Probing top quark electromagnetic dipole moments in single-top-plus-photon production

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Collider Cross Talk

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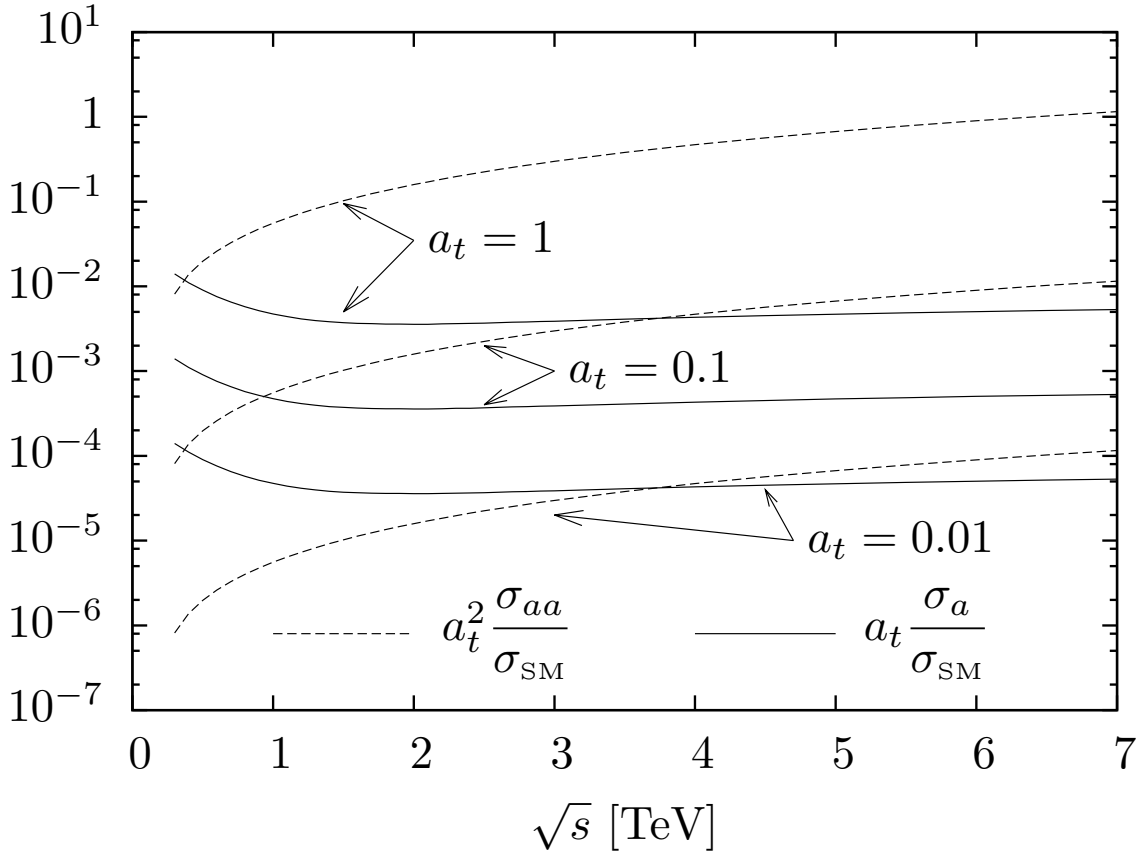
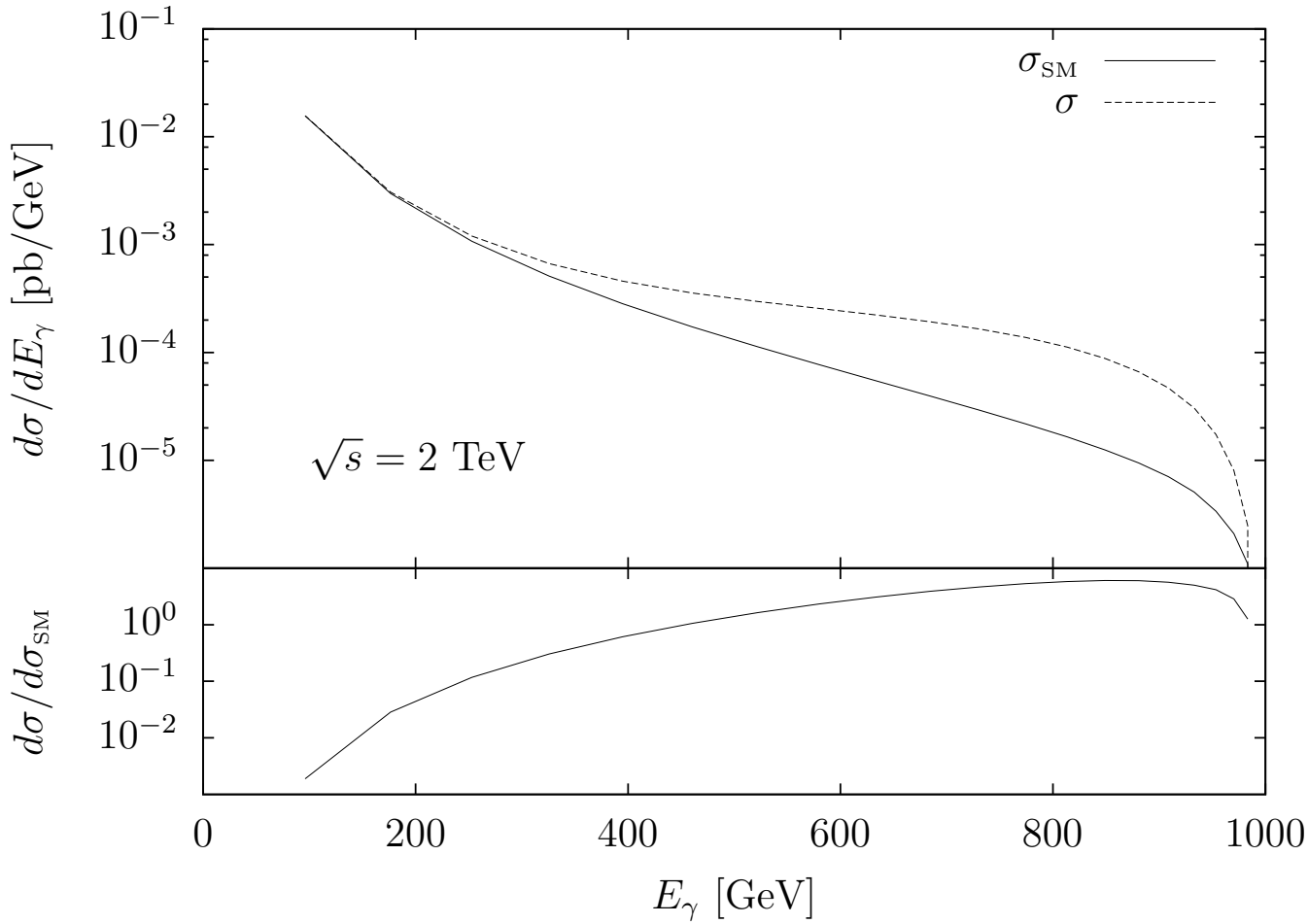
work in collaboration with T. Gehrmann.

Parton-parton cross section

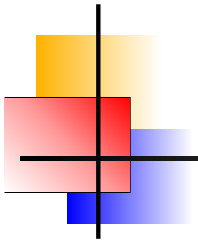


The parton-level cross section for $ub \to td\gamma$. The parton-level cross section as function of the parton-parton centre-of-mass energy $\sqrt{s}$. Ratio of the anomalous terms σ_a and σ_{aa} to the Standard Model process for different values of a_t.

Photon energy distribution



The parton-level cross section for $ub \to td\gamma$. Photon energy distribution at $\sqrt{s} = 2$ TeV. Standard Model process and anomalous contribution for $a_t = 1, d_t = 0$.



Single-top-plus-photon

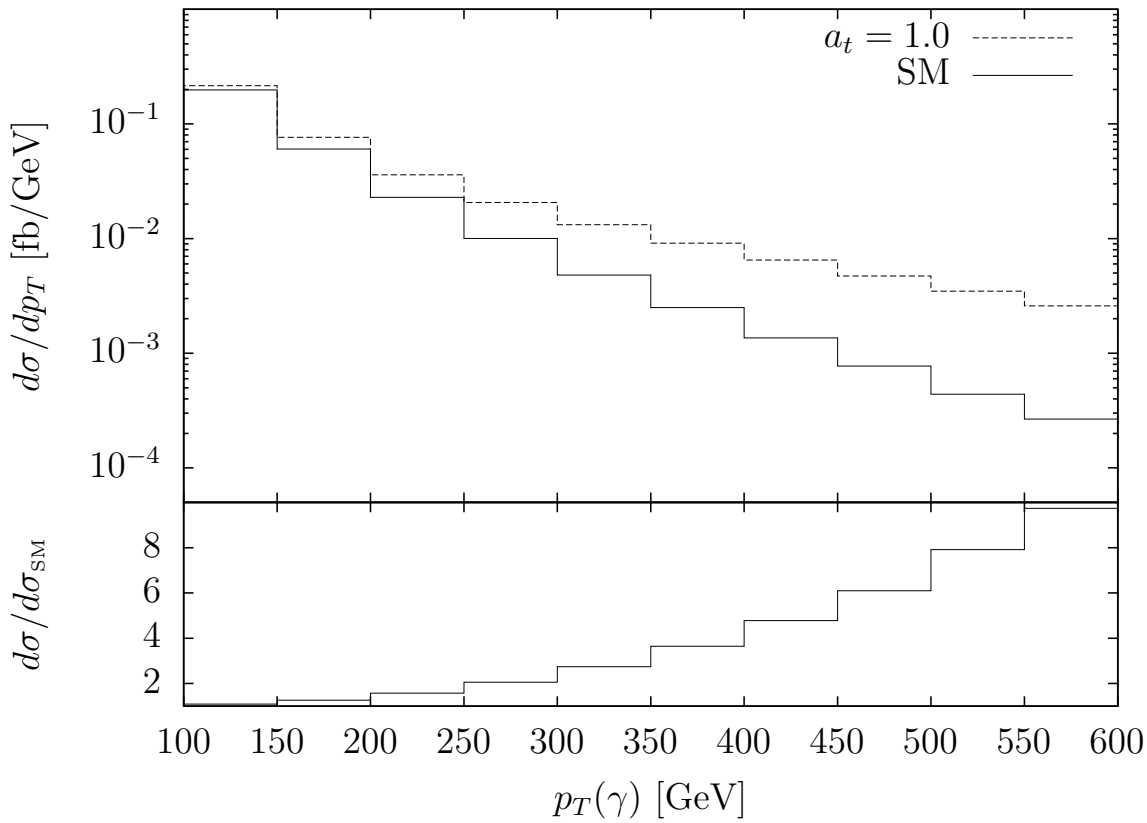
Single-top-plus-photon production at the LHC ($\sqrt{s} = 14$ TeV):

$$\begin{aligned} pp &\to \gamma l^+ \nu_l b j, \\ pp &\to \gamma l^- \bar{\nu}_l \bar{b} j, \quad \text{with } l = e, \mu, \end{aligned}$$

Acceptance cuts of signal and background events:

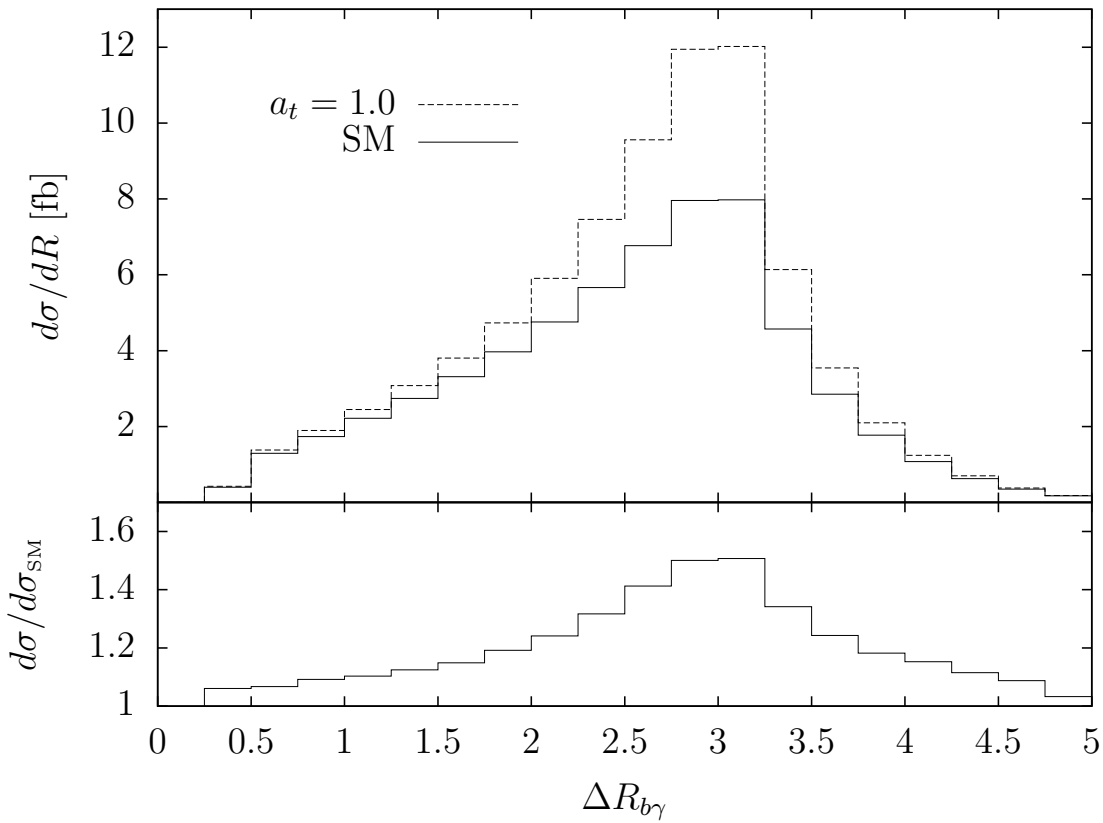
$$\begin{gathered} p_T(\gamma) > 100 \text{ GeV}, \quad p_T(j) > 20 \text{ GeV}, \\ p_T(b) > 20 \text{ GeV}, \quad \not{p}_T > 20 \text{ GeV}, \\ |\eta(\gamma)| < 2.5, \quad |\eta(b)| < 2.5, \\ |\eta(j)| < 5, \quad |\eta(l)| < 2.5, \\ \Delta R(j,b) > 0.4, \quad \Delta R(j,l) > 0.4, \quad \Delta R(j,\gamma) > 0.4, \\ \Delta R(l,\gamma) > 0.4, \quad \Delta R(l,b) > 0.4, \quad \Delta R(b,\gamma) > 0.4, \end{gathered}$$

Kinematical distributions in single-top+γ



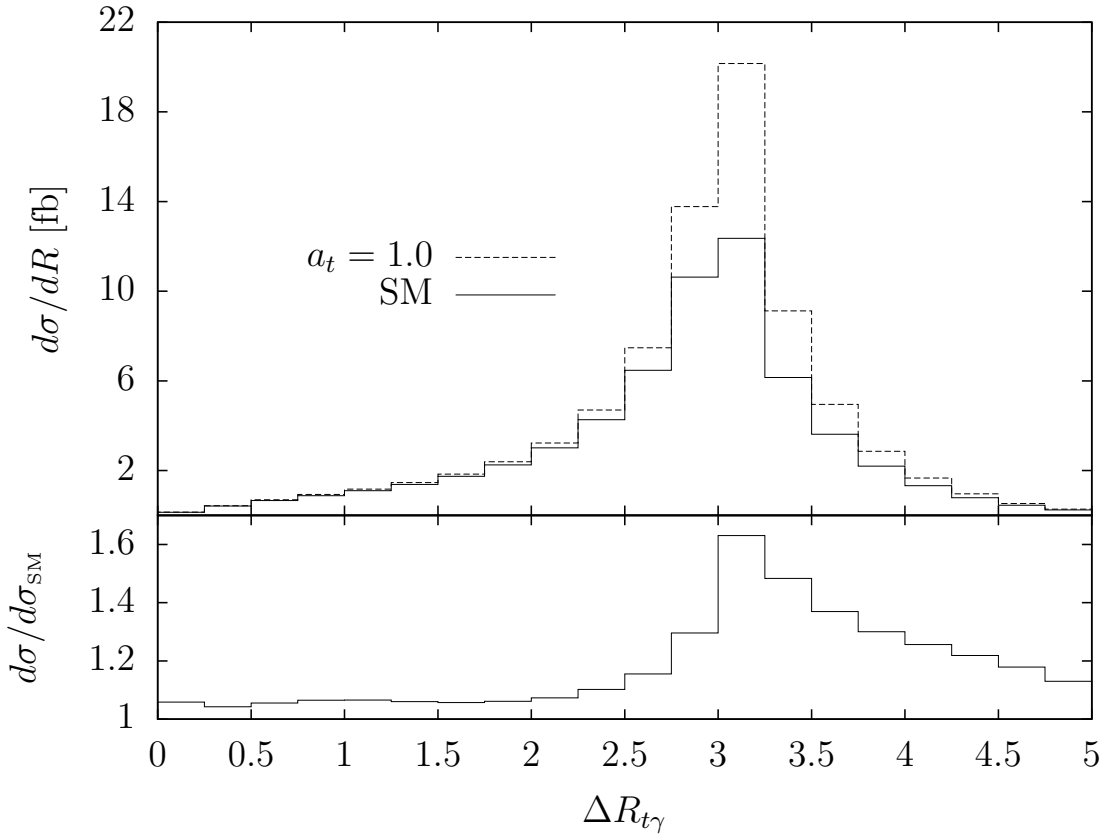
Photon transverse energy distribution for single-top+γ production at the LHC. The plot compares the Standard Model prediction with a prediction including a non-standard $tt\gamma$ coupling with $a_t = 1.0$, $d_t = 0$.

Kinematical distributions in single-top+γ

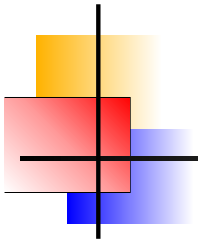


Rapidity-azimuth plane separation between b-jet and photon. The plot compares the Standard Model prediction with a prediction including a non-standard $tt\gamma$ coupling with $a_t = 1.0$, $d_t = 0$.

Kinematical distributions in single-top+γ



Rapidity-azimuth plane separation between t candidate and photon. The plot compares the Standard Model prediction with a prediction including a non-standard $tt\gamma$ coupling with $a_t = 1.0$, $d_t = 0$.

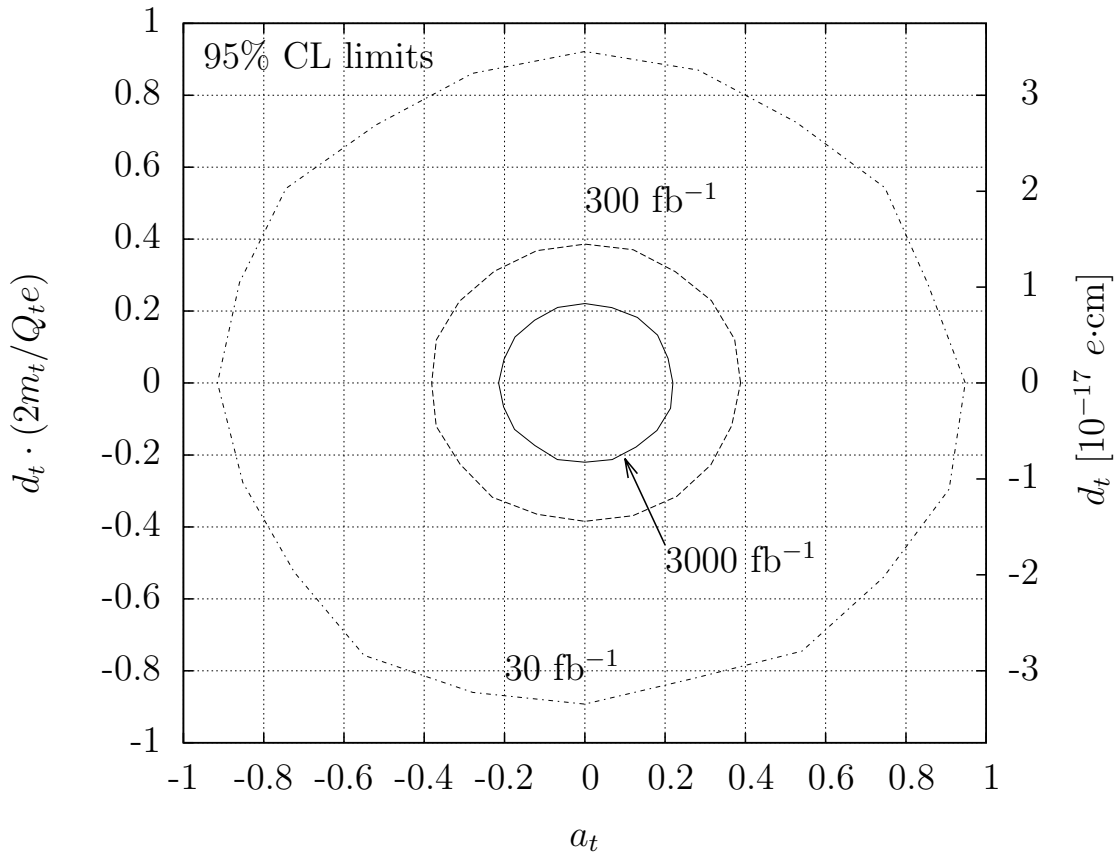


Backgrounds

Process	Measurable cross section [fb]
single-top+γ	8.0
$Wbj\gamma$	$\mathcal{O}(10^{-2})$
$t\bar{t}$ full lep.	15.0
$W\gamma$+jets	1.5
W+jets	0.4
$t\bar{t}\gamma$	0.2
$Z\gamma$+jets	$\mathcal{O}(10^{-2})$
Z+jets	$\mathcal{O}(10^{-2})$

Expected cross section for single-top+γ signal and the most important background processes at the LHC. Photon misidentification probabilities and b-jet mistag rates and efficiencies are included.

Bounds from future LHC data



Bounds on the anomalous dipole moments of the top quark at 95% confidence level, for LHC operation at $\sqrt{s} = 14$ TeV.

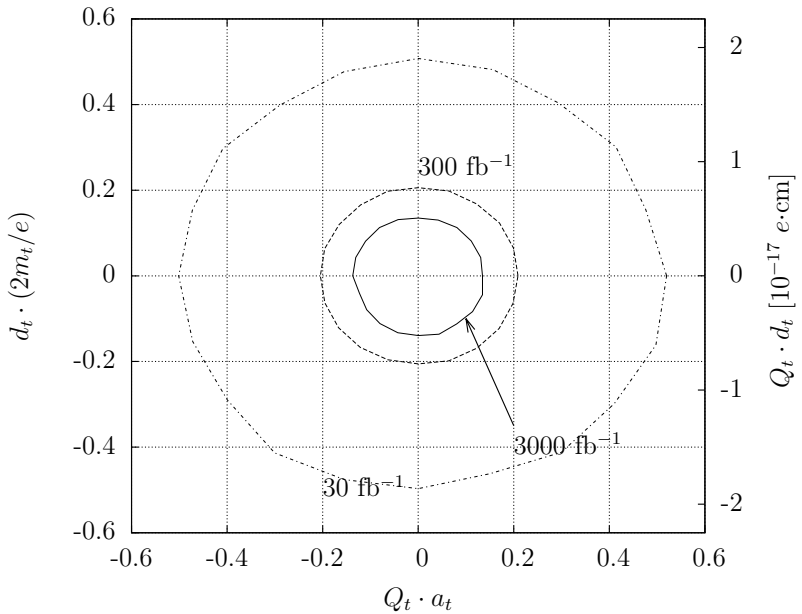
Bounds from future LHC data

coupling	30 fb^{-1}	300 fb^{-1}	3000 fb^{-1}
a_t	$+0.94$ -0.92	$+0.39$ -0.38	$+0.22$ -0.21
$d_t\,[10^{-17}\,e\cdot\text{cm}]$	$+3.5$ -3.4	$+1.5$ -1.5	$+0.83$ -0.82

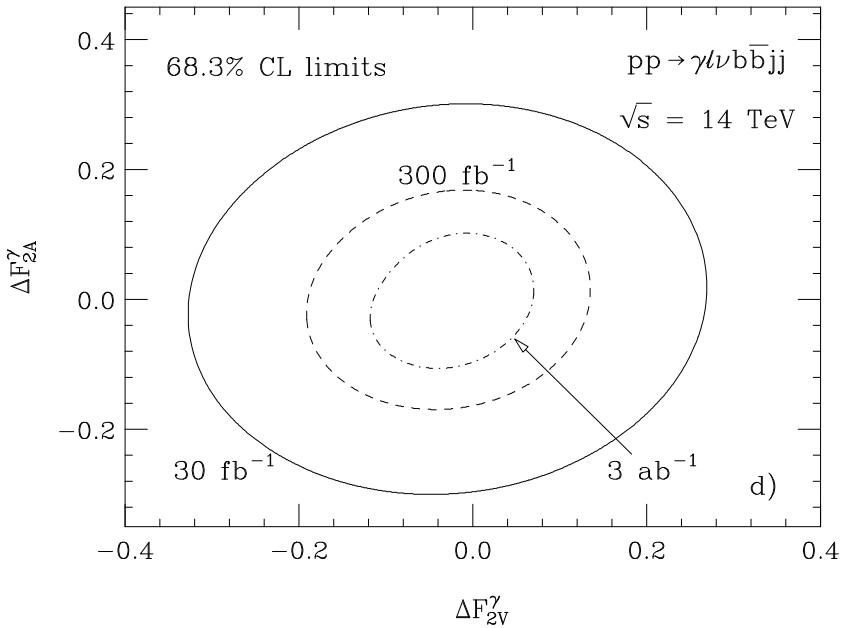
Sensitivity achievable at 95% C.L. in single-top+γ at the LHC ($\sqrt{s} = 14$ TeV) for an integrated luminosities of 30 fb^{-1}, 300 fb^{-1} and 3000 fb^{-1}.

Bounds from future LHC data

single-top+γ production

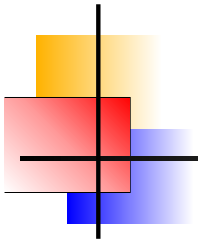


$t\bar{t}\gamma$ production



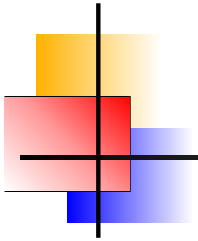
Baur et al. PRD71 (2005) 054013

Sensitivity achievable at 68% C.L. in single-top+γ and $t\bar{t}\gamma$ at the LHC ($\sqrt{s} = 14$ TeV) for an integrated luminosities of 30 fb^{-1}, 300 fb^{-1} and 3000 fb^{-1}.



The more important fundamental laws and facts of physical science have all been discovered, and these are so firmly established that the possibility of their ever being supplanted in consequence of new discoveries is exceedingly remote . . .
. . . our future discoveries must be looked for in the sixth place of decimals.

A. A. Michelson, in "Light Waves and Their Uses",
University of Chicago Press (1903), pp 23-25



Thanks!