

Single Vector-Like Quark Production via Chromo-magnetic Moment at the LHC

Alexander Belyaev,^{1,2,*} R. Sekhar Chivukula,^{3,†} Benjamin Fuks,^{4,5,‡} Elizabet Simmons,^{3,§} and Xing Wang^{3,¶}

¹*School of Physics & Astronomy, University of Southampton, Southampton SO17 1BJ, UK*

²*Particle Physics Department, Rutherford Appleton Laboratory, Chilton, Didcot, Oxon OX11 0QX, UK*

³*UC San Diego, 9500 Gilman Drive, La Jolla, CA 92023-0001, USA*

⁴*Sorbonne Université, CNRS, Laboratoire de Physique*

Théorique et Hautes Énergies, LPTHE, F-75005 Paris, France

⁵*Institut Universitaire de France, 103 boulevard Saint-Michel, 75005 Paris, France*

I. INTRODUCTION

With the Large Hadron Collider (LHC) quickly accumulating data at the energy frontier of particle physics, searches for beyond-the-Standard Model (BSM) physics are of great importance to address the open questions associated with the Standard Model (SM). In many models that address the naturalness problem, top-quark partners (T) are often postulated in order to cure the issue related to the quadratic corrections of the mass of the Higgs boson, stabilizing it at the electroweak (EW) scale. One of the most important search channels for those top partners at the LHC is based on their QCD pair production [1–3], $pp \rightarrow T\bar{T}$. Such a production has the advantage to allow for model-independent computations, as the rate only depends on the strong coupling and the partner mass. However, as bounds on the top partner mass approaches the multi-TeV regime, the pair production channel starts suffering from a large phase space suppression. In contrast, the single production of a top partner in association with another quark or a weak boson may be promising [4–11], since there is more available phase space. The price to pay is however a strong model dependence, as the strength and structure of the coupling of a single top partner to a SM quark and boson are dictated by the model details.

In this contribution, we discuss alternative modes for single T production, that can potentially benefit from higher rates, fewer combinatorial issues at the level of the collider signature, and dis-

* belyaev1967@gmail.com

† rschivukula@physics.ucsd.edu

‡ fuks@lpthe.jussieu.fr

§ ehsimmons@ucsd.edu

¶ xingwang@physics.ucsd.edu

tinctive means for separating the associated signal from the SM background. These modes feature QCD-initiated single production of top partners in association with a t quark via a chromomagnetic moment coupling. For instance, if T is a color-triplet composite fermion, its production will be driven by a chromomagnetic coupling to the gluon field strength,

$$\frac{g_s}{M_T} \bar{T}_R \sigma^{\mu\nu} G_{\mu\nu}^a T^a T_L . \quad (1)$$

Moreover, if the gauge eigenstate T_R turns out to be an admixture of the right-handed physical SM top quark t and new physics T states, $T_R = T_R^{\text{physical}} + \epsilon_R t_R^{\text{physical}}$, then an off-diagonal gtT coupling is additionally generated and could yield interesting phenomenological effects,

$$\frac{g_s \epsilon_R}{M_T} \bar{t}_R \sigma^{\mu\nu} G_{\mu\nu}^a T^a T_L . \quad (2)$$

In this proposal, we plan to explore the sensitivity of the future hadron collider projects currently discussed within the community to those top partners featuring novel production modes. We suggest the realization of the Eq.(2) within the consistent model incorporating partial compositeness [12] with only few parameters which is also a very attractive feature of this study. In particular, we will quantify under which circumstances these new single production modes are useful with respect to current and future top partner searches at the LHC and the HL-LHC.

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