phot}\right)\frac{1}{GeV^2\,fm^4}$			
	T= 150 MeV	T= 200 MeV	T=250 MeV	T= 300 MeV
	$a_{esc} = 0.3787GeV$	$a_{esc} = 0.3276GeV$	$a_{esc} = 0.2965GeV$	$a_{esc} = 0.2752GeV$
1	4.717924 10^{-9}	3.26610 10^{-8}	1.064223 10^{-7}	2.33577 10^{-7}
1.5	2.39931 10^{-10}	4.02275 10^{-9}	2.29083 10^{-8}	7.5030 10^{-8}
2	1.037216 10^{-11}	4.0835 10^{-10}	3.91699 10^{-9}	1.8312 10^{-8}
2.5	4.201804 10^{-13}	3.8495 10^{-11}	6.15838 10^{-10}	4.0653 10^{-9}
3	1.64516 10^{-14}	3.4935 10^{-12}	9.28244 10^{-11}	8.6136 10^{-10}
3.5	6.30998 10^{-16}	3.0992 10^{-13}	1.36471 10^{-11}	1.7764 10^{-10}
4	2.38730 10^{-17}	2.7087 10^{-14}	1.9741 10^{-12}	3.5997 10^{-11}
4.5	8.9453 10^{-19}	2.3426 10^{-15}	2.8234 10^{-13}	7.2066 10^{-12}
5	3.328 0 10^{-20}	2.0100 10^{-16}	4.0040 10^{-14}	1.4300 10^{-12}

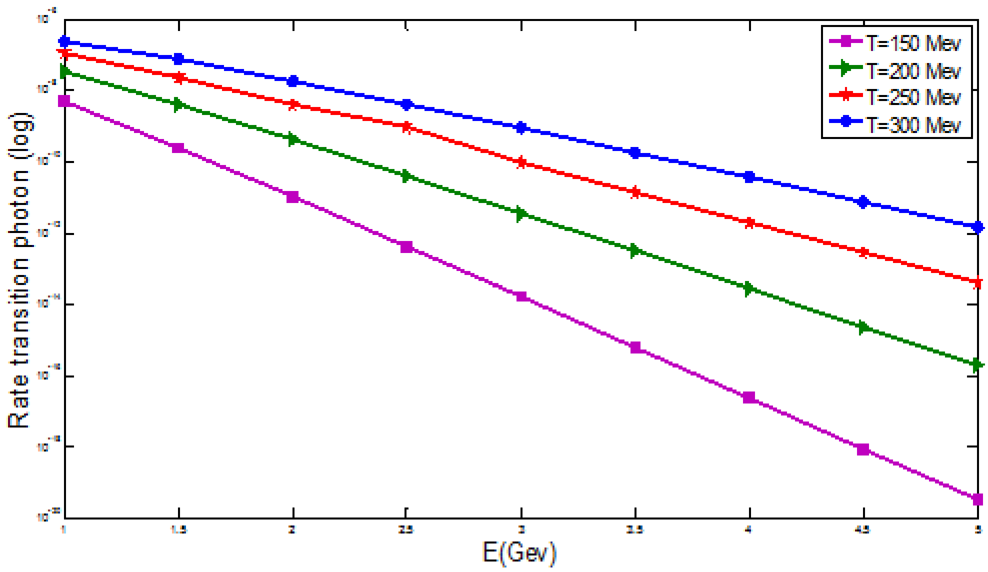

Figure 1: Photons rate $\mathbb{R}_{Compton}\left(\alpha_{esc}, T, E_{phot}\right)$ as a function of E_{Phot} for ug → dγ system with , N_F= =3, $\sum e^2 = \frac{5}{9}$, T_c= 190 MeV

Table 3: The result of photon rate production $\mathbb{R}_{Compton}\left(\alpha_{esc}, T, E_{phot}\right)$in Cg→uγ system at Compton scattering due toT_C=190 MeV with flavor number =5

E_{phot} GeV	$\mathbb{R}_{Compton}\left(\alpha_{esc}, T, E_{phot}\right)\frac{1}{GeV^2\, fm^4}$			
	T= 150 MeV	T= 200 MeV	T=250 MeV	T= 300 MeV
	α_{esc} = 0.4446GeV	α_{esc} = 0.38463GeV	α_{esc} = 0.348168GeV	α_{esc} = 0.32313GeV
1	7.37050 10^{-9}	4.92105 10^{-8}	1.53215 10^{-7}	3.17200 10^{-7}
1.5	3.97441 10^{-10}	6.55962 10^{-9}	3.67098 10^{-8}	1.17945 10^{-7}
2	1.75828 10^{-11}	6.85222 10^{-10}	6.50205 10^{-9}	3.00542 10^{-8}
2.5	7.21456 10^{-13}	6.55917 10^{-11}	1.04090 10^{-9}	6.81588 10^{-9}
3	2.84831 10^{-14}	6.01086 10^{-12}	1.5868 10^{-10}	1.46318 10^{-9}
3.5	1.09892 10^{-15}	5.3688 10^{-13}	2.35136 10^{-11}	3.04438 10^{-10}
4	4.17625 10^{-17}	4.71628 10^{-14}	3.42107 10^{-12}	6.20951 10^{-11}
4.5	1.57037 10^{-18}	4.09530 10^{-15}	4.91504 10^{-13}	1.2493 10^{-11}
5	5.85914 10^{-20}	3.52607 10^{-16}	6.99697 10^{-14}	2.4890 10^{-12}

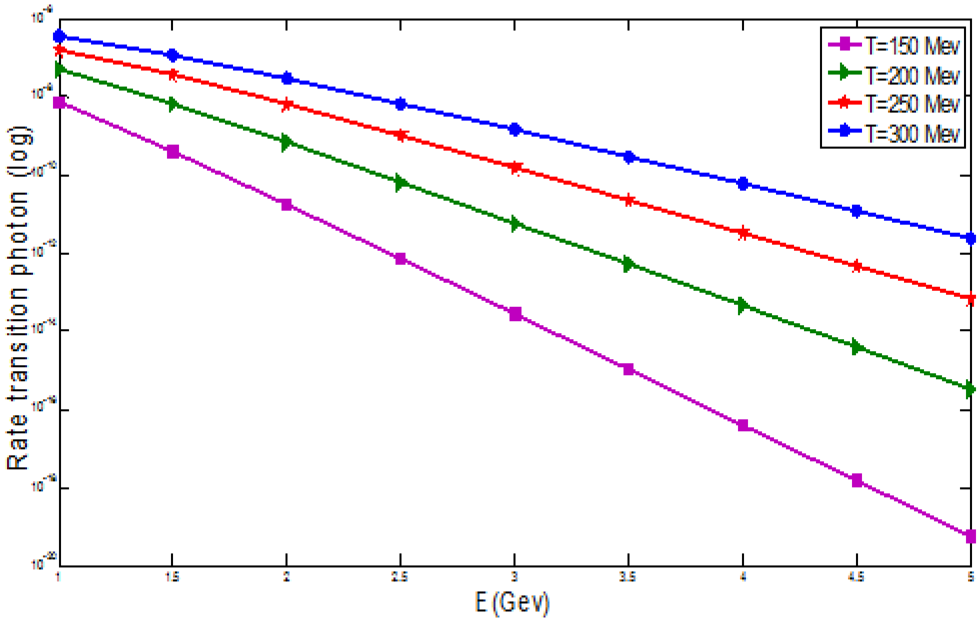

Figure 2: Photons rate $\mathbb{R}_{Compton}\left(\alpha_{esc}, T, E_{phot}\right)$as a function of E_{Phot} for cg → uγ system with , N_F =4, $\sum e^2 = \frac{8}{9}$, T_c= 190 MeV

4. Discussion

Theoretical calculation of the photons rate at Compton scattering processes is depending on applied the quantum chromodynamics theory to investigation the quark-gluon interaction .In contrast to study and calculation the photon rate at highest energy is a test and probe of quantum chromodynamics theory which is primarily based on the exchange the gluon deduced of properties strong interaction and provided the structure of the nuclear matter (neutrons and protons) properties . Photons rate is the important theoretical tolls to study of the nuclear structure for any nucleus and depending on many parameter's. It is clear from Eq.(12) and Eq.(13) that calculation of the effective strength coupling α_{esc} and rate of photons depending on the quantum chromodynamic theory, it is necessary to determine out the order of magnitude of flavor number , and charge quantum in Eq.() via an electron charge scaling analysis. So far, the quarks have fractions of the electron charge ,its means that the up,Charm,and Top have 2/3 while the others have −1/3 in unit of electron. This means that at a given distance between quarks the strong force between these depending on their electric charge Although the different quark have flavors number ,it‟s the quantum number required to satisfied the generation the quarks and effected on the photons rate and effective strength coupling ,that‟s. It is important to evaluate the effective strength coupling α_{esc} and photons rate production at system. On the other hand, the quarks system have three deferent state colors for quarks and eight different colors for gluons describing the quark-gluon interaction . In general , color charge indicate the binding energy of the strong interaction. All have different masses, the theory is perfectly symmetrical with respect to the three colours charge. This colour symmetry is described by the Lie group[24]. Quark –gluon in the strong interaction the high-energy which is electric charge dependent. The effective of strength coupling α_{esc} is the tool to investigate the behavior in quark-gluon system that establishment at high energy in the confiment state or asymptotic freedom state ,it is the most important parameter of probe the QCD theory . It is analogous to the fine structure constant α which used to represent the coupling strength in QED.The estimation of the effective strength coupling α_{esc} is depending on the momentum transfer for reactions . Since the effective strong coupling constant $\alpha_{eff}\left(P_{eff}\right)$ for the two systems strongly interaction quarks in the QCD is depend on the thermal energy or momentum transfer scale . Since the produce a new quarks at distance becomes very easy rather than kept the quarks distance against the increasing force. Therefore, the decreases of strong force rapidly at some distance. This reason to called the strong force was short distance force with mechanism named confinement of quarksdepending on color origin .However, the strength of the strong force has component of proportional to distance. The study and discussion of the photons emission at quark gluon interaction at Compton scattering processes is very high related due to the effective strong coupling constant that‟s the bases coefficient for the calculation of photons rate and to know the behavior of quarks system at confinement and deconfinement phenomena for quark-gluon interaction system due to the physical conceptsof the effective momentum transfer P_{eff} ,color quantum number , flavor quantum number and thermal energy T. The effective strength coupling α_{eff} decreases with increasing thermal energy T until it vanishes at the critical temperature $T_c \ll 200MeV$; the critical temperature estimated is $T_c \approx 190MeV$.

We can show the photons rate in tables(2) to (3) and figures (1) to (2) are increases with decreases the effective strong coupling constant $\alpha_{eff}(P_{eff})$ and is large for system have small contribution of $\alpha_{eff}(P_{eff})$, this indicate that photons emitted for the system have least effective strong coupling constant and vice versa. This means the effective strong coupling constant α_{eff} increases with decreases of the momentum transfer P_{eff} ,it be small when $P_{eff} \gg T_c$ and with increases the thermal energy T, and make the system have bind the quarks strongly to each other inside system have small momentum transfer and thermal energy. The confinement of quarks is one of essentially to discussion the reasons of the nuclear forces have was having short range properties ,on the other hands ,the exchange of gluons were be long range. On the other hand, the quarks move farther apart the force becomes stronger then the quarks in state called (confinement). However ,the behavior of quarks depending on the results of the effective strength coupling constant due to the distance of the interaction is unique. This indicate that quarks behavior due to height energy at QCD is opposite the behavior at the electromagnetism effect and that‟s means the quarks at large distance are very attractive strength and quarks binds force to each other . It is believed a consequence of this property is that quarks become weakly interacting in Compton scattering processes occurring at very high energies or equivalently at very small distances that quarks could be close to each other and the strong force is relatively weakling that‟s mean the quarks in deconfinement or (asymptotic freedom). However , we can able to comparing the data of photons rate in tables (2) to (3) for different values of effective momentum transfer that calculated $ug \to d\gamma$',and$cg \to u\gamma$systems respectively and showing the photons rate increases with increases the effective momentum transfer and vice versa. The photons rate that‟s emission at quark gluon system at various thermal energy T = 150 - 300 MeV and critical temperature Tc= 190 MeV dependent exponentially $e^{-\frac{E_{phot}}{T}}$on the the photonic energies E_{phot} due to Eq.(12) . Here ,we can show in that result the photons rate inversely proportional due to photons energy ,it has been shown the photons rate decreases with increases the energy of photons that‟s leads to discussion because the photons have large energy is small amount than photons have small energy that‟s view in tables (2) to (3).However , it can be shown the data of photons rate increases approximately due to decreases of the photon energy E_{phot} andplotted at figures(1) to (2) at thermal energy = 150 MeV, = 200 MeV =250,tand = 300 MeV respectively. This means that when the energy of the emitting photon be large, the photon rate became small and vice versa. Although , at high temperature, perturbative QCD has been used to study the quark-gluon Compton scattering always lead to to match smoothly with the non perturbative between quark and gluon scatterings We have found that photons rate increase in tables (2) and (3) are highly effected by increasing thermal energies of the the$ug \to d\boldsymbol{\gamma}$ and$cg \to u\gamma$systems, and decreasing with decreases the thermal energy ,it seems the photons rate to be large near 300 MeV is considered to be exist at very hot temperature compare to that in 150 Mev. At very high temperatures 300 MeV the effective coupling constant of QCD becomes weak and quark-gluon systems are collective excitations particles and should to be good approximation become hadronic system. The photon's rate give facilities to study the strong force dominates and the formed of nucleus by combined the protons and neutrons due to the nuclear force. However , the nuclear force is one of the strong force works between the quarks and gluons due to the color quantum number .Two of the six elementary particles up and downquarks cooperation in the building of both protons and neutrons ordinary matter . This two quarks are light $m_u \approx 1.5 - 4\ MeV/c^2$[25]for Up quark ,$m_d \approx 4 - 8\ MeV/c^2$[25]and stable quarks compare with other quarks heavy and unstable quarks . The results of photons rate shown in tables(2) for s $ug \to d\boldsymbol{\gamma}$ystem which is smaller than the results in tables (3) for$Cg \to u\gamma$ system . This is lead to general the rate of photon transition are large when a small quark mass of systems

5. Conclusion

Photons rate at quark gluon reactions at Compton scattering processes is studied due to the quantum chromodynamic theory. The photonsemissionat quark gluon system is a tool tested the quantum chromodynamic theory depending on the confinement and deconfinment state .Photons rate is relatively due to the effective strength coupling of the quark gluon interaction at $ug \to d\boldsymbol{\gamma}$and $cg \to u\gamma$systemsand the photons rate are large for system have a small effective strength coupling and increases with decreases the photons energy. In summary, it can be concluded that‟s for high temperatures the effective coupling constant of QCD becomes weak and quark-gluon systems are collective excitations particles and should to be good approximation become hadronic system. The photon's rate give facilities to study the strong force dominates and the formed of nucleus by combined the protons and neutrons due to the nuclear force.

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