

FCC-hh arpıřtırıcısında Ulusal Fizik alıřmalarının İnceleme

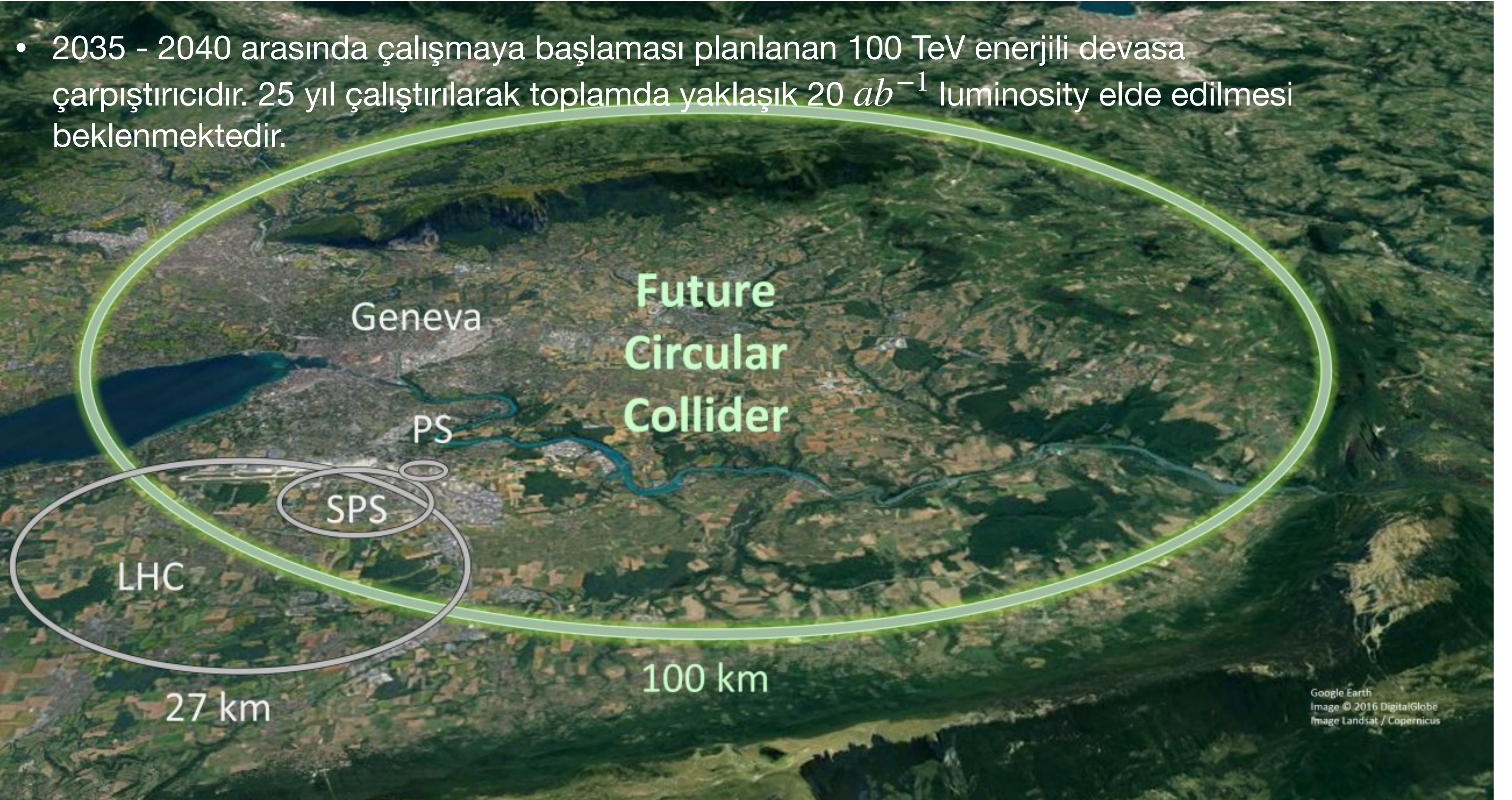
Sinan Kaday, Ankara Üniversitesi

FCC İř birlięi erevesinde Ulusal Bilgi Paylařımı alıřtayı
2-3 Nisan 2022

FCC-hh Çarpıştırıcısı

FCC = Future Circular Collider

- 2035 - 2040 arasında çalışmaya başlaması planlanan 100 TeV enerjili devasa çarpıştırıcıdır. 25 yıl çalıştırılarak toplamda yaklaşık 20 ab^{-1} luminosity elde edilmesi beklenmektedir.



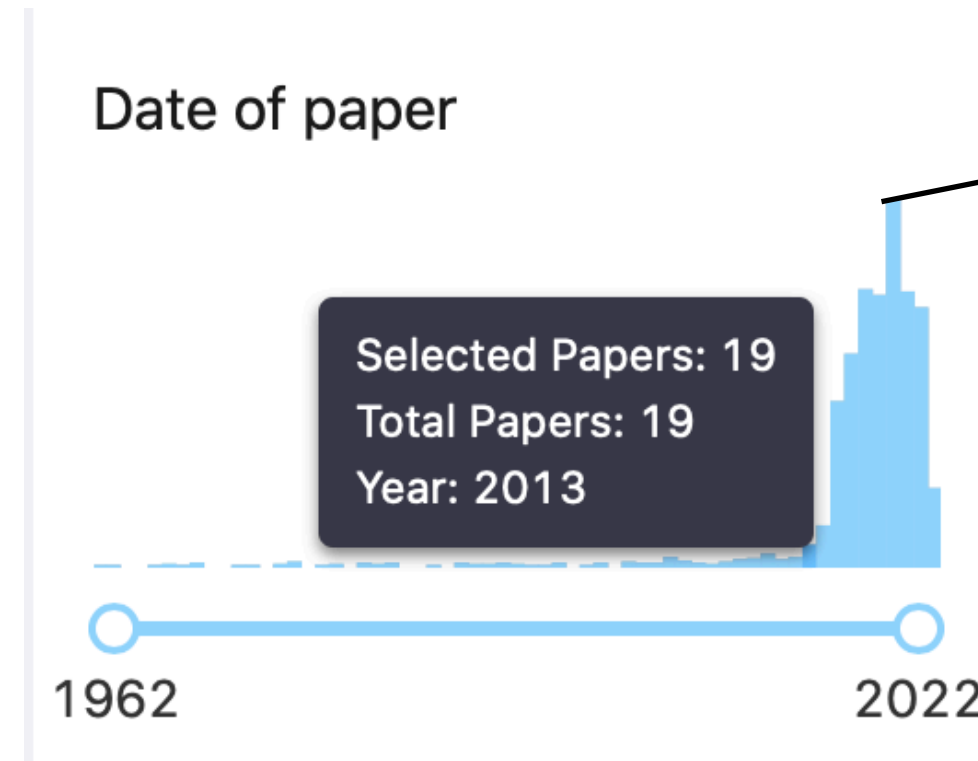
Kapsam

- Dünya genelinde FCC yayınları InspireHEP'e göre 2013 yılından sonra artış göstermiştir.



MoU

: M&O için protokol imzalayarak FCC işbirliğine girdiğini gösterir.



326 adet @ 2019

Tüm FCC Yayınları

FCC ≠ Face Centered Cubic

- Bu çalışmada InspireHEP veritabanında indekslenmiş FCC-hh kapsamında Türk yazarlı yayınlar tanıtılmıştır.
- Çalışmalar FCC-hh çarpıştırıcısında Fizik konularında gerçekleştirilen çalışmalardır. Detektör, Tasarım, ..vs. çalışmaları dahil edilmemiştir.
- Preprintler ve proceedingler dahil edilmiştir.

Konu Başlıkları

- **E6 Modeli ve GUT Çalışmaları (1)**
- **Etkin Alan Teorisi ile Anormal Bağlaşımlar (9)**
- **FCNC Bağlaşımları (2)**
- **Süpersimetri: MSSM + R-parite + Diğer SM Genişletim (4)**
- **Vektör Benzeri Parçacıklar (BSM) (2)**
- **Higgs-Radion Karışım Modelleri (1)**
- **Uyarılmış Kuark ve Lepton Durumları (2)**
- **İki Higgs Çiftlisi Modeli (2HDM) (2)**
- **QCD Teorisi ve Jet Algoritmaları (2)**
- **Tartışma - Sonuç**

E6 Modeli ve GUT Çalışmaları

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THE EUROPEAN
 PHYSICAL JOURNAL C



$$\begin{pmatrix} u_L \\ d_L \end{pmatrix}, \quad u_R, d_R, D_L, D_R;$$

$$\begin{pmatrix} c_L \\ s_L \end{pmatrix}, \quad c_R, s_R, S_L, S_R;$$

$$\begin{pmatrix} t_L \\ b_L \end{pmatrix}, \quad t_R, b_R, B_L, B_R.$$

Üretim ve analiz süreçlerinde:
 CutLang, Madgraph5, Pythia6 ve
 Delphes kullanılmış.

Regular Article - Theoretical Physics

Down type iso-singlet quarks at the HL-LHC and FCC-hh

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Abstract We study the discovery potential of down type iso-singlet quarks, D , predicted by the E_6 GUT model in the $pp \rightarrow D\bar{D} \rightarrow ZZd\bar{d} \rightarrow \ell^+\ell^-\ell^+\ell^-\bar{d}\bar{d}$ channel, at the HL-LHC and FCC-hh colliders. The analysis is performed using a high level analysis description language and its runtime interpreter. The study shows that, using solely this channel, HL-LHC can discover D quarks up to a mass of 730 GeV whereas FCC-hh up to 2980 GeV with data collected in their complete run periods.

1 Introduction

The long-awaited discovery of the Higgs boson at the LHC experiments [1] in the year 2012 completed the experimental validation of the standard model (SM). However, there are some well known issues that are not addressed by the SM, such as the mass hierarchy problem, the unification of the

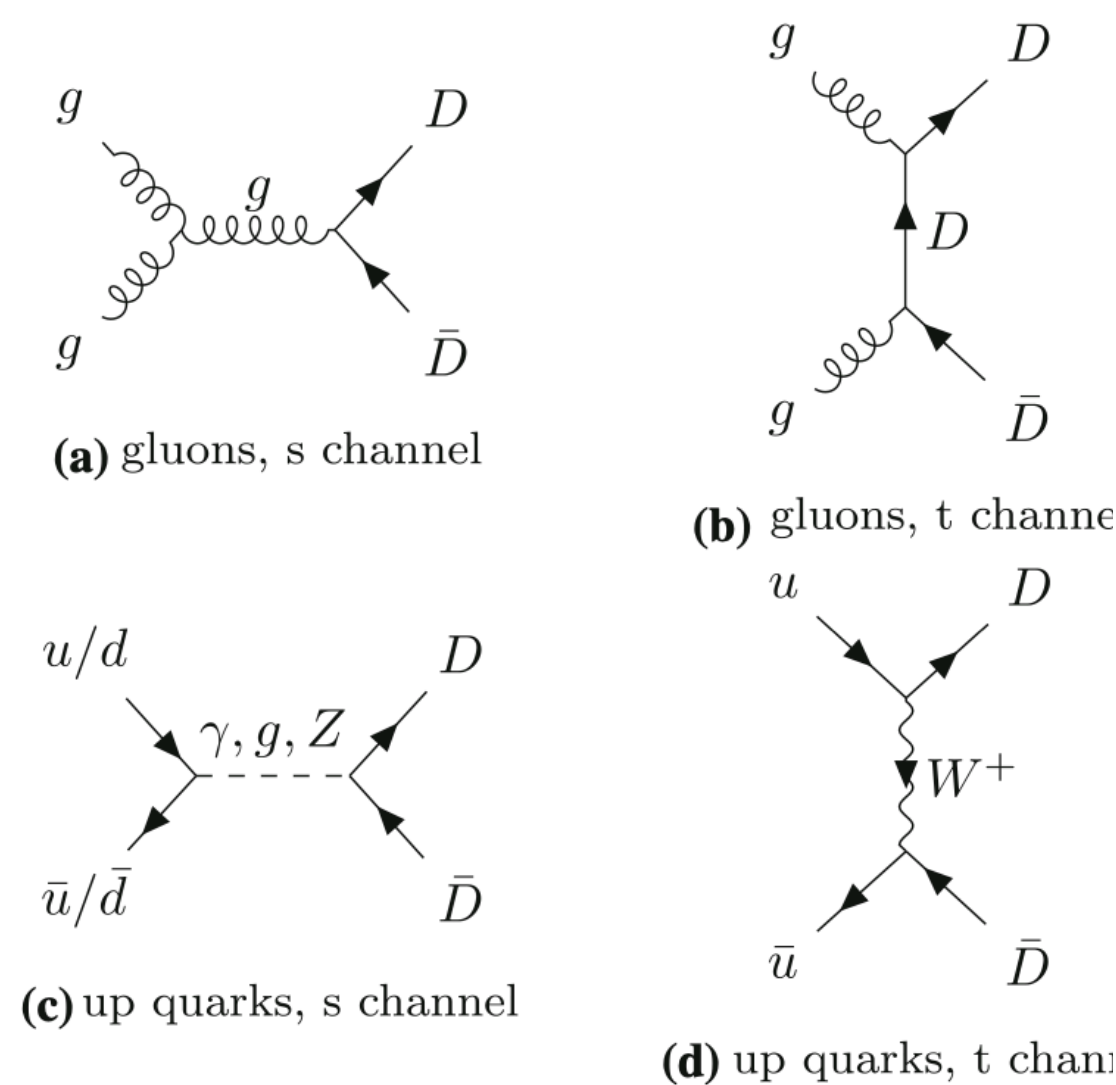
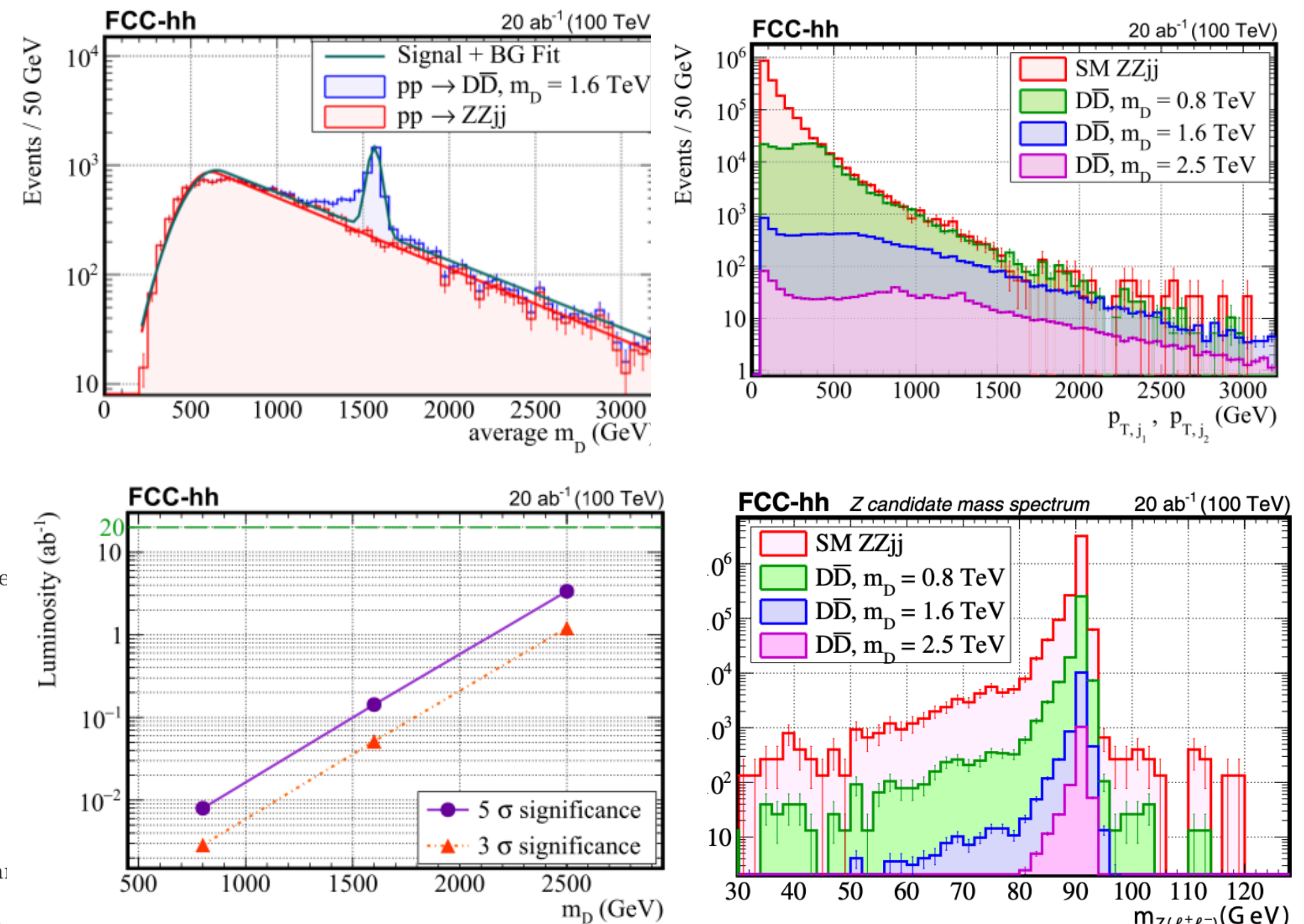


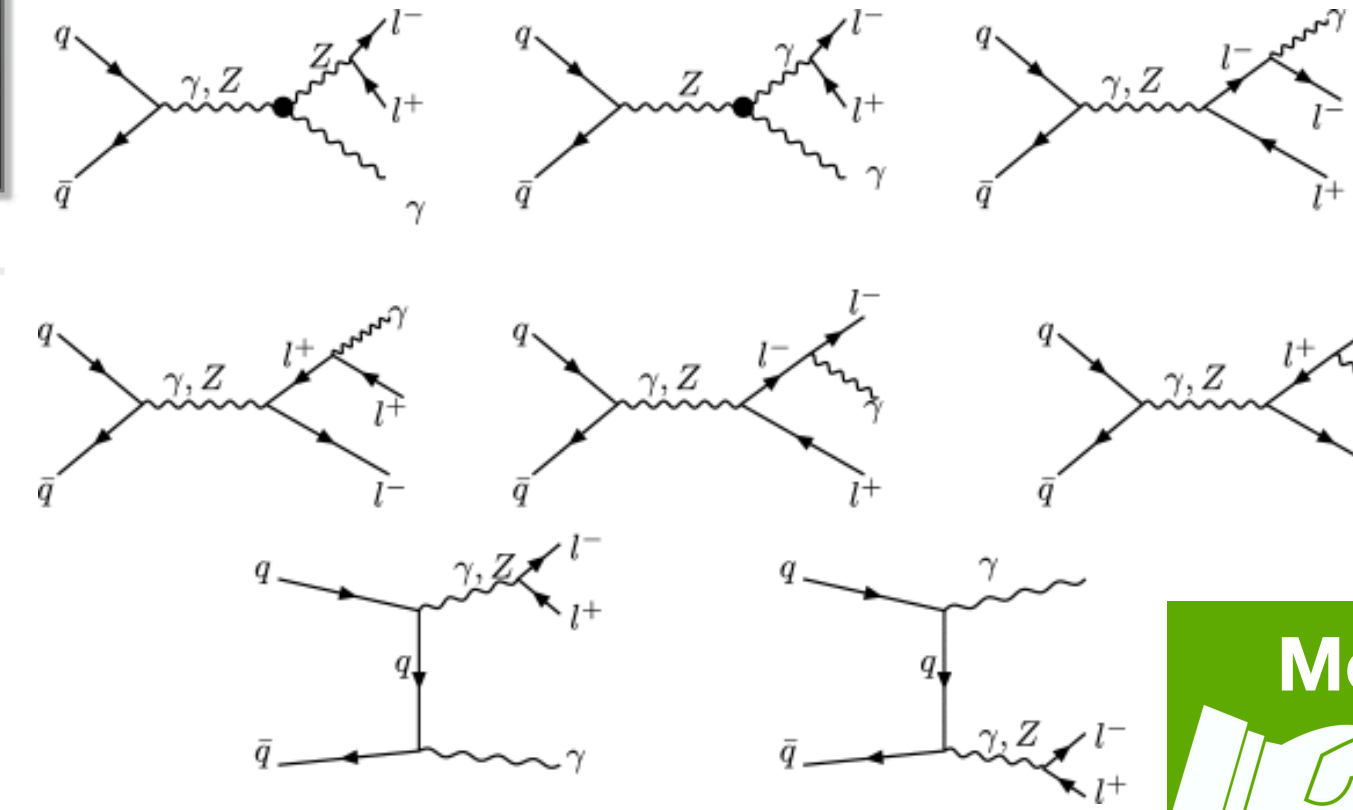
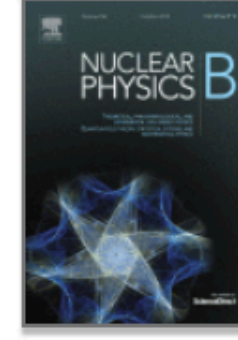
Fig. 1 Tree level Feynman Diagrams for the process $pp \rightarrow D\bar{D}$



Etkin Alan Teorisi ile Anormal Bağlaşımlar



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Probing the effects of dimension-eight operators describing anomalous neutral triple gauge boson interactions at FCC-hh

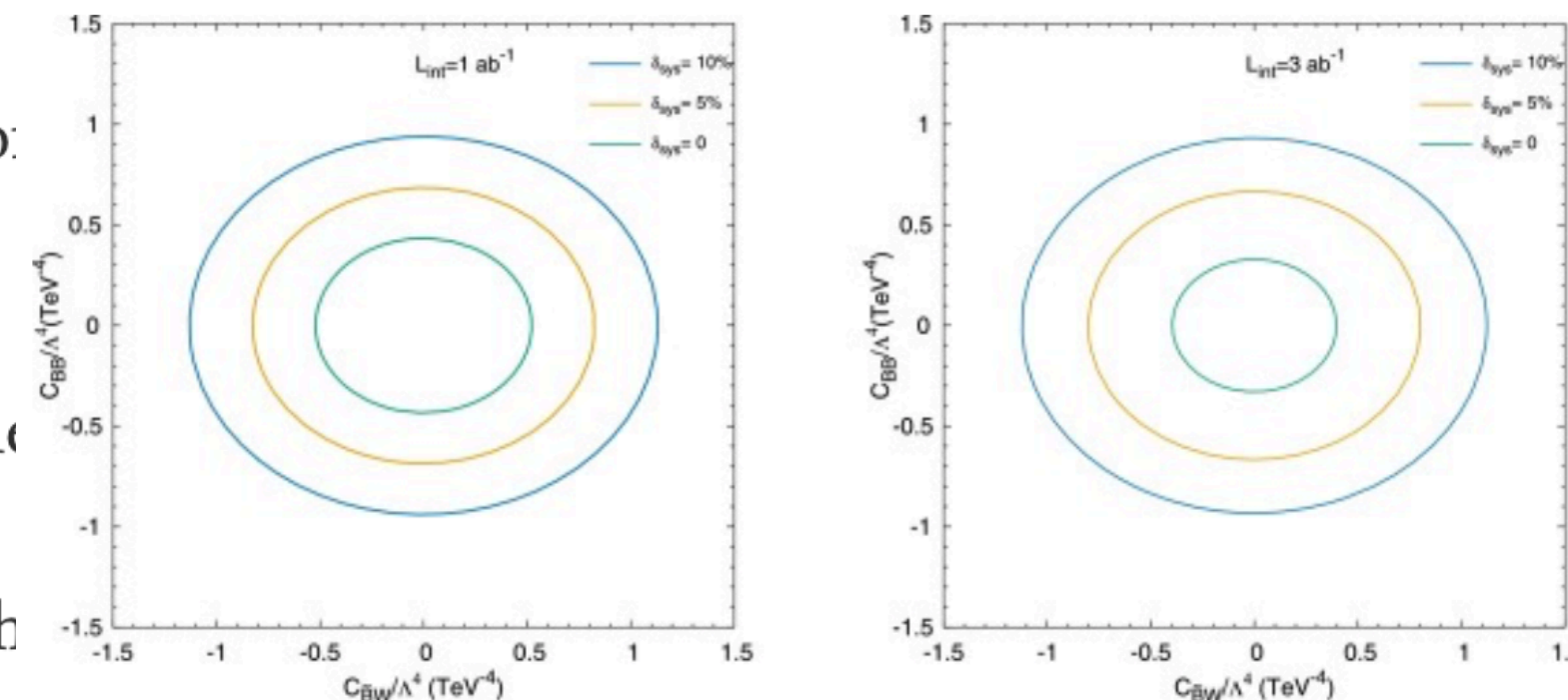
A. Senol ^a ✉, H. Denizli ^a ✉, A. Yilmaz ^b ✉, I. Turk Cakir ^c ✉, K.Y. Oyulmaz ^a ✉, O. Karadeniz ^a ✉, O. Cakir ^d ✉

Abstract

The effects of dimension-eight operators giving rise to anomalous neutral triple gauge boson interactions of $Z\gamma\gamma$ and $Z\gamma Z$ vertices in $pp \rightarrow l^- l^+ \gamma$ and $pp \rightarrow \nu\bar{\nu}\gamma$ are investigated at 100 TeV center of mass energy of future circular hadron collider (FCC-hh). The transverse momentum of photon, invariant mass of $l^- l^+ \gamma$ and angular distribution of charged lepton in the rest frame of $l^- l^+$ and Missing Energy Transverse (MET) are considered in the analysis. The realistic detector effects are also included with Delphes simulation. Sensitivity limits obtained at 95% C.L. for $C_{\tilde{B}W}/\Lambda^4$ and C_{BB}/Λ^4 couplings are $[-0.52; 0.52][[-0.40; 0.40]] \text{ TeV}^{-4}$, $[-0.43; 0.43][[-0.33; 0.33]] \text{ TeV}^{-4}$ in the dilepton+photon channel and $[-0.11; 0.11][[-0.084; 0.084]] \text{ TeV}^{-4}$, $[-0.092; 0.092][[-0.072; 0.072]] \text{ TeV}^{-4}$ in the MET+photon channel with $L_{int} = 1 (3) \text{ ab}^{-1}$, respectively.

Couplings (TeV ⁻⁴)	$\delta_{\text{sys}}=0$	$\delta_{\text{sys}}=5\%$	$\delta_{\text{sys}}=10\%$
$C_{\tilde{B}W}/\Lambda^4$	$[-0.52; 0.52]$	$[-0.83; 0.83]$	$[-1.13; 1.13]$
C_{BB}/Λ^4	$[-0.43; 0.43]$	$[-0.68; 0.68]$	$[-0.94; 0.94]$

Table 6. Obtained limits on $C_{\tilde{B}W}/\Lambda^4$ and C_{BB}/Λ^4 at 95% C.L. with $L_{int}=3 \text{ ab}^{-1}$ by assuming a non-zero dimension-eight operator at a time for $pp \rightarrow l^- l^+ \gamma$ process.



Etkin Alan Teorisi ile Anormal Bağlaşımlar

Sensitivity of anomalous quartic gauge couplings via $Z\gamma\gamma$ production at future hadron-hadron colliders

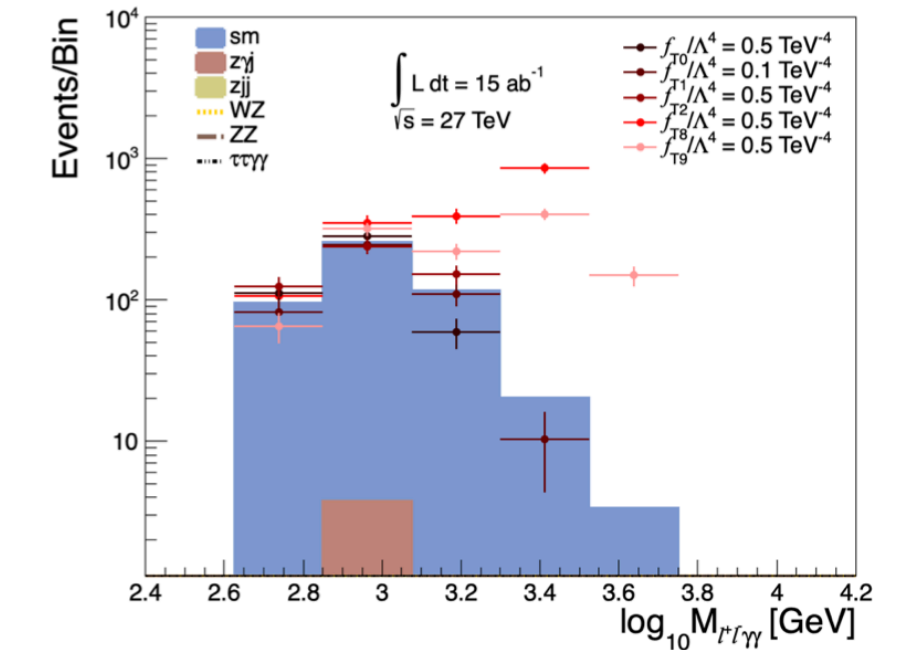
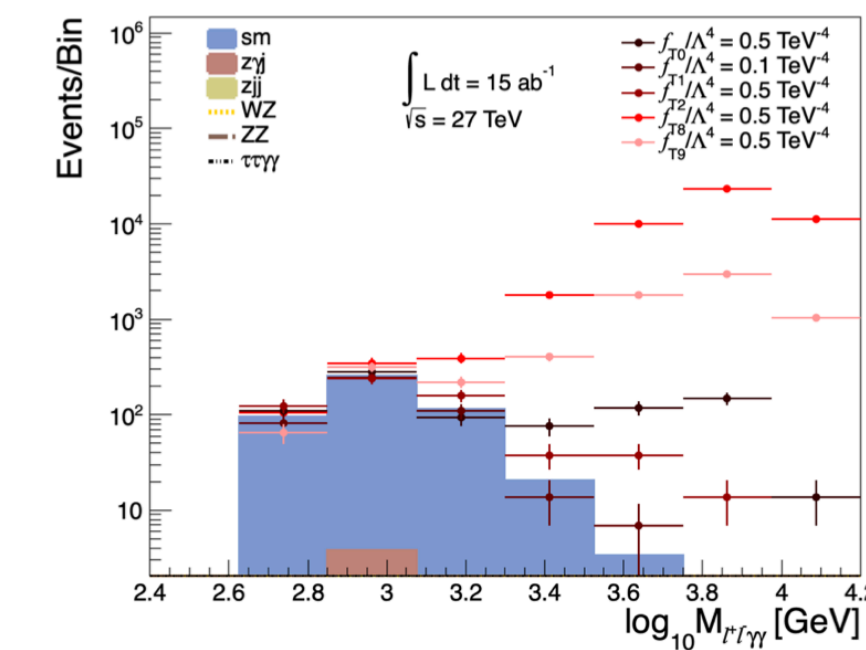
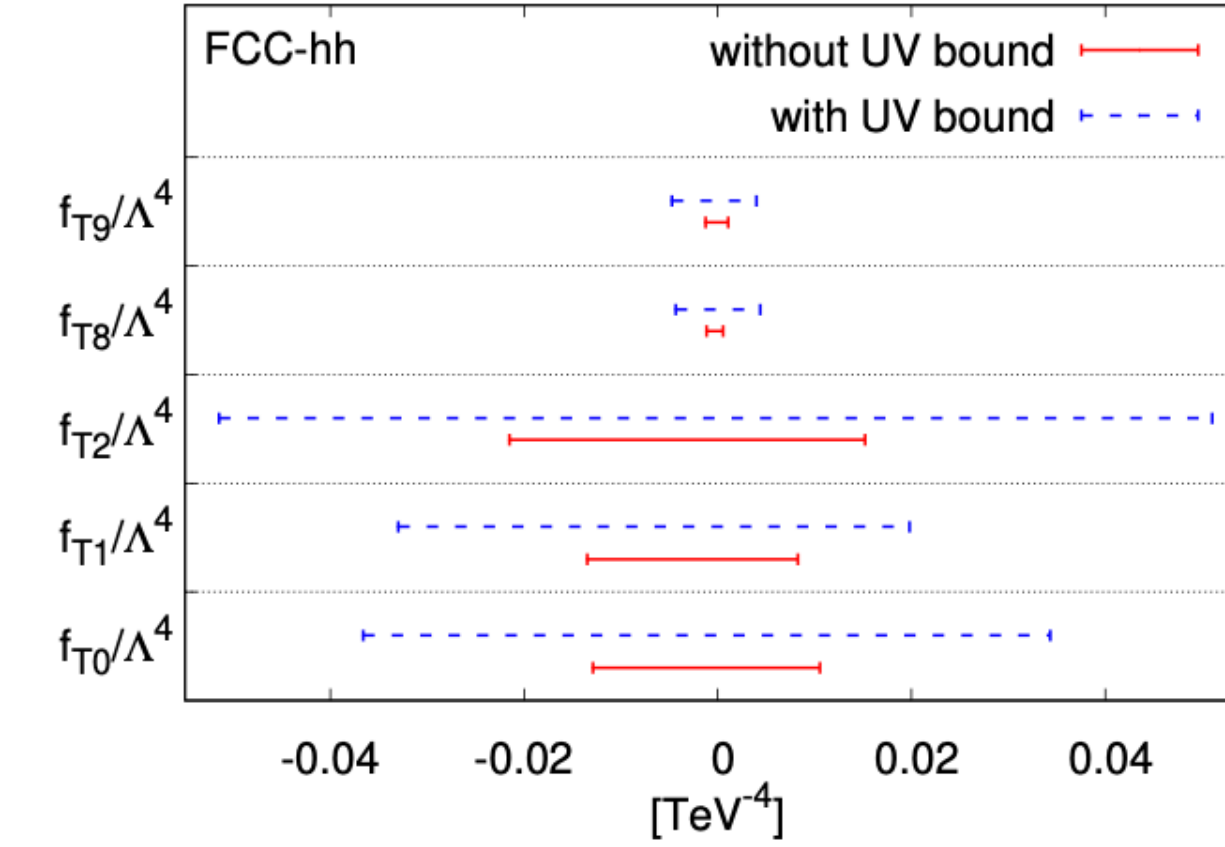
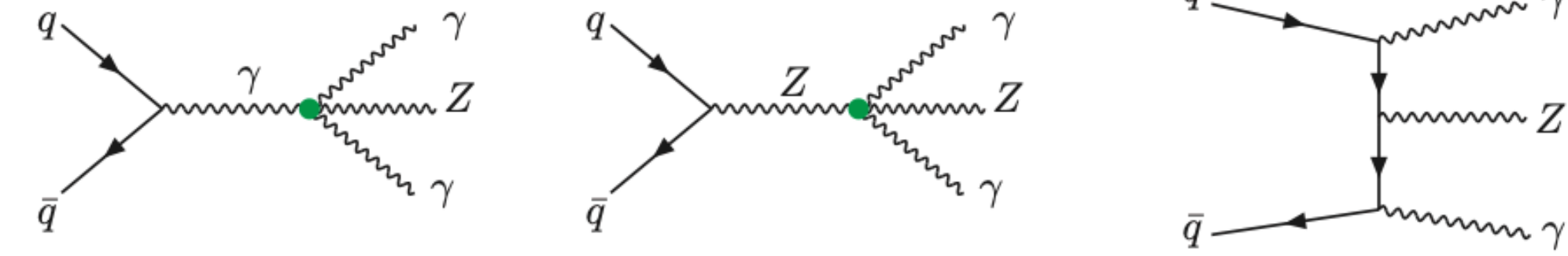


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Abstract

Triple gauge boson production provides a promising opportunity to probe the anomalous quartic gauge couplings in understanding the details of electroweak symmetry breaking at future hadron-hadron collider facilities with increasing center of mass energy and luminosity. In this paper, we investigate the sensitivities of dimension-8 anomalous couplings related to the $ZZ\gamma\gamma$ and $Z\gamma\gamma\gamma$ quartic vertices, defined in the effective field theory framework, via $pp \rightarrow Z\gamma\gamma$ signal process with Z-boson decaying to charged leptons at the high luminosity phase of LHC (HL-LHC) and future facilities, namely the High Energy LHC (HE-LHC) and Future Circular hadron-hadron collider (FCC-hh). We analyzed the signal and relevant backgrounds via a cut based method with Monte Carlo event sampling where the detector responses of three hadron collider facilities, the center-of-mass energies of 14, 27 and 100 TeV with an integrated luminosities of 3, 15 and 30 ab^{-1} are considered for the HL-LHC, HE-LHC and FCC-hh, respectively. The reconstructed 4-body invariant mass of $l^+l^-\gamma\gamma$ system is used to constrain the anomalous quartic gauge coupling parameters under the hypothesis of absence of anomalies in triple gauge couplings. Our results indicate that the sensitivity on anomalous quartic couplings f_{T8}/Λ^4 and f_{T9}/Λ^4 (f_{T0}/Λ^4 , f_{T1}/Λ^4 and f_{T2}/Λ^4) at 95 % C.L. for FCC-hh with $L_{int} = 30 \text{ ab}^{-1}$ without systematic errors are two (one) order better than the current experimental limits. Considering a realistic systematic uncertainty such as 10% from possible experimental sources, the sensitivity of all anomalous quartic couplings gets worsen by about 1.2%, 1.7% and 1.5% compared to those without systematic uncertainty for HL-LHC, HE-LHC and FCC-hh, respectively.



Etkin Alan Teorisi ile Anormal Bağlaşımlar

Prospective constraints on anomalous Higgs boson interactions in an effective Lagrangian via diphoton production at FCC-hh

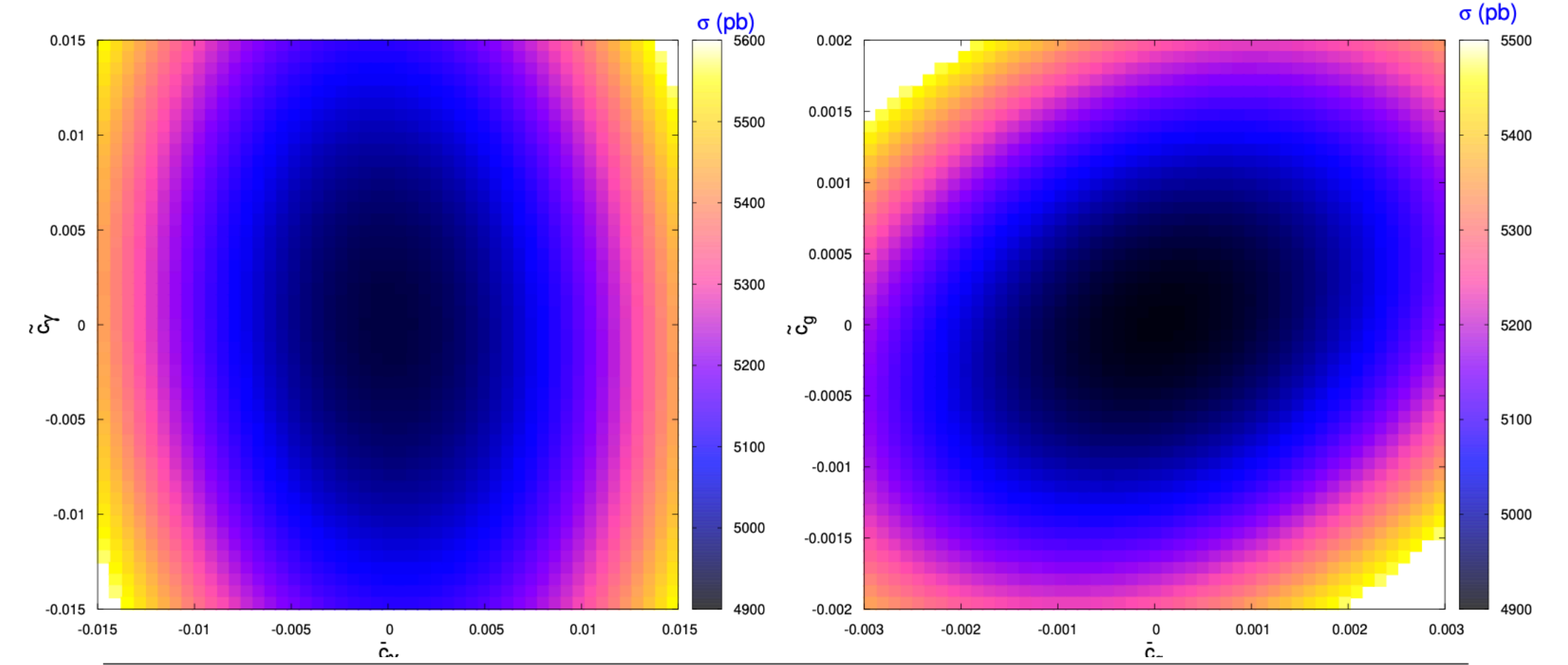
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Coefficient	δ_{sys}	95% C.L. Limits
\bar{c}_γ	0	$[-1.21; 1.21] \times 10^{-6} \cup [4.20; 4.20] \times 10^{-3}$
	0.5%	$[-7.56; 7.84] \times 10^{-5} \cup [4.12; 4.28] \times 10^{-3}$
	2%	$[-2.88; 3.35] \times 10^{-4} \cup [3.87; 4.49] \times 10^{-3}$
\tilde{c}_γ	0	$[-6.96; 6.96] \times 10^{-5}$
	0.5%	$[-5.56; 5.56] \times 10^{-4}$
	2%	$[-1.11; 1.11] \times 10^{-3}$
\bar{c}_g	0	$[-4.88; -4.88] \times 10^{-4} \cup [3.37; 3.61] \times 10^{-6}$
	0.5%	$[-4.96; -4.80] \times 10^{-4} \cup [-0.46; 1.13] \times 10^{-5}$
	2%	$[-5.18; -4.54] \times 10^{-4} \cup [-3.08; 3.35] \times 10^{-5}$
\tilde{c}_g	0	$[-4.06; 4.06] \times 10^{-5}$
	0.5%	$[-7.25; 7.25] \times 10^{-5}$
	2%	$[-1.27; 1.27] \times 10^{-4}$

Abstract

We study the CP-conserving and CP-violating dimension-six operators of Higgs-gauge boson couplings via $pp \rightarrow \gamma\gamma + n\text{-jet}$ signal process in a strongly interacting light Higgs based effective field theory framework at the center of mass energy of 100 TeV. In order to perform a simulation which includes realistic detector effects, the signal events in the existence of \bar{c}_γ , \tilde{c}_γ , \bar{c}_g and \tilde{c}_g Wilson coefficients and the relevant SM background events are generated in MadGraph, then passed through Pythia 8 for parton showering and finally run Delphes with FCC-hh detector card. In our analysis, we focus on the kinematic variables of the two photons in the final states of signal and relevant background processes that can reconstruct Higgs boson. We obtain constraints on the four Wilson coefficients of dimension-six operators using the transverse momentum distribution of reconstructed di-photon system with optimized kinematic cuts. The obtained 95% confidence level limits on these four Wilson coefficients including detector effects at $\sqrt{s} = 100$ TeV with an integrated luminosity of 30 ab^{-1} without systematic error are at least one order or better than current experimental limits reported by ATLAS experiment. Even with $\delta_{sys} = 2\%$ systematic error, we find comparable limits with current experimental results.

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Etkin Alan Teorisi ile Anormal Bağlaşımlar

Testing for observability of Higgs effective couplings in triphoton production at FCC-hh

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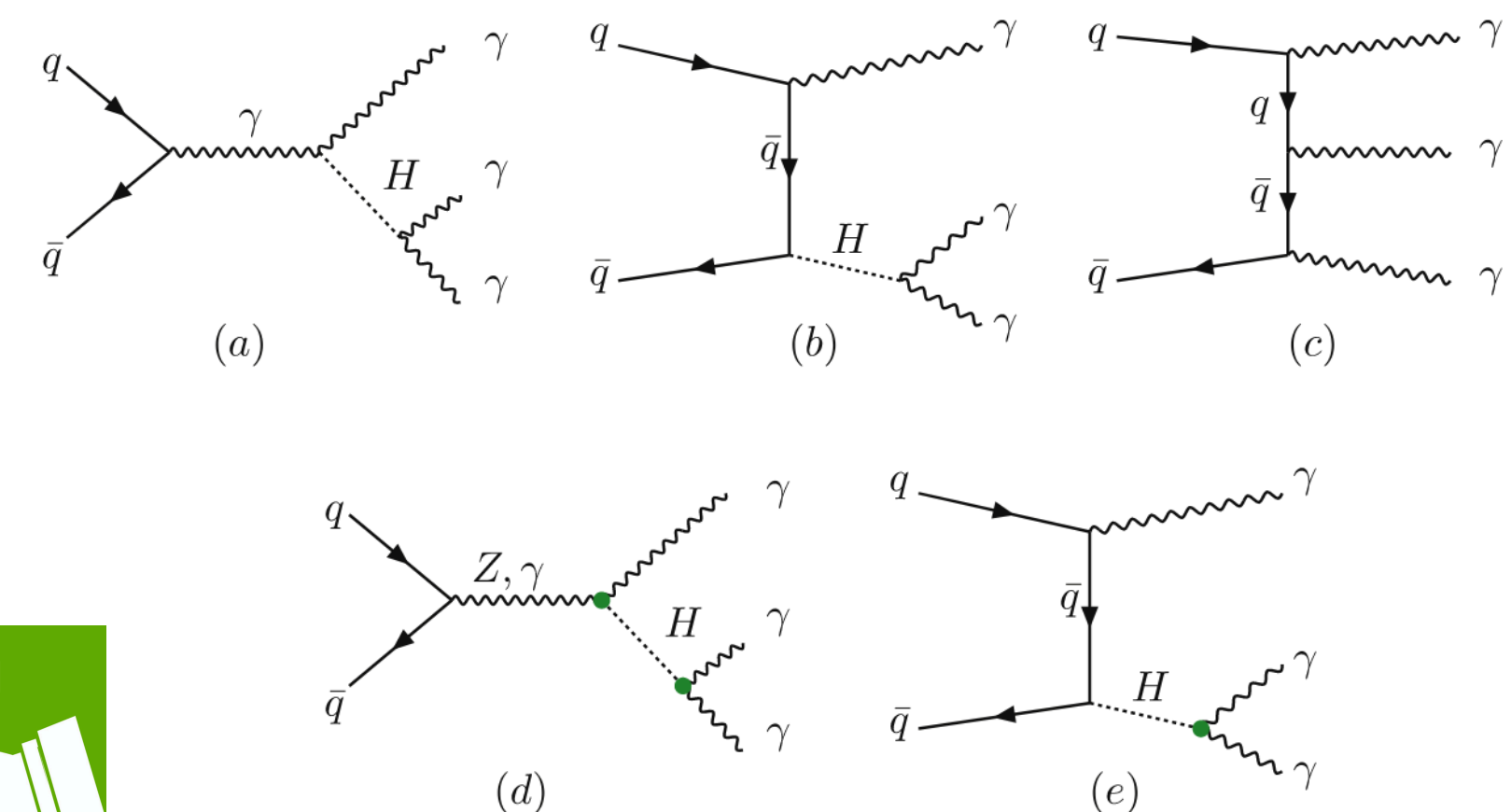
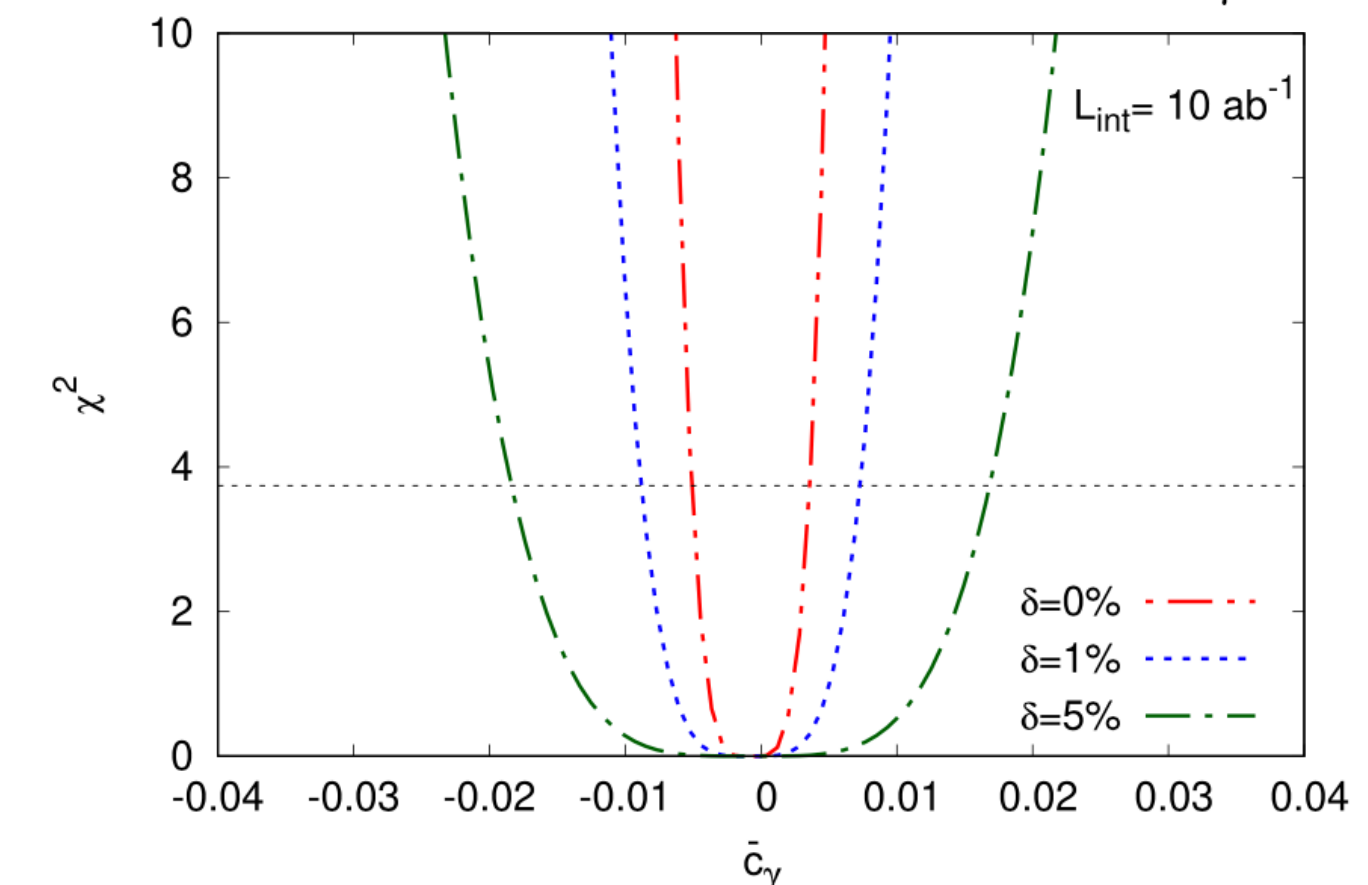
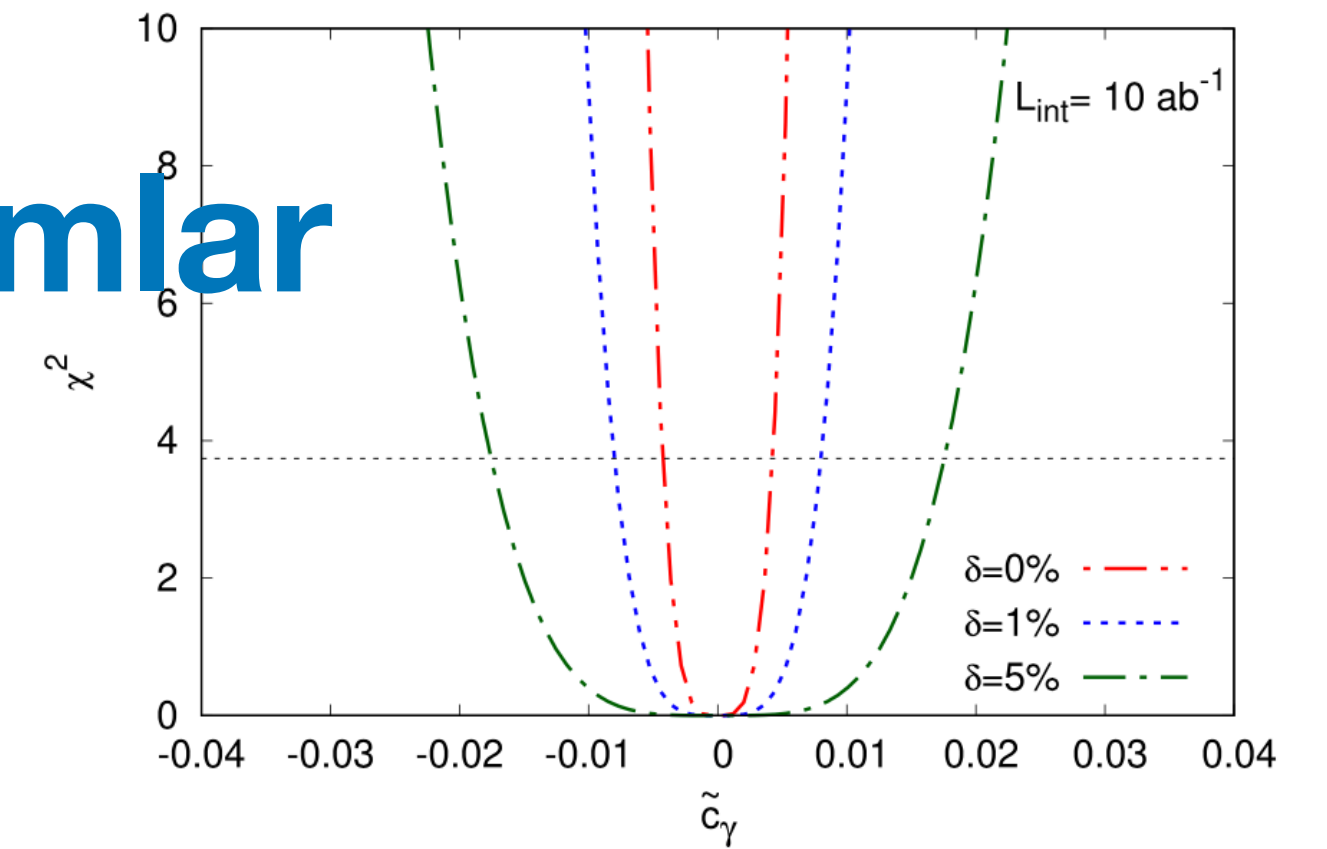
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Abstract

We investigate the potential of the $pp \rightarrow \gamma\gamma\gamma$ process to probe CP-conserving and CP-violating dimension-six operators of Higgs-gauge boson interactions in a model-independent Standard Model effective field theory framework at the center of mass energy of 100 TeV, which is designed for the Future Circular hadron-hadron Collider. Signal events assuming the existence of anomalous Higgs boson couplings at $H\gamma\gamma$ and $HZ\gamma$ vertices and the relevant SM background events are generated in MadGraph, then passed through Pythia 8 for parton showering and Delphes to include detector effects. After detailed examination of kinematic variables, we use the invariant mass distribution of the two leading photons with optimized kinematic cuts to obtain constraints on the Wilson coefficients of dimension-six operators. We report that limits at 95% confidence level on \tilde{c}_γ and \tilde{c}_γ couplings with an integrated luminosity of 10 ab^{-1} are $[-0.005 \ 1; 0.003 \ 8]$ and $[-0.004 \ 3; 0.004 \ 3]$ without systematic error, respectively.

Keywords: effective Higgs couplings, Triphoton production, proton-proton collision



Etkin Alan Teorisi ile Anormal Bağlaşımlar

SENSITIVITY REACH ON ANOMALOUS HIGGS COUPLINGS VIA TRIPHOTON PRODUCTION FOR THE POST-LHC CIRCULAR HIGH-ENERGY HADRON COLLIDERS*



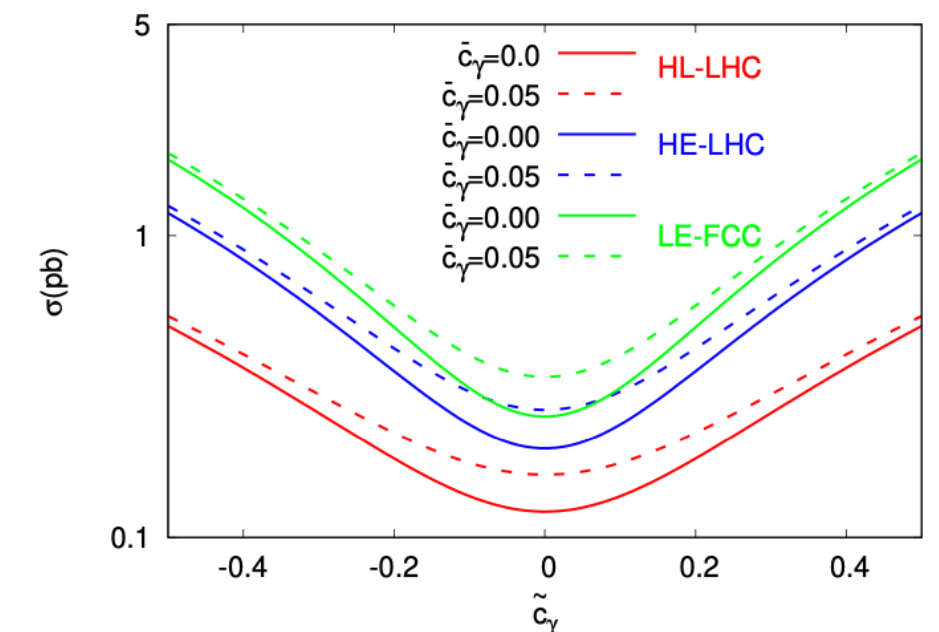
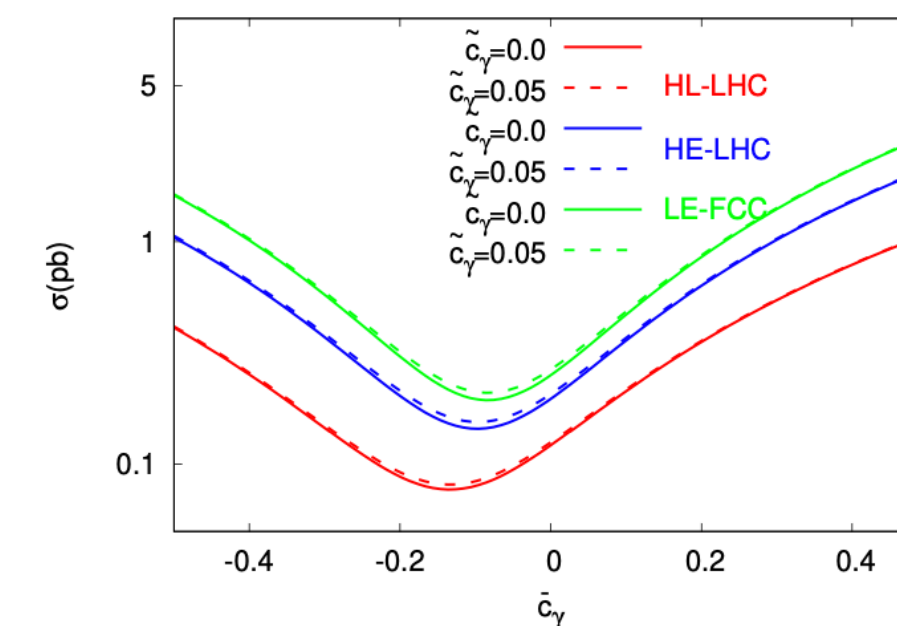
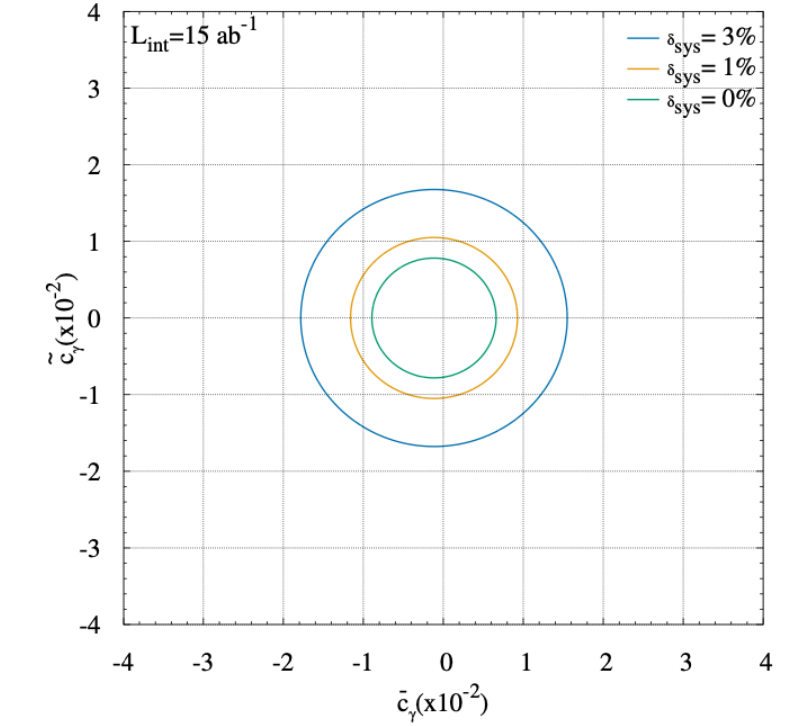
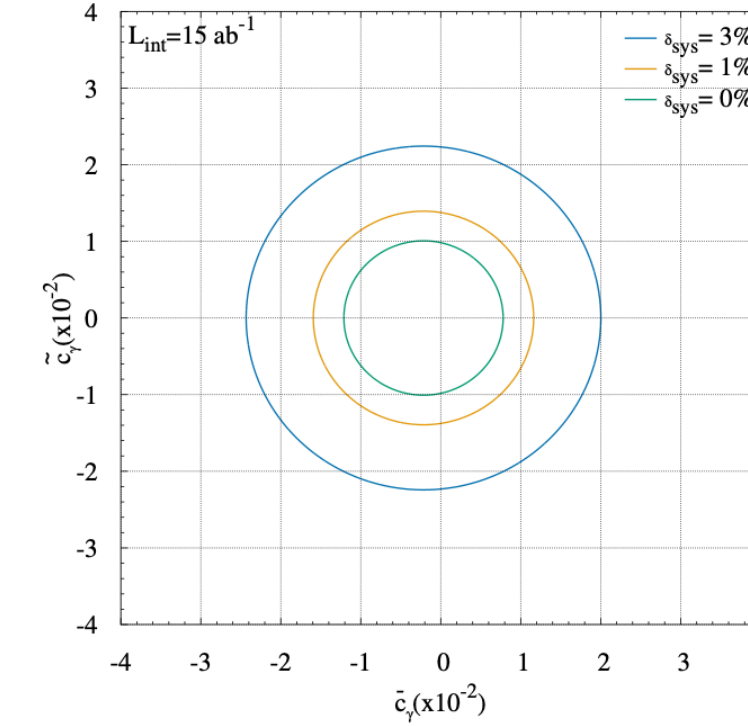
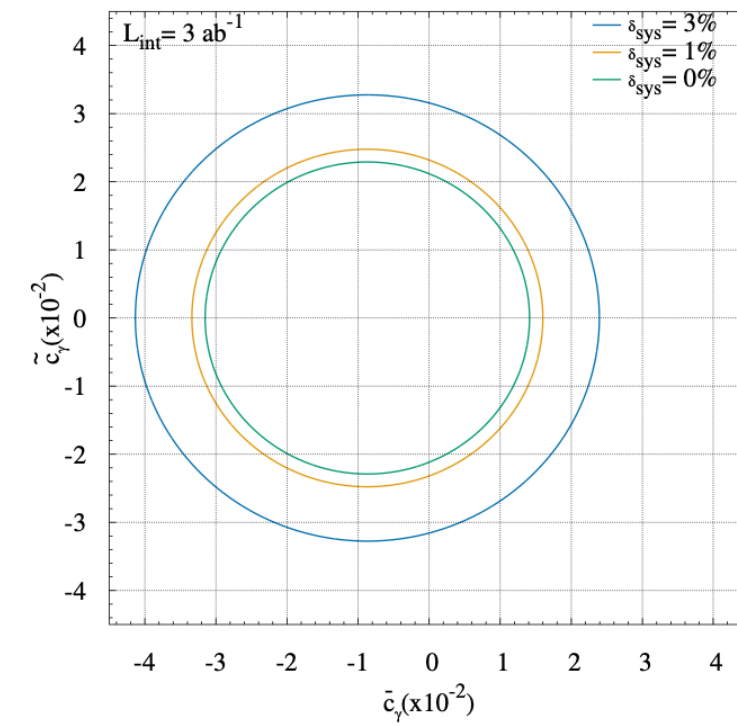
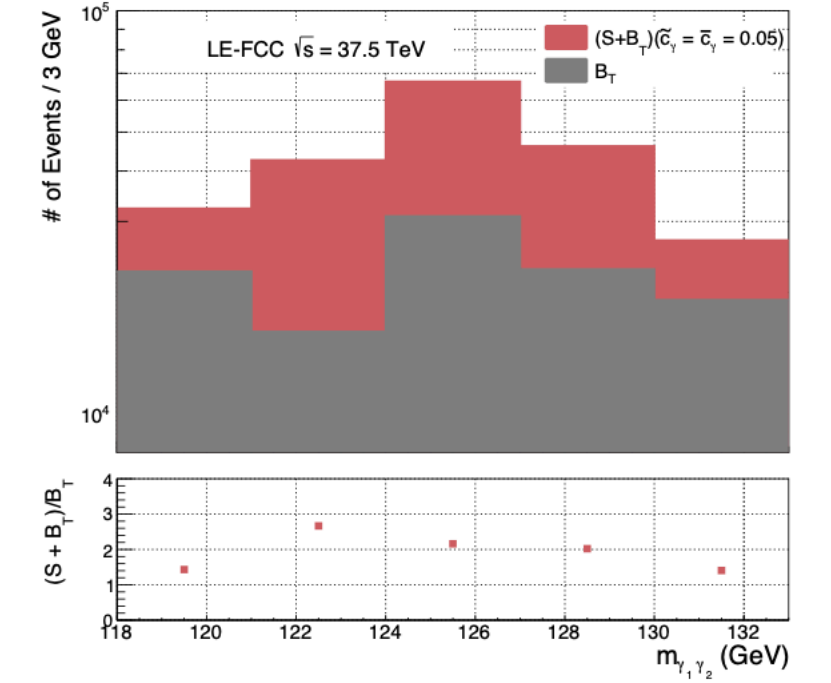
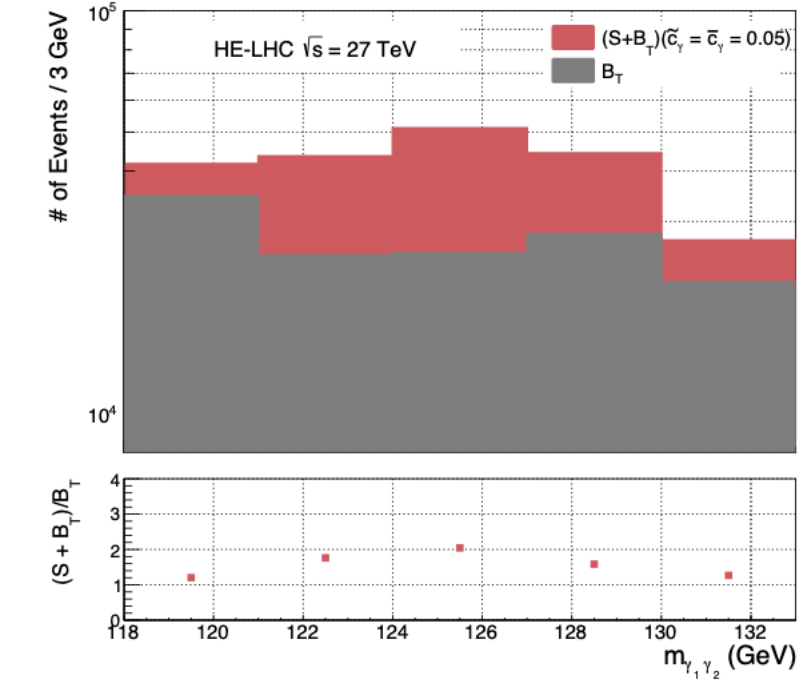
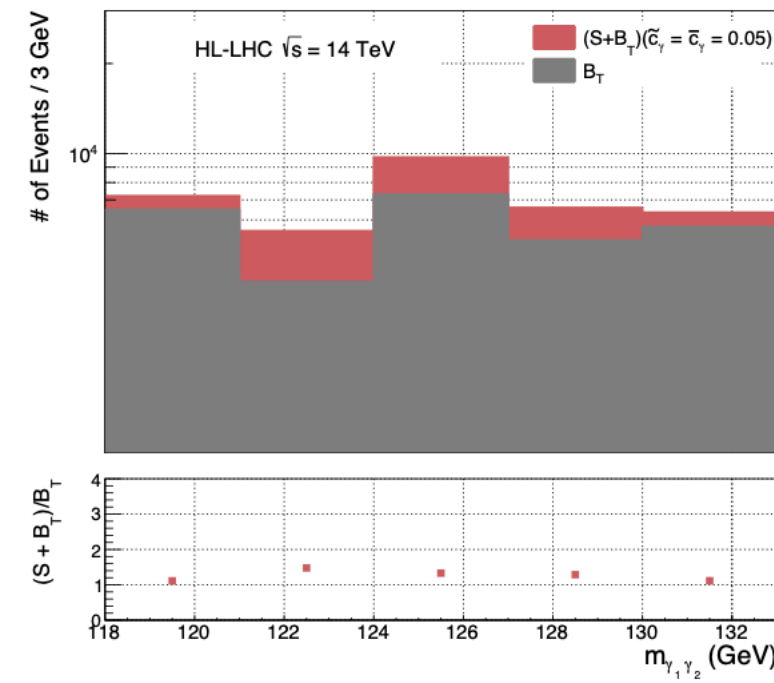
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(Received April 1, 2021; accepted November 3, 2021)

The potential of triphoton production to obtain limits on anomalous Higgs boson couplings at $H\gamma\gamma$ and $HZ\gamma$ vertices is studied in the Standard Model Effective Field Theory (EFT) framework for the post-LHC circular high-energy hadron colliders: High Luminosity-LHC (HL-LHC), High-Energy LHC (HE-LHC), and Low-Energy FCC (LE-FCC) which are designed with standard configurations of 14 TeV/3 ab⁻¹, 27 TeV/15 ab⁻¹, and 37.5 TeV/15 ab⁻¹. Madgraph in which the effective Lagrangian of the SM EFT is implemented using FeynRules and UFO framework is used to generate both background and signal events. These events are then passed through PYTHIA 8 for parton showering and Delphes to include realistic detector effects. After optimizing cuts on kinematics of three photons as well as the reconstructed invariant mass of the two leading photons, invariant mass of three leading photons is used to obtain constraints on the Wilson coefficients of dimension-six operators. We report on the result of a two-dimensional scan of \bar{c}_γ and \tilde{c}_γ couplings at 95% confidence level and compare with the LHC results. Our obtained limits without systematic error on \bar{c}_γ (\tilde{c}_γ) are $[-3.15; 1.41] \times 10^{-2}$ ($[-2.12; 2.12] \times 10^{-2}$), $[-1.21; 0.78] \times 10^{-2}$ ($[-0.98; 0.98] \times 10^{-2}$), and $[-0.89; 0.66] \times 10^{-2}$ ($[-0.77; 0.77] \times 10^{-2}$) for HL-LHC, HE-LHC, and LE-FCC, respectively.

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Etkin Alan Teorisi ile Anormal Bağlaşımlar

Projected Sensivity to Dimension-6 Triple Gauge Couplings at the FCC-hh

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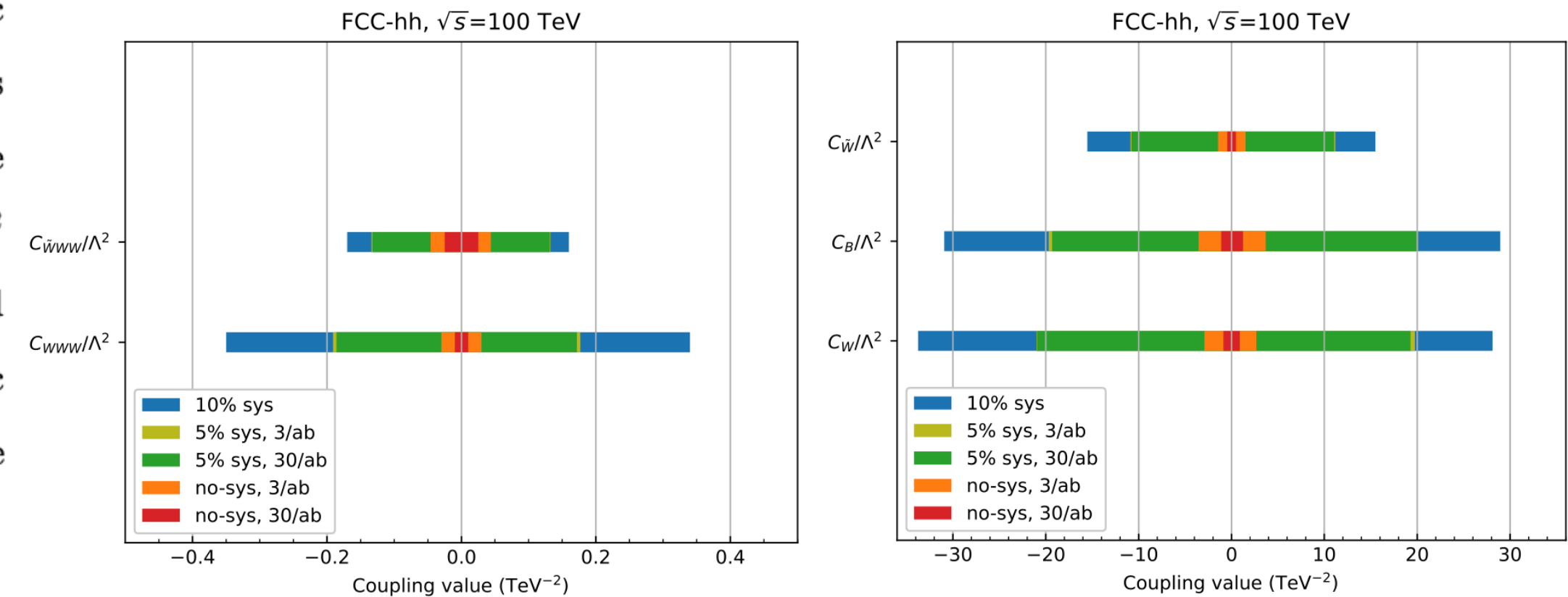
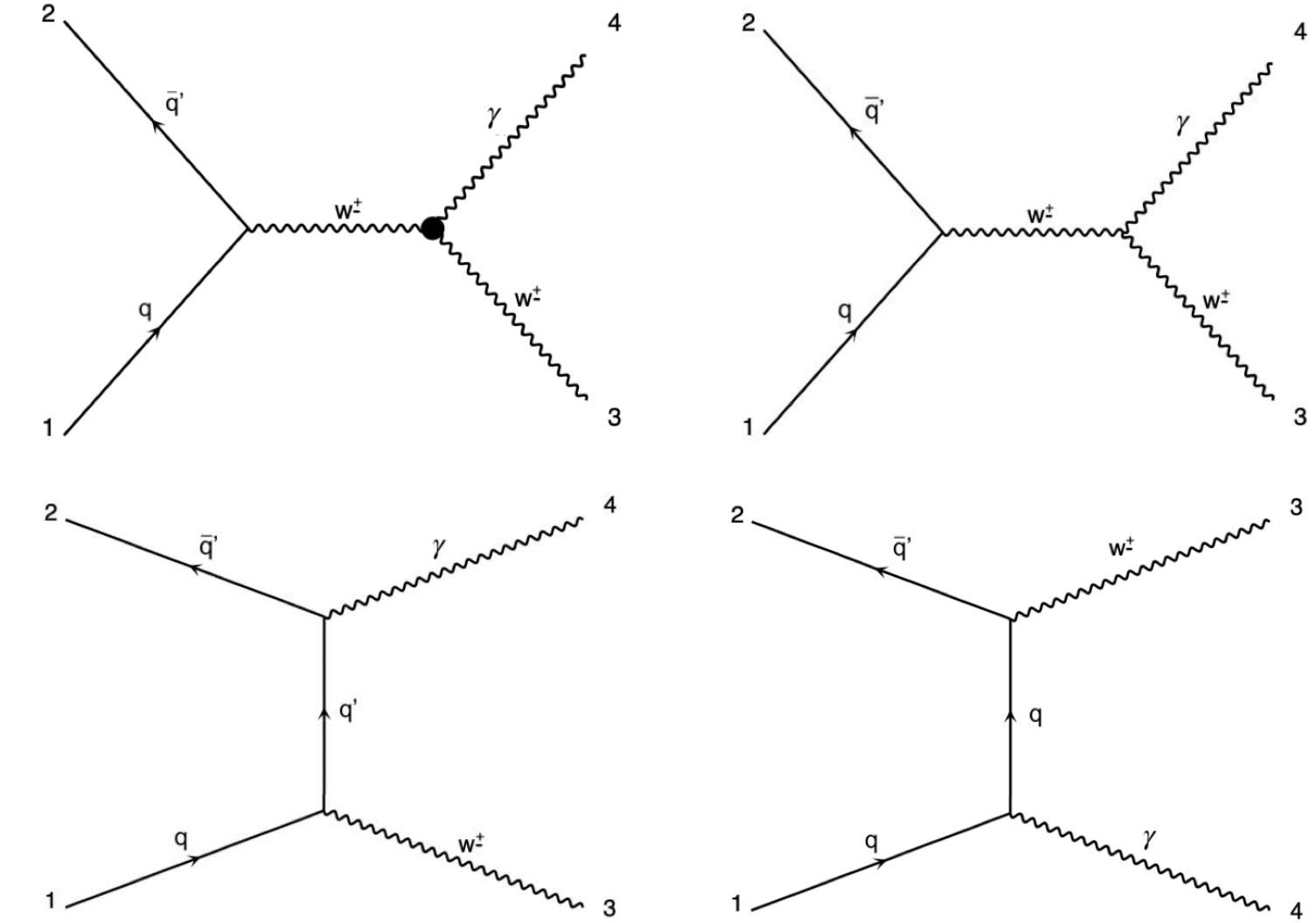
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Abstract

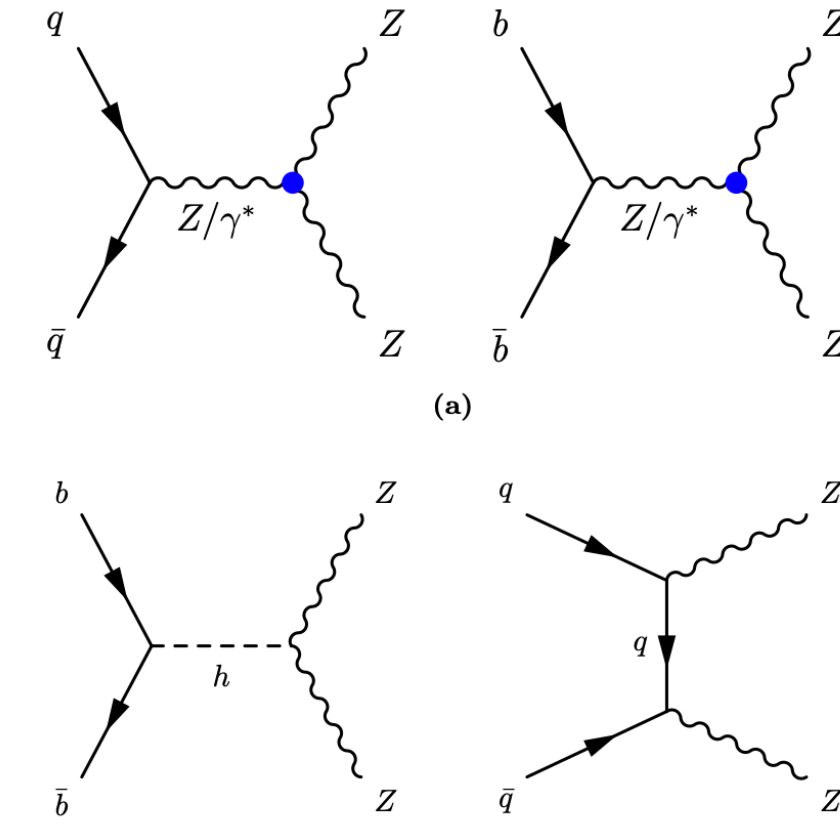
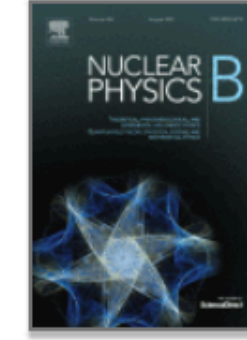
In this study, we investigate the process $pp \rightarrow W^\pm \gamma + X$ for the physics potential of the FCC-hh with $\sqrt{s} = 100$ TeV to examine the anomalous $WW\gamma$ couplings defined by three CP-conserving and two CP-violating effective operators of dimension-6. The analysis containing the realistic detector effects is carried out in the mode where W^\pm bosons in the final state decay into the leptonic channel. The best sensitivities obtained from the process $pp \rightarrow W^\pm \gamma + X$ on the anomalous couplings C_{WWW}/Λ^2 , C_W/Λ^2 and C_B/Λ^2 determined by CP-conserving effective Lagrangians are $[-0.01; 0.01]$ TeV^{-2} , $[-0.88; 0.88]$ TeV^{-2} and $[-1.12; 1.23]$ TeV^{-2} , while $C_{\tilde{W}WW}/\Lambda^2$ and $C_{\tilde{W}}/\Lambda^2$ couplings defined by CP-violating effective Lagrangian are obtained as $[-0.03; 0.03]$ TeV^{-2} and $[-0.47; 0.47]$ TeV^{-2} at the FCC-hh with $\sqrt{s} = 100$ TeV, $L_{int} = 30 \text{ ab}^{-1}$. However, if the systematic uncertainty is included, we obtain reduced sensitivities on the anomalous $WW\gamma$ couplings. The results are compared for assumed systematics of 5% and 10%.



Etkin Alan Teorisi ile Anormal Bağlaşımalar



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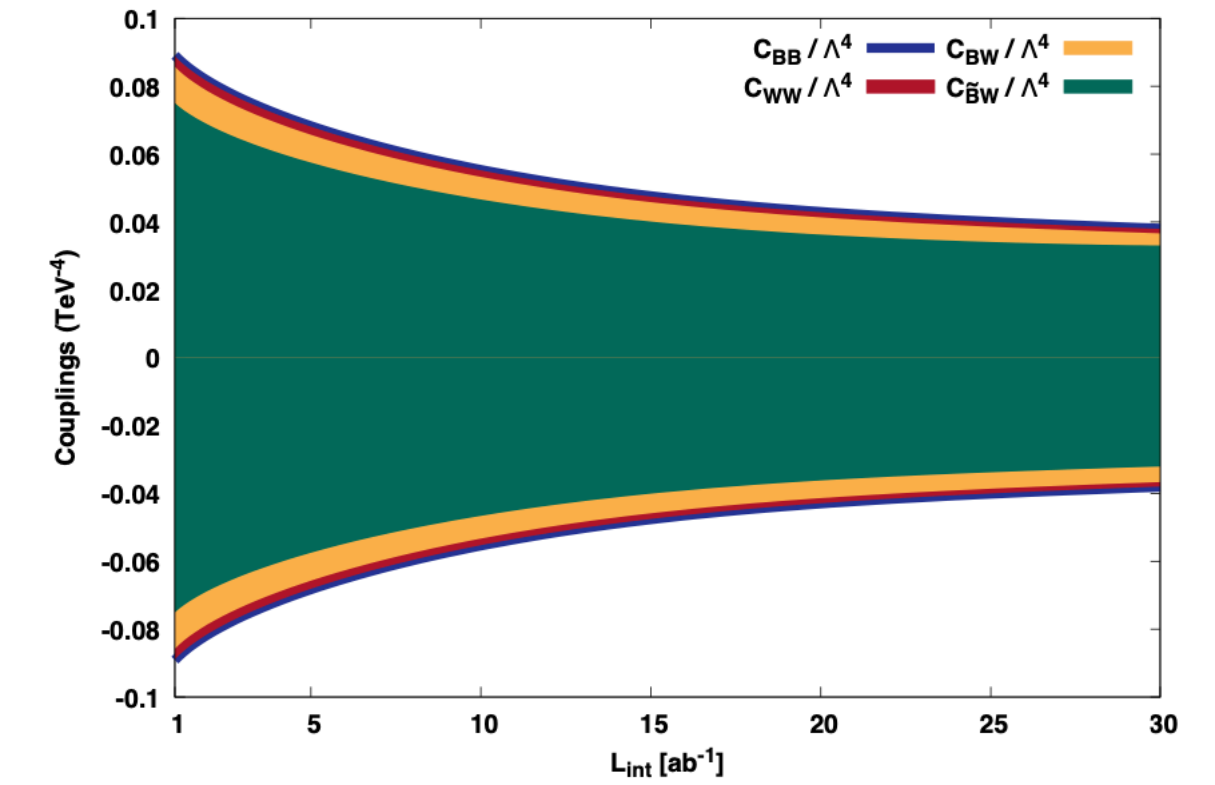
Search for the limits on anomalous neutral triple gauge couplings via ZZ production in the $l\nu\nu$ channel at FCC-hh

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This paper presents the projections on the anomalous neutral triple gauge couplings (*aNTGC*) via $pp \rightarrow ZZ$ production in the $2l2\nu$ final state at a 100 TeV proton-proton collider, FCC-hh. The realistic FCC-hh detector environments and its effects taken into account in the analysis. The study is carried out in the mode where one Z boson decays into a pair of same-flavor, opposite-sign leptons (electrons or muons) and the other one decays to the two neutrinos. The new bounds on the charge-parity (CP)-conserving couplings $C_{\tilde{B}W}/\Lambda^4$ and CP-violating couplings C_{WW}/Λ^4 , C_{BW}/Λ^4 and C_{BB}/Λ^4 achieved at 95% Confidence Level (C.L.) using the transverse momentum of the dilepton system ($p_T^{\ell\ell}$) are $[-0.042, +0.042]$, $[-0.050, +0.050]$, $[-0.050, +0.050]$, and $[-0.048, +0.048]$ in units of TeV^{-4} , respectively.

Keywords: FCC-hh, ZZ production, $l\nu\nu$ process, *aNTGC*



Couplings (TeV^{-4})	Limits at 95% C.L.		
	$\delta_{sys} = 0\%$	$\delta_{sys} = 1\%$	$\delta_{sys} = 3\%$
$C_{\tilde{B}W}/\Lambda^4$	$[-0.042, +0.042]$	$[-0.110, +0.110]$	$[-0.189, +0.189]$
C_{WW}/Λ^4	$[-0.050, +0.050]$	$[-0.131, +0.131]$	$[-0.225, +0.225]$
C_{BW}/Λ^4	$[-0.050, +0.050]$	$[-0.131, +0.131]$	$[-0.225, +0.225]$
C_{BB}/Λ^4	$[-0.048, +0.048]$	$[-0.126, +0.126]$	$[-0.217, +0.217]$

Etkin Alan Teorisi ile Anormal Bağlaşım



Physics Letters B
Volume 818, 10 July 2021, 136375



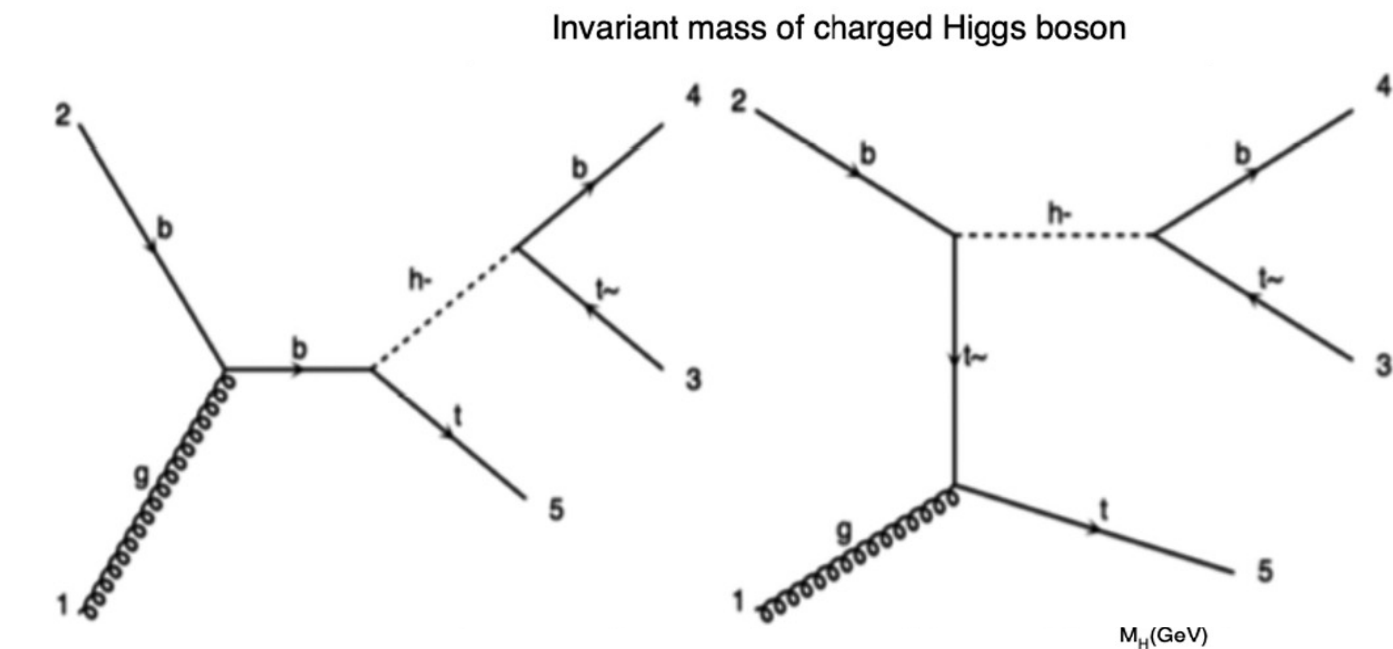
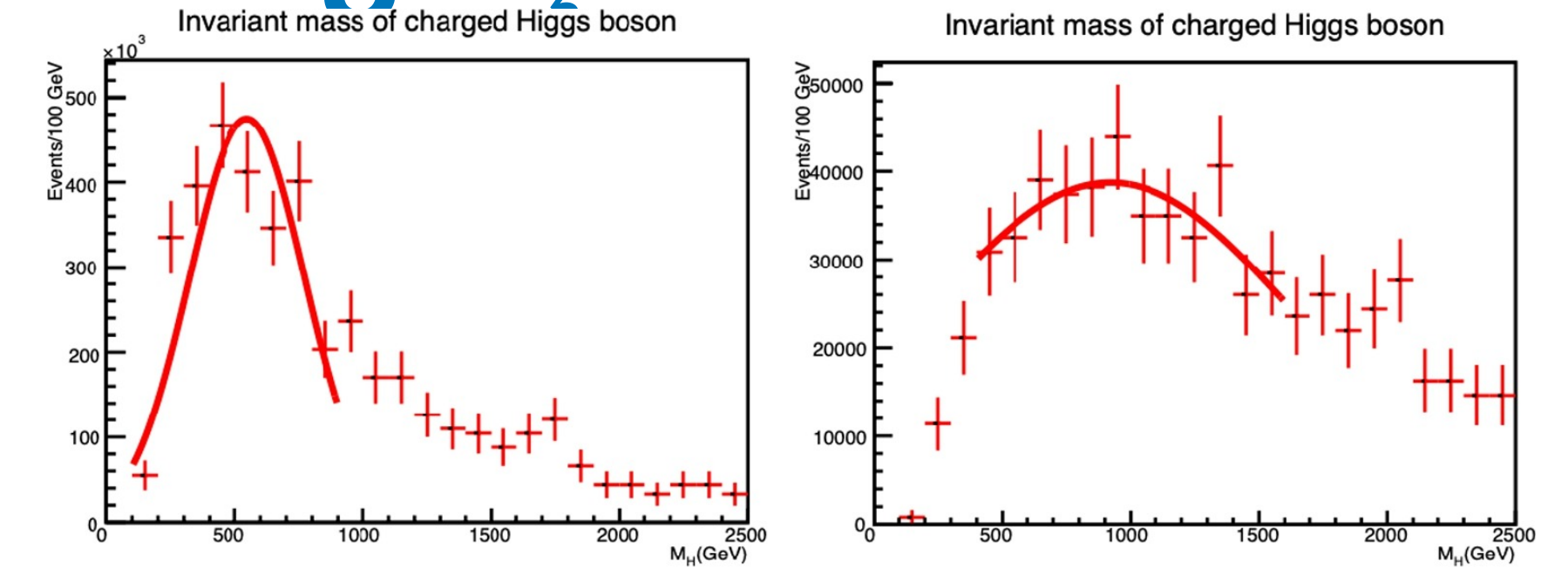
Investigation of charged Higgs boson in the bottom and top quark decay channel at the FCC-hh

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Abstract

After the recent discovery of a neutral Higgs boson with a mass about 125 GeV, we assess the extend of discovery potential of future circular hadron collider (FCC-hh) for a charged Higgs boson in the bottom and top quark decay channel. The charged Higgs boson can be produced through the $pp \rightarrow h^- t + X$ process with a subsequent decay $h^- \rightarrow b\bar{t}$ channel. This decay channel is particularly important for studying the charged Higgs boson heavier than the top quark. We consider an extension of the standard model Higgs sector, namely two Higgs doublet model (2HDM), and perform a dedicated signal significance analysis to test this channel for the FCC-hh running at the center of mass energy of 100 TeV and the integrated luminosity of 1 ab^{-1} (initial), 3 ab^{-1} (comparison with HL-LHC) and 30 ab^{-1} (ultimate). We find that an important part of the parameter spaces of two Higgs doublet model is examinable at the FCC-hh.



Mass (GeV)	$N_B(\Delta m)$	$\tan \beta$	$N_S(\Delta m)$	SS(1)	SS(3)	SS(30)
500	368662140	1	2851903	148.34	256.93	812.49
		7	95340	4.96	8.59	27.17
		10	105201	5.47	9.47	29.96
		30	697536	36.32	62.91	198.93
1000	234516253	1	327598	21.38	37.03	117.10
		7	10993	0.720	1.25	3.94
		10	12013	0.780	1.35	4.27
		30	77940	5.08	8.79	27.82
2000	61585260	1	22825	2.91	5.04	15.94
		7	764	0.097	0.168	0.531



FCNC Bağlaşımları

PHYSICAL REVIEW D **99**, 115023 (2019)

Top quark anomalous FCNC production via tqg couplings at an FCC-hh

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We investigate the top quark anomalous flavor changing neutral current (FCNC) tqg interactions to probe limits on the couplings ζ_c and ζ_u through the $qg \rightarrow l\nu b$ signal subprocess at an FCC-hh collider with center of mass energy of 100 TeV. To separate the signal from relevant Standard Model background processes, selection criteria based on boosted decision trees (BDT) is used with a set of useful kinematic variables. The sensitivities on the anomalous top FCNC couplings ζ_u and ζ_c are found to be 1.239×10^{-4} and 1.149×10^{-4} for FCC-hh with $L_{\text{int}} = 10 \text{ ab}^{-1}$ at 95% C.L. including realistic detector effects of the FCC-hh baseline detector, respectively. The branchings $\text{BR}(t \rightarrow ug)$ and $\text{BR}(t \rightarrow cg)$ converted from obtained limits for FCNC couplings are at the order of 10^{-7} which is at least one order of magnitude better than the projected limits of HL-LHC with $L_{\text{int}} = 3 \text{ ab}^{-1}$.

FCNC Bağlaşımları


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THE EUROPEAN
PHYSICAL JOURNAL C



Regular Article - Theoretical Physics

Probing anomalous $tq\gamma$ and tqg couplings via single top production in association with photon at FCC-hh

K. Y. Oyulmaz^{1,a}, A. Senol^{1,b} , H. Denizli^{1,c}, A. Yilmaz^{2,d}, I. Turk Cakir^{3,e}, O. Cakir⁴

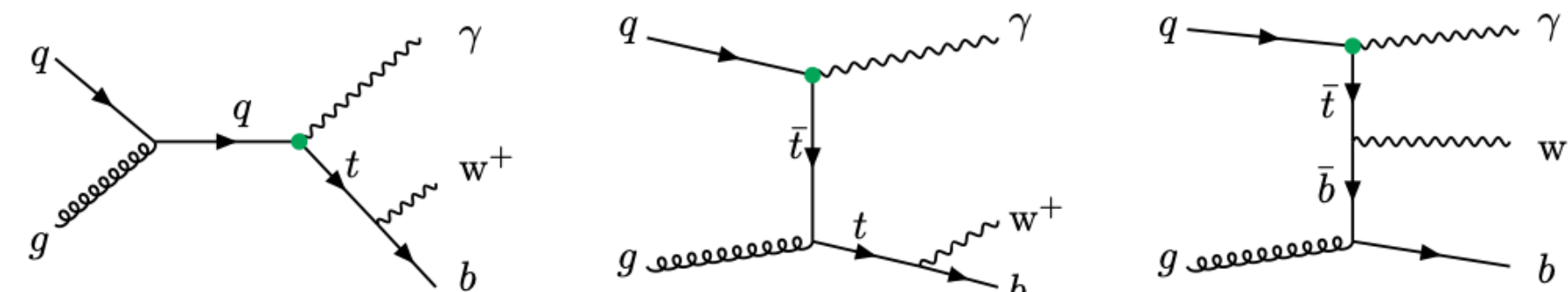
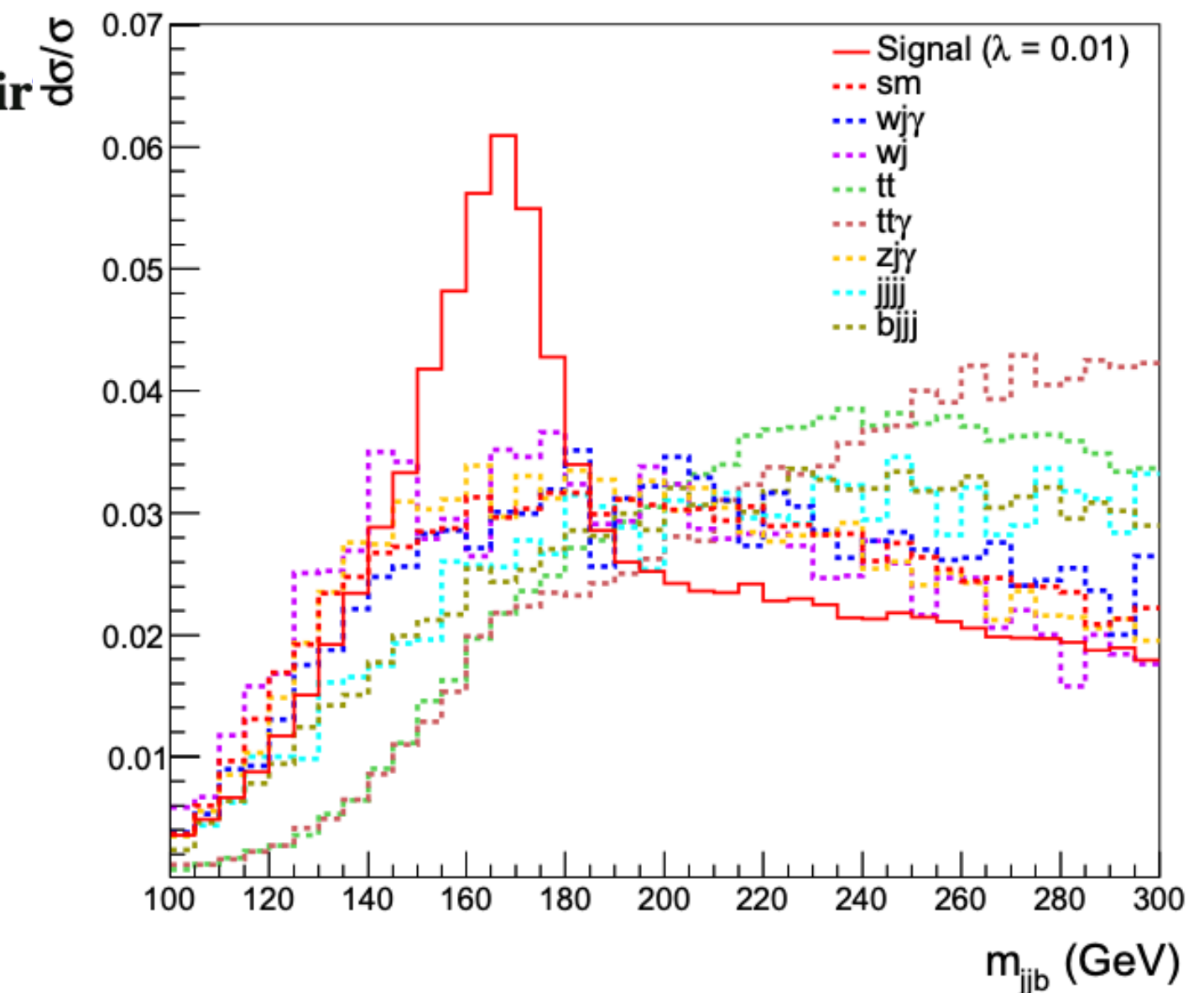
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Abstract We study the anomalous FCNC $tq\gamma$ and tqg couplings via $pp \rightarrow Wb\gamma + X$ signal process including realistic detector effects for both leptonic and hadronic decay channels of the W boson at 100 TeV FCC-hh. The relevant backgrounds are considered in the cut based analysis to obtain not only limits on the anomalous λ and ζ couplings but also branching ratios of $t \rightarrow q\gamma$ and $t \rightarrow qg$ decay channels. We find that the sensitivity to the branching ratio of $t \rightarrow q\gamma$ channel is three order better than the available LHC experimental limits, and it is comparable for the branching ratio of the $t \rightarrow qg$ decay channel with an integrated luminosity of 10 ab^{-1} at 2σ significance level.



SüperSimetri: R-Parite



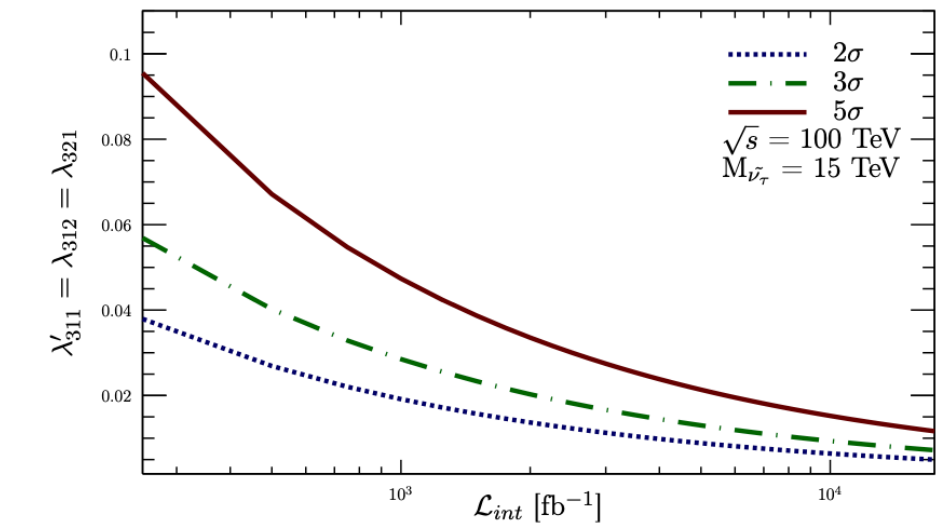
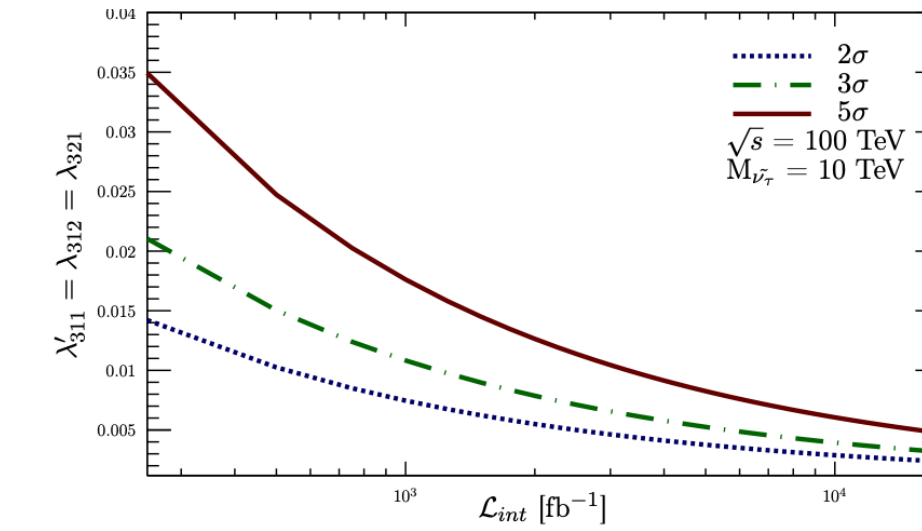
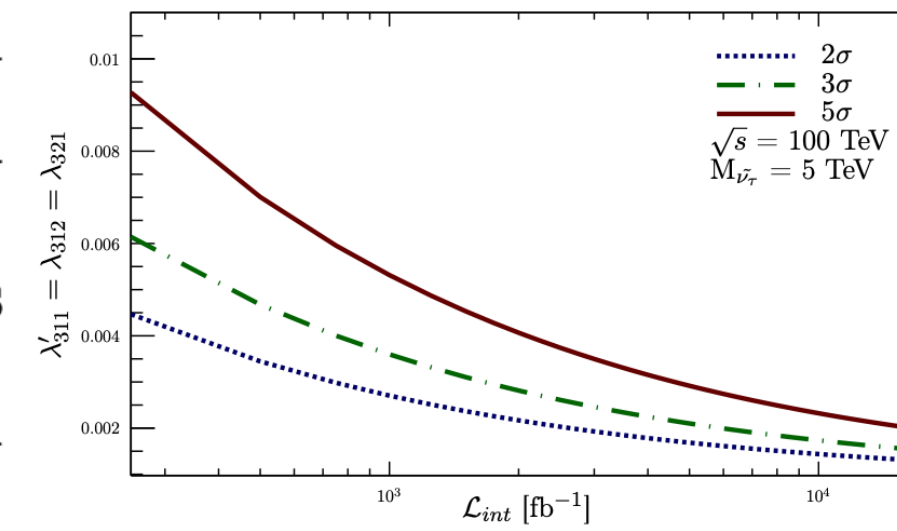
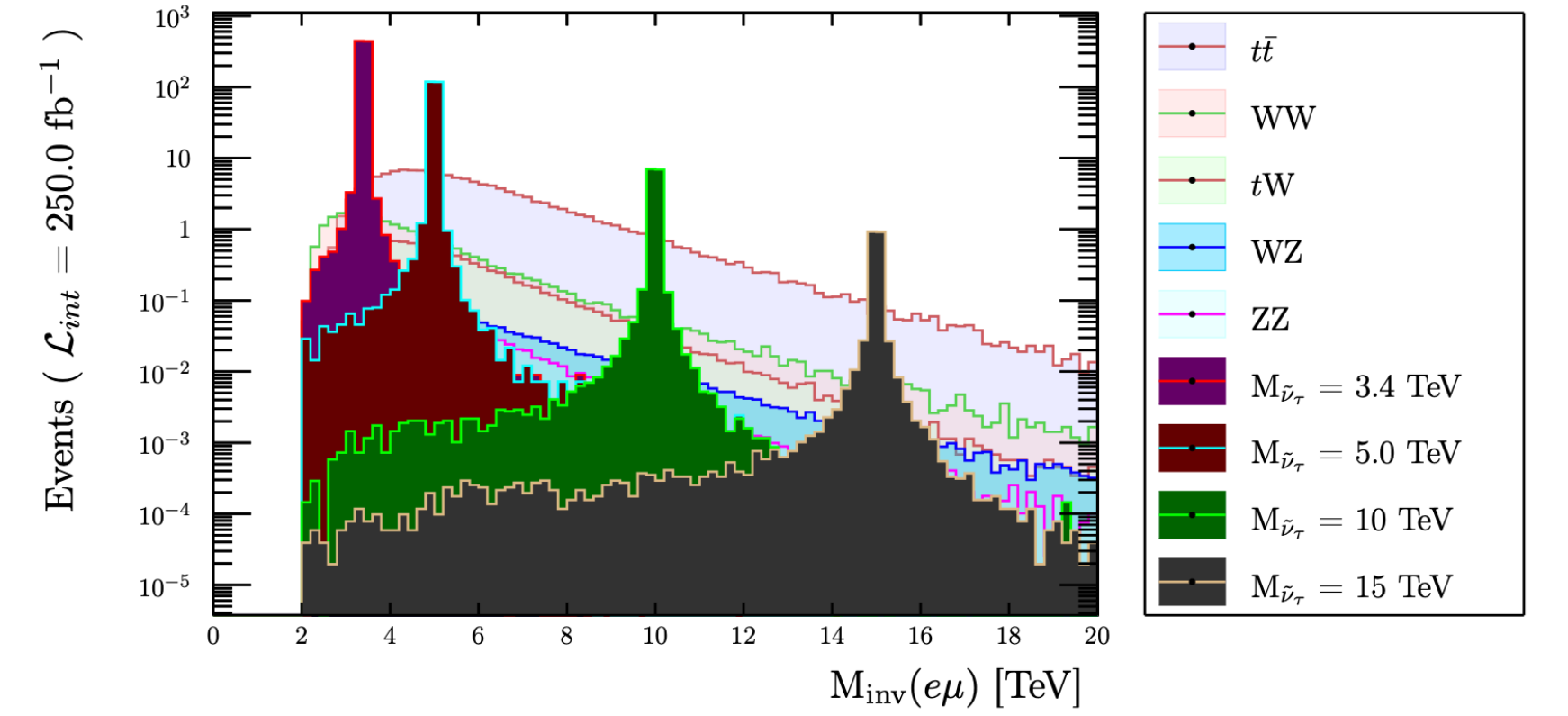
Search for R-Parity Violated Scalar Tau-neutrino ($\tilde{\nu}_\tau$) at the Future Circular Collider

Yusuf Oguzhan Günaydin,^{1,*} Sehban Kartal,^{2,†} Yunus Emre Okyayli,^{3,‡}
Carmine Elvezio Pagliarone,^{4,5,§} Mehmet Sahin,^{6,¶} and Saleh Sultansoy^{7,8,**}

Abstract

Future Circular Collider is one of the next generation energy-frontier proton-proton colliders with 100 TeV center of mass energy and promising very high luminosity. FCC will be an extraordinary machine for searching Beyond the Standard Model physics because of its very high center of mass energy and luminosity. Searching supersymmetric particles via R-parity violated interactions could be listed in promising BSM physics at the FCC. Scalar tau neutrino is one of the most interesting predictions. A search for $\tilde{\nu}_\tau$ neutrino decaying into $e\mu$ final state via R-parity violated interactions has been conducted at the FCC-pp. It is seen from this research that FCC-pp will be able to discover $\tilde{\nu}_\tau$ up to 28.8 TeV, observe 32.0 TeV and exclude 34.5 TeV mass values by taking $\lambda'_{311} = 0.11$ and $\lambda_{312} = \lambda_{321} = 0.07$ at $\mathcal{L}_{int} = 17500 \text{ fb}^{-1}$. FCC-pp, also, will allow to examine very low values of the Yukawa coupling constants which cause R-parity violation interactions. It is obviously seen that FCC-pp will give an opportunity for detailed research on scalar tau neutrino production and decay via R-parity violated interactions.

$$R = (-1)^{3(B-L)+2S}$$



$$L_{RPV_{e\mu}} = -\frac{1}{2}\lambda_{321}\tilde{\nu}_{\tau L}\bar{e}_R\mu_L - \frac{1}{2}\lambda_{312}\tilde{\nu}_{\tau L}\bar{\mu}_R e_L + h.c.$$

$$L_{RPV_{d\bar{d}}} = -\frac{1}{2}\lambda'_{311}\tilde{\nu}_{\tau L}\bar{d}_R d_L + h.c.$$

SüperSimetri: SM-Genişletimi

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https://doi.org/10.1140/epjc/s10052-020-08755-5

THE EUROPEAN
PHYSICAL JOURNAL C

Regular Article - Theoretical Physics

Electroweak stability and discovery luminosities for new physics

Kerem Cankoçak¹, Durmuş Demir², Canan Karahan^{1,a}, Sercan Şen³

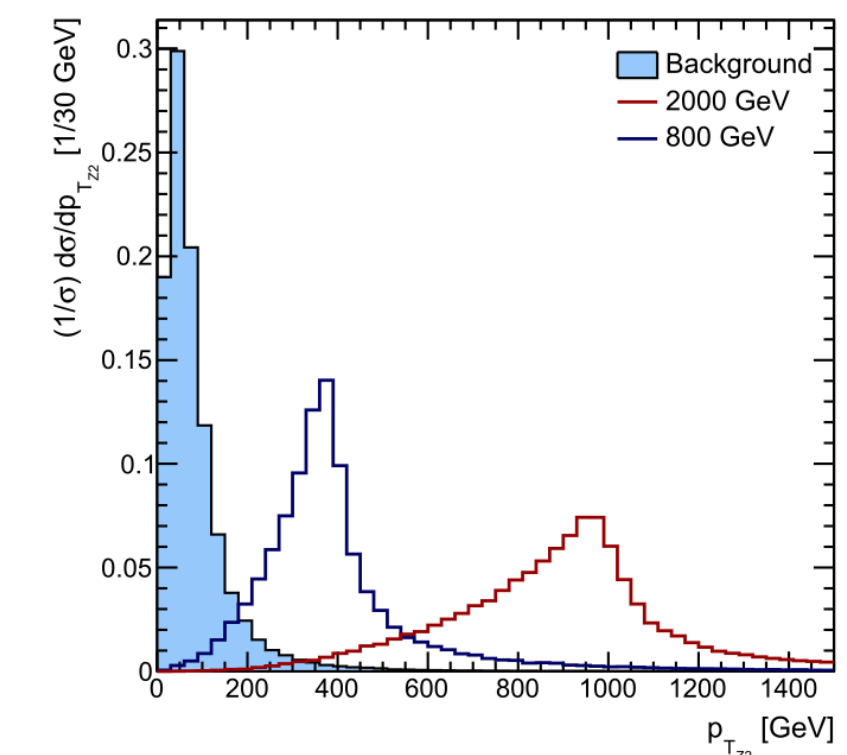
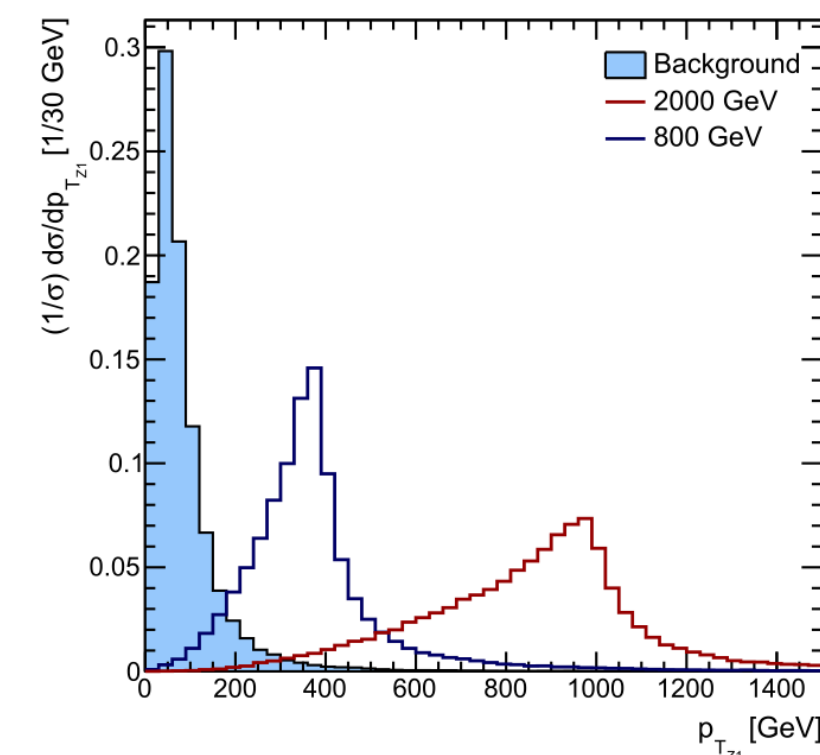
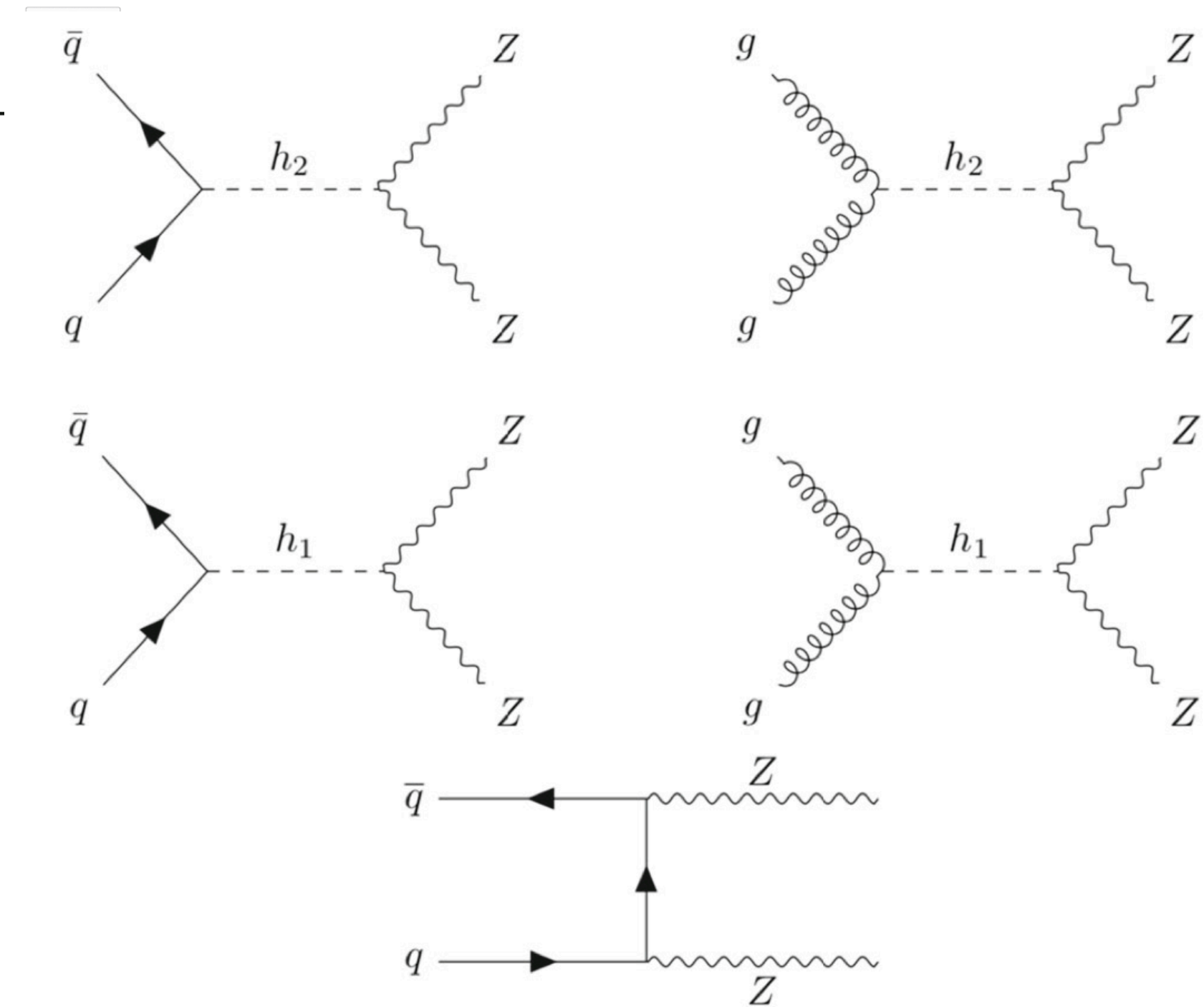
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Abstract What is the luminosity needed for discovering new physics if the electroweak scale is to remain stable? In this work we study this question, with the pertinent example of a real singlet scalar which couples to the Higgs field at the renormalizable level. Observing that the electroweak scale remains stable if the two scalars couple in a see-sawic fashion through a mass-degeneracy-driven unification linkup among quartic couplings at a given scale, we show by detailed simulation studies of the $pp \rightarrow (\text{singlet scalar}) \rightarrow ZZ \rightarrow 4\ell$ channel that the HL-LHC, which is expected to deliver an integrated luminosity of 3 ab^{-1} , has no significant excess of signal over the background in the 800–2000 GeV mass range. The FCC-hh, on the other hand, can discover scalars up to a mass of 870 GeV with an integrated luminosity 20 ab^{-1} . Observation at 3σ (discovery at 5σ) of a new scalar with a minimum mass 800 GeV requires at least 2 ab^{-1} (5.2 ab^{-1}) integrated luminosity, showing that the new physics that does not destabilize the electroweak scale is accessible only at very high luminosities, and can be tested already in the early stages of the FCC-hh operation period.



SüperSimetri: UMSSM



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Nuclear Physics B 970 (2021) 115495

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Family non-universal $U(1)'$ model with minimal number of exotics

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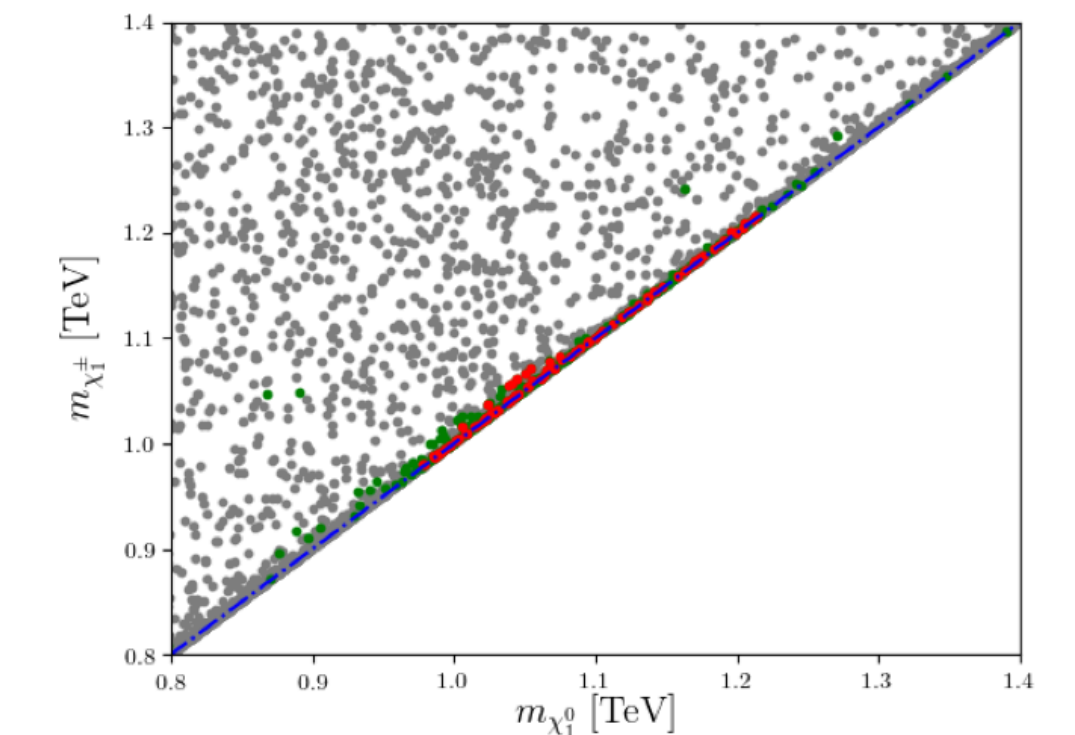
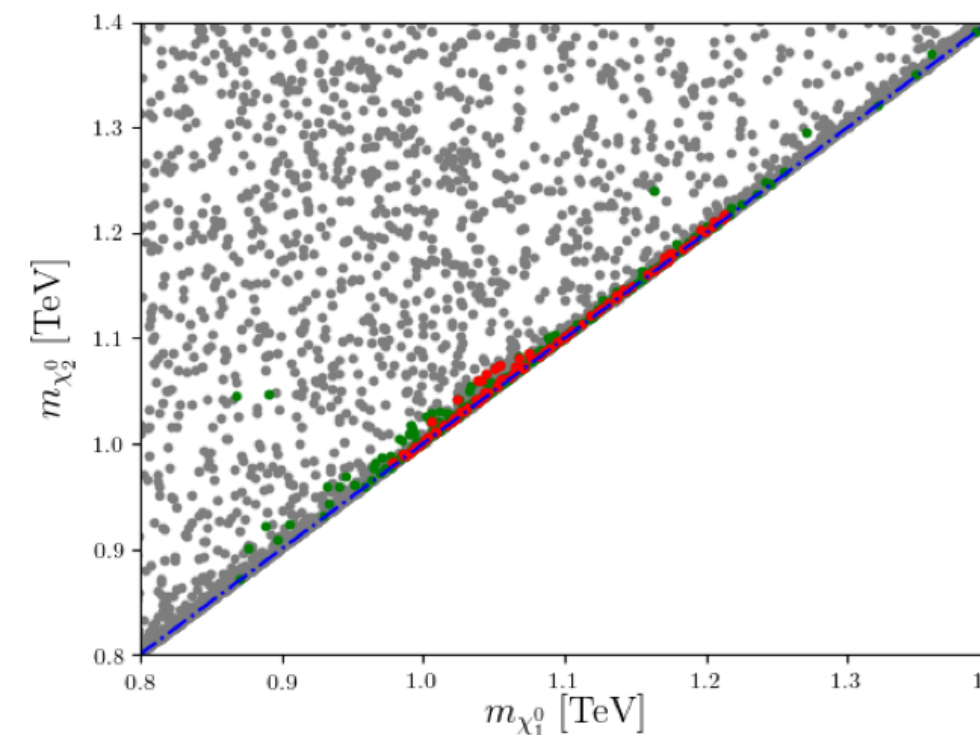
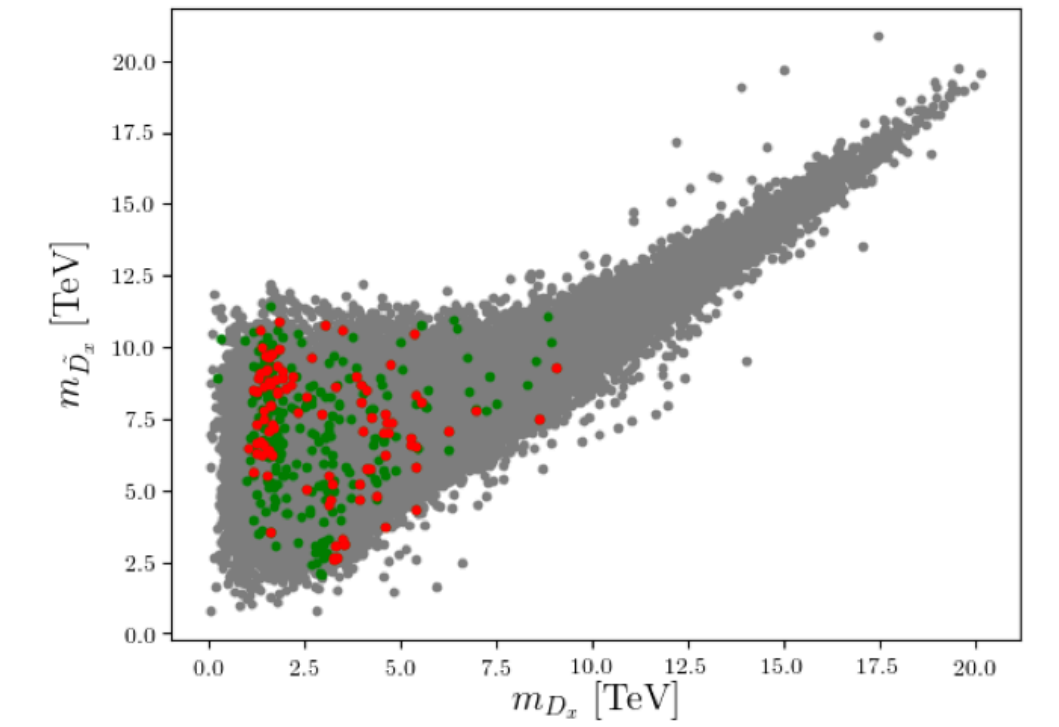
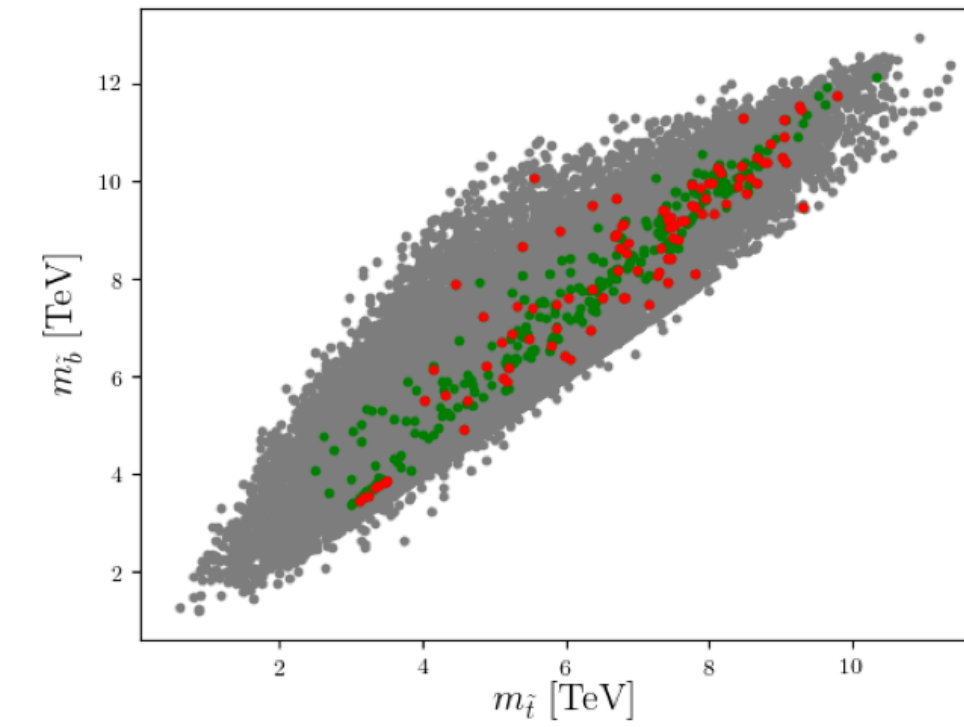
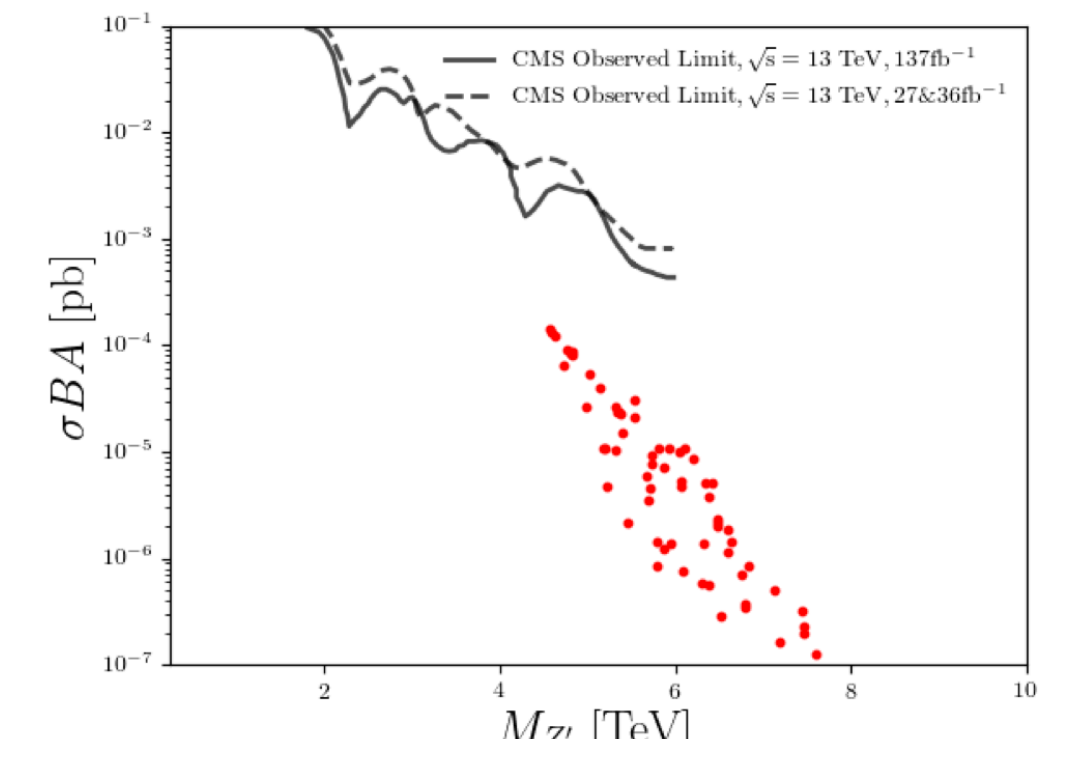
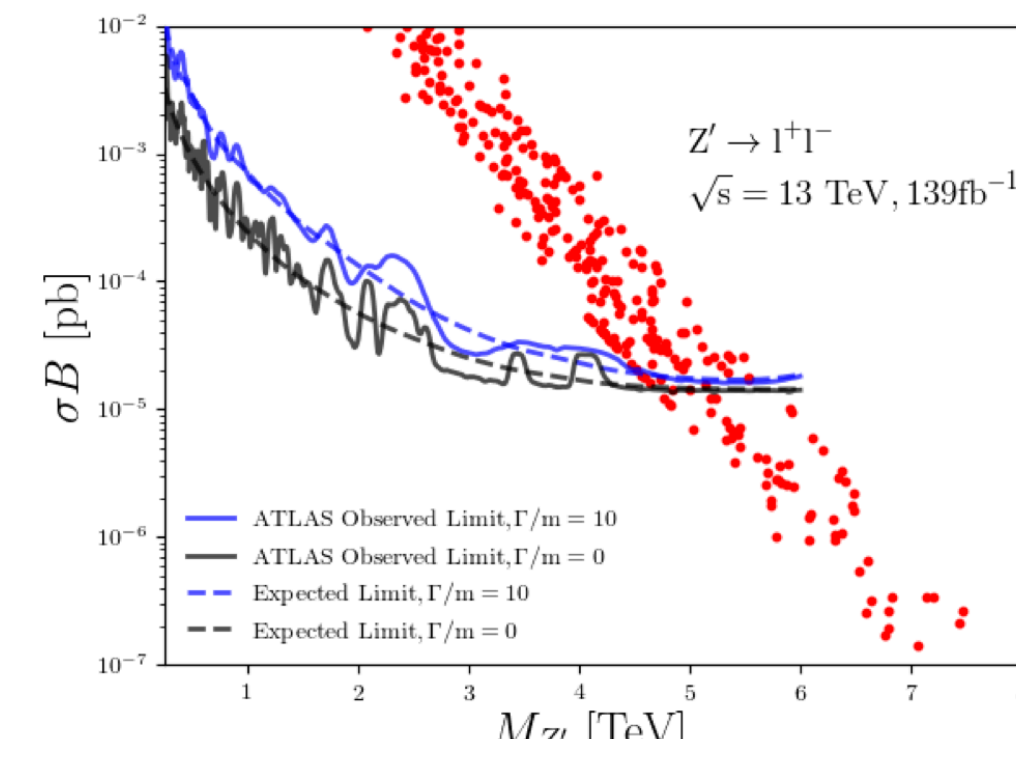
Available online 26 July 2021

Editor: Hong-Jian He

Abstract

We have studied phenomenological implications of several family non-universal $U(1)'$ sub-models in the $U(1)'$ -extended Minimal Supersymmetric Standard Model (UMSSM) possessing an extra down quark type exotic field. In doing this, we have started by enforcing anomaly cancellation criteria to generate a number of solutions in which the extra $U(1)'$ charges of the particles are treated as free parameters. We have then imposed existing bounds coming from colliders and astrophysical observations on the assumed sub-models and observed that current limits dictate certain charge orientations, for instance, $Q_{H_u} \sim Q_{H_d}$ is preferred in general and the charge of the singlet Q_S cannot be very small ($|Q_S| > 0.4$) even if any of the charges is allowed to take any value within the $[-1, 1]$ range. We have finally studied the potential impact of such non-universal charges on Z' mediated processes and made predictions for existing and future experiments. It has turned out that UMSSMs with or without the presence of light exotic quarks can yield distinguishable signatures if non-universal charges are realised in the leptonic sector of such models.

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SüperSimetri: CMSSM

Glino Search with Stop and Top in Nonuniversal Gaugino Mass Models at LHC and Future Colliders

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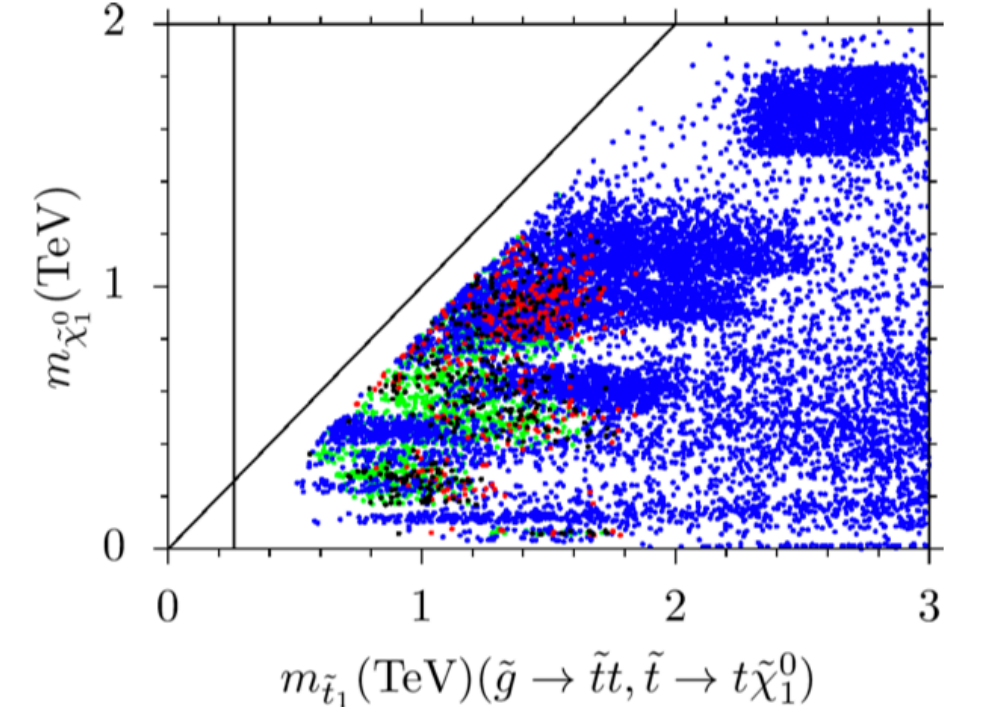
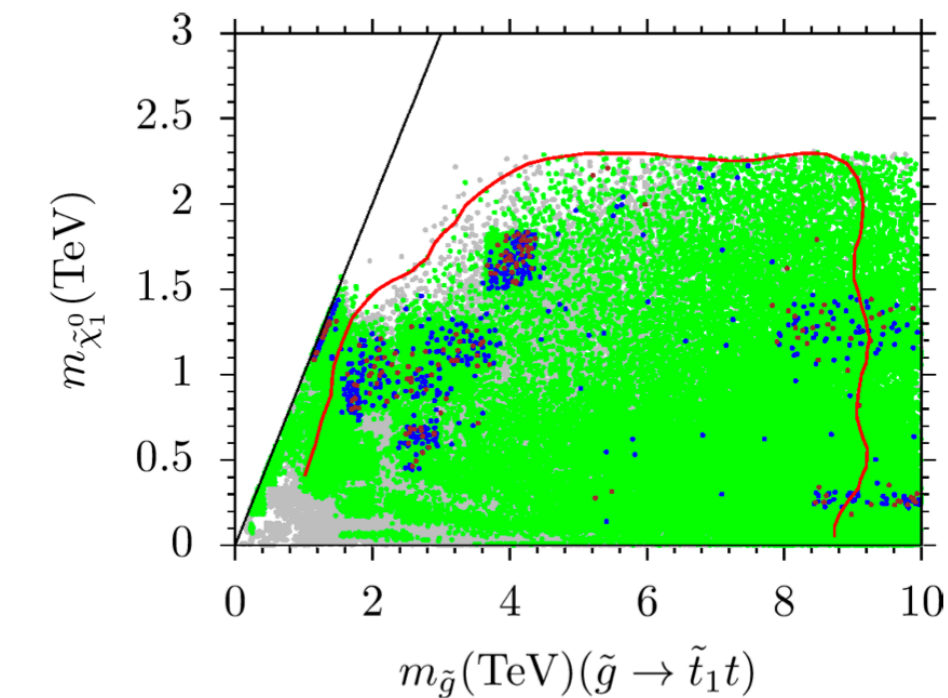
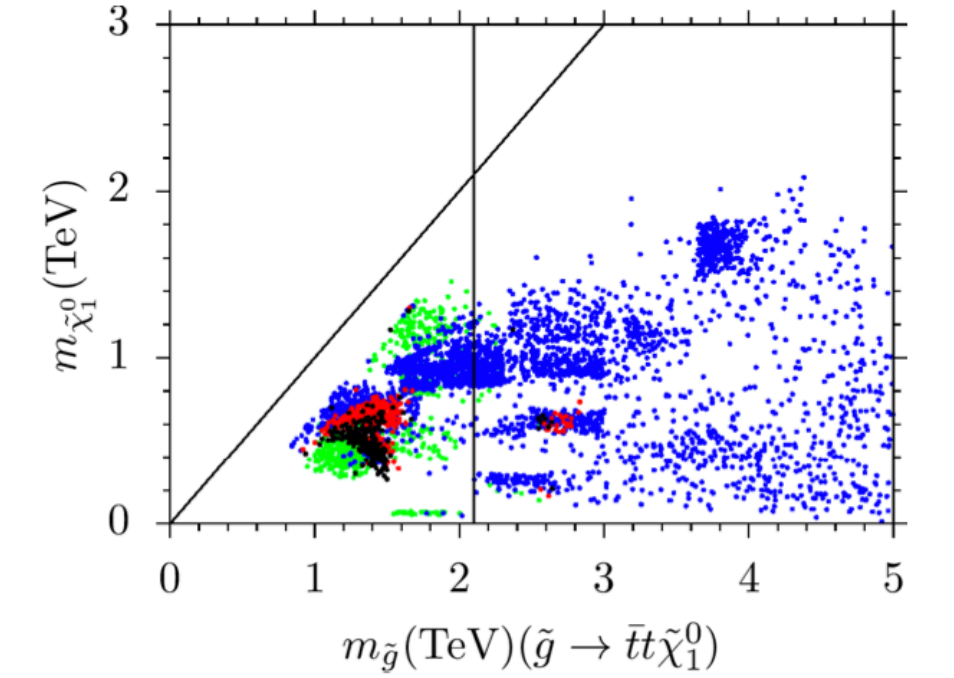
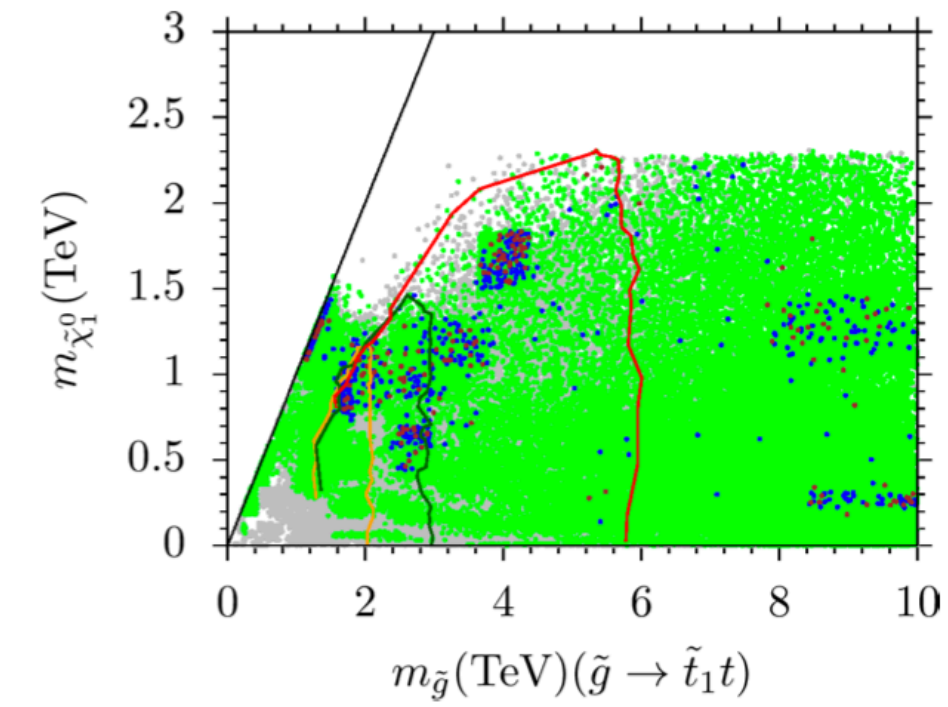
Abstract

We discuss the gluino mass in the CMSSM and Nonuniversal Gaugino Mass Models (NUGM) frameworks in light of the results from the current LHC and Dark Matter experiments. Assuming negative results from the current and near future LHC experiments, we probe the gluino mass scales by considering its decay modes into stop and top quarks, $\tilde{g} \rightarrow \tilde{t}_1 t$ and $\tilde{g} \rightarrow \bar{t} t \tilde{\chi}_1^0$, where $\tilde{t}_1 t$ represents both $\tilde{t}_1 \bar{t}$ and $\tilde{t}_1^* t$. The region with $m_{\tilde{g}} \lesssim 2$ TeV is excluded up to 68% CL in the CMSSM if the gluino decays into a stop and top quark, while the 95% CL exclusion requires $m_{\tilde{g}} \gtrsim 1.9$ TeV. Considering an error of about 10% in calculations of the SUSY mass spectrum, such exclusion bounds on the gluino mass more or less overlap with the current LHC results. The decay mode $\tilde{g} \rightarrow \bar{t} t \tilde{\chi}_1^0$ may take over if $\tilde{g} \rightarrow \tilde{t}_1 t$ is not allowed. One can probe the gluino mass in this case up to about 1.5 TeV with 68% CL in the CMSSM, and about 1.4 TeV with 95% CL. Imposing the Dark Matter constraints yields a lower bound on the gluino and stop masses of about 3.2 TeV from below, which is beyond the reach of the current LHC experiments. A similar analyses in the NUGM framework yield exclusion curves for the gluino mass $m_{\tilde{g}} \gtrsim 2.1$ TeV at 14 TeV for both decay modes of the gluino under consideration. We also show that increasing the center of mass energy to 27 TeV can probe the gluino mass up to about 3 TeV through its decay mode into stop and top quark. The Dark Matter constraints are not very severe in the framework of NUGM, and they allow solutions with $m_{\tilde{g}}, m_{\tilde{t}} \gtrsim 1$ TeV. In addition, with NUGM the LSP neutralino can coannihilate with gluino and/or stop for $m_{\tilde{g}}, m_{\tilde{t}} \approx m_{\tilde{\chi}_1^0} \in [0.9 - 1.5]$ TeV. With the 100 TeV FCC collider one can probe the gluino masses up to about 6 TeV with $36.1 fb^{-1}$ integrated luminosity. We also find that the decay $\tilde{g} \rightarrow \tilde{t} t$ can indirectly probe the stop mass up to about 4 TeV.

$$pp \rightarrow \tilde{g}\tilde{g} \xrightarrow{\tilde{g} \rightarrow \bar{t}t\tilde{\chi}_1^0} \bar{t}t\bar{t}t\tilde{\chi}_1^0\tilde{\chi}_1^0$$

$$pp \rightarrow \tilde{g}\tilde{g} \xrightarrow{\tilde{g} \rightarrow \tilde{t}t} \tilde{t}t^*\tilde{t}t \xrightarrow{\tilde{t} \rightarrow t\tilde{\chi}_1^0} t\bar{t}\bar{t}t\tilde{\chi}_1^0\tilde{\chi}_1^0,$$

$$pp \rightarrow \tilde{g}\tilde{g} \xrightarrow{\tilde{g} \rightarrow \tilde{t}t} \tilde{t}t^*\tilde{t}t \xrightarrow{\tilde{t} \rightarrow b\tilde{\chi}_1^\pm} b\bar{b}t\bar{t}\tilde{\chi}_1^\pm\tilde{\chi}_1^\pm \xrightarrow{\tilde{\chi}_1^\pm \rightarrow W^\pm\tilde{\chi}_1^0} b\bar{b}t\bar{t}W^\pm W^\pm\tilde{\chi}_1^0\tilde{\chi}_1^0.$$



Vektör Benzeri Yeni Parçacıklar (BSM)

Why should we search for vector-like leptons?

Feyza Baspehlivan¹, Burak Dagli^{1*}, Osman Emre Delialioğlu¹, Saleh Sultansoy^{1,2}

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Abstract

There are two strong arguments in favor of vector-like leptons and quarks: Flavor Democracy call for them, and E_6 GUT predicts existence of iso-singlet quarks and iso-doublet leptons. Vector-like quarks (VLQ) are extensively searched by ATLAS and CMS collaborations, but this is not the case for vector-like leptons (VLL), while they have actually similar status from phenomenology viewpoint. In this study we argue that vector-like leptons should be included into the new physics search programs of energy-frontier colliders.

We consider production of vector-like partners of the first SM family leptons at the HL-LHC, HE-LHC, FCC, ILC, CLIC, Muon Collider, as well as, at ep and μ -p colliders. As for decays of vector-like leptons, we present branching ratios formulas to different channels for the most general case. Since there are many different production and decay channels for charged and neutral vector-like leptons, relevant studies should be done systematically. We invite the High Energy Physics community (both experimenters and phenomenologists) to actively participate in research on this topic.

Vektör Benzeri Yeni Parçacıklar (BSM)

A search for the first generation charged vector-like leptons at future colliders

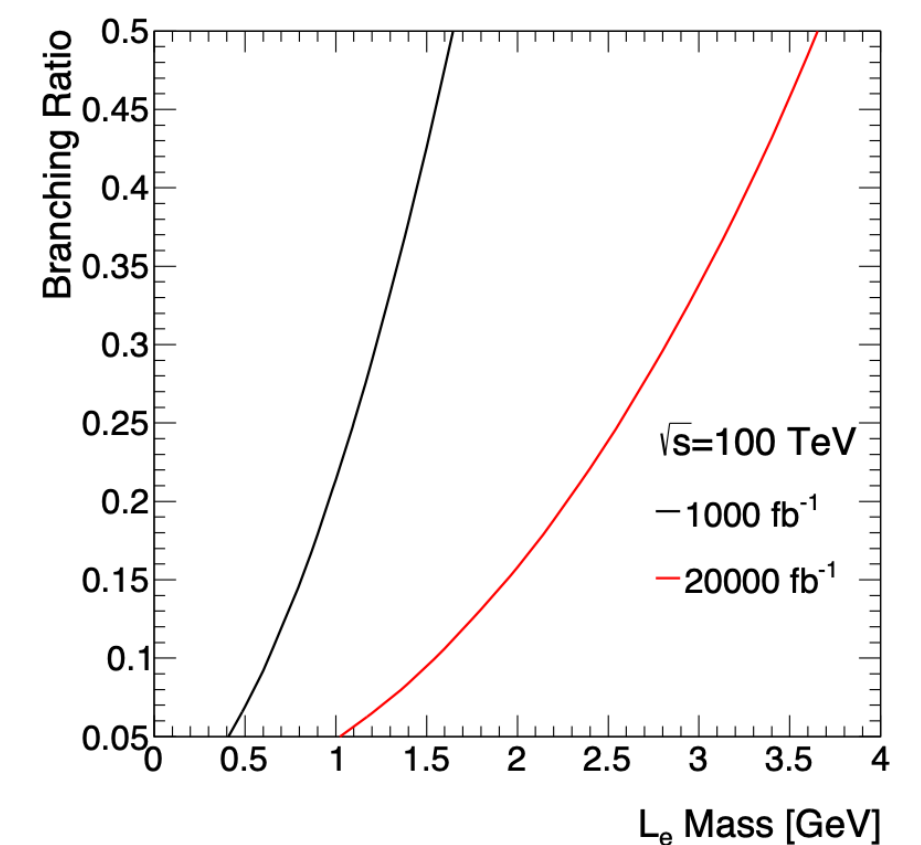
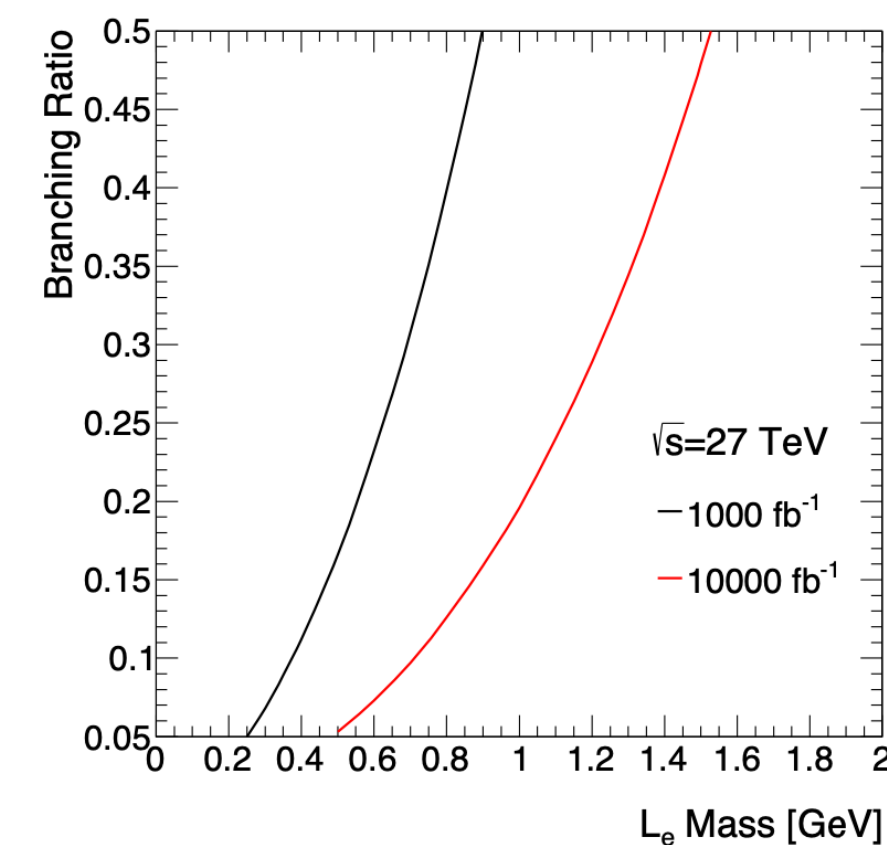
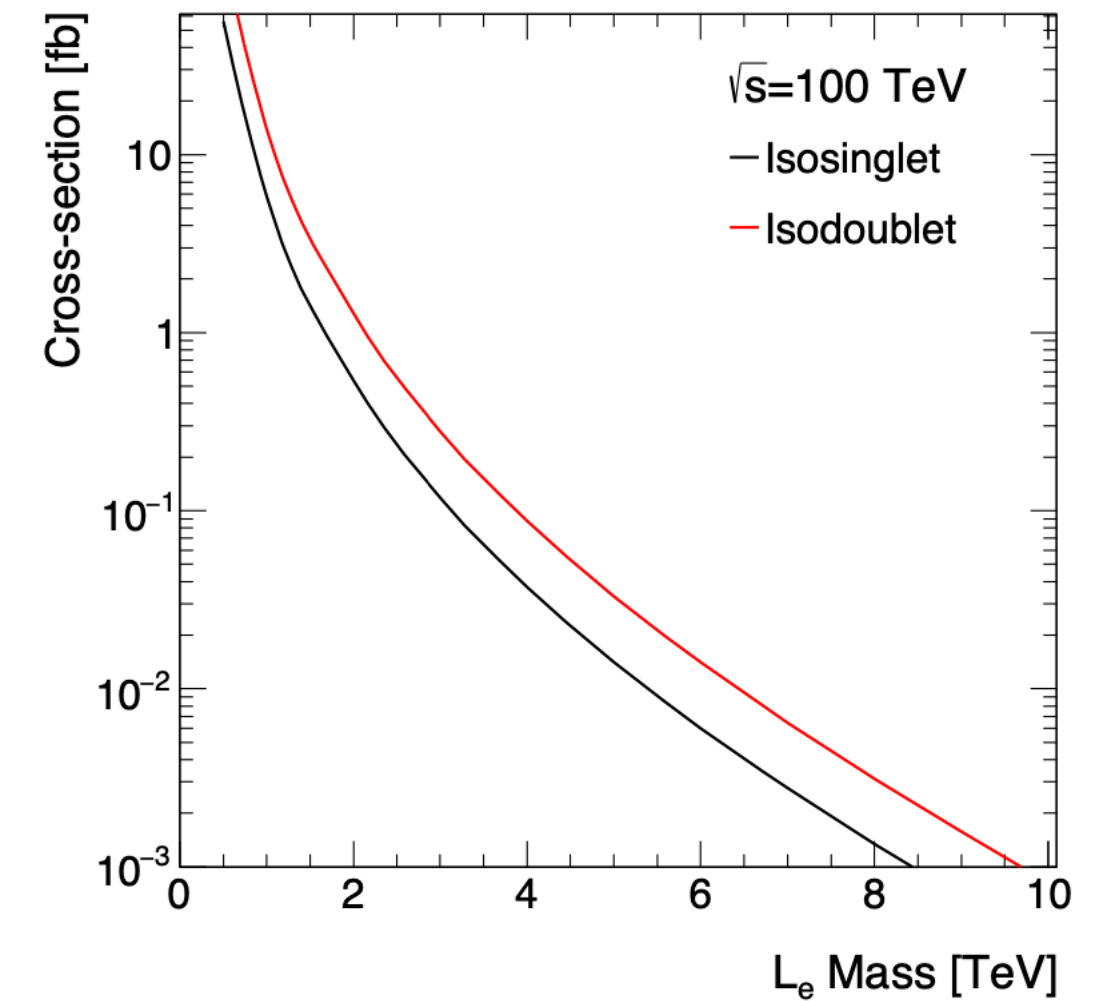
Ali Osman Acar¹, Osman Emre Delialioğlu¹, Saleh Sultansoy^{1,2}

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Abstract

Flavor Democracy Hypothesis favors existence of iso-singlet quarks and vector-like charged leptons. Their observation at future colliders could shed light on the nature of mass and mixing patterns of known leptons and quarks, as well as Higgs boson itself. Vector-like quarks are extensively searched by ATLAS and CMS collaborations. Unfortunately, this is not the case for vector-like leptons, while they have actually similar status from phenomenology viewpoint. We argue that vector-like charged leptons should be included into the new physics search programs of future energy frontier colliders. It is shown that pair production at the HE-LHC with decay of one of the leptons to Ze and another to He channel, followed by $H \rightarrow bb$ and $Z \rightarrow \mu^+\mu^-$ decays will give opportunity to search for iso-singlet and iso-doublet charged leptons up to 0.9 TeV and 1.5 TeV, respectively. This region up to 2 TeV for iso-singlet and 3.6 TeV for iso-doublet charged leptons is shown.



Higgs - Radion Karışım Modelleri

IOP Publishing

Journal of Physics G: Nuclear and Particle Physics

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<https://doi.org/10.1088/1361-6471/ab596b>



Photoproduction of mixed radions at a proton–proton collider

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Abstract

We investigate a Higgs–radion mixing scenario through a single radion photoproduction process $pp \rightarrow p\gamma p \rightarrow pRqX$ at the LHC where X represents the remnants of one of the initial protons. We consider high luminosity values of $L_{int} = 200 \text{ fb}^{-1}$, 500 fb^{-1} and 3000 fb^{-1} . We obtain bounds on the mixing parameter space by considering $R \rightarrow \gamma\gamma$, $R \rightarrow W^+W^-$ and $R \rightarrow ZZ$ decay channels of the radion as the signal. We also perform a similar analysis for a 100 TeV future proton–proton collider and compare its potential with that of the LHC.

Keywords: Higgs–radion mixing, photoproduction, semi-elastic scattering

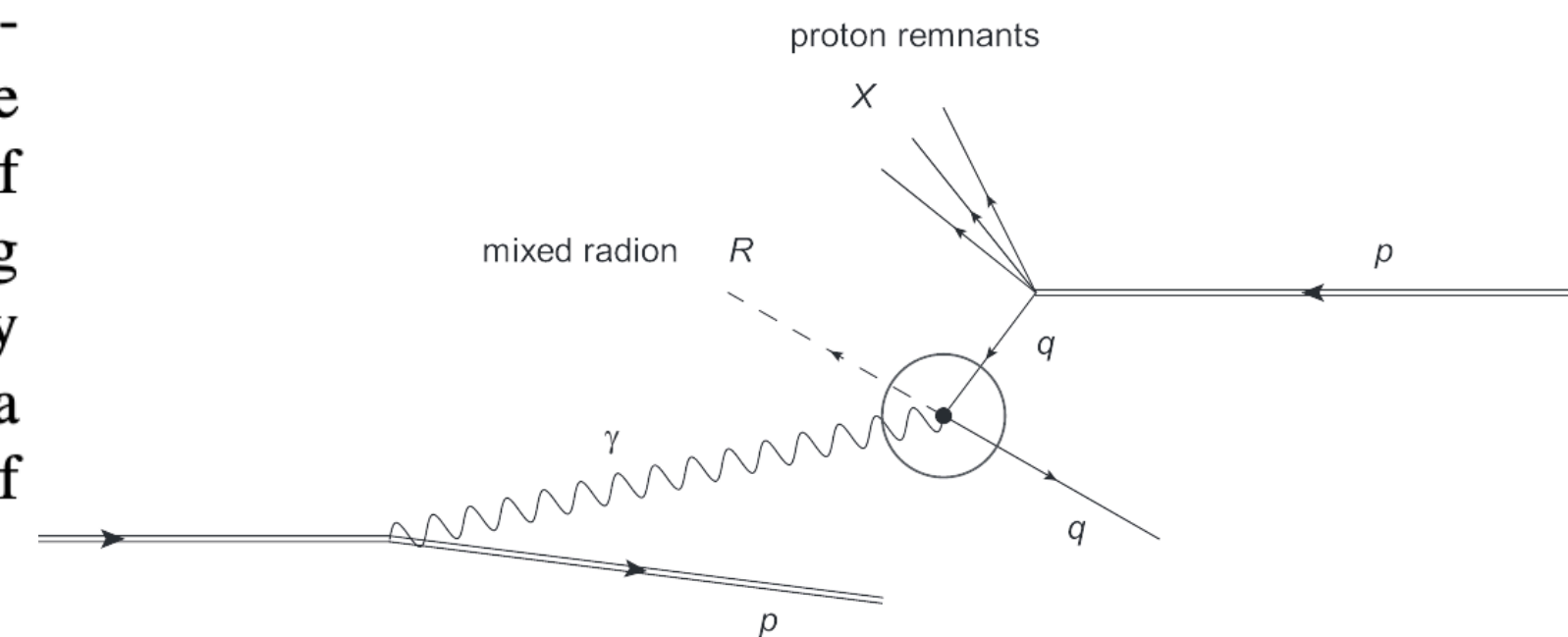
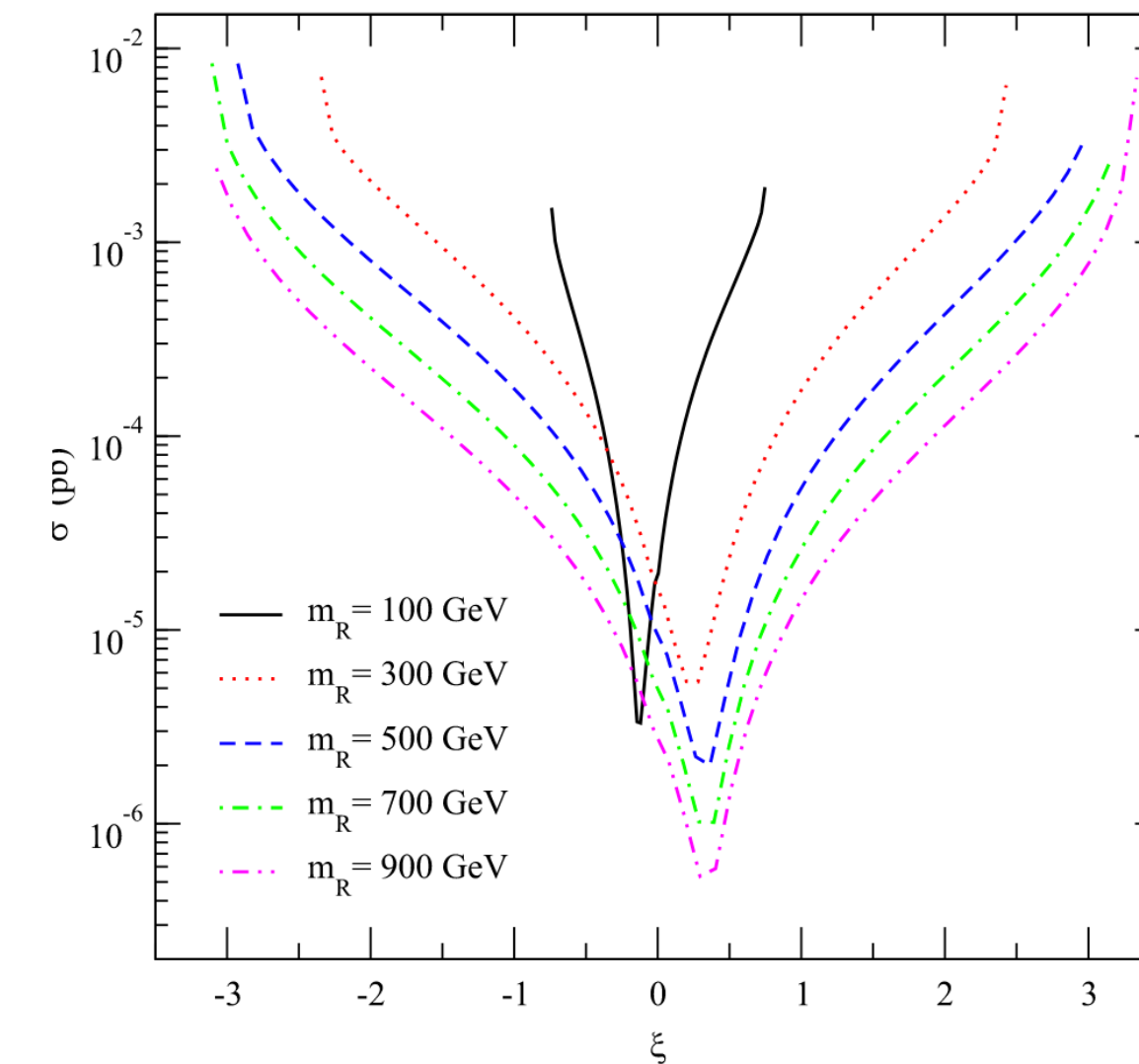


Figure 1. The schematic diagram which illustrates the process $pp \rightarrow p\gamma p \rightarrow pRqX$.

Hindawi
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Uyarılmış Kuark ve Lepton Durumları



Research Article

Search for Excited u and d Quarks in Dijet Final States at Future pp Colliders

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Resonant production of excited u and d quarks at the Future Circular Collider and Super Proton-Proton Collider has been researched. Dominant jet-jet decay mode has been considered. It is shown that FCC and SppC have great potential for discovery of excited u (d) quark: up to 44.1 (36.3) and 58.4 (47.8) TeV masses, respectively. For degenerate case ($M_{u^*} = M_{d^*}$), these values are 45.9 and 60.9 TeV, respectively. This discovery will also afford an opportunity to determine the compositeness scale up to multi-PeV level.

Uyarılmış Kuark ve Lepton Durumları

Excited quarks production at FCC and SppC pp colliders



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Potential discovery, observation and exclusion limits of excited u and d quarks with gamma + jet final state are researched at the multi-TeV scale colliders, FCC and SppC in this paper. Both colliders, FCC and SppC, show that excited u and d quarks could be discovered up to 42.1 TeV and 55.2 TeV for u^* , 30.3 TeV and 39.4 TeV for d^* and 42.3 TeV and 55.5 TeV mass values for degenerate case ($m_{u^*} = m_{d^*}$), respectively. The determination of the excited quarks compositeness scale is examined, which will be up to multi-PeV level. Besides these analyses, free parameters (f_s , f and f') are scanned from around 0.1 up to 1 that show excited quark could be discovered at dozens of TeV with even coupling constants under 0.1.

Keywords: Excited quarks; preonic models; FCC; SppC; compositeness scale.

PACS numbers: 12.60.Rc, 14.80.-j

Mehmet Sahin

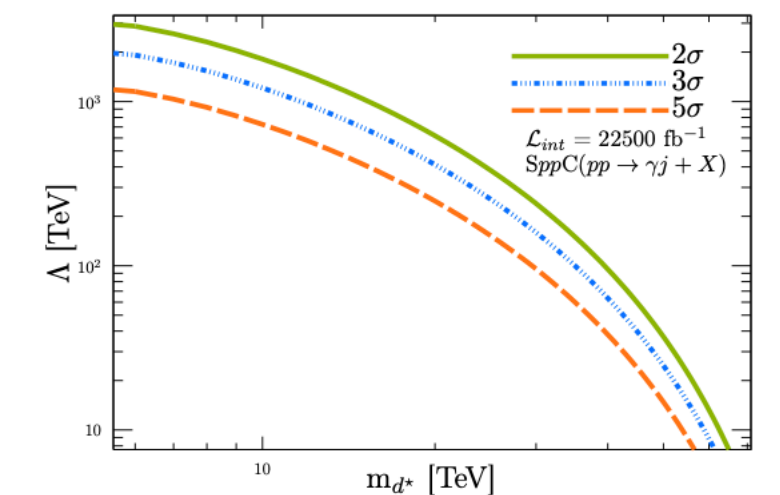
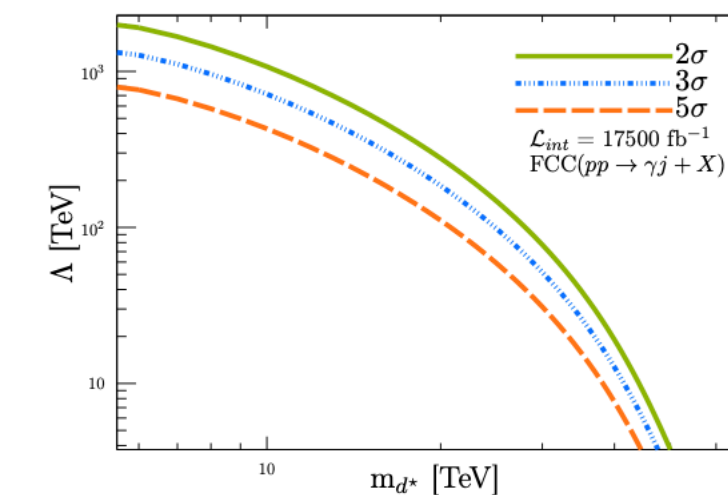
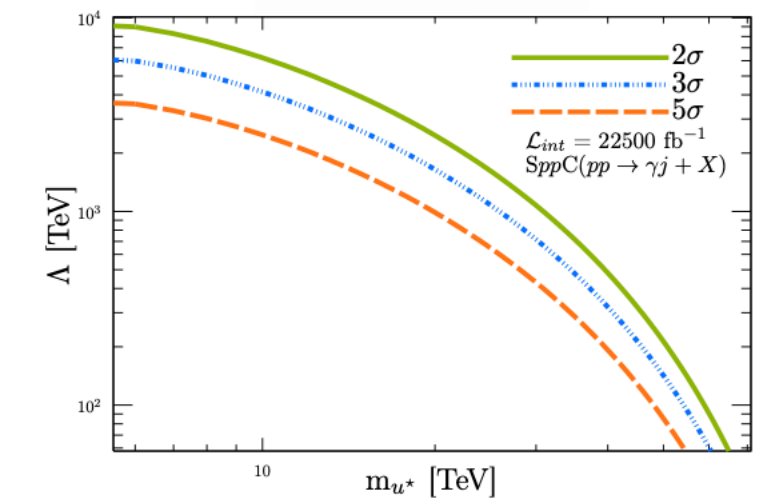
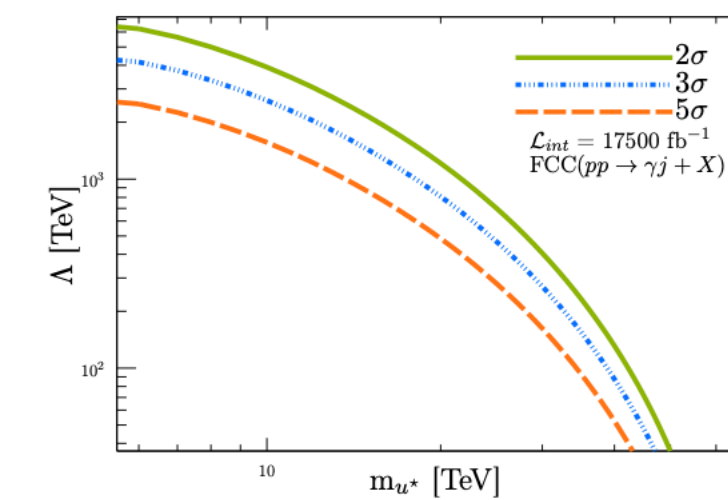
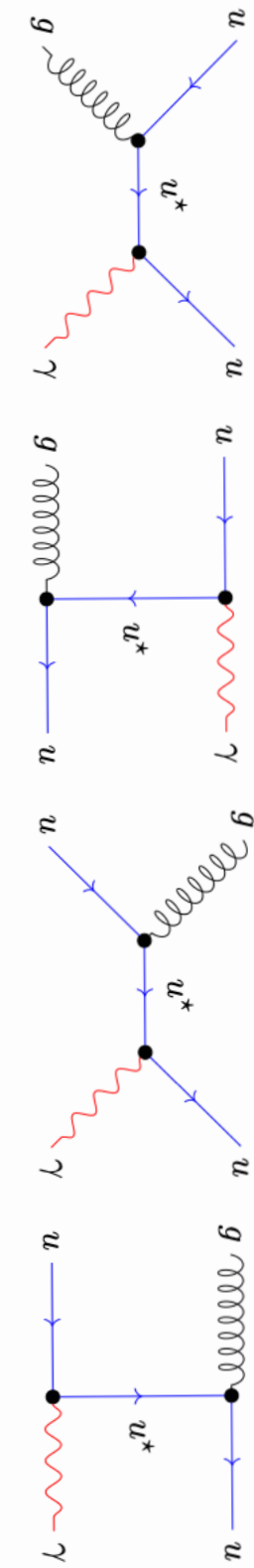
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İki Higgs Çiftlisi Modeli (2HDM)



$$pp \rightarrow t\bar{t}b(\bar{b}) + X$$

$$g_{H^-W^+A^0} \equiv ig(p_{H^-} + p_{A^0})/2$$

$$g_{H^-W^+H^0} \equiv g \sin(\beta - \alpha)(p_{H^-} + p_{H^0})/2$$

$$g_{H^-W^+h^0} \equiv g \cos(\beta - \alpha)(p_{H^-} + p_{h^0})/2$$

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Probing charged Higgs boson couplings at a future circular hadron collider

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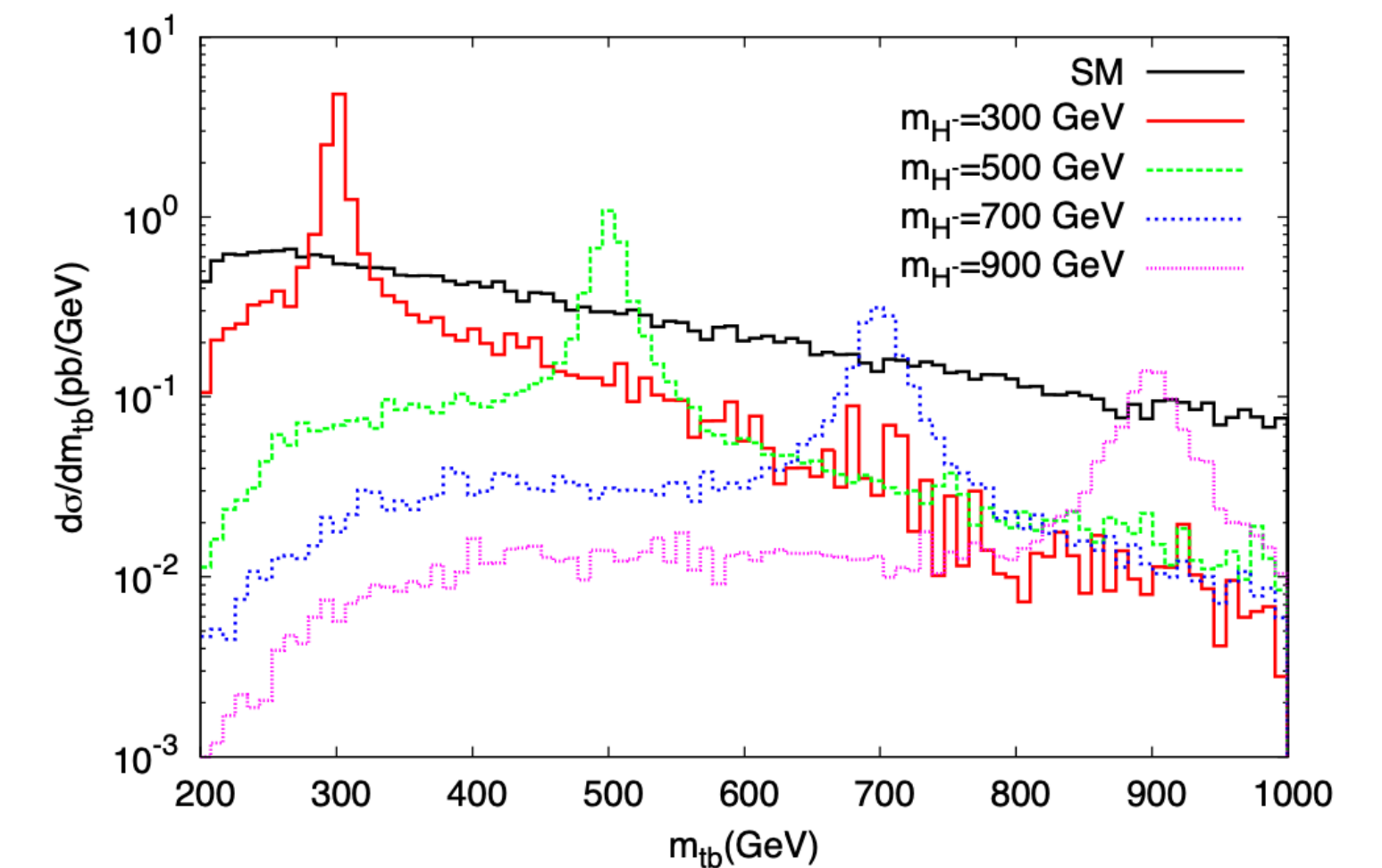
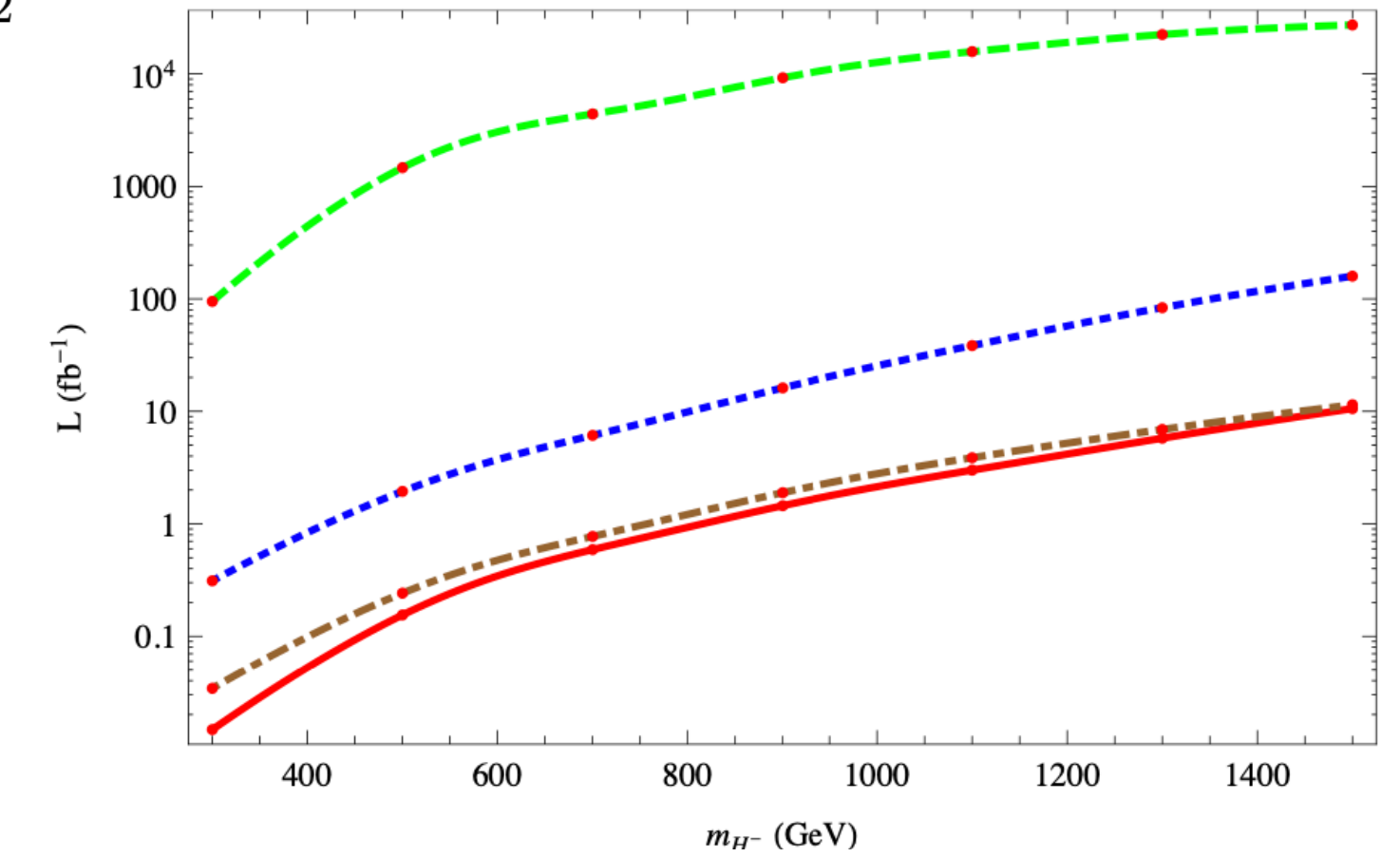
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Many of the new physics models predict a light Higgs boson similar to the Higgs boson of the Standard Model (SM) and also extra scalar bosons. Beyond the search channels for a SM Higgs boson, the future collider experiments will explore additional channels that are specific to extended Higgs sectors. We study the charged Higgs boson production within the framework of two Higgs doublet models (THDM) in the proton-proton collisions at a future circular hadron collider (FCC-hh). With an integrated luminosity of $L_{\text{int}} = 500 \text{ fb}^{-1}$ at very high energy frontier ($\sqrt{s} = 100 \text{ TeV}$), we obtain a significant coverage of the parameter space and distinguish the charged Higgs-top-bottom interaction within the THDM or other new physics models with charged Higgs boson mass up to 1.5 TeV.

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İki Higgs Çiftlisi Modeli (2HDM)



Just a Scalar in THDM

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Abstract

We review the THDM model in which one of the Higgs doublets does not develop a vacuum expectation value. In this case, the Higgs fields with zero VEV does not contribute to the physical masses of the SM particles, and hence, its interactions with the SM particles can have more freedom than in the case of usual considerations on the THDM models. We show that the stability of the Higgs potential minima can be maintained. All the Higgs boson masses are found lighter than about 300 GeV in the low scale spectrum when $v_1 = 0$. Such light mass scales are in the detectable regime, and hence, the SM predictions and the experimental results are essential to be applied in the analyses. Especially the decay channels; $h \rightarrow W^+W^-$ and $h \rightarrow b\bar{b}$ exclude most of the solutions, while it is still possible to realize a small region, which coincides with the SM predictions. We highlight that it is also possible to realize an excess in $h \rightarrow \gamma\gamma$ decay channel, even one applies the constraints from the Higgs boson decays into W^+W^- and $b\bar{b}$. In addition, if one assumes H is the SM-like Higgs boson of mass about 125 GeV, the solutions with $m_h \lesssim 125$ GeV can be acceptable. In this case, the solutions can still be realized consistent with the SM predictions; however, an excess in $H \rightarrow \gamma\gamma$ cannot be observed, while the implications for this channel in THDM can stay in the SM prediction rates at most. Even though the light masses of the Higgs bosons can be favored in resolution to discrepancy between the Standard Model and the experiment in the muon anomalous magnetic moment measurements, we find that it is not possible to accommodate such a resolution with $BR(b \rightarrow s\gamma)$ results simultaneously.

Sarah ve SPheno kullanılmış

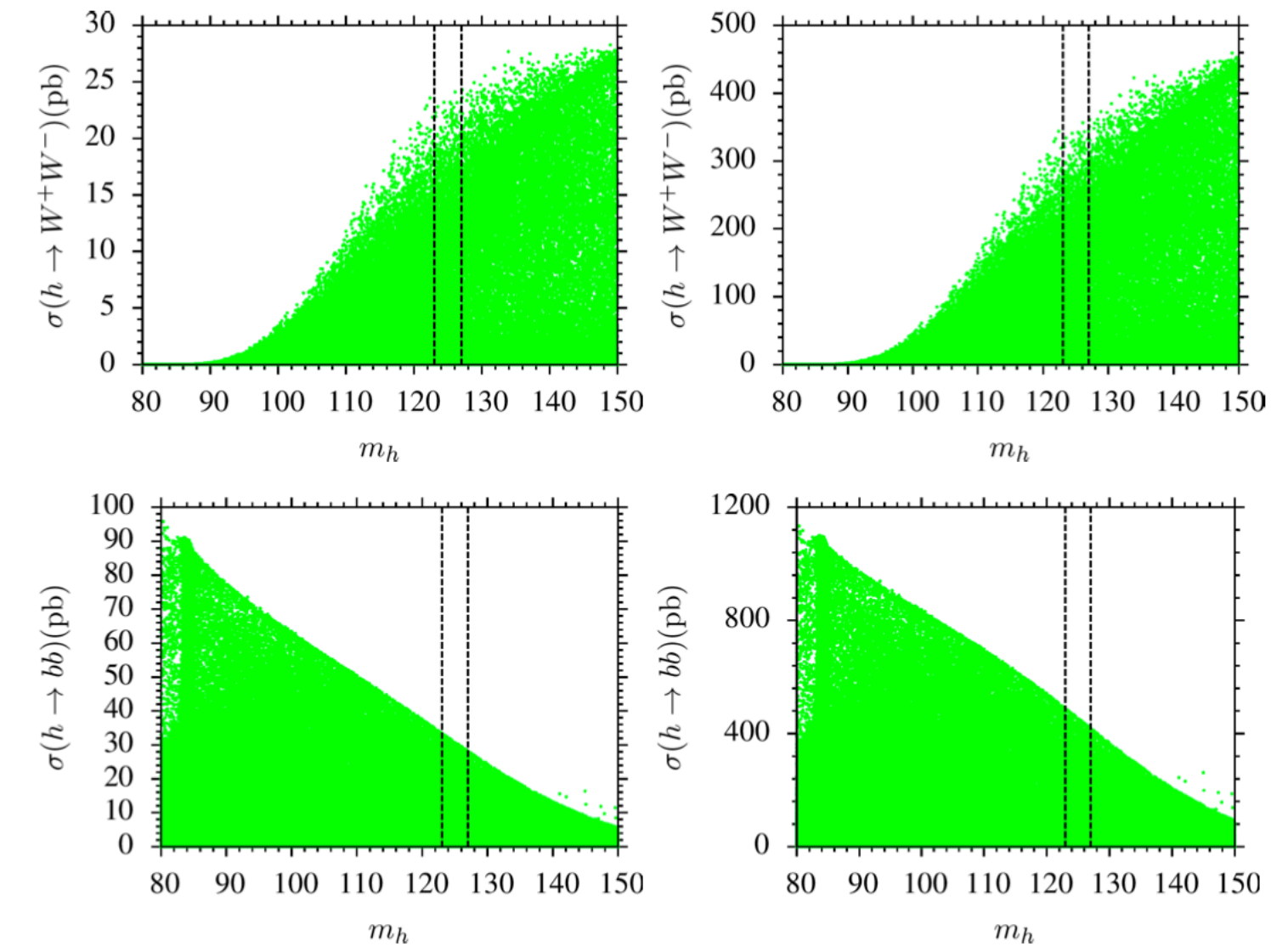
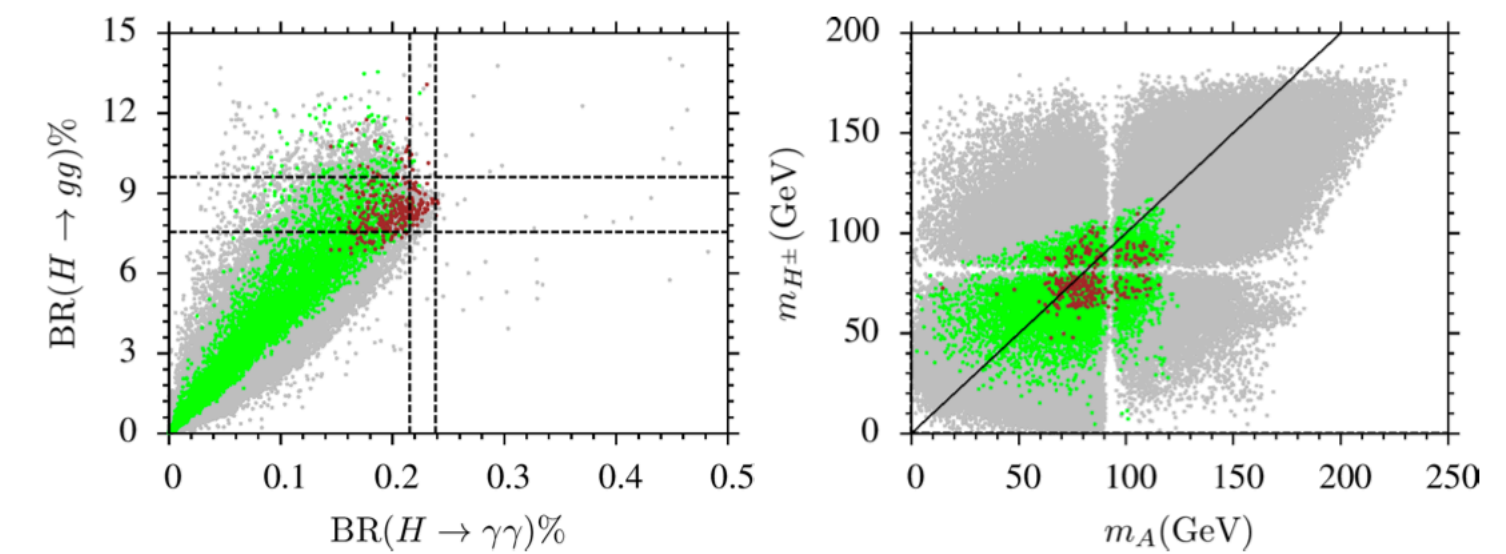


Figure 8: Cross-sections for the decay channels $h \rightarrow W^+W^-$ (top) and $h \rightarrow b\bar{b}$ (bottom) for the 14 TeV (left) and FCC (right) in a correlation with the Higgs boson mass m_h . The color coding is the same as Figure 7.



QCD Teorisi ve Jet Algoritmaları

AZIMUTHAL ANGULAR DECORRELATION OF JETS AT FUTURE HIGH-ENERGY COLLIDERS*



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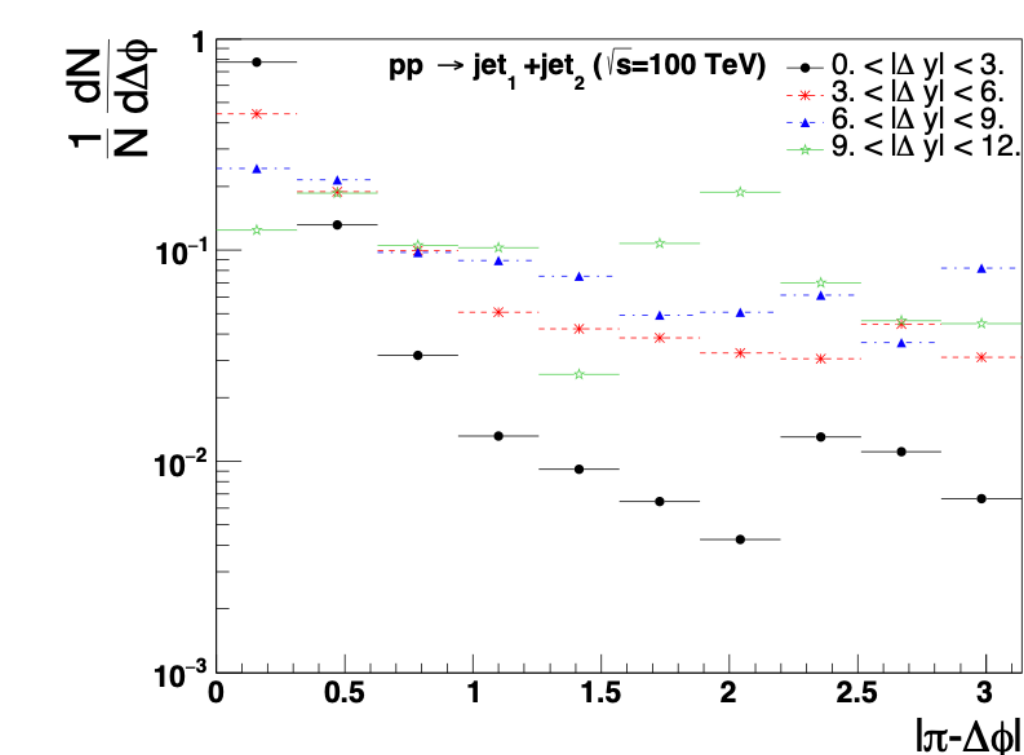
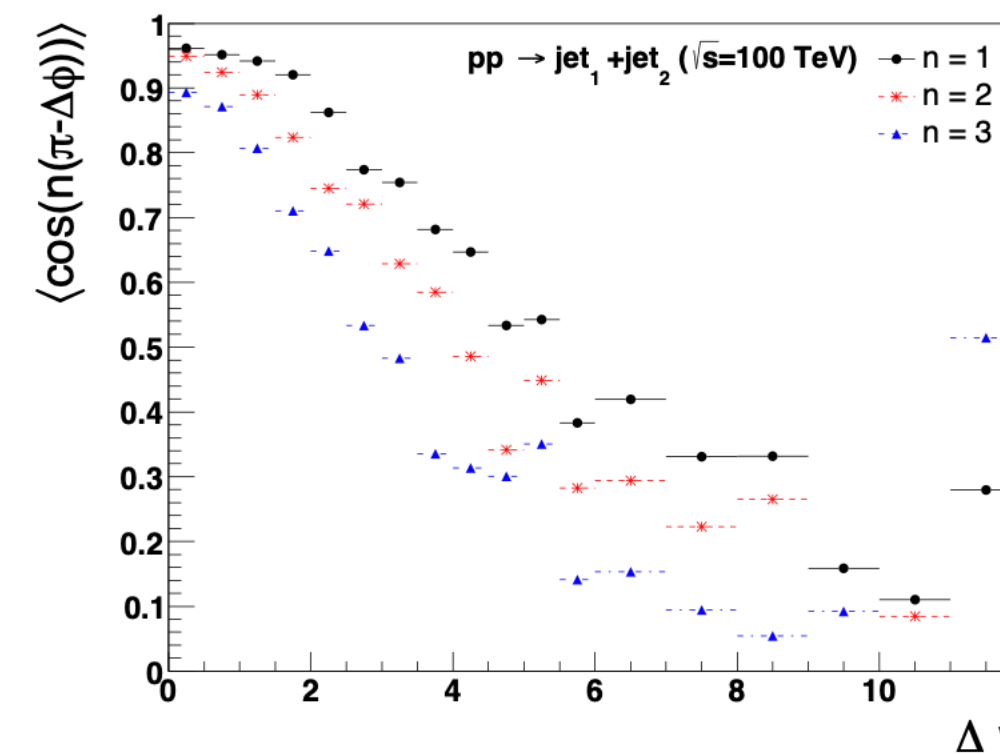
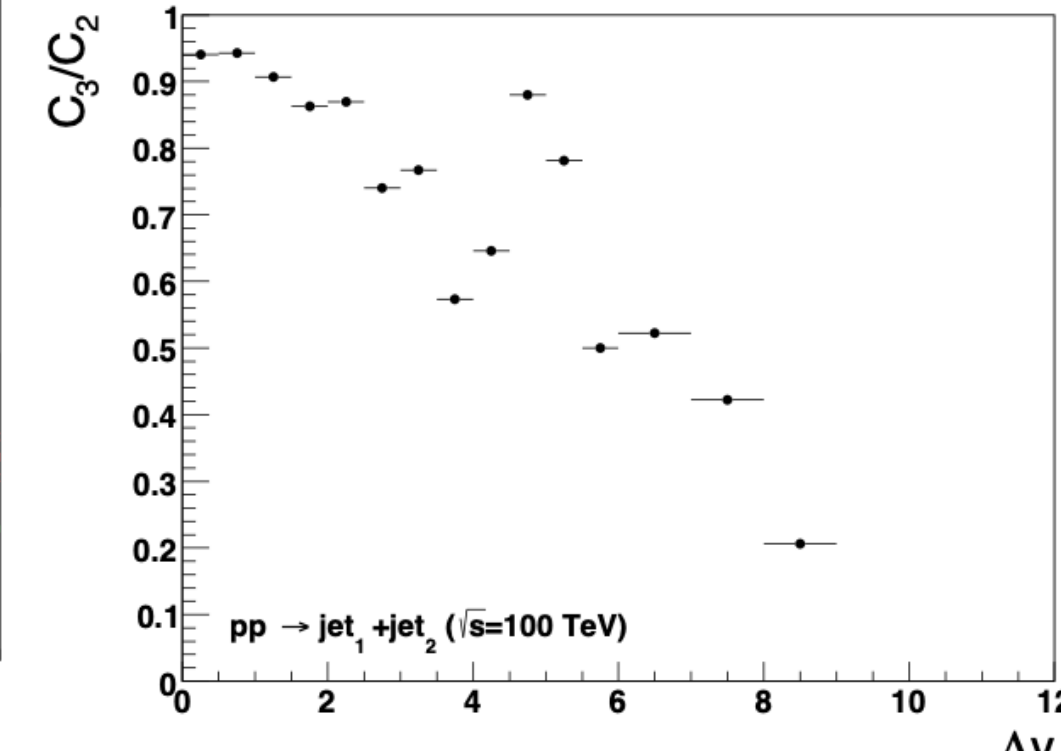
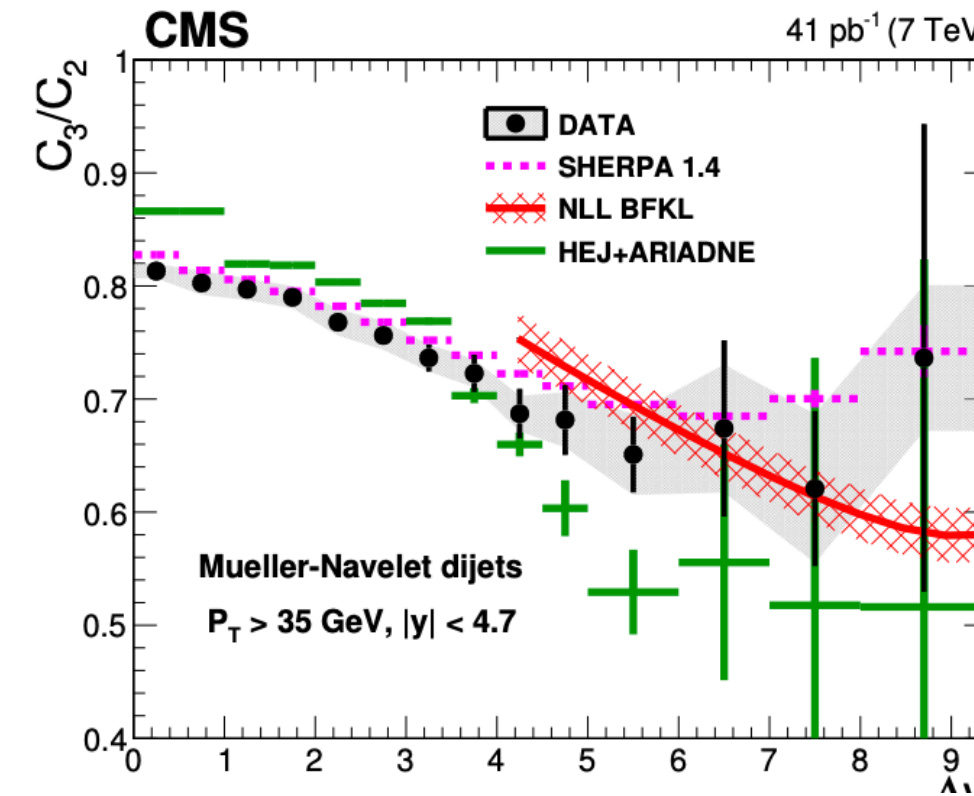
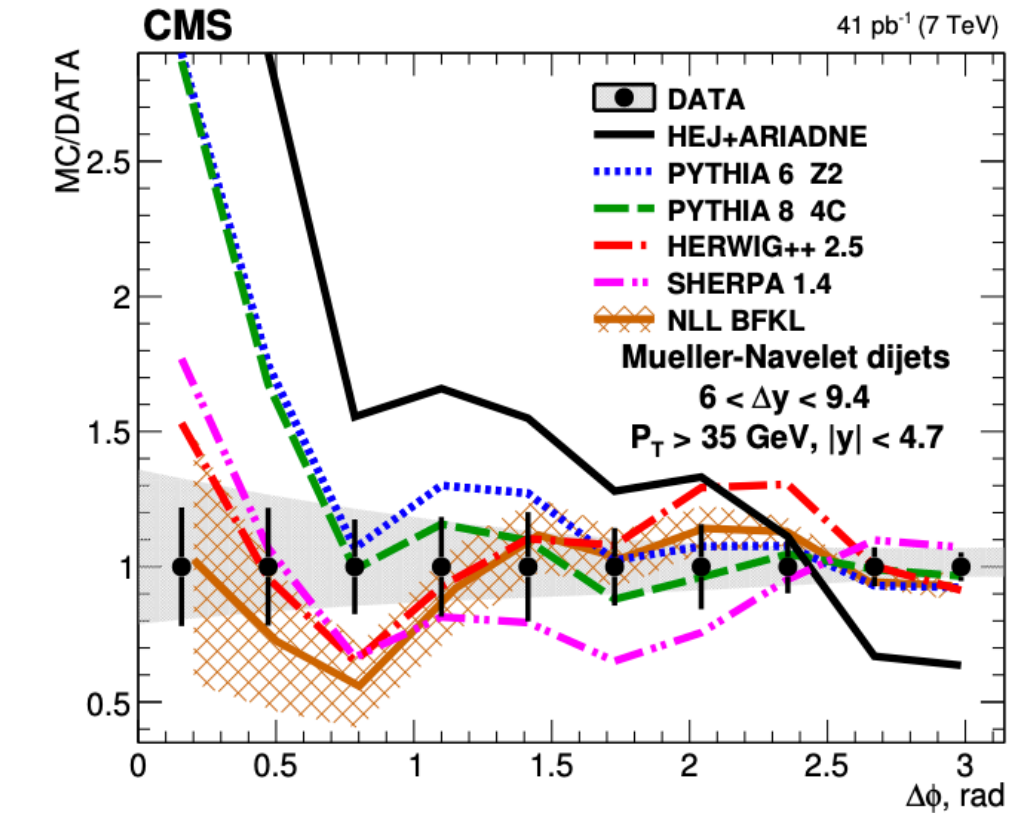
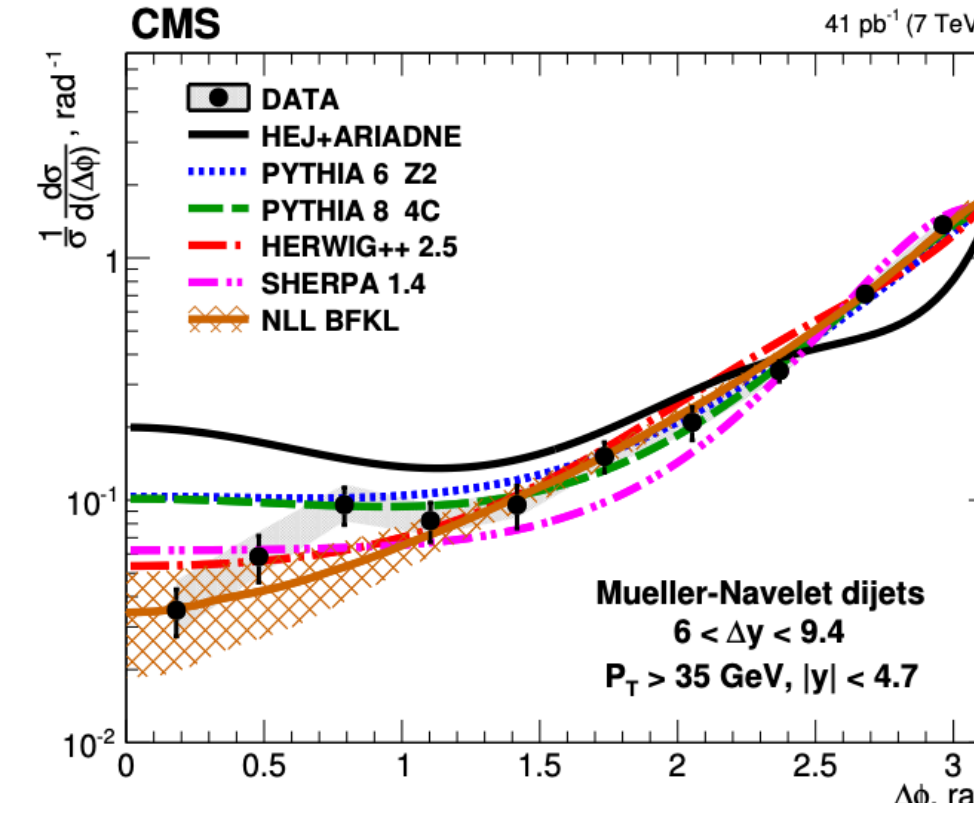
The azimuthal angular decorrelation that is relevant to small- x QCD physics is studied in this paper to show the BFKL effect with a recent event generator. Events are generated at $\sqrt{s} = 100$ TeV with proton-proton collisions and jets that are reconstructed by the anti- k_T algorithm ($R = 0.7$) with $p_T > 35$ GeV and in the rapidity range of $|y| < 6$ are selected for the study. The azimuthal-angle difference between Mueller-Navelet jets ($\Delta\Phi$) in the rapidity separation (Δy) up to 12 is analysed. The distributions of $\langle \cos n(\pi - \Delta\Phi) \rangle$ for $n = 1, 2, 3$ and their ratios are also presented as a function of Δy .

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1. Introduction

The strong interaction between quarks and gluons, called partons, are defined by the theory of Quantum Chromodynamics (QCD). According to QCD, quarks carry colour charges (blue, red and green) and cannot be observed as free particles but in colourless states. This behaviour is named as confinement. To study partons experimentally, one needs to consider jets described by QCD in terms of pp scattering.



QCD Teorisi ve Jet Algoritmaları

Differential QCD Predictions of the $W^\pm + 1$ Jet for the Large Hadron Collider and Possible Future High Energy Colliders

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The differential quantum chromodynamics (QCD) predictions for the W^\pm boson and a single jet as functions of the lepton pseudorapidity in proton-proton collisions are presented up next-to-leading order correction in QCD. The predictions are done by using the most modern parton distribution functions (PDFs). To check the reliability of the PDFs, we compared 7 TeV predictions with the available experimental results at the corresponding energy. Finally, the differential QCD predictions and the asymmetry between the $W^+ + 1$ jet and $W^- + 1$ jet events at $\sqrt{s} = 7, 8, 13, 14$ and 100 TeV are discussed in detail.

PACS numbers: 14.70.Fm, 13.85.Qk, 12.38.-t

Keywords: QCD, LHC, FCC, Jets, W bosons.

DOI: 10.3938/jkps.73.1240

Tartışma ve Sonuç

- FCC-hh için 25 yayın 10 farklı ulusal çalışma grubu tarafından yapılmıştır.
- 25 yayından sadece 7 tanesi BSM parçacıklarını / gözlenebilirliğini araştırmaktadır.
- 18 yayın, SM genişletimi + Etkin Alan Teorisi + QCD + Uyarılmış Durumlar + FCNC konularındadır.
- Yayınlar; 2018TAEK(CERN)A5.H6.F2-20 nolu TAEK - FCC projesi ve 114F337 nolu TUBİTAK projeleri kapsamında desteklenmiştir.
- Yayınlardan bir kısmı ULAKBİM-TRUBA küme bilgisayar erişimi kullanılarak yapılmıştır.

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