Probing the prospective FCC-he sensitivities on the electromagnetic dipole moments of the top-quark

M. A. Hernández-Ruíz[1], A. Gutiérrez-Rodríguez[2], M. Köksal[3] and A. A. Billur[4]

(1) Unidad Académica de Ciencias Químicas, Universidad Autónoma de Zacatecas
Apartado Postal 585, 98060 Zacatecas, México.
e-mail: mahernan@uaz.edu.mx

(2) Unidad Académica de Física, Universidad Autónoma de Zacatecas
Apartado Postal C-580, 98060 Zacatecas, México.
e-mail: alexgu@fisica.uaz.edu.mx

(3) Deparment of Optical Engineering, Sivas Cumhuriyet University, 58140, Sivas, Turkey.
e-mail: mkoksal@cumhuriyet.edu.tr

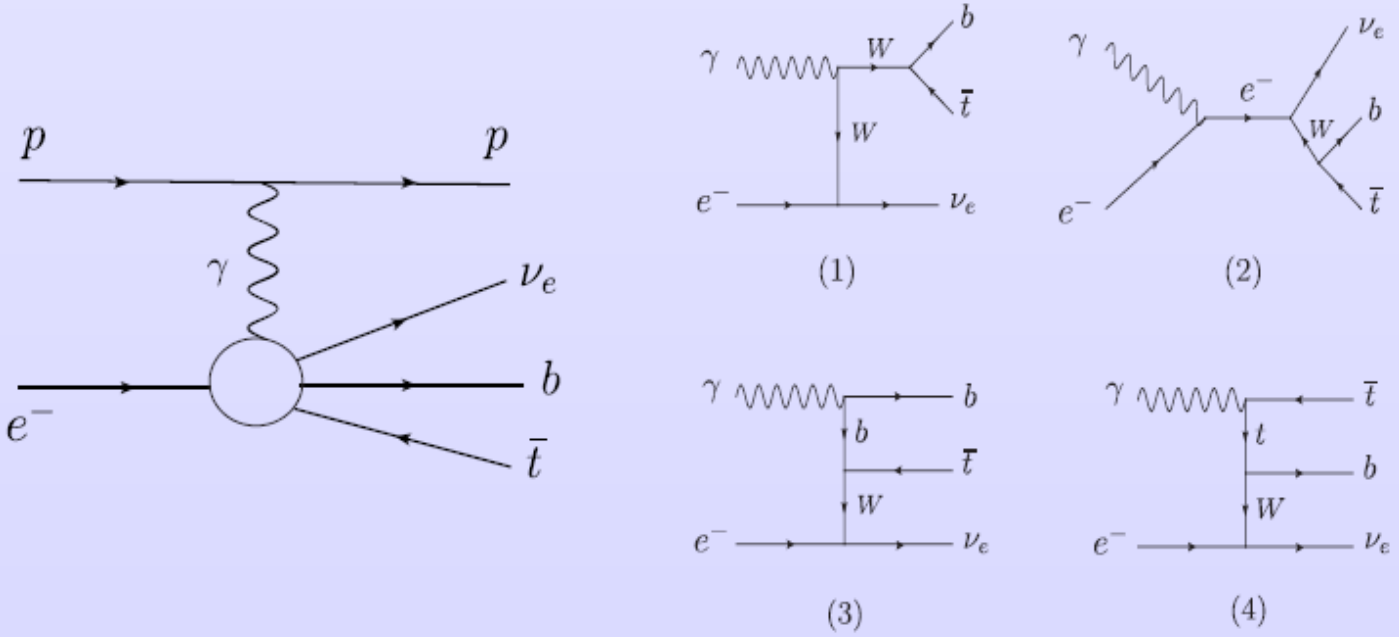
(4) Deparment of Physics, Sivas Cumhuriyet University, 58140, Sivas, Turkey.
e-mail: abillur@cumhuriyet.edu.tr

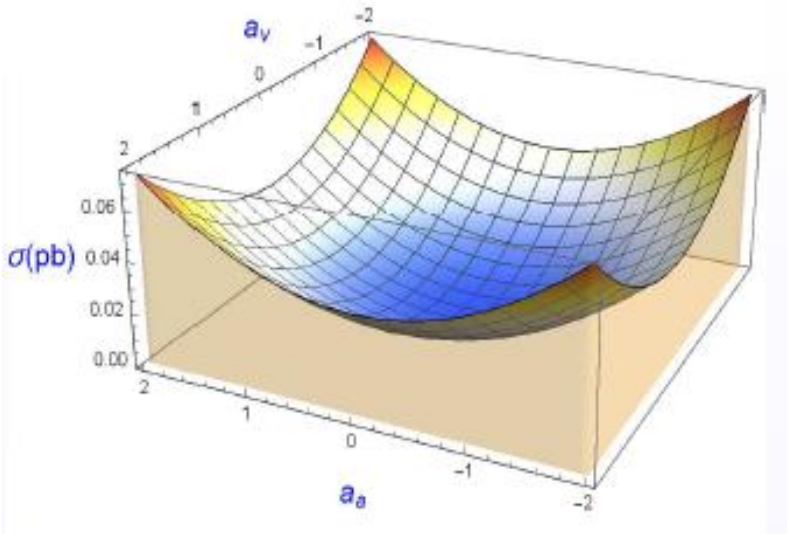
Abstract

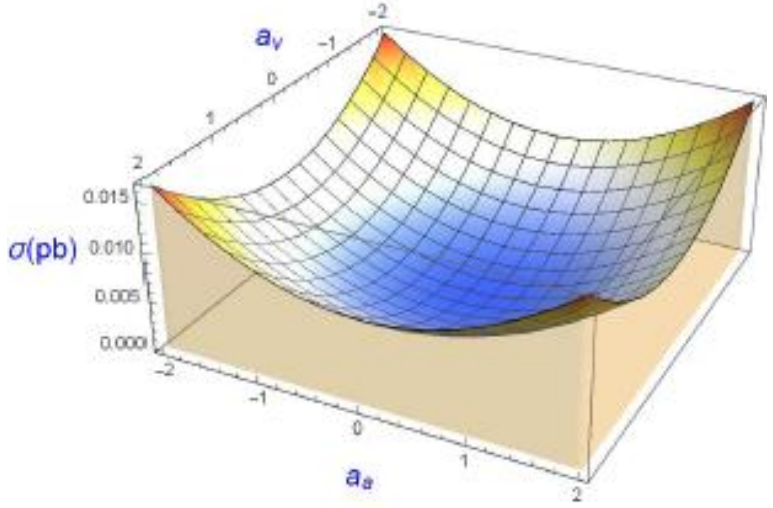
The measurement of the top-quark anomalous electromagnetic couplings is one of the most important goals of the top-quark physics program in the present and future collider experiments. This would provide direct information on the non-standard interactions of the top-quark. We study a top-quark pair production scenario at the Future Circular Hadron-Electron Collider (FCC-he) through $e^-p \to e^-\gamma p \to \bar{t}\nu_e bp$ collisions, which will provide information about sensitivities on anomalous $\hat{a}_V$ and $\hat{a}_A$ couplings at a 95% C.L., and the possibility of probing new physics.

2 Single top-quark production via the process $e^-p \to e^-\gamma p \to \bar{t}\nu_e bp$

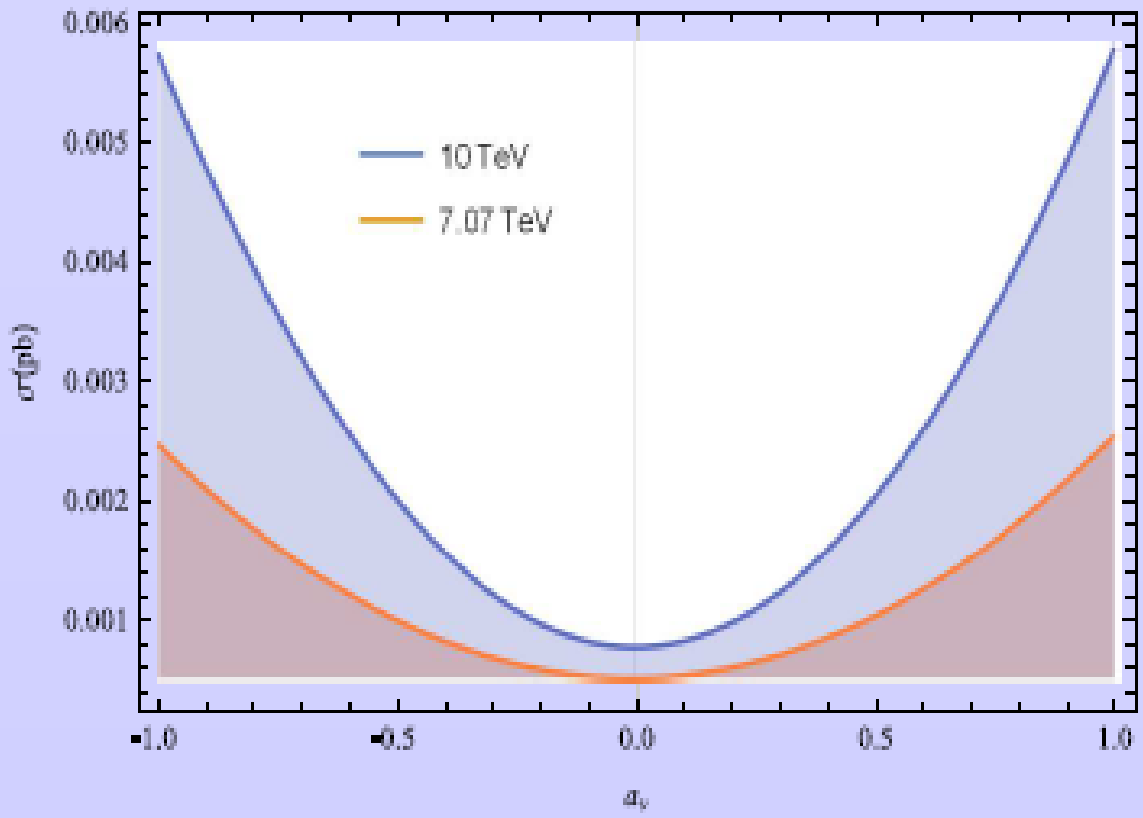
We study in a model-independent way the dipole moments of the top-quark through the process of single top-quark production $e^-p \to e^-\gamma p \to \bar{t}\nu_e bp$. Fig. 1 shows the schematic diagram for the process $e^-p \to e^-\gamma p \to \bar{t}\nu_e bp$ and the Feynman diagrams contributing to the reaction $e^-\gamma \to \bar{t}\nu_e b$.







3 Cross-section of $e^-p \to e^-\gamma p \to \bar{t}\nu_e bp$



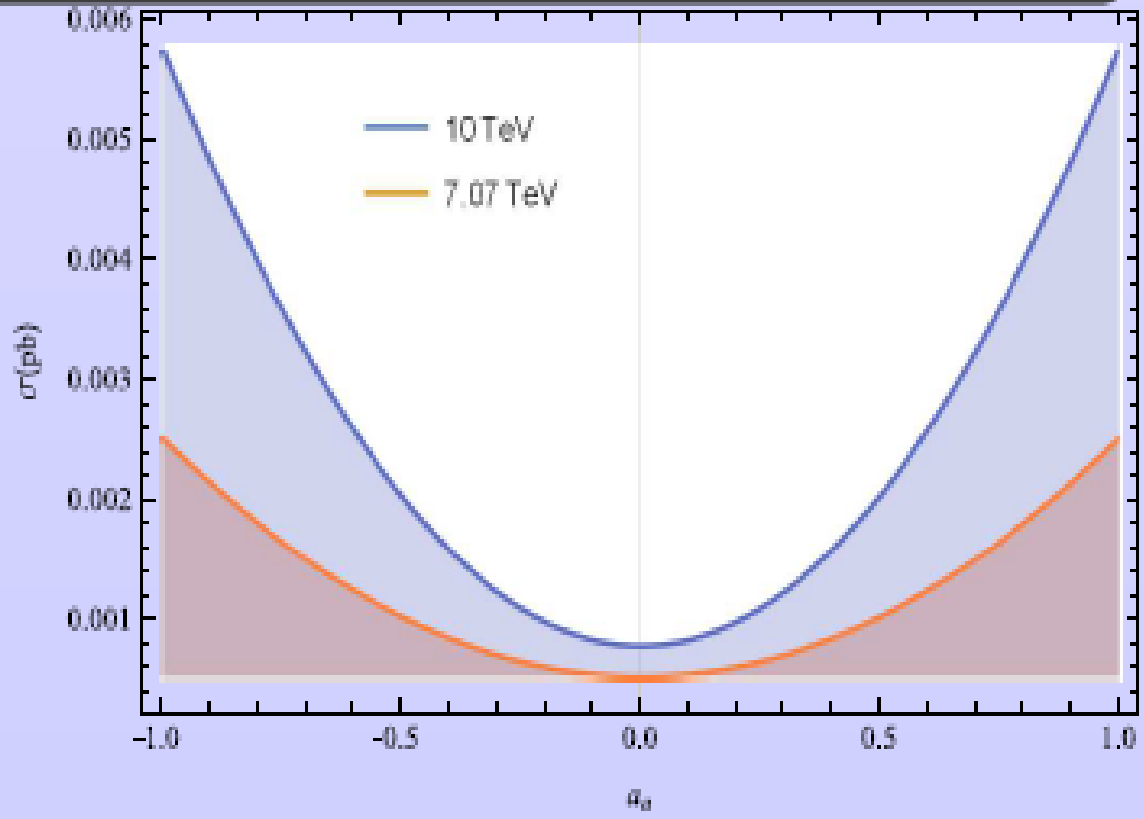


FIG. 2: The total cross sections of the process $e^-p \to e^-\gamma p \to \bar{t}\nu_e bp$ as a function of $\hat{a}_V$ and $\hat{a}_A$ for center-of-mass energies of $\sqrt{s} = 7.07, 10 TeV$ at the FCC-he.

4.2 Conclusion

We sensitivity study is cut-based, polarized electron beam and sources of systematic uncertainties such as leptons and b-jet identification, as well as in a $\chi^2(\hat{a}_V, \hat{a}_A)$ test to extract, enhance and optimize the expected signal cross-section and the sensitivity on $\hat{a}_V$ and $\hat{a}_A$. We find that the total cross-section $\sigma(e^-p \to e^-\gamma p \to \bar{t}\nu_e bp)$ has a strong dependence on the anomalous couplings $\hat{a}_V$ and $\hat{a}_A$, as well as with the center-of-mass energies of the FCC-he and therefore strong sensitivity estimated are obtained on $\sigma(e^-p \to e^-\gamma p \to \bar{t}\nu_e bp)$ and $\hat{a}_V$ ($\hat{a}_A$). Our results show that with the process $e^-p \to e^-\gamma p \to \bar{t}\nu_e bp$ at the FCC-he, the sensitivity estimated on the MM and the EDM of the top-quark can be significantly strengthened. At this time, the FCC-he is an excellent option for the electron-proton collider. It will be useful for any new physics study. Fortunately, future of e^-p colliders remain promising as it is a natural option like a hybrid between the hadron pp and linear e^+e^- colliders.

References

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