On mass limit for chiral color symmetry G'-boson from CMS data on $t\bar{t}$-production at LHC

I. V. Frolov[a*], M. V. Martynov[a†], A. D. Smirnov[a‡]

[a] Division of Theoretical Physics, Department of Physics,
Yaroslavl State University, Sovietskaya 14,
150000 Yaroslavl, Russia.

Abstract

The contributions of G'-boson predicted by the chiral color symmetry of quarks to the cross section $\sigma(pp \to t\bar{t})$ and to the charge asymmetry $A_C(pp \to t\bar{t})$ of $t\bar{t}$ production at the LHC are calculated in dependence on two free parameters of the model, the G' mass $m_{G'}$ and mixing angle θ_G. Using the current CMS data on $\sigma(pp \to t\bar{t})$ and $A_C(pp \to t\bar{t})$ the lower mass limits for G'-mass in dependence on θ_G are discussed. It is shown that the lower mass limits for G'-boson resulting from CMS data exceed the G'-mass region of 1σ consistency with CDF and D0 data on the forward-backward asymmetry $A_{\rm FB}^{t\bar{t}}$ of $t\bar{t}$ production at the Tevatron.

1. Introduction

The search for a new physics beyond the Standard Model (SM) is now one of the aims of experiments at the LHC. There is a lot of the models predicting new physics effects at energies of order of one or a few TeV and which can be verified at LHC.

One of the simplest extensions of the SM can be based on the idea of the originally chiral character of $SU_c(3)$ color symmetry of quarks i.e on the gauge group of the chiral color symmetry

$$\begin{array}{ccccc} G_c = SU_L(3)\times & SU_R(3) & \xrightarrow{M_{chc}} & SU_c(3), & (1)\\ G^L_\mu, & G^R_\mu & \to & G_\mu, \quad G'_\mu, & \\ g_L, & g_R & \to & g_{st}(M_{chc}) = \dfrac{g_L g_R}{\sqrt{(g_L)^2+(g_R)^2}} & \end{array}$$

which is assumed to be valid at high energies and is broken to usual QCD $SU_c(3)$ at low energy scale.

The immediate consequence the chiral color symmetry of quarks is the prediction of the new gauge particle – axigluon G^A (in particular case of $g_L = g_R$) or G'-boson (in more general case of $g_L \neq g_R$):

$$G_c \;\Rightarrow\; \begin{cases} \text{axigluon } G^A \text{ for } g_L = g_R, & [1\text{–}4], \\ G' - \text{boson for } g_L \neq g_R, & [5\text{–}8]. \end{cases}$$

After the chiral color symmetry breaking the G'-boson picks up the mass

$$m_{G'} = \frac{g_{st}(M_{chc})}{s_G c_G}\frac{\eta}{\sqrt{6}}, \qquad (2)$$

*e-mail: pytnik89@mail.ru

†e-mail: martmix@mail.ru

‡e-mail: asmirnov@uniyar.ac.ru

η is the VEV of the $(3_L, \bar{3}_R)$ scalar field $\Phi_{\alpha\beta}$ of the group G_c, which breaks the chiral color symmetry, $\alpha, \beta = 1, 2, 3$ are the $SU_L(3)$ and $SU_R(3)$ indices, $s_G = \sin\theta_G$, $c_G = \cos\theta_G$, θ_G is $G^L - G^R$ mixing angle, $tg\,\theta_G = g_R/g_L$.

So, the G'-boson is the massive octet-colored gauge particle with vector and axial vector coupling constants to quarks of order g_{st} and it can give rise the increase of the cross section and the appearance of the charge asymmetry of $t\bar{t}$ production at the LHC (as well as of a forward-backward asymmetry in $t\bar{t}$ production at the Tevatron)

$$G' \;\; \Rightarrow \;\; \begin{cases} \sigma(pp \to t\bar{t}), \;\; A_C(pp \to t\bar{t}) \text{ at the LHC,} \\ \sigma(p\bar{p} \to t\bar{t}), \;\; A_{\rm FB}(p\bar{p} \to t\bar{t}) \text{ at the Tevatron.} \end{cases}$$

The current CMS data on cross section $\sigma_{t\bar{t}}$ [9] and charge asymmetry $A_{\rm C}$ [10] of the $t\bar{t}$ production at the LHC are

$$\sigma_{t\bar{t}} = 165.8 \pm 2.2(stat.) \pm 10.6(syst.) \pm 7.8(lumi.)\text{pb}(= 165.8 \pm 13.3\text{pb}), \tag{3}$$
$$A_C = 0.004 \pm 0.010(stat.) \pm 0.012(syst.)(= 0.004 \pm 0.015). \tag{4}$$

The SM predictions for $\sigma_{t\bar{t}}$ [11] and $A_{\rm C}$ [12] are

$$\sigma_{t\bar{t}}^{\rm NNLOapprox} = 163^{+11}_{-10}\,\text{pb}\,, \tag{5}$$
$$A_C^{\rm SM} = 0.0115 \pm 0.0006. \tag{6}$$

We discuss below the cross section and charge asymmetry of the $t\bar{t}$-production at LHC with account of the contributions of the chiral color symmetry G'-boson and of the SM predictions (5), (6) and analyse the mass limit for chiral color symmetry G'-boson resulting from CMS data (3), (4) on $t\bar{t}$-production at LHC.

2. Cross sections and charge asymmetry of the parton processes $q\bar{q}, gg \to t\bar{t}$

The interaction of the G'-boson with quarks can be written in model independent way as

$$\mathcal{L}_{G'qq} = g_{st}(M_{chc})\,\bar{q}\gamma^\mu(v + a\gamma_5)G'_\mu q$$

where v and a are the vector and axial-vector coupling constants, $G'_\mu = G'^i_\mu t_i$, t_i, $i = 1, 2, ..., 8$ are the generators of $SU_c(3)$ group.

The gauge chiral color symmetry group (1) gives for v and a the expressions

$$v = \frac{c_G^2 - s_G^2}{2s_G c_G} = \cot(2\theta_G), \quad a = \frac{1}{2s_G c_G} = 1/\sin(2\theta_G).$$

So, the gauge chiral color symmetry model has two free parameters, G'-boson mass $m_{G'}$ (2) and the $G^L - G^R$ mixing angle θ_G.

In the process $q\bar{q} \to t\bar{t}$ of $t\bar{t}$ production in $q\bar{q}$ collisions the momenta of initial quarks in collinear limit can be written as

$$p_q = \{\varepsilon_q, 0, 0, p_{qz}\}, \qquad p_{\bar{q}} = \{\varepsilon_{\bar{q}}, 0, 0, p_{\bar{q}z}\}$$

with $\hat{s} = (p_q + p_{\bar{q}})^2$.

The momenta of the final t- and $\bar{t}$-quarks can be written as

$$p_t = \left\{\sqrt{p_\perp^2 + m_t^2}\,{\rm ch}\,y_t,\, p_{\perp x},\, p_{\perp y},\, \sqrt{p_\perp^2 + m_t^2}\,{\rm sh}\,y_t\right\}, \tag{7}$$
$$p_{\bar{t}} = \left\{\sqrt{p_\perp^2 + m_t^2}\,{\rm ch}\,y_{\bar{t}},\, p_{\perp x},\, -p_{\perp y},\, \sqrt{p_\perp^2 + m_t^2}\,{\rm sh}\,y_{\bar{t}}\right\} \tag{8}$$

where

$$y_i = \frac{1}{2} \ln \left(\frac{\varepsilon_i + p_{iz}}{\varepsilon_i - p_{iz}} \right), \quad i = t, \bar{t} \tag{9}$$

are the rapidities of t- and $\bar{t}$-quarks and $p_{\perp x}$, $p_{\perp y}$ is the the transversal momentum of t-quark.

It is convinient below instead of the rapidities (9) to use the variables

$$Y \;=\; y_t + y_{\bar{t}}, \qquad z = y_t^2 - y_{\bar{t}}^2.$$

The conservation of the 4-momentum fixes for Y and $p_\perp$ the values

$$\overline{Y} = \ln \left(\frac{\varepsilon_q + \varepsilon_{\bar{q}} + p_{qz} + p_{\bar{q}z}}{\varepsilon_q + \varepsilon_{\bar{q}} - (p_{qz} + p_{\bar{q}z})} \right), \quad \bar{p}_\perp^2 + m_t^2 = \frac{\hat{s}}{4\mathrm{ch}^2 (z/2\overline{Y})}$$

whereas z varies in interval

$$-z_0 \leq \;\; z \;\; \leq z_0, \qquad z_0 = \overline{Y} \Delta y_0, \qquad \mathrm{th}(\Delta y_0/2) = \sqrt{1 - 4m_t^2/\hat{s}} \equiv \beta.$$

The <u>total parton cross section</u> of the process $q\bar{q} \overset{g,G'}{\longrightarrow} t\bar{t}$ with account of the G'-boson for $m_q^2 \ll m_t^2$, $\hat{s}$ in tree approximation can be written as

$$\sigma^{LO}(q\bar{q} \overset{g,G'}{\longrightarrow} t\bar{t}) \;=\; \sigma^{LO}_{SM}(q\bar{q} \to t\bar{t}) + \Delta\sigma^{LO}_{G'}(q\bar{q} \to t\bar{t})$$

where

$$\sigma^{LO}_{SM}(q\bar{q} \to t\bar{t}) \;=\; \frac{4\pi\beta}{27\hat{s}}\, \alpha_s^2(\mu)\,(3 - \beta^2)$$

is the the total parton cross section of tree approximation in the SM and

$$\begin{aligned} \Delta\sigma^{LO}_{G'}(q\bar{q} \to t\bar{t}) \;&=\; \frac{4\pi\beta}{27} \left\{ \frac{2\,\alpha_s(\mu)\alpha_s(M_{chc})\, v^2(\hat{s} - m_{G'}^2)(3 - \beta^2)}{(\hat{s} - m_{G'}^2)^2 + \Gamma_{G'}^2 m_{G'}^2} + \right. \\ &+ \left. \frac{\alpha_s^2(M_{chc})\, \hat{s}(v^2 + a^2)\big[v^2(3 - \beta^2) + 2a^2\beta^2\big]}{(\hat{s} - m_{G'}^2)^2 + \Gamma_{G'}^2 m_{G'}^2} \right\} \end{aligned} \tag{10}$$

is the contribution induced by the G'-boson.

One can define the <u>charge difference of the parton cross section</u> of the process $q\bar{q} \to t\bar{t}$ as

$$\Delta_C(q\bar{q} \to t\bar{t}) \;=\; \sigma(q\bar{q} \to t\bar{t}, z > 0) - \sigma(q\bar{q} \to t\bar{t}, z < 0). \tag{11}$$

For of the process $q\bar{q} \overset{g,G'}{\longrightarrow} t\bar{t}$ in tree approximation for $m_q^2 \ll m_t^2$, $\hat{s}$ the charge difference takes the form

$$\Delta_C^{LO}(q\bar{q} \overset{g,G'}{\longrightarrow} t\bar{t}) \;=\; \Delta(\hat{s})\, \frac{\overline{Y}}{|\overline{Y}|}\, \frac{f(p_q, p_{\bar{q}})}{(p_q p_{\bar{q}})} \tag{12}$$

where

$$\Delta(\hat{s}) \;=\; \frac{4\pi\beta^2 a^2}{9}\, \frac{\alpha_s(\mu)\alpha_s(M_{chc})(\hat{s} - m_{G'}^2) + 2\alpha_s^2(M_{chc}) v^2 \hat{s}}{(\hat{s} - m_{G'}^2)^2 + m_{G'}^2 \Gamma_{G'}^2} \tag{13}$$

and

$$f(p_q, p_{\bar{q}}) \;=\; p_{qz}\varepsilon_{\bar{q}} - p_{\bar{q}z}\varepsilon_q \tag{14}$$

is the antisymmetric under permutation $q \leftrightarrow \bar{q}$ function of the momenta of the initial quark and antiquark.

As concerns the process $gg \to t\bar{t}$ of $t\bar{t}$ production in gluon fusion the G'-boson does not contribute to this process in tree approximation. The <u>total parton cross section</u> of the process $gg \to t\bar{t}$ in tree approximation of the SM is well known and has the form

$$\begin{aligned} &\sigma^{LO}_{SM}(gg \to t\bar{t}) = \\ &= \frac{\pi\alpha_s^2(\mu)}{48\hat{s}} \left[\left(\beta^4 - 18\beta^2 + 33\right) \log\left(\frac{1+\beta}{1-\beta}\right) + \beta\left(31\beta^2 - 59\right) \right]. \end{aligned}$$

3. Charge asymmetry and cross section of the $t\bar{t}$-pair production at the LHC

The charge difference of the parton cross section (11) results in the appearence of the corresponding charge difference $\Delta_C(pp \to t\bar{t})$ of the $t\bar{t}$-production in pp-collisions. One usually uses the charge asymmetry of $t\bar{t}$-production in pp-collisions defined as

$$A_C(pp \to t\bar{t}) = \frac{\sigma(pp \to t\bar{t}, z > 0) - \sigma(pp \to t\bar{t}, z < 0)}{\sigma(pp \to t\bar{t})} \equiv \frac{\Delta_C(pp \to t\bar{t})}{\sigma(pp \to t\bar{t})}.$$

With account the G'-boson the charge asymmetry $A_C(pp \to t\bar{t})$ can be written as the sum

$$A_C(pp \to t\bar{t}) = A_C^{SM}(pp \to t\bar{t}) + A_C^{G'}(pp \to t\bar{t})$$

of the charge asymmetry $A_C^{SM}(pp \to t\bar{t})$ in the SM and of the contribution induced by the G'-boson

$$A_C^{G'}(pp \to t\bar{t}) = \frac{\Delta_C^{LO}(pp \stackrel{g,G'}{\to} t\bar{t})}{\sigma(pp \to t\bar{t})}$$

where $\Delta_C^{LO}(pp \stackrel{g,G'}{\to} t\bar{t})$ is the contribution of the leading order into the charge difference $\Delta_C(pp \to t\bar{t})$ from the G'-boson.

The contribution of the G'-boson into the charge difference in the leading order has been calculated with account of (12), (13), (14) as

$$\Delta_C^{LO}(pp \stackrel{g,G'}{\to} t\bar{t}) = 2 \iint\limits_{D_1} F_{\Delta_C}^{pp}(x_1, x_2)\Delta(x_1 x_2 s) dx_1 dx_2,$$

where $\Delta(x_1 x_2 s)$ is defined by (13) with $\hat{s} = x_1 x_2 s$, $s = (P_1 + P_2)^2$, the integration is performed over the region D_1

$$D_1 : x_0^2/x_1 \le x_2 \le x_1, \quad x_0 \le x_1 \le 1, \quad x_0^2 = 4m_t^2/s$$

and the function $F_{\Delta_C}^{pp}(x_1, x_2)$ is defined by the parton distribution functions of quarks and antiquarks as

$$F_{\Delta_C}^{pp}(x_1, x_2) = \sum_k \left[f_{q_k}^p(x_1) f_{\bar{q}_k}^p(x_2) - f_{\bar{q}_k}^p(x_1) f_{q_k}^p(x_2) \right]$$

and is nonzero because of difference of the PDF of the (valence) quarks and (see) antiquarks in proton (the sign minus appears due to the antisymmtric function (14)).

The cross section of $t\bar{t}$-production in pp-collisions is expressed in terms of the parton cross sections $\sigma(ij \to t\bar{t})$ and the parton distribution functions $f_i^p(x_1)$, $f_j^p(x_2)$ in the usual form

$$\sigma(pp \to t\bar{t}) = \sum_{i,j} \iint f_i^p(x_1) f_j^p(x_2)\, \sigma(ij \to t\bar{t}) dx_1 dx, \qquad (i, j = q_k, \bar{q}_k, g).$$

The parton cross sections $\sigma(ij \to t\bar{t})$ can be written as the sum of the SM cross sections $\sigma_{\rm SM}(ij \to t\bar{t})$ and the contributions $\Delta\sigma_{G'}^{\rm LO}(ij \to t\bar{t})$ induced by the G'-boson

$$\sigma(ij \to t\bar{t}) = \sigma_{\rm SM}(ij \to t\bar{t}) + \Delta\sigma_{G'}^{\rm LO}(ij \to t\bar{t}).$$

The SM cross sections $\sigma_{\rm SM}(ij \to t\bar{t})$ can be written as the expansion

$$\begin{aligned} \sigma_{\rm SM}(ij \to t\bar{t}) &= a_s^2 \Big[\sigma_{\rm SM}^{(0)}(ij \to t\bar{t}) + a_s \sigma_{\rm SM}^{(1)}(ij \to t\bar{t}) + \\ &+ a_s^2 \sigma_{\rm SM}^{(2)}(ij \to t\bar{t}) \Big] + O(a_s^5), \quad a_s = \alpha_s/\pi \end{aligned}$$

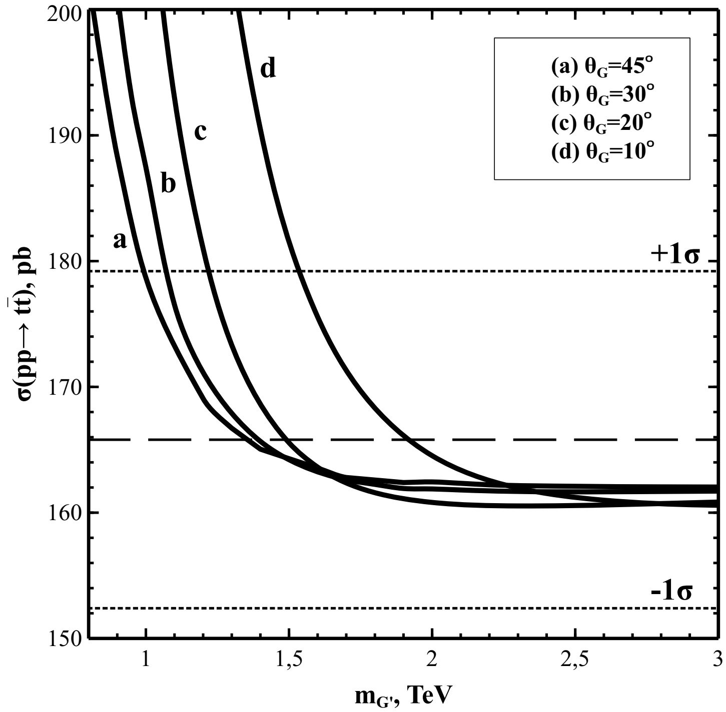

Figure 1: Cross section $\sigma(pp \to t\bar{t})$ of $t\bar{t}$ production at the LHC as a function of the G' mass $m_{G'}$ in dependence on the mixing angle θ_G, $(\sqrt{s} = 7\,\text{TeV})$.

so that

$$a_s^2\, \sigma_{\rm SM}^{(0)}(ij \to t\bar{t}) \quad = \quad \sigma_{\rm SM}^{LO}(ij \to t\bar{t}) \quad \text{for} \quad i = q_k(\bar{q}_k)g,\; j = \bar{q}_k(q_k)g$$

are the SM cross sections of leading order and

$$\sigma_{\rm SM}^{(1,2)}(ij \to t\bar{t}) \quad = \quad \hat{\sigma}_{i,j}^{(1,2)}(\hat{s}, m_t, \mu_r, \mu_f)$$

are the perturbation corrections of the first two orders of the perturbation theory. For these corrections we use the expressions $\hat{\sigma}_{i,j}^{(1,2)}(\hat{s}, m_t, \mu_r, \mu_f)$ of ref. [13].

For the the G'-boson contributions $\Delta\sigma_{G'}^{\rm LO}(ij \to t\bar{t})$ we use the expressions (10)

$$\Delta\sigma_{G'}^{\rm LO}(ij \to t\bar{t}) \quad = \quad \Delta\sigma_{G'}^{LO}(q_k\bar{q}_k \to t\bar{t}) \quad \text{for} \quad i = q_k(\bar{q}_k),\; j = \bar{q}_k(q_k).$$

4. Results and discussion

We have calculated and analysed the cross section $\sigma(pp \to t\bar{t})$ and the charge asymmetry $A_C(pp \to t\bar{t})$ of $t\bar{t}$-production in pp-collisions in the form

$$\begin{aligned} \sigma(pp \to t\bar{t}) \quad &= \quad \sigma_{\rm SM}(pp \to t\bar{t}) + \Delta\sigma_{G'}^{\rm LO}(pp \to t\bar{t}), \\ A_C(pp \to t\bar{t}) \quad &= \quad A_C^{SM}(pp \to t\bar{t}) + A_C^{G'}(pp \to t\bar{t}). \end{aligned}$$

We use the parton distribution functions MSTW2008 with $(Q^2 = \mu_r = \mu_f = m_t)$ [14].

For $\sigma_{\rm SM}(pp \to t\bar{t})$ as a result of calculation we have obtained the value

$$\sigma_{\rm SM}(pp \to t\bar{t}) \quad = \quad 162^{+7.8}_{-13.6}\,\text{pb}$$

in agreement with CMS experimental value (3). For the SM contribution into the charge asymmetry $A_C^{SM}(pp \to t\bar{t})$ we have used the value (6).

The cross section $\sigma(pp \to t\bar{t})$ and the charge asymmetry $A_C(pp \to t\bar{t})$ of $t\bar{t}$-production in pp-collisions at the LHC are shown in fig. 1, 2 as the functions of the G' mass $m_{G'}$ in dependence

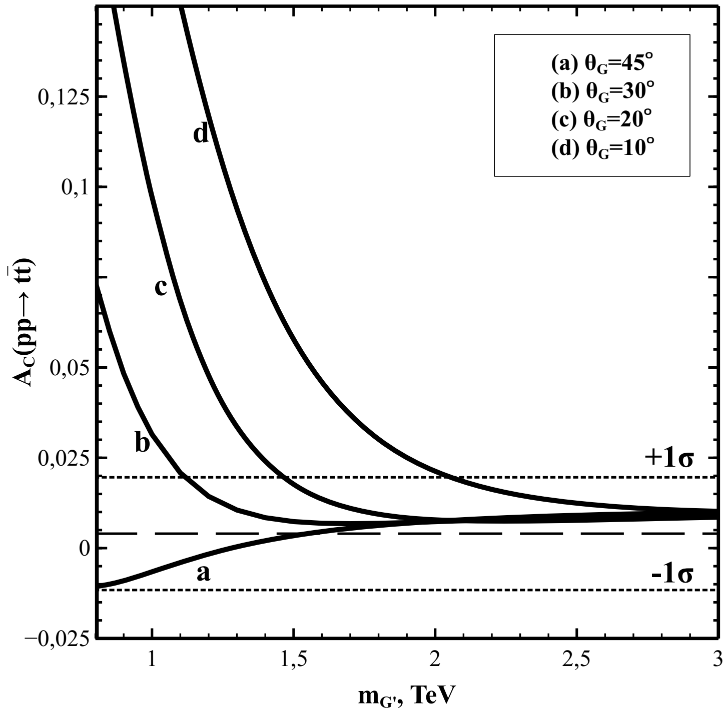

Figure 2: Charge asymmetry $A_C(pp \to t\bar{t}) = A_C^{SM}(pp \to t\bar{t}) + A_C^{G'}(pp \to t\bar{t})$ of $t\bar{t}$ production at the LHC as a function of the G' mass $m_{G'}$ in dependence on the mixing angle θ_G, $(\sqrt{s} = 7\,\mathrm{TeV})$.

on the mixing angle θ_G, $(\sqrt{s} = 7\,\mathrm{TeV})$. The experimental values of the cross section (3) and of the charge asymmetry (4) and the corresponding experimental errors of 1σ are indicated by the horizontal lines.

As seen, for the masses of the G' mass of order or larger 1 TeV for appropriate mixing angles the cross section and the charge asymmetry can be in agreement with CMS experimental values (3) and (4).

The fig.3 showes the regions in $m_{G'} - \theta_G$ plane which are consistent within 1σ with CMS data (a) on the cross section $\sigma(pp \to t\bar{t})$ (3) and (b) on the charge asymmetry $A_C(pp \to t\bar{t})$ (4), $(\sqrt{s} = 7\,\mathrm{TeV})$.

One can see from the fiq.3 that, for example, for the mixing angles

$$a)\ \theta_G = 45^\circ \text{ (axigluon)}, \quad b)\ \theta_G = 30^\circ, \quad c)\ \theta_G = 15^\circ$$

G'-boson with masses

$$a)\ m_{G^A} > 1.0\,\mathrm{TeV}, \quad b)\ m_{G'} > 1.1\,\mathrm{TeV}, \quad c)\ m_{G'} > 1.7\,\mathrm{TeV}$$

is consistent within 1σ with the CMS data on the cross section $\sigma(pp \to t\bar{t})$ and on the charge asymmetry $A_C(pp \to t\bar{t})$ of $t\bar{t}$ production at the LHC.

It should be noted however that G'-boson can have also the mass limits from another sourses. For example, G'-boson interacts also with the light quarks and could manifest itself as the peak in the light quark dijet production and unobservation of such peak gives the corresponding lower limit on G'-boson mass which can be more stringent than those resulting from $t\bar{t}$ production. Nevetheless the limits on G'-boson mass obtained in this paper from the $t\bar{t}$ production are interesting as independent ones.

The region in $m_{G'} - \theta_G$ plane which is simultaneously consistent within 1σ with CMS data on the cross section $\sigma(pp \to t\bar{t})$ and on the charge asymmetry $A_C(pp \to t\bar{t})$ should be compared with the regions which are consistent within 1σ with CDF and D0 data on the cross

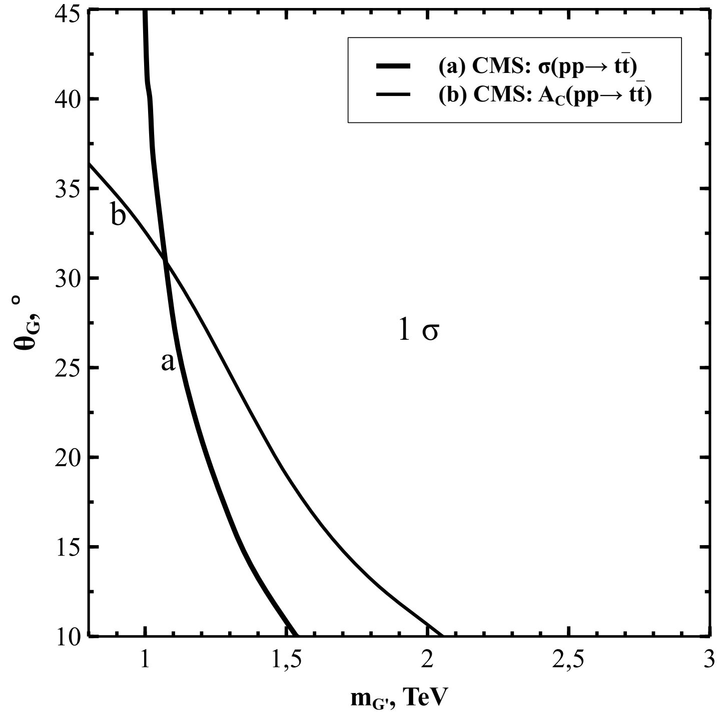

Figure 3: The $m_{G'} - \theta_G$ regions consistent within 1σ with CMS data (a) on the cross section $\sigma(pp \to t\bar{t})$ and (b) on the charge asymmetry $A_C(pp \to t\bar{t})$ of $t\bar{t}$ production at the LHC, $(\sqrt{s} = 7\,\mathrm{TeV})$.

section $\sigma(p\bar{p} \to t\bar{t})$ and on the forward-backward asymmetry $A_{\rm FB}(p\bar{p} \to t\bar{t})$ of $t\bar{t}$ production at the Tevatron.

For this comparision we use below the current Tevatron data on $t\bar{t}$-production

$$\begin{aligned} \mathrm{CDF:} \quad & \sigma_{t\bar{t}} = 7.5 \pm 0.48\mathrm{pb}\ [15], && (15)\\ & A_{FB}^{t\bar{t}} = 0.162 \pm 0.047\ [16], \quad (1.6\sigma \text{ above the } A_{FB}^{t\bar{t}} \text{ of SM}) && (16)\\ \mathrm{D0:} \quad & \sigma_{t\bar{t}} = 7.56^{+0.63}_{-0.56}\mathrm{pb}\ [17], && (17)\\ & A_{FB}^{t\bar{t}} = 0.196 \pm 0.065\ [18], \quad (1.5\sigma \text{ above the } A_{FB}^{t\bar{t}} \text{ of SM}) && (18) \end{aligned}$$

and the corresponding current SM predictions

$$\sigma_{t\bar{t}}^{\rm NNLOapprox} = 7.08 \pm 0.36\mathrm{pb}\ [11] \quad (19)$$

$$A_{FB}^{t\bar{t}} = 0.087(10)\ [12]. \quad (20)$$

We have calculated and analysed the cross section $\sigma(p\bar{p} \to t\bar{t})$ and the forward-backward asymmetry $A_{\rm FB}(p\bar{p} \to t\bar{t})$ of $t\bar{t}$ production at the Tevatron with account of the contributions of G'-boson and of the SM predictions (19), (20). We have found the regions in $m_{G'} - \theta_G$ plane which are consistent within 1σ with CDF and D0 data on the cross section $\sigma(p\bar{p} \to t\bar{t})$ and on the forward-backward asymmetry $A_{\rm FB}(p\bar{p} \to t\bar{t})$ of $t\bar{t}$ production at the Tevatron.

The fig.4 showes also the regions in $m_{G'} - \theta_G$ plane which are consistent within 1σ with CDF data (15), (16) (curve(c)) and with D0 data (17), (18) (curve(d)) on the cross section $\sigma(p\bar{p} \to t\bar{t})$ and on the forward-backward asymmetry $A_{\rm FB}(p\bar{p} \to t\bar{t})$ of $t\bar{t}$ production at the Tevatron. As seen from fig.4, the regions (c) and (d) are below the lower G'-boson mass limits resulting from CMS data (3) and (4) and reproduced here by the curves (a), (b).

5. Summary

In conclusion we summarize the results of the work.

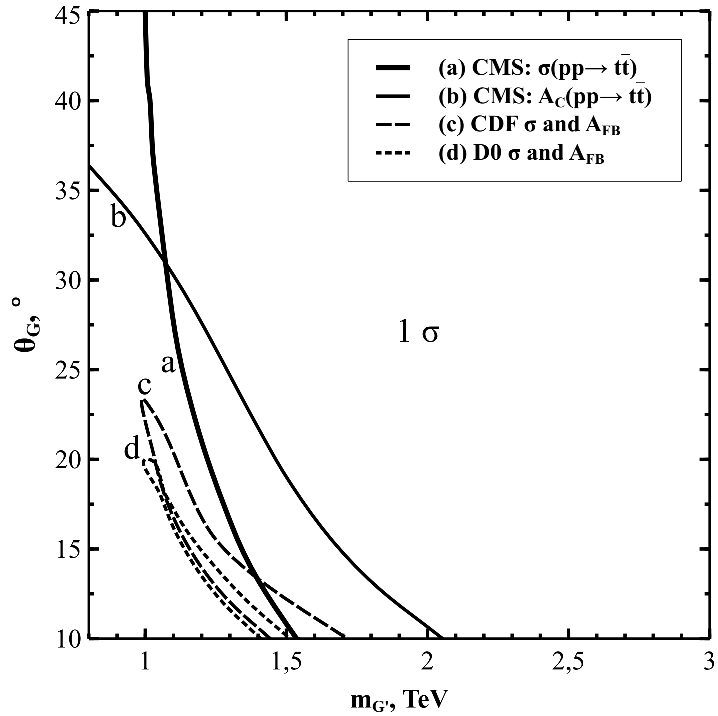

Figure 4: The same in comparision with the regions consistent within 1σ with (c) CDF and (d) D0 data on the cross section $\sigma(p\bar{p} \to t\bar{t})$ and on the forward-backward asymmetry $A_{\rm FB}(p\bar{p} \to t\bar{t})$ of $t\bar{t}$ production at the Tevatron.

- The contributions of G'-boson predicted by the chiral color symmetry of quarks to the cross section $\sigma(pp \to t\bar{t})$ and to the charge asymmetry $A_C(pp \to t\bar{t})$ of $t\bar{t}$ production at the LHC are calculated in dependence on two free parameters of the model, the G' mass $m_{G'}$ and mixing angle θ_G.
- Using the current CMS data on $\sigma(pp \to t\bar{t})$ and $A_C(pp \to t\bar{t})$ the lower mass limits for G'-mass in dependence on θ_G are obtained. In particular, the axigluon ($\theta_G = 45°$) with masses
$$m_{G^A} > 1.0\,\text{TeV}$$
is shown to be consistent within 1σ with the current CMS data on $\sigma(pp \to t\bar{t})$ and $A_C(pp \to t\bar{t})$.
- The lower mass limits for G'-boson resulted from these CMS data exceed the G'-mass region of 1σ consistency with CDF and D0 data on the forward-backward asymmetry $A^{t\bar{t}}_{\rm FB}$ of $t\bar{t}$ production at the Tevatron.

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